Processing Unfamiliar Words: A Study in the Perception and Production of Native and Foreign Placenames

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Abstract

This thesis sets out to examine some of the linguistic processes which take place when speakers are faced with unfamiliar and potentially foreign place names, and the possible psycholinguistic origins of these processes. It is concluded that lexical networks are used to map from input to output, and that phonological rule-based models do not fully account for the data.

Previous studies of nativisation have tended to catalogue the phonological and spelling changes which have taken place in historical examples, and explanations have generally been limited to comparison of details of the borrowed and borrowing languages, rather than being set in a solid linguistic framework describing the ways in which speakers and readers process words. There have been psycholinguistic studies of unfamiliar words, but these have generally ignored the foreign dimension, and have been limited in scope. Traditional linguistic work, meanwhile, focuses on descriptions, either abstract or more related to mental processes, of the language that we know and use every day. Studies of foreign language learning also have a rather different focus from the current work, as they examine what happens when we attempt, over a period of time, to acquire new sounds, vocabulary and grammar.

This study takes an experimental approach to nativisation, presenting Edinburgh secondary school pupils with a series of unfamiliar spoken and written European town names, and asking them to reproduce the names either in writing or speech, along with a judgement of origin. The resulting pronunciations and spellings are examined for accuracy, errors and changes, both in perception and production. Different explanations of the output are considered, and it is concluded that models which apply a set of linguistic rules to the input in order to generate an output cannot account for the variety of data produced. Lexicon-based models, on the other hand, using activation of known words or word-sets, and analogy with word-parts, are more able to explain both the details of individual responses and the variety of responses across subjects.

Declaration of originality

I declare that this thesis was written by me and describes original work undertaken by me.

Permission has been obtained or applied for with regard to the inclusion of published papers in this thesis.

Susan Fitt

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Notational conventions

Words

[stɹɪŋ]	phonetic transcriptions are transcribed in square brackets. Phonetic and phonemic transcriptions use the 1993 version of the International Phonetic Alphabet; in addition a hash (#) denotes a word boundary. For examples quoted directly from other authors, their own transcription system and format are used.
/strɪŋ/	phonemic transcriptions are given in forward slashes
<string>	orthographic examples are given in angled brackets
string	italics are used to refer to a word or sequence as an entity

All the above may be used for whole or part words.

Quotations and concepts

'string'	single quotation marks are used for introducing or discussing terms
"string"	double quotation marks are used for quotations, or for referring to a quoted use of a particular term, and for referring to sections of the thesis

Graphs

For graphs of data, a negative axis has sometimes been included in order to show multiple parameters more clearly on one graph. In these cases the absolute value is to be read, rather than the negative value; this has been noted in the text.

Definition of terms

Although many of the following are common linguistic terms, they are defined here for clarity since some of them are used in slightly differing senses in different theoretical models.

L1	used to refer to a speaker's native language
L2	used to refer to a second or foreign language
cross-media	used to describe spoken input and written output, or written input and spoken output
same-media	used to describe spoken input and output, or written input and output
hyperforeignism	overgeneralisation of a foreign language feature, either into a different language, or into an inappropriate linguistic context
phone	an individual token of a phoneme. In this study, 'phone' is often used in preference to 'phoneme', since when discussing a segment in a subject's repetition of a foreign word, or indeed their perception of a spoken foreign word, we cannot be sure what phonemic system they are using.
onset	the initial consonant or consonant cluster of a syllable
rime	the vowel and following consonants of a syllable
syllable	a vowel and associated consonants. As different possible structures are discussed within this study, a more detailed definition is not given here.

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Chapter 1.
Introduction

1.1. Motivation for the study

Some areas of language behaviour have been well-documented and thoroughly discussed, although there are few which we could claim to understand completely. However, there remain a number of topics which fall outside the common fields of study, and one such area is the behaviour of speakers and readers who are faced with words, and in particular names, which are unfamiliar and potentially foreign.

This research has practical applications. Within the field of speech technology, determining the pronunciation of unknown foreign names is a growing problem. Speech synthesis systems need to produce pronunciations for names which are not in their pronunciation lexicons; speech recognition systems will eventually need to recognise inaccurate pronunciations of foreign names by speakers who are unfamiliar with these names. It may be possible for a synthesis system to make educated guesses for pronunciations of unknown names, but such systems use sophisticated knowledge which may not be available to the average native speaker, and so are unlikely to model speaker behaviour in a manner useful for speech recognition.

If we look at where this issue fits into linguistic theory, we find it has rarely been included in theories of native speaker knowledge. Loanwords have been treated, but even they are generally regarded as marginal in speakers' knowledge and organisation of language. Second language learning has, of course, been studied extensively, but this is a rather different topic as, firstly, it generally involves only two languages, and secondly it is a different task for the speakers, as they are trying to acquire and retain knowledge of a particular foreign language, rather than use what knowledge they already have in a passing situation. There are also many studies of the transfer of names (generally personal names of people who move from one country to another), but these again mostly involve two languages, with the foreign name having prolonged contact with the borrowing language. Additionally, these studies tend to be descriptive (tracing the history of particular names, or categorising processes) rather than predictive.

1.2. The scope of this study

This thesis aims to investigate the linguistic behaviour that takes place when people process unknown, potentially foreign, placenames, either spoken or written. So, the basic question to be addressed is, "What do speakers do when faced with (potentially foreign) unknown placenames?" Within this are many sub-topics, ranging from their initial judgements (for instance "What, if anything, do speakers do to determine language of origin") through other levels of perception (such as "How well do speakers perceive spoken foreign segments, or combinations of graphemes?"), and on to production ("What choices do speakers make in pronouncing or spelling such words? Which elements of the foreign language do they reproduce, and which do they nativise? How much is dependent on the individual subject?").

Linguistic theory should be able to explain the strategies speakers use to process unfamiliar native and spoken words, whether spoken or written, and to explain the interplay between those strategies. The current work, although not a psycholinguistic study, draws on psycholinguistic research to examine some of the issues involved. As this is a large and little-explored topic, the current study focuses on the areas listed in the previous paragraph. Some further comments, and an outline of the thesis, are given below.

1.2.1. Experimental situation

This study uses an experimental method, rather than existing data as is common with names studies, in order to control some of the many factors which influence language production. These include, as is usual in linguistic studies, age, region of origin, and education of subjects. In this case the factors also include exposure to the name (in real-world studies it is often difficult to establish accurately how familiar a name is to a subject, how it was presented, whether orally or in written form, what feedback was given to the subject, and so on). It is also rare to have recorded spoken data in such situations. Limiting the parameters of course means that some questions cannot be addressed, but this is the case in any experiment.

The experiments use town names from six European countries including Britain, chosen to be unfamiliar to the majority of subjects. These town names were presented in an experimental setting to teenage Scottish subjects, who were asked to either read them aloud onto tape or write them down. Because real town names were used, rather than manipulated forms designed to test particular hypotheses, analysis is dependent on finding patterns across diverse input and diverse output, so it is not always possible to isolate particular features of a given word as leading to a particular response. Additionally, constraints of time and concentration by subjects meant limiting the word-structures that could be included. However, enough data was collected to allow a detailed study of some aspects of the strategies used for processing unknown words. It should be noted here that no explicit comparison was made of placename data and similar data on other words, to see whether speakers treated names any differently, so interpretation of the results is subject to this limitation.

1.2.2. Perception

A number of diverse factors are likely to be involved in producing or re-producing a pronunciation or spelling for a mixture of native and non-native unknown words. Firstly we need to examine the subjects' perception and cognitive processing of the words. One aspect of perception, that of judgements of word origin, was tested directly, as it was thought that this would influence subsequent processing of the names. Other aspects, such as perception of stress patterns, are inferred as far as possible from the subjects' production of the names; while this indirect approach renders examination of some factors difficult, the use of both written and spoken output for both written and spoken input allows cross-media comparisons. This enables us to say that some features in the output are linked to perceptual processes, rather than production.

1.2.3. Production

This thesis aims primarily to study the output which results when native speakers are presented with an unknown name which they must then reproduce. There are a number of different linguistic parameters in the output, for instance segmental features, or phonotactics, which will be examined in the results and discussion of the experiments. However, the real interest lies not in the description of the relationship between input and output, but in the processing which leads to the output.

A particular problem in examining the production of unknown words, especially foreign ones, is that some words elicit the same output from different people, while other words elicit many different answers. It will be seen that this variation does not fall along a single continuum of pronunciations or spellings from 'language of origin' at one end to native at the other. This shows that we cannot posit a single pattern of processing from input to output that will account for all answers. Some of the diversity lies in individual knowledge differences between subjects, while some may lie in the features of the words themselves (certain aspects of the foreign words, such as stress versus syllable structure, may conflict with subjects' expectations and lead to different solutions by different subjects), and some of the variability may lie in different processing strategies. We also cannot ignore the fact that since English spelling has a notoriously variable relationship with pronunciation, even for native names there may be a number of different pronunciations for a given spelling; it is thus not surprising that for cross-media experiments subjects often give a variety of responses.

This leads us to ask, though, what leads a speaker to choose between alternative paths. Is there a default strategy? Do all speakers in a community use the same strategy, with output dependent on their ability to use the different components which build a pronunciation or a spelling? If so, 'ability' must encompass more than just 'foreign language ability' in order to explain the range of responses, and perhaps covers ability to use letter-to-sound rules, or skill in spotting analogous words. Or, do they select different strategies according to learnt processes (perhaps dependent on their different skills)? What influence do the cues in a given word have? While the answers to some of these questions are beyond the reach of this study, these issues will be examined as far as possible in relation to the results.

1.2.4. Outline of thesis

Due to the wide variety of topics involved in this study, the literature review has been divided into two parts. Firstly, Chapter 2 discusses issues of perception in linguistic theory. This includes a discussion of the relationship between perception and production, lexical access, spoken forms, written forms, unknown words and foreign words. Chapter 3 then looks at production, focusing on attempts to reproduce spoken or written input either in writing or speech, and the means by which cross-media output may be achieved. It also covers the (re)production of foreign words.

Chapter 4 describes in detail the experimental design used, and how this was arrived at. Chapters 5-7 give an analysis of the results, broken down into perception, production (same-media) and production (cross-media), with sections on spoken and written forms, though of course there are some features of the data which cannot be neatly classified.

Finally, Chapter 8 discusses the findings and their consequences, and then summarises the conclusions and highlights some areas for future research.

Chapter 2.

Processes of Perception

This chapter examines issues in the perception of language for both spoken and written words. This study will require subjects to reproduce unfamiliar words, so it is important to identify areas of difficulty in perception, and to consider various perceptual models, if we are to be able to give a full analysis of production. As perception is a vast area, the discussion will focus on the primary factors relevant to the current study.

The chapter begins with a discussion of general issues, such as use of and access to a mental lexicon, and difficulties in perceiving unfamiliar words as opposed to familiar ones. It then covers segmental features such as phones and graphemes, structural features, such as phonotactics and syllables, and suprasegmental features. Finally there is a section on particular problems in perceiving foreign words, including classification of origin and various linguistic parameters.

2.1. General issues

This section briefly introduces the question of lexical access, and then describes the problem of unknown words. It also includes discussion of the relationship and overlap between perception and production, and personal variation in perceptual skills and strategies. Both spoken and written language are included.

2.1.1. The mental lexicon and lexical access

It is assumed in this study that perception is the beginning of access to a mental lexicon. It is also assumed that this is the case even for nonwords, since it will require a search through the lexicon to determine whether a word exists or not (Forster and Bednall 1976). In order to assess the problems in perceiving words, we need to consider both the way in which words are represented in the mind, and how we access them. For example, it may be that word-stems only are stored, and rules applied to construct derived forms, or that lexemes are stored under their most common forms. Access to the lexicon could be performed by sequential matches (accessing all candidates, for instance, starting with the first phoneme or leftmost grapheme and gradually eliminating incorrect matches), or through syllables or some other feature. Multiple levels of information might well be used, for example in a sentence we can often predict the grammatical class of the next word, and this might be used to narrow down the list of candidates. It also seems, from various studies including work on speech errors, that related words may be accessed even if they are not needed, for instance reading the word <dog> might raise activation levels of *cat*, *fur*, *bite* and so on.

However, despite numerous studies in this area, the way in which words are stored in the lexicon, and the means of access and use, are controversial: "it is anything but clear how we should envisage the mental representation of word forms." (Rischel 1991: 235.) As for experimental evidence, Srinivas et al. (1992: 220) note that "It has been argued that most of the methods used to explore the issue of how the mental lexicon is organized have serious limitations."

Different studies suggest a different balance between storage in memory and derivation through rules (of, for example, noun plurals). Different accounts also have varying levels of representation, for example the TRACE model (McClelland and Elman 1986) uses a phonemic level between acoustic input and lexical representation, while Marslen-Wilson and Warren (1994) claim that the phonemic level can in fact only be derived after lexical access. Some accounts claim that lexical access can be achieved through a number of features of the input, for example acoustic, visual, part-of-speech (where context is available and a certain part-of-speech is expected), semantic and so on. For example, Marslen-Wilson (1989) claims that the speed of processing means that access to the lexicon must use a variety of routes (in his study acoustic/phonetic and semantic).

Obviously, access to lexical representations is affected by initial categorisation of the input. If perceptual errors are made early in the word, incorrect lexemes may be activated, and given that we do not require all segments or word-features to be identified correctly in order to perform a word match (so enabling us to understand deficient input), it sometimes happens that a poor match in subsequent segments is ignored until the word-identity hypothesis can no longer be sustained. Kashino and Craig (1994), examining

Japanese listeners' recognition of spoken American words, note:

> "Many initial phonemes or syllables were not recognized until second syllable information was provided. In these instances, retroactive recognition and perseveration occurred. If an ESL listener misperceived the initial phoneme or syllable, a garden path type of lexical search frequently developed. Once an erroneous representation occurred the error tended to perseverate even when new conflicting acoustic-phonetic information was presented." (Op. cit.: 2050.)

This shows that once recognition is made, subsequent features may be treated as redundant and little attention is paid to them, even if they do not follow the prediction made by the word recognition. This error may only be corrected, if at all, after a number of conflicting elements have followed.

These and other topics relevant to lexical access will be explored further in subsequent sections.

2.1.2. Known words vs unknown words

Given that the current study is concerned with unfamiliar words, we need to know the role of lexical access in the perception of unknown words, and how existing words affect the perception of new ones.

Kashino and Craig (1994) (see above), show that for spoken language lexemes may be activated even when some elements do not match; by extension, we can assume that this is the case for nonwords as well as words. The first segment of a word such as *Acri* (['a.kɾi]) might activate numerous words, such as *addle*, *ant*, *angry*, and so on. Since it is possible for these hypotheses to persist even when some segments contradict the activated word, it might be that on reaching the end of the input a word such as *angry* would retain a high level of activation for some listeners. Or, indeed, if the first vowel is perceived as [ɔ] rather than [a], the set of words activated might be quite different again.

There are many examples in onomastic studies of people adapting the unfamiliar to the familiar in this way (e.g. Metcalf 1985, Klymasz 1963). Murray (1986) gives some amusing anecdotes by residents of St. Louis, 'explaining' the origin of local French-language place names such as *Ferrier* (interpreted as *Fairy Air*) or *Falaise* (*Falsies*). Presumably this is not an effect of production, but of either initial perception of the input, or the mental processing which occurs between input and output, matching the name with more familiar words or word-elements in the mental lexicon. Although it is usually reported in cases where the change has happened over a period of time, during which various other factors come into play, such as the development of myths 'explaining' the origin of the name, there is evidence of such processes in the experiments reported later in the current study.

2.1.3. The relationship between perception and production

For the most part, this thesis divides discussion into perception and production, but it should be remembered that perception and production are not necessarily independent skills. It is often assumed that perception is a pre-requisite for production, and that perception precedes production in learning language skills, but this may not always be the case. Strange (1995: 79) goes so far as to suggest that "perception and production mastery may be uncorrelated in more experienced L2 learners."

Llisterri (1995) reviews a number of studies which examine the link between perception and production in L2 learners, and finds that there is a certain amount of contradiction in the results of different experiments. He also notes that some studies claim that "different classes of sounds may behave in a different way concerning the relationship between production and perception" (p. 93). For example, Strange (1995) suggests that, since consonant production involves contact between articulators, while vowel production relies on spatial positioning of the tongue, articulatory feedback is difficult for vowel production and self-perception may be important: "it may be the case ... that production of vowels is more dependent on auditory feedback" (p. 81).

Dissosway-Huff (1981) also finds that perception does not always precede production in second language learning. She tests Japanese learners of American English with respect to their mastery of both perception and production of English /r/ and /l/, and finds that "the overall ability of Japanese subjects to perceive English /r/ and /l/ is poorer than their ability to produce them" (op. cit.: 243). One possible explanation for this, suggested by Sheldon (1985), is that due to redundancy a low level of perceptual discrimination between these sounds is sufficient for most purposes, while poor production is stigmatised, so speakers make more effort to improve their production than their perception. According to Strange (1995: 79), "some perceptual difficulties may persist, even after production of non-native phonetic segments is mastered." Furthermore, training in production of a second language may improve perceptual ability, which suggests a co-dependency of the two skills (Rochet 1995, Catford and Pisoni 1970, Weiss 1992).

Evidence for native language skills, and for the written aspect, comes from Bryant and Bradley (1980). They report a study of children's reading and writing performance, and note that some children manage to spell words accurately which they cannot read, despite the normal assumption that reading skills precede spelling. Of course, there was more to the reading task than perception of written words, since spoken output was required, while the spelling task was not simply production of written words, as it involved perception of spoken input. Bryant and Bradley suggest, however, that the discrepancy arises from the use of different skills to perform the two tasks - children use phonological strategies for spelling, but mainly visual and contextual ones for reading. They propose that this discrepancy (which, in any case, does not apply to all children or all words) disappears as children grow older and develop their literacy skills.

2.1.4. Personal variation

It is reasonable to assume that linguistic skills affect language perception. There are numerous aspects to this. Firstly, aside from physical factors such as hearing problems, some people seem to be better at language than others, for instance in mimicry of different accents, spelling and so on. Secondly, knowledge of and skill in a foreign language will affect perception of words and sounds in that language. Finally, there may be variations in breadth of vocabulary, or exposure to other accents and dialects which affect perception of words in one's native language. As well as these different levels of skill and experience, however, it seems people sometimes have different strategies for the same tasks.

Bohn (1995a) notes three subject variables which affect foreign language perception: L1 background, L2 experience, and the age of the learner, though he points out that other factors must be involved as these three alone cannot account for the variation found across subjects. Some variables can be discounted - although personal attitudes have an effect on speakers' productions, for instance making some learners reluctant to produce foreign sounds, Bohn finds no evidence that cultural and motivational factors affect perception. "At present, the large individual differences especially among adult subjects can at best be attributed to some "talent" for language learning, but this cover term is clearly unsatisfactory because it is unknown what makes for a talented perceiver." (Op. cit.: 84.)

An example of personal variation dependent on language experience comes from Kashino and Craig (1994), who looked at spoken word recognition of English by Japanese learners with varying experience. They found that not only did more advanced listeners recognise words more quickly and accurately than beginners, but they demonstrated "greater anticipatory recognition", using the first syllable or word to help predict or recognise the second part. In fact, it seemed as though "the beginning listeners used acoustic-phonetic information as effectively as the advanced listeners, however, the advanced listeners were able to take advantage of the linguistic contextual information to more quickly and accurately complete their recognition processes" (p. 2049). Of course, such information can only be used in the case of familiar words (or ones which the listener perceives, or re-interprets, as familiar).

Flege (1991) found that when Spanish-speaking subjects were asked to label the American English vowels /i/, /ɪ/, /ɛ/ and /æ/ using one of the five orthographic Spanish vowels <i>, <e>, <a>, <o>, and <u>, or as 'none' if they thought the vowel was not found in Spanish, experienced speakers of English used the 'none' label more often than inexperienced learners, who in turn used it more often than Spanish monolinguals. Flege interprets this as "suggesting that L2 learning heightens bilinguals' awareness of cross-language phonetic differences" (op. cit.: 701).

However, it also seems that linguistic experience may affect perception even where the experience is not directly relevant to the task in hand. For example, Holmes (1995) presented bilingual English-German speakers, as well as monolingual speakers of both languages, with vowel tokens covering the vowel space from [ɛ] through [æ] to [a]/[ʌ]. The bilinguals were given one test in German test conditions, and one in English conditions. Her results show a significant difference between the performance of German monolinguals and the bilinguals in a German environment; she suggests that "the bilinguals' categorisation of the front open vowel in the German condition was mediated by their linguistic experience of the English /æ/ category, although this would not have been relevant to the German task" (p. 627). This suggests that native language skills and foreign language skills are not separate components in the brain, to be switched on and off as needed; we will return in later sections to the integration of native and foreign elements, and show that the experimental data in this thesis can only be described by an integrated model.

2.2. Perception of spoken forms

This section will examine the general processes involved in perceiving spoken words, and issues at the sub-lexical level. Evidently the initial input for perception is acoustic, but there are many different accounts of how perception proceeds after that.

Speech perception, due to the nature of the input, is linear:

> "The important characteristics of the auditory image will, of course, differ from those in the visual image. The major difference between the two images appears to be the critical dimension of the stimulus necessary for feature recognition. Whereas the spatial pattern is the important dimension in visual stimuli, the sequential pattern is critical in audition." (Massaro 1972: 124.)

This is not to say that the phonetic or phonemic representation of words in the brain is necessarily linear (see below). However, for lexical access to these representations we would have to assume either that cohorts of words are activated when the word begins (and decay as the acoustic input progresses and certain words fail to match), or that listeners wait till the end of a word before accessing the mental lexicon. (Of course, due to feature spreading the input is not strictly phone-by-phone, so some information about future segments is contained in earlier word-portions, but there is a limit to the amount and scope of this information.) We know that listeners rarely wait for completion of spoken input, and there is evidence that words are indeed activated at an early point. As the input progresses, lexical items are activated, and if the input strays from activated forms, these are dropped in favour of closer matches:

> "These assumptions ... lead to the characteristic cohort view of the form-based access and selection process, as specified for words heard in isolation. The process begins with the multiple access of word candidates as the first one or two segments of the word are heard. All the words in the listener's mental lexicon that share this onset sequence are assumed to be activated." (Marslen-Wilson 1989: 7.)

Radeau et al. (1992) report various other studies also showing that the efficiency of spoken word recognition is highly influenced by the location of the "uniqueness point", i.e. the point at which there are no competing word candidates - the earlier the uniqueness point, the more efficient the recognition process. Experiments using non-words, however, have had less clear results.

In the case of words, Marslen-Wilson admits:

> "This emphasis on the beginnings of words has been widely disputed ... first, on the grounds that the sensory input in fluent speech cannot guarantee the system reliable information about word onsets ... [and second,] models in the connectionist tradition, where what is

> most important is the total amount of overlap between the input and a given lexical representation ... and where directionality *per se* does not play a major role." (Marslen-Wilson 1989: 12.)

However, he claims that experimental evidence shows cohort activation for word-initial strings, but not for rhymes (word-final strings). He admits that listeners may be able to recognise words such as *bleasant*, as *pleasant*, but does not specify how this can occur within a cohort model with left-to-right processing. Connine et al. (1993) reject the idea that initial segments must conform exactly to the prototype in the mental lexicon for lexical activation to take place. They find in experiments that, while changes in initial phonemes of one or two features allow priming, (though to a lesser degree than the original word) changes of four features inhibit priming. Their results also suggest that the same effect occurs whatever the location of the phoneme within the word. So, while they claim that the beginnings of spoken words are no more important than other parts for lexical activation, their model does require a very high degree of overlap of input and mental representation.

It has been argued, though (e.g. Gaskell et al. 1995) that lexical entries must be phonologically underspecified, in order to cope with phonological variation and natural processes such as assimilation; if this is the case, then it would broaden the range of permissible matches for spoken language. However, it seems that in order for efficient access to take place, the phonological context must be appropriate, for example 'wicked' pronounced as [wɪkɪb] would be recognised as 'wicked' if it precedes 'prank', since the [d] has assimilated to [b] before a labial, but if [wɪkɪb] precedes 'game' lexical access of 'wicked' would be inhibited.

It should also be noted that, while traditional models of speech and language assume a phonemic representation of some kind, the results of Connine et al. (1993) suggest input in terms of features rather than phonemes. Marslen-Wilson and Warren (1994)) also claim that lexical items are directly activated from featural input, rather than progressing hierarchically through the phonemic and other levels. According to this account, if phoneme identification is needed for a specific task, this is performed after lexical access:

> " ... featural information extracted from the speech input is projected directly onto the lexical level, ... there is no prelexical phonemic level, and ... all phonemic or phonetic judgements are fundamentally postlexical and postperceptual in nature" (Marslen-Wilson and Warren 1994: 673.)

In their experiments, Marslen-Wilson and Warren used spliced English phonemes and forced-choice response. It is unclear what the outcome of a phonetic decision task would be in this model of foreign phoneme input and a free-choice perceptual response, as was the case for the experiments in this thesis. It may be that in this model the sound would be recognised as foreign due to the lack of any match in the lexicon, or re-categorised as native due to similarity with a native sound, especially if the surrounding phonetic context matched native words.

2.2.1. Segments

a) The relevance of phones and phonemes

We have already noted that the basic input to perception may not be segments, but features. However, most studies agree that sound segments are an important unit of speech perception, though their place in theories of recognition varies.

An example of a hierarchical model of perception, in which segments are crucial, is Studdert-Kennedy (1973). Firstly, there is an auditory stage consisting of acoustic phenomena such as pitch and duration, and then secondly comes the phonetic stage, where the signal is converted into phonetic features and segments. Next comes the phonological stage, which converts the phonetic features into phonemes, which are then grouped into clusters, syllables and so on. Lastly this string is assigned lexical, semantic and other higher-level information. This does not rule out the possibility (or probability, given what we know about our ability to predict what is coming next) that higher levels may feed back to lower levels and influence our perception of the acoustic string, in some cases leading to errors if the wrong prediction is made. This is intuitively satisfactory as it forms a logical progress from smaller units to larger, or higher-level, ones, but it is contradicted by experimental evidence in more recent studies.

For example, Marslen-Wilson and Warren (1994), as mentioned above, reject the notion of a phonemic level in the perceptual process:

> "One of the attractions of the standard phonemic theory is that it seems to offer a consistent account of the perception of both words and nonwords. In each case, the listener's perceptual experience is assumed to be built up out of common sublexical elements, with words differing from nonwords only in the presence of an additional representation at the lexical level. ... Here ... we have rejected the notion of a sublexical phonemic level. ... The most plausible

> suggestion is that [nonwords] are perceived through the lexicon, in an analogical fashion... If we assume a distributed computational substrate for the process of mapping from featural inputs onto lexical representations, then the output of this process provides the internal product, the lexical percept, on which we can then operate postperceptually - for example, to make lexical or phonetic decisions. Such a system will also give an output when it is presented with a nonword, where this output will partake of the properties of the lexical items with which it overlaps" (Marslen-Wilson and Warren 1994: 673.)

They base this claim on experiments presenting listeners with spliced word/word and word/non-word pairs, with the splice occurring in the middle of a phoneme. Listeners were asked to make decisions as to the lexical status of the items, and, in a different experiment, phoneme identity, and the interaction of lexical status and place information at the sub-segmental level led Marslen-Wilson and Warren to propose a direct mapping from features to lexical items. A lexical decision task, for instance on a word+non-word item (created from, say, *smog* and *smob*) had a slower decision time than a non-word+non-word item (such as *smob* plus *smob*); this, they claim, is due to mapping of the features onto lexical representations. In a phonetic decision task, using a subset of the stimuli from the lexical decision task, with the subjects recording the place of the spliced consonant, the word-bias is confirmed. If a phonemic level intervenes between the input and the lexical level, the word-status of the fragments should have no effect on phonetic decision, but it seems that it does:

> "These data ... suggest that the interpretation of partial phonetic cues is affected by the availability of the appropriate target representations at the lexical level. Specifically, the coarticulatory cues to place of consonantal articulation ... do not lead to strong place hypotheses unless there is a unique lexical item onto which this place information can be mapped" Marslen-Wilson and Warren 1994: 664.)

They found the phonemic level to be redundant: they claim that their results "rule out theories of lexical access where contact between featural analysis and the lexical level is discontinuous - the kind of view that requires an intervening processing unit, such as a phoneme or a syllable, to be fully identified before an output can be sent to the next level." (Marslen-Wilson and Warren 1994: 671.) They go on to claim that phoneme identification, which people can evidently achieve, actually occurs post-lexically.[1] This theory contradicts traditional

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[1]They in fact point to studies which suggest that phoneme identification is only performed easily by subjects who are literate in alphabetic languages (see Marslen-Wilson and Warren 1994: 673). It is also interesting to note that subjects report actually hearing missing phonemes which are replaced with a cough or tone (Warren 1970, quoted in Massaro 1972: 137).

accounts of word perception, which require mapping from lower levels to progressively higher levels, possibly with feedback from the higher levels, before reaching completion. In Marslen-Wilson and Warren's account, mapping occurs straight from the 'lowest' to the 'highest' level.

The cognitive route of the spoken input will be seen to be important in later chapters, since the model of perception determines what is and is not plausible as an explanation of output in the experiments.

b) Sound similarity and identification

Even in the native language, there can be problems in identifying sounds. In order to assess whether perceptual mistakes have been made, we need to consider which sounds are perceptually most similar and so are likely to be confused. This is not simply a matter of acoustic similarity, but of sound type, phonemic contrasts and so on. Unfortunately a comprehensive model of these is lacking:

> "... what is needed is a phoneme matrix in which the entries represent the different distances between phonemes. ... All of [the theoretical models] have an important common problem - how to weight the different features - since they do not all contribute equally. A different approach would be to empirically scale the rated differences between such segments without regard to a theoretical system." (Vitz and Winkler 1973: 385.)

Derwing and Nearey (1994: 351) propose that the similarity of sounds is related to the number of feature differences. They find that, when judging the perceptual similarity of spoken segments in English CVC monosyllables, "a major or multiple-feature mismatch (as between the consonants /p/ and /z/ or the vowels /æ/ and /ɑy/) produces a greater effect than a minor or single-feature mismatch (as between the consonants /p/ and /b/ or the vowels /æ/ and /ɛ/)". Additionally, "small one-feature mismatches in two segment positions have a greater effect than a many-feature difference in one segment position. (Thus /pæp/:/bæb/ is judged less similar than /pæp/:/pæz/, confirming the general phonemic character of the phenomenon.)"

Vitz and Winkler (1973: 385), on the other hand, find that on a simple count of features "the Chomsky-Halle feature distance has only a very moderate correlation with perceptual and memory data". They suggest that vowels are more important in similarity ratings than consonants: "That vowels, or at least certain vowels, are given more weight [than consonants] would not be more surprising, since vowels tend to have considerably more energy and to last longer than consonants" (p. 383). This view of the importance of vowel similarities to word similarity ratings, at least for monosyllabic words, is supported by Sendlmeier (1995).

Descriptions of phonetic distance between segments (for example, Laver 1994: 392) can be useful for comparison with perceptual difficulty, but there are certain limitations to this. Firstly, contrary to what measures of phonetic distance imply, the perceptual confusion of two segments is not always symmetrical, and secondly, perception is affected by word position and phonetic environment. We would thus need experimental data to investigate further the applicability of such phonetic descriptions to human perception.

We should also note that perception of sounds cannot be entirely separated from our wider knowledge of language, including spelling. For example, Derwing and Dow (1987: 174) describe work by Read (1973) on English word-initial *tr*: "whereas literate adults invariably interpret this sequence as a /tr/, in accord with the orthography (cf. the words *tree* and *truck*), Read's preliterate child subjects commonly preferred the spelling *chr*, implying the analysis /čr/." Derwing and Dow conclude that "there are probably influences on phonological judgements quite separate from sound perceptions *per se*, and orthography may be only one of these" (p. 178). Fries and Pike (1949) make similar observations. In the case of phonetics students learning transcription skills, for instance, "Spelling difficulties may interfere temporarily ... [the student] may, for example, divide *ax* into [æ] and [ks] (instead of into [æ], [k] and [s]) until he is cautioned to listen to the individual sounds of the word" (op. cit.: 35).

2.2.2. Structure

Lexical processing of written or spoken language is made easier by familiarity with the units and expectation of what will come next. This can involve several levels, such as discourse level, sentence level, semantics, sub-lexical patterns, and so on.

a) Phonotactics

Defining permissible sequences of spoken segments in English, as found in dictionary or citation forms of words, is fairly straightforward. However, many other sequences, which would be unallowable in citation forms, occur in fast speech and other processes. Scholes (1966) notes the problem:

> "It is often assumed that there is a given set of phoneme strings which are fully grammatical by virtue of their occurrence in accepted words of the language ... to equate 'fully grammatical' with 'occurring' would not be satisfactory since 'occurring strings' is not well-defined." (Op. cit.: 17-18.)

In the current study 'native sequence' is generally taken to mean 'sequence occurring in the dictionary' rather than 'sequence which might occur in particular spoken-word tokens', since the theoretical standpoint of the study is lexically-based rather than output-based, i.e. the view is taken that speakers act on representations in the mental lexicon, rather than on surface forms of words.

However, it is important to bear in mind that the issue of lexical information versus surface information is not a clear one, and in the case of nonwords this is particularly so since speakers have no representation; thus, a form such as [pə'lɪnt] (*Pelynt*, current study) may be repeated as [plɪnt], which is of course a perfectly permissible sequence. For such words, it is particular difficult to determine whether this is an error of perception or an elision at the production stage, although the existence of comparable data from the listening-writing mode is a valuable source of information; if the same word is written as <Plint>, we can assume an error of perception.

b) Syllables

We have discussed theories which propose that the primary units of recognition are segments, and others which claim that words are accessed directly from features, but some other accounts claim that the syllable is the unit of perception:

> "... the poorest speech recognition is produced by replacing the speech signal with silent periods that last between 100 and 330 msec. Since the durations of syllables are within this range, the results implicate the syllable as the perceptual unit for speech." (Massaro 1972: 137.)

It should be noted, however, that Massaro does say that "the term "syllable" must be interpreted loosely" (p. 140). Savin and Bever (1970) and Sendlmeier (1995) also claim that the syllable is the primary perceptual unit. Sendlmeier notes:

> "stress patterns cannot be determined without a concept of the syllable. Although in some languages the determination of the syllable boundaries is uncertain and so some cases of ambisyllabic segments exist, the native speakers of these languages also do have at least implicitly a concept of the syllable" (op. cit.: 141).

Echols (1993) suggests that the syllable is an important unit in perception for young children. She says that they are most likely to reproduce accurately syllables which are stressed or final; other syllables are more likely to contain a simple filler sound which may not bear any resemblance to the segments in the target.

Whether or not syllables are primary units in perception, there are other points we need to examine further. In the current study, various aspects of perception and production will be analysed from the point of view of the syllable, so we need to form a definition. However, although linguists, and also non-linguists, usually agree on the number of syllables in a word, there are greatly varying opinions on syllable boundaries, or whether a syllable should be defined phonologically, phonetically, and so on. There is a huge body of literature on this topic, which cannot all be discussed here. During analysis of the data in the current study, syllable structures defined by maximal phonemic onset and maximal phonemic offset will be compared for their effect on stress, and it will be seen that the definition of the syllable is important for its explanatory power of the results. However, a model of syllable structure which provides explanations of output is not necessarily the most appropriate definition for perception, and we should bear in mind that, however theoretically unsatisfactory it may be, different definitions of syllables may be needed to describe different aspects of language.

There is also evidence that there are intermediate units between phonemes and syllables, i.e. onsets and rimes (Mackay 1972, Treiman and Kessler 1995). These play a part in, for example, speech errors, but are not directly relevant to the current study.

2.2.3. Suprasegmental features

Stress is the only suprasegmental feature which will be discussed here; tone and phonologically-distinctive segment length, which occur in the experiments used in this study, are not features of English and so are discussed under "The foreign dimension" below.[2]

There are of course various acoustic correlates of stress, such as increased vowel duration, higher pitch and so on, which lead listeners to perceive a stressed syllable (Fry 1958); these vary somewhat between different languages or accents, but we can assume that listeners will generally be able to locate

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[2]According to some accounts, length is phonologically distinctive in Scottish vowels, but here it is treated as contextually and morphologically conditioned (see p. 46 ff.).

stress in unfamiliar native words spoken in their own accent. As for the psycholinguistic importance of stress, Echols (1993: 291) suggests that "prosodic elements, such as stress pattern, may ... be salient and, accordingly, may tend to be included in children's early representations for words." However, stress does not seem to aid recognition, and the effect of incorrect stress placement on word perception seems to depend on various factors, summarised in McQueen and Cutler (1997). For example, in English, incorrect stress is usually accompanied by a change in vowel quality, with a schwa becoming a full vowel or vice versa. If there is no change in vowel quality, for bisyllabic words with full vowels, there are perceptual problems only if the change is from initial to final stress. So, *nutMEG* causes difficulty, but *TYphoon* does not. It is suggested that English listeners are accustomed to this kind of change due to contextually-conditioned stress shift, for example in the phrase *TYphoon LINda*.

McQueen and Cutler (1997) also discuss the implications of stress for lexical access:

> "On the one hand ... stress marking could be an essential part of the access code by which lexical entries are located; on the other, it could be part of the phonological code listed for a word in the lexicon and consulted only in retrieval, i.e. once access has been achieved." (Op. cit.: 581.)

They then claim that their experimental results do not differentiate between the possibility that *nutMEG* causes difficulty because the stress is needed for lexical access and so the input does not match, and the possibility that the stress found in the lexical entry activated by the phonological string does not match the input. They note that results from other experiments suggest that stress is not used in lexical access, since homophones differentiated only by stress, such as *FORbear* and *forBEAR* each activate related words for both meanings. This is not to say that stress has no perceptual function, since listeners may use it for disambiguation, location of word boundaries and so on; furthermore, it will be seen in the experiments that stress is very rarely misperceived.

2.3. Perception of written forms

This section will discuss perception of written words, including letter perception and perception of letter combinations, and the question of whether visual perception of words automatically initiates phonological activation.

Units of perception in written words are not uncontroversial, and nor is the way we decode written forms. However, we can say that it does not appear to be the case that written words are processed serially from left to right. Radeau et al. (1992: 861) point out that "data on eye movements reveal no serial scan of the letters, at least for short words", though they do note some recognition studies give evidence of sequential processing. In their study of French written words (with French subjects), they conclude that there are important differences between the processing of spoken and written forms. Although an early position of the "uniqueness point" (the point at which a word has no competing candidates) aids recognition of spoken words, for written words late uniqueness points seem to be easier to recognise:

> "Although cohortlike models of written-word recognition predicted that words with early UP [uniqueness point] would be recognized faster than those with late UP, we have found longer gender classification times for words with early UP than for words with late UP. This result differs from that obtained with spoken words and argues against a directional view of printed word processing." (Radeau et al. 1992: 864.)

The same result was found for various experimental recognition tasks, and the only way they could reverse it was by presenting the words incrementally on a screen, starting with the first letter and adding letters at short intervals. They conclude that "printed-word processing does not occur sequentially and that recognition does not result from the progressive attrition of a cohort of lexical candidates as successive letters are analyzed." (Op cit.: 869.) They suggest that the slowness of recognition of words with early uniqueness points is due to the fact that they contain less common bigrams, which other studies have shown to be correlated with difficulty of recognition.

It also seems that real or familiar words are more quickly perceived than pseudowords, for example in letter-spotting tasks, but this does not necessarily mean that the word is the primary unit of perception. Pseudowords are perceived more quickly than random strings of letters, but this alone does not show that letter-groups are preferred as perceptual units over single letters. It may be, for instance, that in the case of real words a reader starts a lexical search immediately on decoding the first letter; if such a search were completed more quickly than a letter-by-letter analysis, this would account for the word superiority effect. For pseudowords, the advantage over random strings may be due to pronounceability rather than familiarity of letter-clusters.

This brings us to an important point in the perception of written forms: there is some evidence to suggest that the perception of a written word is not divorced from activation of the corresponding phonological form, that is to say, it is not perceived simply as a string of graphemes, but as a string (or word, if it is a word) with a corresponding pronunciation. This is significant since one of the experiments in this study involves written input which subjects are required to remember and write down. Although on the surface there is no phonological aspect to this, simply the retention of visual elements, we should not assume that such a task involves simply remembering and re-transcribing a written form. Instead, it is very likely that while reading the word they will assign it a pronunciation:

> "Subjects do derive a phonological recoding of the letter string, even when the task does not require this, and even when this can make the task more difficult." (Coltheart 1978: 196.)

Chastain (1987) describes experiments which suggest automatic phonological activation and access through the phonological form is indeed used for written words. He presented subjects with nonwords, some of which were homophones of real words, and asked them to identify certain target letters. If no phonological conversion were used, there should be no difference between nonword homophones and nonword non-homophones, but he found that target identification was faster and more accurate for homophones, suggesting phonological access in what was purely a visual task. "An interpretation of these results ... is that strings sounding like a word activate entries in the mental lexicon via a phonological route, and the feedback resulting from such activation enhances the perceptibility of letters in the strings. Such feedback is absent when strings neither spelled like nor sounding like a word are presented." (Chastain 1987: 155.) However, he does note that some earlier studies suggested that written words triggered phonological access to the lexicon only rarely, and that this route was slow and therefore disfavoured.

Of course, there still remains the question of what happens to lexical access in the case of written nonwords which are not homophones of real words, which is the case for the majority of words in the current study. Chastain notes that:

> "Target discrimination in nonwords that follow the rules of written English is better than in random letter strings ... supposedly because such nonwords partially activate word entries that provide the feedback. An orthographic string that differs from each of several words by only a single letter might receive as much total feedback from the partially activated entries as a word." (Chastain 1987: 151.)

On investigation of his data, he finds that the homophones he used were in fact less similar in written form to real words than the non-homophones. Since the subjects performed better on the homophones, this suggests either that visual similarity to real words is irrelevant, or that it is less important than homophony.

We cannot conclude from this, however, that there is no phonological activation - or, indeed, graphemic activation - of the lexicon in the case of such nonwords, since there will presumably be a search for a matching string, in the course of which similar words or part-words may be activated. It is possible that these activated words are either discarded or retained depending on the task. In either case, though, conversion of a written string to phonemes might then affect the output spelling in a reading-speaking task if the written string is not remembered accurately; the data in the current study will be examined to see if this is the case.

2.3.1. Graphemes

It is obvious that letters with similar shapes, such as <i> and <j>, or <o> and <e>, may lead to perceptual errors. This is perhaps more likely to occur in unfamiliar words than in familiar ones, due to the lack of supporting information in the mental lexicon (if access to the full graphemic form is achieved, segmental perception errors may be corrected).

This issue is discussed in Massaro et al. (1979). They claim that, "There is some evidence that overall letter shape can be resolved and made available to later stages of processing before the letter is completely recognised." (Op. cit.: 112.) Visually similar lower-case letter groups are quoted from Bouma (1971):

m	n	r	u	v	w
a	s	x	z		
c	e	o			
b	d	h	k		
f	i	j	l	t	
g	p	q	y		

However, reaction time results on experiments containing confusable letters were inconclusive.

The current study includes a reading-writing task; errors in this will be examined to see whether they are likely to have been caused by perceptual difficulty of graphemes, or whether they have other causes. It is also possible that errors in perception of graphemes will occur in the reading-speaking task, but since this is a more complex activity it is likely to be more difficult to determine whether misperception has occurred.

2.3.2. Structure

This section covers the perception of grapheme sequences and syllables in written words.

a) Grapheme combinations

It is well known that the overall shape of a word is used in perception. Frith (1980: 507) claims that "Words can often be recognised on the basis of minimal cues, e.g. first letter and overall length." Graphemic structure, as opposed to visual structure (i.e. the identity of graphemes in sequence, as opposed to word shape), can also help the perception of nonsense words:

> "recognition performance [of letters] improves as the structure is increased from that possessed by a single letter or a string of random letters to that of a regular string comprising a pronounceable pseudoword, and improves again, though rather less substantially, for common real words." (Henderson and Chard 1980: 87.)

(See also Chastain 1987 above.) Skilled readers use the word shape to aid recognition, which explains the greater ease with which we recognise lower-case words compared to upper-case words, and also partly explains why we sometimes do not notice spelling errors when we are reading (anticipation and expectation also contribute to this). For example, <Belin>, a name used in early pilot experiments in the current study, was interpreted by one subject as *Berlin*. However, there are various explanations for the easier recognition of real combinations of letters than single graphemes or random letter strings: pronounceability may aid both recognition and memory of letter groups; familiarity with letter combinations leads to a certain amount of predictability; and for real words there may be yet more redundancy, leading a reader to guess a word based on partial information.

Spoehr and Smith (1975: 21) note that various studies support the claim that, for strings of letters, "perceptual accuracy increases as the letter string increasingly approximates the orthographic structure of English." We would thus expect that certain foreign written names in the current study might cause perceptual difficulties, if they contain unfamiliar sequences. This could affect both reading-writing and reading-speaking tasks; although it may initially be assumed that a difficult letter combination which is assigned an inappropriate phoneme string has caused conversion or pronunciation difficulties, it might in fact be a problem at the perceptual stage

For letter combinations, various studies, quoted in Henderson and Chard (1980), found that bigram and trigram frequency did not affect recognition performance, but suggest that what is important might not be frequency per se but presence or non-existence of letter combinations. The frequency measure will be briefly examined in the reading-writing experimental results in the current study.

b) Syllables

There is a substantial body of research on the importance of the syllable in orthographic judgements such as identifying target letters in a string. However, studies on the psychological basis of syllables give inconsistent results. For instance, some find a syllable effect in lexical decision tasks; others do not. Srinivas et al. (1992: 220) point out that one of the problems is that "there is no theoretical consensus on what constitutes a syllabic unit in English ... Perhaps the inconsistent results observed in the literature are a result of linguistically naive definitions of syllables." Their own study uses the crossword puzzle paradigm, in which subjects are given part of a word and asked to complete it, for example:

_ _ _ d i c _ _ _ _ → vindictive

Some of their data showed no advantage for syllabic over non-syllabic fragments, while other data showed some facilitation on a syllabic basis. They come to the conclusion that syllables play only a minor role in the mental representation of words, and other orthographic factors are more important, for instance trigram frequency, and that similar studies which show an advantage for syllabic fragments did not use strict enough controls. Whether this suggests that readers process complete words in the same way, using uncommon segments or combinations of graphemes to aid word-recognition, or whether they work on a different basis, is not covered. They refer, for example, to other works which suggest that the beginnings and ends of written words facilitate word-recognition more than medial strings, but their experiments only use medial strings. (See also the discussion on reproduction of written words in the next chapter, p. 53 ff.)

2.4. The foreign dimension

The current study uses as prompts both native and foreign names. This raises a number of issues related to perception. Firstly, does the origin of the name have any effect on perception? If so, is this effect restricted to difficulty with particular non-native features (an area which has been widely discussed in the literature), or does it also affect the perception and interpretation of other parts of the word? How important is the perceived origin of the word compared to the real origin, and what features of the name lead to the judgement of origin? Indeed, what origins are used in classification - are particular languages necessary, or does a simple native/non-native classification have any effect?

We cannot answer all these questions in this review, nor in the experiments later in the study, but these issues do have a bearing on the interpretation of the data in later chapters and so are addressed below.

2.4.1. Perception of origin

It is necessary to gain some insight into how subjects perceive and classify the origin of words, since this can affect how they pronounce or interpret them. It should be remembered that English contains a large number of loanwords, and this may affect perception of origin:

> "It seems to be the case that there is a continuum ranging from a clear perception that a word is totally foreign, to a complete acceptance of a word as standard English ... we are claiming that a large proportion of literate speakers of English are aware that the English spelling system is heterogeneous, and that different sets of rules apply to different parts of the system." (Smith 1980: 41-2).

Native speakers are often able to identify many loanwords without knowing their history, for instance by the presence of unusual spelling patterns such as word-initial <#Ps-> (English seems to be more tolerant of unusual written forms than unusual spoken forms, though there are some examples of the latter, at least for some speakers, for example use of a nasal vowel in the *bon* of *bon voyage*). Also, unless the spelling and the pronunciation of a word are nativised in harmony, or one or other is already similar to the native language, there may well be a mismatch between the spelling and pronunciation vis-à-vis the correspondences pertaining in native words. Native speakers who are linguistically aware often recognise some of these differences.

As a caveat, it should be noted that according to Trubetzkoy,

> "Proper names (i.e. the names of persons as well as places) in many

> languages form a special class since it is in them particularly that foreign, archaic, and dialectal elements have been retained in unaltered form in the standard language. Examples are such German names as Leipzig, Leoben, Altona, Luick, Treische, Pschor, which contain either unusual phoneme combinations or belong to very rare morpheme types. Incidentally, proper names also behave in a very special way with regard to the phonological and morphological system in some other respects" (Trubetzkoy 1939: 254).

a) Classification of origin

Speakers may, of course, vary considerably as to both the divisions they use in classifying origin and the assignment of words to the different categories. There may also be variation according to the task, and how important it is to identify or narrow down the probable origin or a word. One suggested hierarchy for the perception of origin of a word is given below.

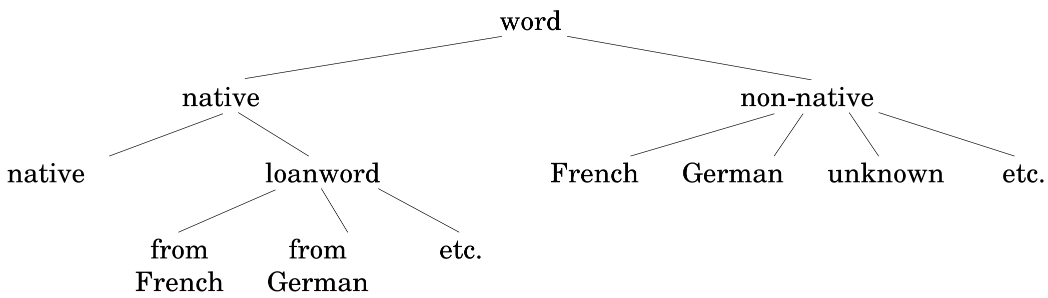

Figure 1: Possible hierarchy for perception of origin

The subdivisions of this hierarchy might vary considerably from speaker to speaker. There could also be an extra layer grouping non-native languages into 'European', 'Oriental' and so on, or 'Romance', 'Germanic' etc., depending on the linguistic sophistication of the speaker. For some groups there might be no subdivisions, if the speaker does not have enough knowledge to distinguish the individual languages. Loanwords may or may not be subdivided into different languages, or may not exist as a separate category at all. Assignment of words to categories will also vary, even for familiar words. Some may think of *psychology* as a loanword, others as a native word. Some may categorise *schlep* as a foreign word, others as a loanword.

In the absence of data on how subjects treat the issue of language categorisation, the framework in Figure 2 was devised for use in this study. This gives a workable number of distinctions, with a primary division between native and non-native. The loanword category is not included as a category in the response list, as this would make the task more complex for subjects.

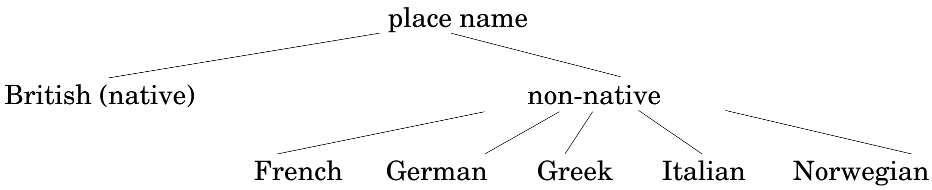

Figure 2: Framework for judgements of place names

b) Determining origin

◊ ***Spoken forms***

> "Humans ... have a special ability to identify a language which they have heard before, even though they are not proficient enough in it to neither [sic] understand what was being spoken nor speak that language. Some of this ability comes from generalizations about languages, consonant clusters, syllable structure, stress patterns, the prosodic features etc." (Kadambe and Hieronymus 1994: 1879.)

It has even been suggested that children less than two months old can distinguish native from non-native speech (see Echols 1993), though she notes that at this point the cues used may be prosodic rather than segmental.

It is not easy to provide a theoretical framework which would give a scale of nativeness. Is a nasal vowel more foreign than a palatal consonant? Is [ɖ] less English than initial pre-vocalic unaspirated [t]? If a feature occurs elsewhere in English (for example pre-vocalic unaspirated [t] occurs after [s]), or in other varieties of English,[3] is this a factor? In a few cases we could appeal to a database of English (either native words only or including loanwords) which might result in, for example, final [tθ] being found to be more common and so less foreign than initial [pf]. However, Haugen (1950) notes the difficulty in correlating this with speakers' judgements: "word counts have shown that patterns vary in frequency from the extremely common to the extremely rare, with no absolute boundary between the two. ... just how infrequent must a pattern be before it begins to 'feel foreign'?" (Op. cit.: 229-31.)

Segment sequences have been found to be a strong predictor of language origin in automatic systems. For example, using a phone recogniser combined with triphone probabilities, Kadambe and Hieronymus (1994) achieved an identification accuracy of 91% on 50 second utterances of English, Spanish and Mandarin, compared to 72% without "phonemotactic constraints". However,

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[3]This might include RP, if this is not the subject's own accent.

such models are likely to perform better than humans, since they have the advantage of expert linguistic knowledge, and there is also no reason to suppose that humans process words in the same way. Previous studies which do analyse psychological judgements, for example Scholes (1966), suggest that native speakers' judgements of phonotactic acceptability (in this case for American English) do not always coincide neatly with analyses of actual words. It is therefore not expected that there will be an exact correlation between features that do or do not occur in English words and the subjects' judgements of English/non-English. However, some studies (described in Jusczyk et al. 1995), suggest that even 9-month old infants differentiate between their native language and others based on phonotactic differences.

It should be noted that fine phonetic differences are not being considered in the current study, although such cues can lead to identification of language origin (see, for example, Barry 1974). Due to the experimental structure, it was necessary for one speaker to produce prompts in six different languages, and although the speaker was a trained phonetician and produced the prompts as accurately as possible, it was not possible for her to reproduce the exact timing, coarticulation and so on for each language.[4] Even had she been able to do so, such detail would complicate the analysis of perception; as Barry says, "Natural stimuli just do not allow the certainty that all the parameters that have interacted in the judgments have been included in the correlation." (Op. cit.: 87.)

◊ *Written forms*

Two main factors can make the orthography of a word appear non-native. The first, and the easiest to define, is the use of a different writing system, which may apply to the whole word, or to one or more characters in the word, for instance:

<outré> (French, or loanword from French)

Although some languages are tolerant of other writing systems, possibly due to education or language contact, or even typesetting and typewriting facilities, other languages, such as English, are not. While certain letters, such as those with diacritics, are tolerated in loanwords taken into English, words in completely different alphabets, such as Cyrillic, are transliterated.

Secondly, and somewhat more complex, are written forms which use the

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[4] See Chapter 4 for further discussion of the preparation of the prompts.

same symbols as the native language, but in unusual combinations. In some cases these correspond to non-native phonotactics, but in others they are simply spelling conventions, for example the following do not conform to usual English patterns:

<Iraq>	(with final <q>)
<schnapps>	(with initial <schn>)

Church (1986) describes a method of determining the origin of written words similar to that of Kadambe and Hieronymus (1994) for spoken words. He proposes that for text-to-speech systems trigram statistics can be used to determine etymology: "The probability that Aldrighetti is Italian, for example, is estimated by computing the probability that each of the trigrams in Aldrighetti came from Italian and multiplying each of these together" (Church 1986: 2424.) Despite reservations about his precise method (it is not clear how his figures could have been arrived at by the method stated in his article), it is clear that letter combinations can often be used to determine or narrow down the origin of written words.

Indeed, any features of written words which are either not found in English, or are uncommon, or are limited to loanwords, can lead a reader to suppose that the word is non-native, even when the reader does not know enough to assign the word to a particular foreign language. These features will be taken into account in analysing the results of the current study.

2.4.2. Perception and categorisation of foreign spoken features

As already noted, in a literate society we cannot entirely separate the spoken language from the influence of the written. Flege (1987b) discusses this point with respect to the interlingual identification of sounds:

> "Degree of literacy might also be an important factor. For example, adults who learn an L2 through formal instruction may be more inclined to judge realizations of /p, t, k/ in L1 and L2 as belonging to the same category because they are spelled the same than young children or illiterate adults" (op. cit.: 80).

Particularly relevant to the current study is Wode (1977), who notes that certain equivalences are commonly used for non-similar segments in borrowings or by adult learners, such as the various types of /r/ in different languages ([ɾ], [ɹ], [ʀ] and so on). These equivalences are often influenced by spelling and so are not used by children who are unaware of the orthographic forms. However, for convenience, and comparison with the results in the current study (which has separate spoken and written prompts), the discussion has been divided into spoken and written language.

a) Segments

A number of linguists have argued that, in second language learning, perception must precede production, and that an L1 speaker who does not perceive an L2 sound correctly cannot reproduce it accurately. According to Trubetzkoy (1939: 51-2),

> "The phonological system of a language is like a sieve through which everything that is said passes...when [a person] hears another language spoken he intuitively uses the familiar "phonological sieve" of his mother tongue to analyse what has been said. However, since this sieve is not suited for the foreign language, numerous mistakes and misinterpretations are the result".

As an example, he claims that since palatalisation of consonants is phonologically distinctive in Russian, and is combined with vowel variants such as /i/, a Russian speaker hearing a German /i/ will perceive palatalisation in the accompanying consonant even where it does not exist. "If a Russian speaker does not hear it [palatalisation of the consonant], he assumes this can only have been due to an acoustic delusion" (ibid.).

A speaker may also interpret a foreign phoneme in terms of two native phonemes, if the foreign phoneme contains a combination of features not occurring simultaneously in the native language. Trubetzkoy explains this by saying that "the phonemes are not symbolized by sounds but by specific distinctive *sound properties*, and ... a combination of such sound properties [which do not occur together in the native language] is interpreted as a combination of phonemes. However, since two phonemes cannot occur simultaneously, they must be interpreted as occurring in succession" (op. cit.: 64). As an example, he cites German /y/, which is interpreted by Bulgarian speakers as /ju/. The Bulgarian hears the features front and rounded, but perceives them as occurring consecutively.

Werker and Tees (1984) note that there are some indications that young children have the ability to discriminate many different speech sounds that are not used in their native language, which they lose as they grow older.[5] Werker and Tees try to examine whether the problem in perception is due to a change in auditory response capabilities, or processing strategies, by focusing subjects'

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[5]According to Echols (1993: 259): "the loss of the ability to perceive non-native contrasts ... appears to happen before most infants have produced their first word and at an age at which they understand few words."

attention in different ways for different experiments. Although "under most conditions, listeners demonstrate categorical perception" (p. 1876), Werker and Tees claim that there is a phonetic level between the acoustic signal and the phonemic categorisation level, which listeners can use to discriminate sounds if the task is given in an appropriate manner. However, their findings may not be relevant to the current study, as they presented a string of similar sounds for direct comparison; in the experiments for this study subjects were given dissimilar words, and did not have their attention focused on fine phonetic detail. We would therefore not expect that the subjects would be able to achieve such discrimination of sounds as Werker and Tees's subjects.

According to Flege (1991), there are three levels involved in perception: auditory, phonetic and phonemic. While he suggests that interlingual identification (comparison of an L2 sound with an L1 sound) generally occurs at the phonemic level, he acknowledges that perception at other levels may be involved. If interlingual identification takes place at a phonetic level, he says, listeners should not use allophonic information in their judgements as allophones presuppose a phonemic level. Flege conducted an experiment with Spanish and English subjects, rating CV syllables on a 9-point scale of (dis)similarity. He found that the Spanish subjects found [æ]-[ɛ] pairs to be more dissimilar than did the English subjects. If the subjects were comparing the sounds phonemically, says Flege, the Spanish subjects would have identified [ɛ] with /e/, since Spanish /e/ has the allophones [e] and [ɛ], and the reverse result would have been obtained.[6] In addition, the phonemic level is probably favoured by Flege's experimental design, which requires subjects to label sounds using ordinary graphemes.

Flege (1987a, 1987b, 1991) claims that the place in the phonemic system to which an L1 learner assigns a foreign sound affects the accuracy with which the learner reproduces that sound. In contrast to the predictions made by the Contrastive Analysis Hypothesis, which claims that sounds which are different in the foreign language should be difficult for learners, Flege proposes that sounds which are similar in L1 and L2 are never properly learnt, whereas sounds which are different are learnt from scratch and so are more likely to be

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[6]It is not clear from the information given in Flege (1991) where [æ] fits into this picture, i.e. whether the Spanish subjects were subconsciously identifying it with Spanish /e/ ([e], [ɛ]) or /a/ ([a]), though results in Flege (1991) suggest identification with /a/ is more common. However, as the two English phones [ɛ] and [æ] both fall somewhere between the nearest Spanish vowels, even if English [ɛ] had been identified with Spanish /e/, it is likely that Spanish speakers would consider [ɛ] and [æ] to be closer than English speakers, who have [ɛɪ], [ɛ], [æ], [ɑ] in this area of the vowel space.

accurately acquired.[7] "It may be [that] L2 sounds that match an L1 sound closely, or else differ *considerably* from any sound in the L1 may be produced authentically, whereas L2 sounds that *partially* resemble an L1 sound may be pronounced poorly" (Flege 1991: 707). For example, in the case of French and English, /u/ and /t/ are realised differently in each language but are judged by speakers to be equivalent; French /y/, on the other hand, is not readily identifiable with any English sound. Flege quotes research (Flege 1984, Flege and Hammond 1982) which contradicts Trubetzkoy's hypothesis that a native phonological sieve makes L1 speakers incapable of perceiving L2 phones accurately, so he rules out this explanation. He notes instead that, although we can perceive variation in sounds, we need to be able to classify them as equivalent:

> "Equivalence classification is a basic cognitive mechanism which permits humans to perceive constant categories in the face of the inherent sensory variability found in the many physical exemplars which may instantiate a category. ... Equivalence classification is undoubtedly important for L1 learning because it permits children to identify phones produced by different talkers, or in different phonetic contexts, as belonging to the same category" (Flege 1987a: 49-50).

He then goes on to suggest that, because of equivalence classification, if an L2 sound is similar (though not necessarily identical) to an L1 sound, learners assign it to the category they already have; for sounds which are dissimilar, a new category must be established. He tests this hypothesis by studying experienced French learners of American English, and vice versa, with monolingual subjects for comparison. On examining formant frequencies, he concludes that the American subjects pronounced French /y/ considerably more accurately than French /u/. One criticism which can be made of this experiment, though, is that the French and English words were elicited during the same test, necessitating language-switching and possibly making the pronunciation task more difficult.[8]

Flege 1987b makes similar claims with respect to English and Spanish,

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[7]In a later paper, Flege (1991) defines "similar" as "a sound that is represented by the same IPA symbol as a sound in the L1, provided it can be shown to differ from the corresponding L1 sound"; new sounds are "L2 sounds that are represented by an IPA symbol not used for any sound in the L1 (and, of course, which differ auditorily from the nearest L1 sound." (Footnote, p. 704.) However, there are problems with this definition, as Flege himself notes, for example the number of "distinct vowel types"; another problem could be the conventional (convenient) representation of different sounds in different languages using the same IPA character, such as /ẽ/ in French and Portuguese, or the same sounds with different characters.

[8]The same criticism, it should be noted, could be made of the experiments in the current study.

but with the added hypothesis that variation may occur in different age groups (in particular, he suggests that children may be able to form new categories for similar phones, though the evidence is unclear). He also suggests that inaccurate L2 input from other L1 speakers may have an effect on the degree of success the learners achieve in pronunciation.

Another point to note is Flege's comment that vowels and consonants differ in categorisation: "Unlike consonantal sounds, vowel sounds are discriminated readily even if they are not classified differently" (op. cit.: 704). Perhaps this is due to higher variability of the phonetic realisation of vowels than of consonants in different accents of a language.[9] He also notes that the difference between vowels in two languages is not always easy to classify, due to "uncertainty as to whether the distance between vowels in two languages is judged in terms of an auditory, phonetic, or phonemic metric" (ibid.). It should also be pointed out that not all of Flege's studies (for instance Flege et al. 1992) support his hypothesis that learners will be able to learn correctly sounds for which they do not have an equivalent.

Bohn (1995a: 88) gives an overview of L2 segmental perception, and points out that a number of studies suggest that consonants and vowels are perceived in different ways, and that "studies of vowel discrimination suggest that L2 vowel perception is less influenced by L1 background than L2 consonant perception." Also, studies suggest that foreign-language learners may use different cues for perception of contrasts than native speakers. For example, Yamada and Tohkura (1992) found that Japanese learners used the F2 transition to try to differentiate American English /r/ and /l/, while native listeners used F3 onset frequency. On the other hand, Best (1995) suggests that articulation is used in perception; this article proposes an articulatory method of classifying difficulty in perception of L2 sounds. If two non-native phones are both gesturally[10] similar to a native phone, they are difficult to distinguish; if they can be assigned to different native phones, they should be easily distinguishable.

It has also been suggested that particular segments or types of contrast may be more difficult to learn than others, at least for certain groups of speakers. For instance, Werker and Tees (1984) found that place contrasts in Hindi were more difficult for English speakers to perceive than voicing contrasts.

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[9]This, of course, is language-dependent; at the segmental level, English, for instance, differentiates accents primarily by vowels, while Spanish uses consonantal variation.

[10]Gestures are defined here as the actual articulations made in the speaker's vocal tract.

However, Best et al. (1988) found that voicing and place contrasts in Zulu clicks were easily differentiated by English speakers. Closer to home, Gottfried (1984) found that even experienced students of French had problems in distinguishing French front rounded vowels.

Differentiating amongst French nasal vowels is also difficult for foreign language learners (Calbris 1978). These illustrate another an important point, which is the accuracy of linguistic description and its implications for theories of perception. The supposed relationships between nasal and oral French vowels are shown below:

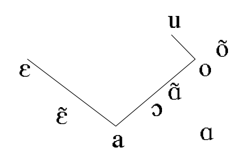
(i) /ɛ̃/ ↔ /ɑ̃/ ↔ /ɔ̃/
↙ ↙ ↓ ↓ ↘
/ɛ/ /a/ /ɑ/ /ɔ/ /o/

However, perception tests using both native French speakers and a variety of learners of French as a second language show that the above correspondences do not always hold.[11] Instead, Calbris notes the following confusions:

(ii) /ɛ̃/ ↔ /ɑ̃/ ↔ /õ/[12]
↙ ↓ ↓ ↘
/a/ /ɔ/ /o/ /u/

This is quite easily explained from articulatory and auditory points of view. In terms of tongue and jaw position, for instance, the nasal vowels lie between their corresponding oral vowels in (i) and (ii) above:

(iii)



/õ/ is closer to /o/ than to any other vowel, /ɑ̃/ is closer to /ɔ/ and /o/ than to /ɑ/ or /a/, and /ɛ̃/ is similar to /a/. The question is then, why are the correspondences in i) normally taken to be correct? The answer presumably lies in orthographic correspondences and derivational relationships involving verb conjugations or gender, for example:

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[11]Some criticisms can be made of Calbris's methodology: for instance, for the French subjects he used nonsense sequences which he asked them to write down in ordinary French, noting any peculiarities. The phrases were rationalised by the subjects into meaningful French, suggesting that at least some of the sounds were misperceived, either consciously or sub-consciously, in order to make sense of the input. Other data comes from real perception errors by native speakers and foreign students repeating phrases.

[12]Calbris deliberately transcribes this vowel as /õ/ rather than /ɔ̃/, as he believes the former to be a more accurate representation.

<vien> ~ <viennent>	/vjɛ̃/ ~ /vjɛn/
<Jean> ~ <Jeanne>	/ʒɑ̃/ ~ /ʒan/
<bon> ~ <bonne>	/bɔ̃/ ~ /bɔn/

Thus, we have non-phonemic information influencing the commonly used transcription system.

Derwing and Nearey (1994) find an effect of word-position on the perception of sounds. They attempted to obtain judgements of sound similarity in various languages, by native speakers of those languages. They found that for the five languages they studied (English, Arabic, Taiwanese, Korean and Japanese), segments were judged to be most dissimilar in positions of the greatest number of potential contrasts. "This suggests the possibility of a link between the relative weighting on segments and the amount of information that each segment contributes to the identification of a particular string." (Op. cit.: 354.) This held true, for example, for initial consonants in CVC words in Taiwanese, the position in which the greatest number of consonants can occur, but for medial consonants in Arabic CVCVC words, again the position of greatest contrast.

On the other hand, Dissosway-Huff (1981), in a study of Japanese perception of American /l/ and /r/, found that analysis of word-position showed considerable variation in accuracy of identification, with final-cluster sounds being perceived the most accurately. Japanese has more possible consonantal contrasts in initial position than final, which seems to contradict Derwing and Nearey's findings; however, final /l/ and /r/ are not possible in Japanese, either phonemically or phonetically, and this is a situation not covered by Derwing and Nearey.

In summary, we are still lacking an adequate description of phonetic similarity: "An important task for future research is to characterize the notion of phonetic similarity in explicit and non-circular ways." (Strange 1995: 81.) This is a problem in assessing native speakers' perception of foreign sounds, as will be seen in the analysis of the experimental results of this study.

b) Structure

Perception of a foreign language in terms of the native language can occur with sequences as well as single phonemes: "Japanese does not have any consonant sequences at all ... its high vowels are very short and can optionally be suppressed. Japanese speakers think that they also hear short high vowels between consonants and in final position in foreign languages" (Trubetzkoy

1939: 62). This is reflected in Japanese speakers' pronunciations of foreign words containing consonant clusters - they insert high vowels in the clusters (and after final consonants) to make them conform to a CV syllable pattern, for example *Christ* becomes *Kirisuto*. After considerable practice in foreign languages, the speaker "often goes to the opposite extreme and suppresses the foreign *u*'s and *i*'s that are etymological" (op. cit.: 63). Difficulties of Japanese listeners in perceiving consonant clusters are also noted by Kashino and Craig (1994), who give an example of a consonant in a cluster in an American word being interpreted as vowel by a Japanese listener:

hardware → *haraware*

Of course, these changes affect the number of syllables in the word, as well as the syllable structure.

In the current study there are only a few examples of spoken sequences in the prompts which do not fit the phonotactics of English (if we can assume that the individual foreign segments in the sequences may be compared to similar English phonemes, which of course is not a trivial assumption). These will be examined for perceptual difficulty as well as difficulty of reproduction.

c) Suprasegmental features

The non-native prompts in the study contain variations in stress pattern, tone and segment length, so perception of these aspects is discussed below.

◊ *Stress*

Stress cues may be different in different languages (see for example Niemi 1979b), or indeed in different accents of the same language, and this can lead to misperception of stress. Laver (1994) notes that English is one of the few languages which exploits phonetic segment quality as a correlate of stress. Furthermore, Lass, quoted in Laver, claims that while Southern English stressed syllables have high pitch, Northern Irish English and Danish stressed syllables have low pitch. The precise differences in stress cues fall outside the scope of this study, and in any case, these differences may not have been accurately produced by the speaker of the prompts used in the experiments. It should be remembered, though, that as the prompts were judged acceptable by native speakers (see Chapter 4), the stress cues may well differ from those normally used in Scottish English.

There are also various studies (e.g. Durand 1995) noting stress changes in borrowed words. However, it is not clear whether this is an issue of perception or production, nor how listeners perceive stress in foreign words. In the case of loanwords, of course, the written form often enters the language along with the spoken form, thus confusing the issue. It can sometimes be observed that non-native speakers with knowledge of an L2 in the spoken form use different stress patterns from non-native speakers with no knowledge of the spoken L2. For example, English speakers with no knowledge of Japanese will usually stress the penultimate syllable of place-names such as *Yokosuka* and *Hiroshima*; those who are familiar with the spoken forms of these names will stress the pre-penultimate syllable (personal observation).[13]

◊ ***Tone***

The prompts in the current study include Norwegian, which has a tone system using two different lexical tones applied to many multisyllabic words. These are a noticeable feature of the Norwegian prompts, so we need to consider how (and, indeed, whether) subjects might perceive and reproduce these tones.

Nishinuma (1994) studied French subjects' perception of Japanese tone and found, unsurprisingly, that they did less well than Japanese subjects. They were asked to detect a high-low tone change, and on various tests, such as locating the syllable with the tone change scored from 45%-66%, while Japanese subjects averaged 89%. It is not clearly indicated, however, whether the words in the study were real words, which might affect the performance of Japanese subjects. Additionally, there are indications that native speakers and non-native speakers use different features to try to differentiate tones. For example, Gandour (1983), looking at perception of tone in Far Eastern tone languages by native and non-native speakers, found that fundamental frequency was generally more important to listeners from nontone languages than listeners from the tone languages, who found direction of pitch change more important.

Burnham and Torstensson (1995) looked at the perception of Swedish tones by English children and adults, using a same/different task. They found that subjects discriminated vowels better than tones, and also that older subjects did better on tones than younger ones, which they claim is due to older subjects' greater ability to understand the task. They explain the good performance on tones compared to vowels by saying that it "is due to the

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[13]This is not exclusively a stress issue; the high vowels in the penultimate syllables of these names are usually reduced by Japanese speakers, leading English speakers to perceive them as unstressed. Also, what is perceived as stress in Japanese is more accurately described as pitch-accent.

relatively high acoustic salience of tone differences compared with spectral qualities of vowels, rather than to any linguistic salience of tones" (p. 561). However, there is no description of the instructions given to subjects, in particular whether it was pointed out to them that some of the words used different tone patterns.

For the experiments in the current study (see Chapter 4), subjects were not given explicit instructions regarding tones, and of course the task was rather different. We can expect these factors to affect perception of tone; it is very likely that speakers of English are able to perceive differences in lexical tone if required to do so, but otherwise, since they are not conditioned to pay any attention to lexical tone, it may well be ignored. If the tone corresponds to an English intonational pattern, it may be thought part of a sentence pattern, and if it doesn't it might be perceived as something foreign or unnatural, but of little significance in itself. Studies in this area are unfortunately lacking.

◊ ***Segment length***

The current study includes prompts with segments of varying length. This may cause difficulty of perception or categorisation. We would expect that non-native long vowels would be perceived by speakers of Scottish English as equivalent to short vowels, since this is the case in their native language, but that long consonants might be perceived as geminate consonants, since such combinations do sometimes appear in English at morpheme-boundaries, such as *bookcase*.

There has been little work on perception of segment length by non-native speakers. One study which looks at long consonants is Rochet and Rochet (1995). They suggest that English listeners hearing long Italian consonants actually perceive the difference to be in the length of preceding vowel (short for a long consonant, long for a single consonant) unlike Italian speakers who perceive a difference in the length of the consonants.[14] This in fact would suggest that English speakers might not perceive long consonants as geminate consonants; if they did perceive the difference to be in the vowel, they might then classify it as non-distinctive and so not repeat it.

Experiments by Barry (1974) suggest that English speakers are not

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[14]It should be noted that the current study analyses Italian double consonants as long consonants, so they fall under the topic of 'segment length'; in some analyses they are geminates, which would make them a structural issue. However, it is suggested in some accounts (see for example Badecker 1996: 57) that geminates have the same suprasegmental status as long segments.

particularly sensitive to vowel duration. He presented British and German subjects with words which were similar in both languages (for example *tip* and *Tip*), read by English and German speakers, and asked the subjects to rate the words for acceptability in their native language. He notes that the subjects used mainly vowel quality to assess the vowels, while the German subjects used both quality and vowel length. However, his data is complicated by regional variation amongst the German speakers and subjects.

It should be noted that some studies (see discussion in Bohn 1995b) suggest a sensitivity to vowel length as a means of classifying vowels by speakers of accents such as American English, in which vowel quality differences (such as /o/, /ɔ/) are accompanied by length differences. However, this should not occur for Scottish English subjects, for whom vowel quality and length are not related in the same way. In summary, we must be careful not to assume that subjects' perception of foreign features can necessarily be analysed in terms of perception by native speakers of the language in question, or indeed any non-Scottish speakers.

2.4.3. Perception and categorisation of foreign written features

a) Graphemes

The written prompts in the current study contain a number of graphemes with diacritics, such as <ö>, which will be examined for errors of perception and production, where the two can be differentiated. Unfortunately, there is little work on the perception of such graphemes, for example whether they are perceived as a segment plus a diacritic, a whole unit, or whether they are likely to be misperceived entirely as another grapheme with a similar shape, but these questions will be addressed in analysis of the data here.

b) Combinations of graphemes

Readers are generally aware that different languages have different orthographic structures. They are, of course, familiar with the structure of native written words, for example experiments by Massaro et al. (1979) show that native speakers are aware of orthographic regularity in their own language. English-speaking subjects were presented with written strings and asked to rate them according to how much they looked like English words, and it was found that their judgements correlated with orthographic regularity (regularity being defined by rule, rather than by comparison with existing words). It is also the case that readers usually have some awareness of non-native graphemic patterns, as part of general knowledge as well as specific language-training.

However, this still leaves the question of how we perceive non-native graphemic patterns, in the sense of whether these combinations are more prone to perceptual error, or difficulty of recall. Of course, automatic phonological encoding may compound any difficulty in the perception and retention of non-native grapheme combinations, as subjects may find it difficult to produce an appropriate phonemic form for these. In the current study, particular attention will be paid to the non-native graphemic strings and whether they lead to errors of perception.

2.5. Summary

Perception is a vast area of research, and this chapter has been able to cover relevant topics only briefly. Many different areas of linguistics contribute to this subject, including psycholinguistics, second language learning, visual perception research and phonology.

In summary we can say that subjects may have perceptual difficulties at different sub-lexical levels, such as segment identification or word structure, whether word presentation is visual or aural. Although these may cause particular difficulties for foreign words, there can also be perceptual errors in native words, and these will need to be taken into account in analysing the results of the experiments in the current study.

There is also a substantial amount of research at the word-level, including access to entries in the mental lexicon and how this might be achieved. Although the words in the current study are unfamiliar, it seems that lexical access is initiated automatically, so we can expect real words to affect subjects' the perception of the input. Research also suggests that phonological forms are activated for written words, and that literacy can affect the perception of spoken words, so we need to take cross-media effects into account when examining subjects' perception.

Chapter 3.

Processes of Production

This chapter looks at issues in the production of language. Due to the scope of the thesis, the discussion is limited to the word level, and primarily deals with production in the sense of 'reproduction' or repetition of input, whether in the same medium as the word was presented, or cross-media. Since, for adults, accurate reproduction of known words is usually a trivial issue, much of the discussion focuses on foreign and unfamiliar words. There is naturally some coverage in this chapter of general issues of planning, articulation, timing and so on, which affect known words as well as unknown ones; these are of course complex mechanisms and in this sense are not 'trivial', but these processes are carried out by normal speakers without difficulty, and are not a topic of investigation here.

The chapter begins with a brief discussion on rule sets and analogy in language production, and individual variation. Also included is a description of the Edinburgh accent of the subjects who participated in the current study, so that their language production can be set in context. Then follows a review of issues and studies in reproduction of words within the same medium, first spoken and then written, and a section on the relationship between spoken and written forms of words. Finally, foreign words are addressed, in terms of the reproduction of spoken and written forms, and the correspondences between the two media.

3.1. General issues

This section outlines the distinctions between grapheme-to-phoneme rule sets and analogy. There is also some discussion of personal variation in word production, whether written or spoken, and a description of the Edinburgh accent which characterises the subjects in the current study.

3.1.1. Rule sets and analogy

Many studies assume a grapheme-to-phoneme rule set, or the reverse, for translating written into spoken forms and vice versa, and there have been numerous attempts (e.g. Venezky 1970) to record the correspondences for English. Since we are able to assign pronunciations to unknown written words, or create spellings for unfamiliar spoken words, it is clear that we must have a system to analyse words at the sub-lexical level. However, it may be that the concentration on grapheme-to-phoneme rules arose because they are a convenient way to describe the relationship between written and spoken language, to teach spelling, and to create pronunciations for unknown words in text-to-speech systems, rather than because this is how speakers actually behave. Recent studies suggest rather that cross-media output for unknown words is achieved by analogy with known words.

Firstly, we need to discuss the difference between rules and analogy, and the way in which they might operate. Analogy, we can say, involves basing the pronunciation (or spelling) of a word on the pronunciation (or spelling) of another word or words. This requires that the other word be accessed; evidently, the word must then be accessed through a partial form, for example to pronounce <sead> by analogy with *bead* or *head* would require accessing these words through <-ead> alone. Rules are an explicit correspondence and do not rely on or access particular lexical items. In this example we would have two rules, one for <-ead> → /id/ and one for <-ead> → /ɛd/, or possibly just <ea> → /i/ and <ea> → /ɛ/ combined with <d> → /d/. On the other hand, we can question where native speakers obtain their knowledge of such rules. Some of this knowledge will come from formal education in reading and spelling skills, but much of it is not explicitly taught and, if it exists in speakers' minds, must have been derived from lexical correspondences, even if these are not recalled when later using the rule.

So, it can be seen that grapheme-to-phoneme rules and analogy do not necessarily draw on separate stores of knowledge - the question is more how we use the knowledge we have. This leads us to the problem of how to determine the way in which the knowledge is being used, when it is often unclear by which route output was achieved. Effects of analogy have been found by presenting related words, for example Rosson (1983) found that preceding <louch> with <sofa> encouraged a pronunciation of <louch> which rhymed with *couch*, while preceding it with <feel> encouraged a pronunciation rhyming with *touch*.[15] This effect was modified, however, by the regularity of the respective pronunciations, with a more regular pronunciation chosen more often. This suggests that even if an analogy to a nonword is obviously available, we cannot expect it to be used by all subjects. Rosson (1985) provides further evidence that lexical analogy and grapheme-to-phoneme rules are both used in the pronunciation of written pseudowords. If many words exhibit a certain grapheme-to-phoneme correspondence, she says, this is a strong rule, and lexical analogy is less likely to be needed if there are strong rules available; if available rules are weak, there is more reliance on analogy with particular words.

Further studies on the use of rules and analogy will be discussed throughout this chapter.

3.1.2. Language skills and personal variation

There is of course a large amount of variation in language production which is influenced by social context and speech or text style. This will not be covered here, as the data to be examined in subsequent chapters is all from the same source, i.e. experiments, and so should not vary greatly in this way. So, this section will look at other factors, such as individual language skills, which influence speech or spelling production.

Obviously, speakers who have experience of foreign languages should perform better at reproducing words in those languages. They may also perform better on words from languages they do not know, due to a broadening of their linguistic experience and training in language skills. Also, some people seem to have a facility for language, and are better at spelling or at imitating sounds than other people.

However, differences which are apparent in the language output from different subjects are not always due simply to level of skill. It is also likely that subjects use different strategies to plan output. For example, Lennox and Siegel (1996) claim that poor and average spellers (they use "average" to cover both average and good) use different strategies to spell. They studied the spelling errors made by children between 6 and 16, who were ranked for spelling ability,

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[15]Note that with this method of presentation it is not necessary for the subjects to access the lexical item <couch> through the part-word <-ouch>. The chain of activation might be:

<sofa> → phonology, semantics, etc. → related words, e.g. *couch* → <-ouch>, /a͡ʊt͡ʃ/ relationship

Presentation of <louch> might then trigger /a͡ʊt͡ʃ/ either through <-ouch> and direct analogy with *couch*, or through a search of grapheme-to-phoneme rules, with /a͡ʊt͡ʃ/ being already more strongly activated than /ʌt͡ʃ/.

and concluded that poor spellers were not merely lagging behind average spellers, but were using a different approach to spelling. Errors were rated as "unconstrained phonological" (a possible spelling for the sound although not appropriate for word-position, e.g. <rech> for *reach*, with <e> representing /i/), and "constrained phonological" (a possible spelling for the sound, appropriate for word-position, e.g. <reche> for *reach*). A score was also given for "visual similarity", reflecting the overlap between the letters in the word and the response, both single graphemes and bigrams, for example <heven>, for *heaven*, has 3/5 correct bigrams and 5/6 correct letters. They then found that average spellers were more likely to use a phonological strategy and poor spellers a visual strategy. "We are suggesting that average and poor spellers use different strategies to spell." (Lennox and Siegel l996: 79.)

Barron (1980: 203) found similar results for reading, suggesting that "good readers used a strategy in lexical access which was predominantly phonological ... Poor readers, on the other hand, appeared to be using a strategy which was predominantly visual-orthographic". However, he found the opposite for dictation tasks, with good readers being better at using a visual-orthographic strategy than poor readers. He suggests the difference between groups may be due less to the amount of knowledge they have of the different word-features, than to the way in which they use this knowledge in specific tasks.

There may also be personal differences in the extent to which analogy is used to such tasks. Frith (1980) looked at children's spellings of spoken nonsense words, and found that good spellers used analogy, while poor spellers produced more varied responses and seemed to be using a phoneme-to-grapheme strategy. She does point out, though, that the poor spellers could also be using analogy, but be unable to spell the analogous words. She also finds that good spellers or good readers, where they did not use analogy, used plausible spellings, but children who were both poor readers and poor spellers were more likely to produce implausible spellings with incorrect phoneme-to-grapheme rules, for example producing <bit> instead of <bite> for a syllable which was presumably /ba͡ɪt/. Those who were good readers but poor spellers had some difficulty in reading nonsense words aloud compared to children who were good at both reading and spelling.

Given the variation in language skills and available strategies, and the apparent variation by age, task and other factors, it is difficult to make any firm predictions about strategies likely to be used by individual subjects. In any case, it is important to note that output may be achieved through different routes, and level of skill alone is not enough to describe and explain inter-subject variation.

3.1.3. Characteristics of Edinburgh speech

It is important to characterise the speech of Edinburgh. However, this is also a difficult task since it is very variable in a number of ways. As in any group of British speakers, there is sociolinguistic variation both across speakers and within speakers in different situations (Reid 1978, Romaine 1978, Johnston 1983). Speakers may have differences in allophones (such as use of glottal stops), phonetic realisation (for example, realisation of /r/), number of phonemes (for example, /a/-/ɑ/ versus /a/ alone), phoneme incidence in certain contexts (variation in rhoticity) and lexical incidence of phonemes. Nevertheless, we can give a general description of Edinburgh pronunciation, and highlight some areas of variation.

a) Phonemic system

Consonant phonemes are generally as in RP, but with the addition of [x] and [ʍ], as in *lo<u>ch</u>* and *<u>wh</u>ich*. Table 1 shows vowel phonemes in Edinburgh, with example words and usual RP correspondences given for comparison. (Correspondences are generally correct but do not hold for all words. RP phonemes with no Edinburgh counterpart, such as [ɪə], are not included in the table.) Some Scottish speakers, including ones from Edinburgh, have an additional vowel phoneme /ɛ̝/, but do not always use it in the same words as each other.

In addition to the vowels in Table 1, the monophthongs have long counterparts [iː], [eː], [ɛː], [aː], ([ɑː]), [ɔː], [oː], and [ʉː], which are not generally considered phonemic as their use is determined by certain phonemic/morphemic environments[16] (see Agutter 1988 for some reservations on the concept of Scottish vowel length). Some speakers have minimal pairs such as *leak* and *leek*, which are not dictated by morphological structure, suggesting that for these speakers the difference between the long and short monophthongs is phonemic (see for instance Wells 1982, Vol. 2: 401). The vowel /aːe/, despite potentially being derived from the vowel /ʌi/ in a similar way to the derivation of

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[16]Relevant environments for long vowels are morpheme-final position (which in this experiment ought to constitute only word-final position), or before /v/, /ð/, /z/ and /r/. Additionally, for /aːe/ open syllables are added to the list of conditioning environments.

long monophthongs from their short counterparts, is normally considered a separate phoneme as it has a different quality as well as length, and is considered different by native speakers.

Phoneme (Edinburgh)	**Example**	**Status in Edinburgh English**	**Corresponding RP phoneme(s)**
i	bead		iː
ɪ	bid		ɪ
e	bait		ɛɪ
ɛ	bed		ɛ
a	bat		æ
ɑ	dart	optional	ɑː
ɔ	caught		ɔː, ɒ
o	goat		əʊ
ɜ	bird	optional	ɜ
ʉ	boot		uː, ʊ
ə	about		ə
ʌ	bus		ʌ
ʌi	tide		aɪ
aːe	tied	debatable phonemic status	
ɔɪ	coin		ɔɪ
ʌʊ	town		aʊ

Table 1: Edinburgh vowel phoneme system

As with most accents, lexical incidence of vowels may vary across speakers. One example is in final unstressed open syllables, such as in *happy*, where some speakers have /e/, some have /i/ and some have /ɪ/; for words such as *comma*, some have /ə/ while others have /ʌ/.

b) Phoneme realisations

The phoneme /r/ varies in phonetic realisation, depending on both speaker and phonetic environment. Romaine (1978) found that in Edinburgh primary school children word-final /r/ was mostly pronounced as [ɹ] before a pause or a word beginning with a consonant, and [ɾ] before a word beginning with a vowel. There were also numerous cases of no word-final /r/, particularly before a pause. Boys used [ɾ], or no rhotic /r/ at all, more than girls. There are also cases of the uvular /r/, [ʁ], in Scotland.

As for other consonants, oral stops are generally tenser than their English counterparts, and voiceless consonants often have less aspiration, making them more similar to many European stop consonants (such as French).

Glottal stops are used for /t/ in certain environments (cf. Reid 1978), like many other accents of British English, while clear and dark /l/ are not generally distinguished.

Vowels listed in Table 1 as monophthongs really are monophthongs, unlike some English accents, and /e/ and /o/ are used in Scottish English rather than the diphthongs /ɛɪ/ and /əʊ/. This means that repetition of such vowels should not present the same kind of production difficulties for Edinburgh speakers as they would for RP speakers. There are no length distinctions in the basic phoneme set, unlike RP, so words such as *bit* and *beat* are similar in length (but see above for long allophones). The vowel /ʉ/ is generally rather central, unlike the corresponding RP vowel /u/. This results in less distance between the Scottish high rounded vowel and French /y/.

c) Structure and syllables

The most obvious difference from RP is that Edinburgh is rhotic, although not all speakers have rhotic /r/, and those who do may not always use it (see above). All vowels may precede /r/, but the monophthongs should always be long as /r/ is one of the phonemic environments conditioning length. This use of the full vowel set before /r/ means that, unlike RP, words such as *horse* and *hoarse*, or *air* and *scarce*, have different vowels. To some extent generalisations can be made about such words from the spelling, or from frequency of, say, /or/ versus /ɔr/ combinations, but use of these vowels is conditioned lexically rather than by rule, so words must be treated on a case-by-case basis. As for /ɜ/, which may appear before /r/, not all Edinburgh speakers have this vowel, and those who do may not use it everywhere that an RP speaker would use it, having instead the sequence /ɛr/ or /ʌr/ in some words of this type. Edinburgh, unlike some other Scottish accents, does not generally use /ɪr/ in words like *bird*, preferring instead /ʌr/ or /ɜr/. Finally, some claim (for instance Abercrombie 1979) that syllabification is different in Scottish English, for instance with word-final consonants being syllabified with a following vowel, making such sequences as "*an aim*" and "*a name*" equivalent.

d) Stress, rhythm and pitch

Some words (such as *magazine*) have different stress patterns in Scottish English from those used in RP, but this is not important in the current study. Of more relevance is the realisation of stress in Scottish or Edinburgh English, and the cues which speakers use to perceive or produce stress, but little research has been done on this. Brown et al. (1980) describe intonation patterns in Edinburgh English, and point out some differences between Edinburgh and RP. For example (p. 146), Scottish speakers listening to read Edinburgh speech identified the element with the highest pitch as the tonic in a sentence, whereas RP speakers chose the element with the most pitch movement. There is little mention of word stress, though, except the assumption (p. 31) that stressed syllables have higher pitch than unstressed syllables.

It is sometimes said that Scottish English has a different rhythm from RP English. Abercrombie (1979: 82) claims that in a two syllable word "Most accents of Standard English have either [an] equal-equal or [a] long-short relationship between the two syllables. In Scotland ... the first syllable is short and the second syllable is long." This will not, however, be especially relevant in the current study.

3.2. Reproduction in the same medium

This section will look at the issues which arise when hearing a word in the native language and then repeating it orally, or reading a native word and then writing it down. The focus will be on unfamiliar words and pseudowords, since they present a more difficult task, and one which is more closely related to the current study, than the reproduction of familiar words.

3.2.1. Reproduction of spoken forms

Although repetition of nonwords (which is in essence the task subjects will be asked to perform for English placenames in the current study) might seem fairly simple, subjects do make errors. Unfortunately, " ... very little is known about the processes that support performance on nonsense word repetition tasks" (Dollaghan et al. 1995: 211.) The following sections look at a few of the problems in the different sub-lexical levels of spoken language reproduction.

a) Segments

Some segmental error types occurring in nonword repetition are quoted by Hartley and Houghton (1996). They note that consonants are more likely to be substituted than vowels, that substituted phonemes are usually similar to each other in terms of shared features, and that syllable-initial phonemes are most likely to be switched with other syllable-initial phonemes. In the case of omissions, they claim that vowel deletions are much less likely than consonant deletions since there is a vowel slot in every syllable, and so if the syllable count is preserved the vowel slot must be retained. They also note that nonword errors are not necessarily the same as errors made in familiar words.

It has been observed in speech error data from real words that segments are more or less prone to error depending on their location in the word (Shattuck-Hufnagel 1992). She notes that most segmental errors seem to be word-initial, and presents experiments with tongue-twisters to encourage error. The word-initial effect could have been influenced by stress, which mostly occurred on the first syllable, but on analysis she found that shared stress had less effect on transpositions than shared word-onset position. One of her experiments involved nonword stimuli, for which the results were similar but still more biased in favour of a word-position effect; there was a higher total of word-initial errors amongst nonwords than for real words. She suggests a possible reason for this:

> "If the nonsense words enter the short-term store of "lexical" candidates directly from a text-to-sound process, rather than via lexical access, then they do not bring with them all of the information that a lexical item brings. As a result, their onset consonants may be even less tightly tied to the rest of the word than are the onset consonants of an existing lexical item." (Op. cit.: 248.)

(The model assumes a short-term store used for holding planned output.) It should be noted that this model does not necessarily conflict with the suggestion that lexical access may be attempted for nonwords.

Whatever the processes involved, it is important to note that accurate reproduction does not always occur for spoken nonwords even if they have native sounds and structure, and this should be taken into account when analysing errors in the current study.

b) Syllables and structure

Much has been written about syllable structure in word-output, often focusing on typological issues and whether, for instance, changes to syllable structure made by phonological processes result in more natural, or unmarked, syllable types. Venneman (1988), for instance, suggests "preference laws" for syllable structure using the notion of consonantal strength. According to these "preference laws" some syllable types are preferred over others, and any changes in syllables which are structurally motivated (rather than, say, morphologically motivated), will move in the direction of a more preferred syllable type. Additionally, he claims that "linguistic change on a given parameter attacks the worst structures first." (Venneman 1988: 2.)

Syllable structure and typology are also discussed by Bell and Hooper (1978), who look at consonant-vowel combinations and the apparent dominance of CV structures in the world's languages. They discuss the role of syllable-location in phonological processes, claiming that, for example "we find weakening, realized as assimilation, sonorization or deletion, to be common in syllable-final position, while strengthening, although never a common process, seems to be restricted to syllable-initial position." (Op. cit.: 14.) In the current study, as well as the more obvious changes which are often prompted by non-English structural input, syllable-structure changes in the spoken output will be examined to see whether there are any overall patterns resulting in, for instance, simplification of syllable structure. Contrary to this hypothesis, however, Hartley and Houghton (1996: 1) claim that "most errors in nonword repetition are phonemic substitutions which preserve the syllabic structure of the target." Insertions and deletions are relatively infrequent compared to errors of segment identity, and errors in the number of syllables are very rare (Dollaghan et al. 1995). Levelt (1992: 10) notes that this fact has been observed in speech errors and suggests "that a word's skeleton or frame and its segmental content are independently generated."

There is another interesting finding in Dollaghan et al. (1995). They examined errors in nonword repetition, and found that there were more errors which changed nonwords into real words than vice versa. They also did a separate analysis of vowel errors, on the basis that these were not likely to have perceptual or articulatory causes, and found that the percentage of these errors which changed nonwords to words, as opposed to changing words to nonwords, was even greater than for the full data set.

While some of these issues are peripheral to the main focus of this study, which concerns the perception and production of unfamiliar and foreign words, it is important to bear them in mind as it is possible that they may affect subjects' output.

Natural processes

There are a number of natural processes which may take place in spoken language when reproducing unfamiliar words (or, indeed, when producing familiar words). These include place assimilation of consonants to adjacent consonants, vowel reduction, cluster simplification and so on. They can have the effect of changing segment realisation, or changing the structure of the word by, for instance, altering the number of syllables or the number of segments. While some of these become fixed in the language (such as place assimilation in certain prefixes, cf. *irregular* and *impossible*), others are optional to varying degrees, such as /s/ + /j/ → /ʃ/ in English, either word-internally (*tissue*), where it is very common, or across word boundaries (*miss you*), where it is less accepted but still common for certain word combinations. It is to be expected that some of these natural processes will occur for subjects reproducing unfamiliar words.

c) Suprasegmental features

Although there has been much work on stress patterns in English, and on their relationship with spelling, repetition of stress patterns in spoken unfamiliar words or nonwords has not been widely studied. It may be that this is because such a task results in few errors, particularly for words with native segments and structure (see results of current study).

3.2.2. Reproduction of written forms

It can be assumed that reproduction of written words is usually simpler than reproduction of spoken words, partly due to the complex nature of speech and partly due to its transitoriness. Although misperception of written words is possible, if a letter or group of letters is not clear at first it can generally be re-examined. In the current study, however, reproduction was performed from memory with the prompt covered, so it was slightly more difficult than a mere copying task. It was also hoped that this strategy would encourage the conversion of the graphemic string into a phonemic string.

a) Segments

According to Hotopf (1980), looking at data on spelling errors in real words (errors due to "slips of the pen" rather than poor spelling ability), letters which have ascenders or descenders, such as <b> and <p>, are less likely to be omitted than others (such as <a>). He also found some evidence of errors caused by use of alternative grapheme-phoneme correspondences, such as <ridgid> for <rigid>, but errors which can definitely be assigned to phonemic influence rather than other factors are rare. He also found that omissions depended in part on structural features of the words (see below).

Segment errors in the reading-writing experiments of the current study will be analysed to see whether there any such patterns, and whether there is any evidence for phonemic re-spellings.

b) Syllables and structure

If there are any errors in reading-writing tasks which relate to structure, we might expect that these will involve unfamiliar clusters interpreted as familiar ones, or an unfamiliar written word reproduced as a familiar one. In such cases it is debatable, though, how much is dependent on perception and how much on production. We also need to consider that the change may not be due just to regularity of the graphemic form but to features of the corresponding spoken form.

Service (1992) carried out a copying task very similar to the one presented in the current study, in which Finnish schoolchildren were shown Finnish and English written pseudowords, which were covered before the subjects wrote them down. She says,

> "One might hypothesize that copying pseudowords requires creating a phonological working memory representation as an intermediate stage between the perception of the visually presented stimulus and the production of the written response ... On the other hand, it is also possible that pseudoword copying ... can perhaps somehow be handled without resorting to phonological representations." (Op. cit.: 32-3.)

Her results (see p. 81 below) do suggest that at least in some cases a phonological form is activated and used in the re-transcription.

Gibson et al. (1962) found that the pronounceability of the word was important. In a copying task involving pronounceable and unpronounceable strings:

> "Errors which changed the projected letter-group in the direction of a more pronounceable one were frequent. This was accomplished in some cases by adding a vowel (e.g. NIKID for NKID), by omitting a consonant (e.g. SKEB for SKSEB), or by changing a consonant-cluster (e.g. BLUS for LBUS). The results ... demonstrate that a letter-group with a high spelling-to-sound correlation is reproduced more accurately than an equivalent letter-group with a low spelling-to-sound correlation." (Op. cit.: 563.)

They point out that this cannot be due to a difference in familiarity of letters or letter-groups as the same clusters are used throughout, but in different positions, for example <nk> in final or initial position. It must be noted, though, that position itself is a component of familiarity.

The position in the word can also affect the likelihood of error. Wing and Baddeley (1980) looked at "slips" in samples of handwritten text, i.e. errors that were due to mistakes rather than to the subjects not knowing how to spell the words. This was tested by seeing whether the subject had corrected the spelling, or had spelt the word correctly elsewhere in the text. They found that errors tended to occur in the middle of words rather than the beginnings or ends. It should be noted that they only counted the first error in each word, which if anything would tend to lower the error count for later positions in the word, but this conclusion was supported by Hotopf (1980) for omissions. He notes that there were very few omissions of the first letter and they were all detected and corrected. He suggests that "the rarity of omissions of this letter is in agreement with studies of the tip of the tongue phenomenon." (Op. cit.: 303.) Wing and Baddeley (1980) suggest that this distribution was due to higher interference from neighbouring letters for medial graphemes than graphemes nearer word-ends. Other findings were that insertions occurred later in the word than other errors, regardless of word length (Wing and Baddeley), and that there were more omissions in longer words (Hotopf). These studies, though, were looking at misspellings of familiar words, rather than written reproduction of visually-presented unfamiliar words, and this difference should be noted when comparing their results to the current work.

3.3. The relationship between spoken and written forms

English has a notoriously variable relationship between pronunciation and spelling. Thus, an unfamiliar spoken name may be transcribed with a number of different spellings, and there are some names which have more than one pronunciation. Even familiar names can cause problems - although most ordinary words have gradually acquired standardised spellings,[17] there are a

[17]There are of course a few words which have variable spelling, such as *standardise/standardize*, or *ash-tray/ashtray*. It is debatable whether names should be treated separately from ordinary words in a study such as this. One view is that personal and place-names are distinctly different from ordinary words, for example that it is more difficult to pronounce unknown names than words. For example, Hochberg et al. (1990: 10), discussing speech synthesis of American surnames, claim that "the difficulty of automatic last name pronunciation lies in the foreign origin of many American names." Another camp holds that names are not problematic per se.

large number of names and name-elements which have more than one accepted orthography. So, we may know that a person's name is [ɹid], but not whether it is <Read>, <Reade>, <Reid> or some other variation. Additionally, if the name is foreign, it may contain sounds which have no obvious orthographic equivalent in English, leading to a number of equally valid ways of spelling the same name.

This section will examine the connection between text and speech at the lexical and sub-lexical levels, focusing on English, and will look at the possible routes by which we achieve pronunciation of unknown words, or a written representation of unfamiliar spoken words. There is a considerable body of psychological research in the area of letter-to-sound correspondences and analogy, mostly involving pronunciation latencies of various categories of word - frequent vs. words, real words vs. pseudowords, 'irregularly' pronounced words vs. 'regular' ones and so on, and some of this will be examined here.

It is often held that when pronouncing written words which we already know, a stored pronunciation is retrieved from memory. This leads to the supposition that there are two routes to achieving pronunciation of a written word: the lexical route, for known words; and a different route, generally involving some form of letter-to-sound rules, for unknown words.

> "Most researchers who study reading and pronunciation share the idea that readers use spelling-to-sound rules to pronounce letter strings for which they do not have stored pronunciations" (Glushko 1979: 674).

Since it is possible to describe the relationship between the orthography and the pronunciation of a language such as English, and since some of this description is common knowledge (such as the rule lengthening a vowel before a single consonant + final <e>), it is tempting to assume that readers do indeed apply such knowledge when reading unknown words aloud. However, Glushko (1979: 675) warns:

> " ... there is no necessary relationship between linguistic descriptions of the orthographic and phonological regularity in the language and a reader's knowledge of such language structure. ... Readers may know a great deal about the spelling-to-sound structure of their language, and linguistic descriptions can be sources of hypotheses about what this knowledge might be, but whether readers know the rules and whether they encode this knowledge as rules remain empirical issues".

Pronunciations of written nonsense words elicited from native speakers sometimes appear to support the theory that readers do use grapheme-to-phoneme knowledge, but Glushko (1981) suggests a different mechanism for assigning pronunciations. He claims that it is not necessary to assume that a reader uses letter-to-sound rules to pronounce an unknown word such as *toves*. The pronunciation /tovz/, he says, can indeed be achieved by using rules of English such as the "e-marker principle". However, "a reader might be directly reminded of *cove* or *stove* when confronted by *toves* and pronounce it by analogy without going through a mediating rule" (p. 63).

> "The pronunciation of a novel letter string like *toves* with a "correct" or "regular" pronunciation like /tovz/ does not reveal the level of generality of the knowledge of spelling-to-sound correspondences that made the pronunciation possible. Yet this ambiguity or indeterminacy is overlooked by psychologists and teachers of reading, who often assume that being able to pronounce unfamiliar words is evidence for abstract spelling-to-sound rules" (ibid.).

Examples of pronunciation errors from his experiments show:

i. interference from similar words to real words:

Orthography and pronunciation		**Subject's pronunciation**	**Word causing interference**	
<tomb>	/tum/	/tom/	<comb>	/kom/

ii. interference from similar words to pseudowords:

Pseudoword and "regular" pronunciation		**Subjects' pronunciations**		**Word causing interference**	
<tave>	/tev/	/tev/	/tæv/	<have>	/hæv/

iii. regularisation of exception words:

Orthography and pronunciation		**Subject's pronunciation**
<great>	/gret/	/grit/

For Glushko, the difference between real words and pseudowords is merely in the scope of the lexical look-up: for known words, the whole pronunciation is retrieved from memory; unknown or pseudowords may be broken down into smaller parts for which pronunciations are obtained by analogy with known words, a synthesis of these creating the complete pronunciation. This is a strong view of analogy, since it rejects the possibility of rules as an abstract tool.

Of course, it could be argued that "irregular" or secondary rules exist as alternatives to the regular rules, and that these are responsible for Glushko's findings. For example, the rule

<ea> → /i/ (e.g. *heat*)

might be regular, but there could also be a second rule

<ea> → /ɛ/ (e.g. *head*)

which is less common than the first but is nonetheless part of our linguistic knowledge, and may be used to produce pseudoword pronunciations. It is difficult to determine in particular cases whether analogy or rules are being used. Even if particular words are presented in experiments to suggest analogies (e.g. Rosson (1983), discussed above), and give the desired results, the mechanism by which the reader produces a phonemic representation is unclear; it may be due to direct analogy, or it may be due to higher activation of the related common grapheme-to-phoneme rule.

A number of researchers (for example, Forster and Chambers 1973, Baron and Strawson 1976) have noted that when subjects read real words which follow what we might call 'regular' spelling-to-sound rules, they are pronounced more quickly than irregular words. This has sometimes been used as evidence to suggest that the speakers are using grapheme-to-phoneme rules even for real word pronunciations, but Bauer and Stanovich (1980) explain the results in terms of an analogical model, claiming that the particular words chosen for some studies affected the results:

> "What gives rise to the regularity effect ... is not spelling-to-sound rules, but rather the consistency or inconsistency of the set of words activated by the target word ... Indeed, with such a conception, the distinction between regular and irregular words becomes considerably blurred." (Bauer and Stanovich 1980: 429-30.)

So, in summary, we can say that there is evidence both that subjects are aware of some grapheme-to-phoneme rules, and that analogy may be used as a tool for assigning spellings to pronunciations, or pronunciations to spellings, but in many cases the experimental data is open to different interpretations. Although relationships can be shown between output of nonwords and familiar lexical items, or between the "strength" of grapheme-to-phoneme rules and the likelihood that these rules will be reflected in nonword pronunciations (Rosson 1985), we are far from understanding the mechanism by which these effects occur. However, this area will be of particular interest in examining the results of the current study.

3.3.1. Segments

Certain sounds may cause more spelling problems than others for familiar native words. For example, Lilly (1995: 606) notes that for American English "reduced vowels ... appear to cause spelling errors twice as often as statistically predictable, [which] may provide an indication that neither surface nor underlying representations are fully specified." In fact, he found that most cases of vowel misspelling (substitution of one vowel grapheme for another) occurred in unstressed syllables. "Spellers have been seen to rely on deep forms when they contain phonological information" (p. 608), which suggests that many schwas are unspecified in the internal lexicon.

For the present study, of course, related morphemes or word-forms are unavailable, so subjects should have no clue from the word itself as to the 'correct' output for such a segment; the only pattern we might expect in the data would be a correlation with the statistical likelihood of a given grapheme or sequence of graphemes representing the sound. This comment is relevant for all spoken or written segments in the data which have a variety of possible outputs, and for certain segments the results will be examined to see if there is any relationship between the frequency of relationships in the dictionary and the output chosen by subjects.

It should also be noted that grapheme-to-phoneme correspondences are not the mirror image of phoneme-to-grapheme correspondences. Henderson and Chard (1980) suggest that the latter is more difficult, or at least more open to variation, since there is a "tendency for correspondences to be more ambiguous in the phoneme to grapheme direction." (Henderson and Chard 1980: 110.) They go on to say:

> "Vowels are highly ambiguous in both directions, whereas ... consonants are often very low in ambiguity in the grapheme to phoneme direction. Not only, then, are the total number of options unequal for the two directions of mapping but for an individual grapheme-phoneme pair the ambiguity of either item taken alone is unrelated to that of the other member of the pair. Moreover, there is asymmetry not only in the number of options but in the relative frequency of a given pathway." (Op. cit.: 110-1.)

We might then expect greater variety of segmental output in listening-writing tasks, at least for native monosyllables, than in reading-speaking tasks. The imbalance might of course be counteracted in multisyllabic words by the complications of stress and associated phonological processes.

3.3.2. Structure

In discussing the pronunciation of written words, or spelling of spoken words, it is not easy to draw a line between discussion of segments and discussion of larger word-portions. However, as far as word-based explanations are concerned, we can say that Campbell (1985), in asking subjects to spell nonwords, moves still further towards whole words than the above studies of analogy. She found that for 9-11 year old English children, who were asked to spell nonwords, in some cases after being primed with similar real words:

> "children show little evidence of the use of a simple, alexical rule-based system in writing nonwords to dictation. Rather, they use their knowledge of real word spelling to generate acceptable nonwords, even when this knowledge is limited ... it could even be claimed that word spelling knowledge may precede the acquisition of an efficient alexical nonword spelling system ... This allows the possibility that the characterization of nonword reading and writing processes in terms of such automatic rules may not reflect a basic skill at all, but may be the consequence of a very high level of literacy and abstraction." (Campbell 1985: 143-4.)

At a reading age of around 11 years the word bias effect became similar to that of adults. However, it may be that the priming effect in these experiments (nonwords being preceded immediately by rhyming real words) was too obvious. Given that Campbell found high levels of word bias when subjects were primed with real words, compared to subjects who were not primed, we are left to wonder what effect, if any, the spelling of real words had on the second set of subjects. Did they use the spelling most commonly found in real words, or one from the most frequent words? Or did they use a spelling from just any similar word, which they happened to access randomly?

Frith (1980), as mentioned briefly above, found that good spellers used analogy in writing down spoken nonsense words. She did not use primes, but we are still no closer to knowing how spellers select which of competing words to use for analogy, since her tests concerned words with obvious parallels, such as *zatest* (like *latest*), or *rituated* (*situated*). In the spelling task, there were also a few structural errors involving consonant clusters, such as omission of a nasal consonant before a stop (<groud> for *ground*); Frith notes that this type of omission is usually a problem of younger children and in older children tends to indicate phonological problems. She also notes that consonant cluster reductions in spelling decrease with age (and had mostly disappeared by age 12, younger than the subjects for the current study), but persist in poor readers/spellers.

Data from Praninskas (1968) also shows evidence of interference from similar words, this time in the pronunciation of trade-names by tradespeople handling the products. Praninskas found, for example, that *Homerama* was always pronounced as four syllables, presumably by analogy with *panorama*, while *Homelite* was always pronounced as two syllables, which appears to be due to morphemic analysis into *home* and *lite* prior to assignment of phonemes (p. 34). That the issue can be more complex than this is shown by *Cakelite*, which was given two syllables by some informants and three by others; perhaps some analysed the name as *cake* + *lite*, while others pronounced it by analogy with *Bakelite*. Praninskas does not attempt to explain the difference in pronunciations between the pronunciations of *Homelite* and *Cakelite* (after all, *Homelite* could also be pronounced by analogy with *Bakelite*), though one possible explanation is that *Cakelite* shares more letters and phonemes with *Bakelite* than does *Homelite*; another possibility is that the product *Cakelite* is more similar to *Bakelite* than is the product *Homelite*, thus invoking semantic as well as lexical analogy.[18] With these results in mind, in order to control for morphemic breakdown in the current study (see Chapter 4), obvious morphemes were avoided in constructing the prompts, although it is difficult to avoid inclusion of all possible morphemes.

It is important to note that the interference may be stronger in words of the same grammatical class. For example, Smith (1980), looking at spellings of spoken nonsense words, notes a difference in spellings of long vowels in the final syllable, depending on word class; he finds that spellings with final <-e>, such as <-ute>, are more favoured for verbs than for nouns, which have a higher tendency towards pairs of graphemes, such as <-oot>. He also found that in pronouncing written nonsense words, final <-e> in bi/trisyllables such as <nodude> was more likely to lead to a trisyllabic pronunciation in nouns than verbs. He notes that these tendencies are not found in the dictionary, and suggests that they can be explained by the fact that nonsense words might be compared to low frequency words, and therefore be seen as borrowings; <nodude> as a modern foreign language borrowing might well be three syllables. To verify this, he asked subjects to guess the language of origin of these words and found that although the words could be English, subjects gave an extremely wide variety of responses: "this in itself suggests that the origin of a word is not

[18]See, for example, Dell and O'Seaghdha (1992) for semantic relatedness and phonological planning of word output.

something that subjects were unaccustomed to consider." (Smith 1980: 41.) (In the current study, subjects will be asked to guess the country of origin of the placename prompts, so that their use of such judgements can be included in the analysis of the results.) Smith, incidentally, explains the pronunciations in terms of rules rather than analogy: "The effect of *-e* spellings for adults ... is to create a special class of 'French' words, which have low probability of first syllable stress and for which the normal English rule, that gives nouns a higher probability of first syllable stress than verbs, is blocked."

Unfortunately, comprehensive psycholinguistic studies on multisyllabic words rather than monosyllables are lacking, presumably because it becomes more difficult to achieve matches for all the different factors, and because the results become more variable. Many of the above studies involve multisyllabic words, but not with controlled structures or features to enable strict comparisons. When pronouncing unknown written multisyllabic words the speaker has the problems (at least for English) of deciding primary stress and, in some cases, determining the syllable structure (e.g. the <nodude> example above). These will of course affect or be affected by the segments used in the output. There have been various studies of stress assignment for unknown words, which naturally involve multisyllabic pseudowords, but this topic has usually been approached from the point of view of linguistic theory and stress rules, and how well they correspond to speaker behaviour (see below). Experimental studies are somewhat lacking on the specific interrelationships between the different sub-lexical levels of multisyllabic pseudowords, or the operation of analogy and rules for multisyllabic words.

3.3.3. Suprasegmental features

The discussion here will concentrate on stress assignment in English, and the relationship between stress and the written form.

a) Stress patterns

> "The stress rules of English are first of all riddled with exceptions and secondly fail the simplest attempts to confirm them directly, in many cases." (Kahn 1980: 134.)

Many attempts to explain stress patterns in English are complex and opaque and can only be said to have a role in the description of the English language, rather than the behaviour of English speakers (see, for example, proposed stress rules in Halle and Vergnaud 1987, Chapter 7, or some of the rules in Chomsky and Halle 1968).

If we are looking to explain how speakers assign stress to unfamiliar written words, use of such rule systems is implausible; we must then look at explanations using simpler rule systems (perhaps a reduced version of a full rule-set), or analogy with known words. (This of course then leaves us with an unresolved issue; if stress is indeed explainable only by complex rule sets, and speakers are incapable of manipulating these rules, how do the stress patterns come about? It is possible that analogy might play a substantial role here, but this question must remain open for the time being.)

Smith (1980), reporting on experiments in which subjects read aloud bisyllabic nonsense words, claims that "Whether the final vowel is lax or tense, whether the word ends in one or two consonants, and whether the word appears as a noun or a verb, all have large and significant effects on the assignments of primary stress in the word." (Op. cit.: 37.) Lax/tense vowels and the consonants in the rime of a syllable are the basic components of syllable weight, whose relationship with stress will be examined in the following section. The principle and use of analogy is covered in other sections of this study, so will only be mentioned briefly here.

b) Stress and syllable weight

Type of stress pattern	**No. of languages**
Languages with dominant initial stress (inc. German)	114
Languages with dominant second-syllable stress	12
Languages with dominant penultimate stress	77
Languages with dominant final syllable stress (inc. French)	97
Languages with no dominant stress placement (inc. English, Modern Greek)	113
Syllable weight stress	9
Antepenultimate stress	6
No stress or tone	16
Total languages studied	444

Table 2: Stress patterns found in languages of the world (Hyman 1985)

Amongst others, Hyman (1985) looks at the issue of syllable weight and its relationship to stress. He groups languages according to their stress patterns, as in Table 2 above. English partly conforms, he says, to a group of languages which "treats a syllable whose rime consists solely of a short (or lax) vowel as light, whereas a syllable whose rime has either a long (or tense) vowel and/or a final consonant (or more) is treated as heavy" (p. 5), and this can affect stress assignment.

We must first note that application of the notion of 'syllable weight' depends on the definition of syllable structure. If we applied the syllable structure, for instance, of Wells (1990: xx), in which "consonants are syllabified with whichever of the two adjacent vowels is more strongly stressed"[19], we would have a circular argument. Vowels would be stressed because the syllable ended in a consonant and was therefore heavy, and the syllable would end in a consonant because the vowel was stressed. (Wells's approach, however, is phonetic rather than phonological as it depends on factors such as articulation, and for our purposes it is preferable to take phonological approaches to syllable definition.) As for the reasons why syllable weight should affect stress placement, it has been suggested that it may be a result of similar auditory effects from syllable weight and stress, such as increased duration (see discussion in Ohsiek 1978).

Some theories of phonological weight, and the domain over which it applies, are briefly examined below. Only stress patterns for nouns are taken into account here, as it is assumed that town names, which will be examined in the current study, fall into the class of nouns.

i) Chomsky and Halle (1968) allow all consonants following a vowel to be grouped with that vowel. In certain cases, however, they form a 'weak cluster', i.e. the group consists of "a lax vowel followed by [r] or [w]" (p. 82).[20] So, for example, the *nd* affects the stressed second syllable of *veranda*, but the *cr* of *ludicrous* forms a weak cluster and so is unstressed. According to this theory, words such as *vanilla* contain a geminate *ll*, which forms a strong cluster and so is stressed. We can summarise as follows:

weak cluster	lax vowel followed by up to one consonant
strong cluster	tense vowel followed by zero or more consonants; or lax vowel followed by two consonants (where the second consonant may not be [r] or [w])

For a noun, then, a vowel takes primary stress in the following cases (Main Stress Rule):

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[19] An example of this syllabification is *mattress*, which would be [ˈmætr.əs]. There are some exceptions to the syllabification rule, which are not discussed here.

[20] There are also other kinds of weak clusters.

$$V \longrightarrow [1stress \;\Big/\; [x \text{——} (\begin{bmatrix} -tense \\ V \end{bmatrix} C_0^1 \begin{bmatrix} \alpha voc \\ \alpha cons \\ -ant \end{bmatrix}_0) \text{——} \;\Big/\; <_1 <_2 + C_0 >_2 \begin{bmatrix} -tense \\ V \end{bmatrix} C_0 >_1] <_{1N} <_{2A} >_2 >_1$$

(In brief, stress is assigned to the antepenultimate syllable of a string ending in two weak syllables, or to a strong penultimate syllable.[21] There are other rules and modifications which cannot be covered here.)

ii) According to many theories, syllable structure is based around the CV syllable, which of course affects the rules governing stress: "the numerous syllabic frameworks have invoked principles that automatically result in a CV sequence being assigned to the same syllable" (Hyman 1985: 2). Thus, VCCV can be VC.CV or V.CCV, but not VCC.V. If we used this syllable-structure theory to define the scope of the stress rules, we would be unable to allow Chomsky and Halle's analysis of *veranda*. In this type of theory, the important features defining syllable weight are not weak and strong clusters, but closed and open syllables, with tense or lax vowels. *Veranda* would be syllabified as *ve-ran-da*, and the penultimate syllable would be stressed as it is closed; if the penultimate is open, the antepenultimate syllable could be stressed (as in *al-ge-bra*). Tense, or long, penultimate vowels are also stressed. As Kahn notes (1980: 136), the stress rule taken from the Main Stress Rule of SPE (above):

$$\text{——}\; C_2 V C_0]_N$$

"will fail not only when C_2 is a possible initial cluster of the type called "weak" by SPE (i.e., clusters consisting of C{r, w}) but when C_2 is <u>any</u> cluster which is possible syllable initially", for example *st* in *minister*.

iii) Some theories explicitly allow ambisyllabic consonants or clusters, for example Anderson and Jones (1974), quoted in Kahn (1980). In this account, "all syllables have maximal initial and final clusters, regardless of the amount of overlapping entailed." (Kahn 1980: 177.) *Boston*, for example, consists of the syllables "/bost/" and "/ston/". However, Kahn claims that "English stress assignment differs from many other phonological rules in applying at a level at which ambisyllabicity, necessary for accurate phonetic representations and relevant to the conditioning of certain low-level rules, is not yet appropriate" (pp. 178-9). If the syllabification from Anderson and Jones were applied, then stress in words such as *cinema* would fail to be predicted correctly by the stress rules in

[21]Chomsky and Halle do not use the term 'syllable', but 'string' and 'cluster' - 'syllable' is used here in order to give a brief summary.

ii) above, since the penultimate syllable is closed and should be stressed.

iv) For others, syllable weight depends on the position in the word. Thus, for Giegerich (1985) on German (as described in Kaminska 1995: 115), "word medially a CVC sequence constitutes a heavy syllable and a CV sequence a light one, while word-finally CVCC sequences are heavy and CVC ones light. A CVC sequence is thus heavy in word medial position, whereas it should be interpreted as light in word-final position." Hayes (1982) (also noted in Kaminska) goes further and claims that for English "word final consonants simply do not count in the calculation of syllable weight; they are also not part of the syllable structure and therefore extrametrical".

c) Application of syllable weight to Scottish English

"Syllable weight is ... necessarily tied to the existence of a vowel length (or vowel tenseness) opposition." (Hyman 1985: 6). (No languages have been found in which open vs. closed syllables are the sole determiner for stress placement.) However, this poses a problem in discussing syllable weight for Scottish English. Unlike nearly all other varieties of English (Wells 1982), Scottish English has no phonological vowel length distinctions (although it has environmentally conditioned vowel length, as discussed above, p. 46). Diphthongs are then the only long vowels in opposition to short vowels, so such an opposition is perhaps not the optimal description.

It might be preferable to use the feature [±tense] to distinguish vowels in Scots. However, "the issue of formulating a definition of (the feature [±tense]) and specifying precisely its empirical correlates is complex and controversial ... Moreover, it seems to be the case that the postulation of the feature [±tense] can be more or less motivated (or necessary) depending on the phonological behaviour of segments in a specific language." (Kaminska 1995: 56.) In particular, the vowel /ɛ/ causes problems, as it would normally be classified as lax, but should perhaps be defined as tense due to its phonological and phonetic behaviour, such as appearing in open syllables, and a tendency to lengthen in certain environments. Kaminska, then, classifies Scots vowels as follows:[22]

tense	/i/ /e/ /a/ /ɔ/ /o/ /u/
lax	/ɪ/ /ʌ/ /ə/

/ɜ/, while occurring in middle-class Edinburgh speech, is not general in Scotland,

[22]Although Kaminska uses square brackets, I am here using slash brackets as this is in essence a phonological description.

and is so not included in Kaminska's description, but as it replaces the lax vowels of other accents it should perhaps be considered as lax. Diphthongs would also have to be classified as tense, as they are free vowels, leaving us four lax vowels. However, "the distinction between tense and lax phonemes in many Scots dialects is very fine" (Baker and Smith 1976: 23). They note that "A precise phonetic definition of this distinction is elusive, particularly for many of the Scottish subjects in our experiments whose dialects contain few diphthongs" (p. 10.) Their transcribers in fact disagreed in some cases as to whether certain vowels in the data should be described as tense or lax.

The practical application of the feature 'tense' is by no means straightforward, and in some accounts it varies at different levels of description - Chomsky and Halle (1968: 75) explain the unstressed tense prevocalic [i] of *various* by claiming that it derives from a phonologically lax vowel (/ɪ/); similarly, they claim that the final vowel of *fiasco* is nontense, despite the fact that "a nontense /o/ does not appear phonetically in the utterances of the dialect we are describing." They "specifically reject the assumption that there must be a one-one relationship between the underlying lexical or phonological representation and the phonetic output, and we see no reason to suppose that underlying representations will be restricted to segments that appear in phonetic representations. Such a requirement would, in fact, be quite artificial and ad hoc." However, application of such a theory needs to be very careful in order not to be "artificial and ad hoc" itself.

Baker and Smith (1976) look at the psychological basis for Chomsky and Halle's stress rules. They point out that there is a basic problem in determining subjects' use of phonological rules, which is that given a particular output, even for nonsense words, it cannot be determined whether this is produced by a general rule or by analogy with a similar word. Their experiments use nonsense words for which stress patterns would be predicted to vary depending on whether rule or analogy was used, for example *cinempa*, for which the obvious analogy is *cinema*, leading to initial stress, while rule-based stress assignment would put the stress on the second syllable. Another set of nonsense words which bore little resemblance to real words was also constructed. The words were put in sentence frames to fill either verb or noun slots; subjects were mostly Scottish. They found that "The distinctions between lax and tense vowels, strong and weak clusters, and nouns and verbs all exert an influence on performance, as Chomsky and Halle would claim" (Baker and Smith 1976: 24.), and though the results did not entirely follow Chomsky and Halle's Main Stress

Rule, "the fact that speakers' 'errors' seem to be based on the same distinctions as in Chomsky and Halle's system - lax and tense vowels, strong and weak clusters, nouns and verbs - suggests that these distinctions have some psychological validity" (p. 27.) They also found, as Chomsky and Halle suggest, that subjects scanned the words from right to left for stress assignment, but that the penultimate syllable was more important than Chomsky and Halle believed.

Given the problems in dividing Scottish vowels into long and short, and the controversial nature of the feature [±tense], the analysis of stress assignment and syllable weight in this study will concentrate on the effect of consonant clusters.

d) Stress patterns in the lexicon

There are some graphemic patterns which tend to be associated with a stressed syllable, and it is useful to analyse these so that in later chapters we can see whether subjects in a reading-speaking task use these patterns in determining stress. Although these graphemic patterns are linked to phonological syllable weight, we should note that "syllable weight ... cannot be determined from spelling in general." (Church 1986: 2426); the two may therefore not correspond as closely as we might wish. The following analysis does not come from the literature, but instead is based on the on-line dictionaries described in Chapter 4, p. 114; it is presented here in some detail.

There are problems in determining the limits of a graphemic syllable, for example whether all following graphemic consonants should be included, or only those which are possible at word ends; whether the limits should be dictated by morpheme boundaries; whether a mute <e> and associated consonants (as in <bounced>) should this be included. It appears impossible to form a sensible graphemic syllable analysis without reference to the phonological form, so in the following analysis, a phonological syllable division will be used, and the graphemic syllable divisions based on the phonological syllables. We can then see which of the resulting graphemic structures are more likely to be stressed.

The analysis was performed on the on-line RP pronunciation dictionary.[23] Analysis of primary stress, for words of 2 to 4 syllables (i.e. the same syllable-count as polysyllables in the experiments) gives us the patterns shown in Table

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[23]It should be noted that for this dictionary, contrary to the analysis in this study, a vowel following schwa was treated as one syllable; this has been left as such since adjustment is difficult (c.f. 'diary' /ˈdaɪə.ri/, for which three syllables is a reasonable analysis, and 'fire' /faiə/, for which a two-syllable analysis is inappropriate).

3.

	Number of words (Percentages in brackets are a percentage of the row)			
Syllables in word	**Pre-antepenultimate stress**	**Antepenultimate stress**	**Penultimate stress**	**Final stress**
2			31043 (83%)	6473 (17%)
3		19276 (60%)	11375 (35%)	2244 (7%)
4	5533 (29%)	7692 (41%)	5296 (28%)	238 (1%)

Table 3: Syllable and stress patterns of dictionary entries for all word classes (total 89170)

For comparison with the data in later chapters, it is also useful to separate out singular nouns - Chomsky and Halle's Main Stress Rule, for instance, treats words of different syntactic classes differently. This data is given in Table 4, which shows a shift towards initial stress for all syllable-counts as compared to Table 3.

	Number of singular nouns			
Syllables in word	**Pre-antepenultimate stress**	**Antepenultimate stress**	**Penultimate stress**	**Final stress**
2			15122 (92%)	1365 (8%)
3		8772 (63%)	4675 (33%)	563 (4%)
4	2505 (35%)	2449 35%)	2145 (30%)	67 (1%)

Table 4: Syllable and stress patterns of dictionary entries for singular nouns (total 37663)

We can now look at the consonant patterns within the graphemic forms of the stressed syllables and compare them with unstressed syllables. Two analyses are performed here; firstly, with maximal phonemic onset, as used in the transcriptions in this study (Table 5) and secondly, with maximal offset (Table 6). The maximal offset here is not quite as used by Chomsky and Halle (1968), since they allow all following consonants to be grouped with a vowel, though some do form weak clusters; in the current analysis, only those forming valid syllable offsets are grouped with the vowel. As we are looking at a Scottish accent, /r/ is a valid phonemic offset; an Edinburgh version of the on-line dictionary was used to produce the data for Tables 5 and 6, as this of course includes post-vocalic /r/. Morphology was not taken into account in syllable divisions, so for example *cellphone* with maximal offset is analysed as /sɛlf.on/, <cellph-one>; this is a potential weakness of the analysis. Finally, contrary to Chomsky and Halle's analysis, the transcriptions here are surface not underlying forms, so the 'l' in *vanilla*, for example, is treated as a single consonant rather than a geminate.

Structure of graphemic rime	Structure of phonemic rime	Example syllables	Example word	Primary stress	Secondary or no stress	Primary stress for graphemic rime group	Secondary or no stress for graphemic rime group
C	V	<g-> /d͡ʒi/	*g-string*	20	687	39 (5%)	695 (95%)
	VC	<h-> /et͡ʃ/	*h-bomb*	19	8		
CC	V	<Mc> /mə/	*Mcallen*	6	434	7 (1%)	809 (99%)
	VC	<Mc> /mək/	*Mcbeth*	1	375		
V	V	<ca> /ke/	*allocation*	21605	25662	22158 (45%)	26919 (55%)
	VC[24]	<e> /ɛk/	*explore*	553	1257		
VC	V	<al> /ka/	*calving*	103	230	10718 (35%)	20296 (65%)
	VC	<dop> /dɔp/	*adopted*	10567	19886		
	VCC	<box> /bɔks/	*boxbed*	48	180		
VCC	V	<Cock> /ko/	*Cockburn*	137	99	2657 (17%)	13002 (83%)
	VC	<dress> /drɛs/	*address*	1081	9148		
	VCC	<mount> /mʌ͡ʊnt/	*remount*	1433	3741		
	VCCC	<text> /tɛkst/	*context*	6	14		
VCCC	VC	<catch> /kat͡ʃ/	*catchment*	138	133	308 (48%)	335 (52%)
	VCC	<bench> /bɛnt͡ʃ/	*backbench*	128	136		
	VCCC	<junct> /d͡ʒʌŋkt/	*adjunct*	42	66		
VCCV[25]	VC	<Belle> /bɛl/	*Bellevue*	166	114	337 (32%)	705 (68%)
	VCC	<barge> /bard͡ʒ/	*bargeman*	171	591		
VCCVC[25]	VCC	<clothes> /kloðz/	*clotheshorse*	22	0	35 (100%)	0 (0%)
	VCCC	<Charles> /tʃarlz/	*Charlesworth*	13	0		
VCV[25]	VC	<base> /bes/	*baseball*	1269	2901	1269 (30%)	2901 (70%)
VCVC[25]	VC	<celet> /slət/	*bracelet*	2	18	56 (60%)	37 (40%)
	VCC	<Gates> /gets/	*Gateshead*	54	19		
VCVV	VC	<cheque> /t͡ʃɛk/	*chequecard*	23	18	23 (56%)	18 (44%)
Misc.				55	293	55 (16%)	293 (84%)
Total				37662	66010	37662 (36%)	66010 (64%)

Table 5: Stress patterns and rime structure of dictionary entries for singular nouns of 2-4 syllables (maximal phonemic onset, total words 37663). Graphemically, <y> and <w> count as V when following vowels. Unmatched syllables, or patterns totalling less than 10, are counted as 'miscellaneous'. Percentages are percentages of grouped rows.

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[24] This row mostly consists of words with 'x' or similar graphemes, for which one grapheme represents two phonemes; for maximal onset, the grapheme has been aligned with the second, syllable-initial phoneme, making the first syllable appear to end in a vowel. This analysis is open to question.

[25] This structures mostly include mute <e>.

Structure of graphemic rime	**Structure of phonemic rime**	**Example syllables**	**Example word**	**Primary stress**	**Secondary or no stress**	**Primary stress for graphemic rime group**	**Secondary or no stress for graphemic rime group**
C	V	<p> /pi/	*pobox*	4	9	11 (2%)	697 (98%)
	VC	<h-> /et͡ʃ/	*h-bomb*	7	688		
CC	VC	<Mc> /mək/	*Mcbeth*	11	129	11 (8%)	129 (92%)
CCC	VC	<Mcc> /mək/	*Mccabe*	1	79	1 (1%)	79 (99%)
V	V	<Bau> /bʌ͡ʊ/	*Bauhaus*	771	6580	799 (10%)	7267 (90%)
	VC	<fle> /flɛk/	*flexion*	28	687		
VC	V	<Coh> /ko/	*Cohen*	30	110	17047 (35%)	31821 (65%)
	VC	<Ab> /ab/	*Abner*	16741	31005		
	VCC	<box> /bɔks/	*boxbed*	276	706		
VCC	V	<plough> /plʌʊ/	*ploughing*	18	34	15575 (43%)	21036 (57%)
	VC	<dress> /drɛs/	*address*	6587	11867		
	VCC	<mount> /mʌ͡ʊnt/	*remount*	8931	9058		
	VCCC	<text> /tɛkst/	*context*	39	77		
VCCC	VC	<catch> /kat͡ʃ/	*catchment*	377	259	1614 (60%)	1074 (40%)
	VCC	<bench> /bɛnt͡ʃ/	*backbench*	830	541		
	VCCC	<junct> /d͡ʒʌŋkt/	*adjunct*	407	274		
VCCCC	VCC	<cellph> /sɛlf/	*cellphone*	40	16	105 (76%)	33 (24%)
	VCCC	<gangst> /gaŋst/	*gangster*	54	16		
	VCCCC	<prankst> /praŋkst/	*prankster*	11	1		
VCCV	VC	<Edge> /ɛd͡ʒ/	*Edgeware*	187	113	462 (39%)	718 (61%)
	VCC	<barge> /bard͡ʒ/	*bargeman*	275	605		
VCCVC	VCC	<clothes> /kloðz/	*clotheshorse*	24	1	45 (96%)	2 (4%)
	VCCC	<Charles> /t͡ʃarlz/	*Charlesworth*	21	1		
VCV	VC	<base> /bes/	*baseball*	1434	2918	1434 (33%)	2918 (67%)
VCVC	VCC	<Gates> /gets/	*Gateshead*	379	76	379 (83%)	76 (17%)
VCVCC	VCC	<foreth> /foɹθ/	*forethought*	12	6	35 (83%)	7 (17%)
	VCCC	<milest> /mʌ͡ɪlst/	*milestone*	23	1		
VCVV	VC	<cheque> /t͡ʃɛk/	*chequebook*	23	18	23 (56%)	18 (44%)
Misc.				123	138	123 (47%)	138 (53%)
Total				37664	66013	37664 (36%)	66013 (64%)

Table 6: Stress patterns and rime structure of dictionary entries for singular nouns of 2-4 syllables (maximal phonemic offset, total words 37663). Graphemically, <y> and <w> count as V when following vowels. Unmatched syllables, or patterns totalling less than 10, are counted as 'miscellaneous'. Percentages are percentages of grouped rows.

These alignments were produced automatically and so are not 100% accurate, but there is no reason that errors are not evenly distributed amongst stressed and unstressed syllables. The tables only list syllable rimes, as syllable onsets are not generally taken to be of importance for stress assignment. The tense/lax vowel distinction, as noted above, is problematic in Scottish English, so vowel types are not differentiated here. There are also other potential distinctions which the tables do not reveal, for instance *both* and *folk* both have the phonemic rime VC and the graphemic rime VC, yet the relationship between <oth> and [oθ] is not the same as the relationship between <olk> and [ok].

A clearer picture of the links between stress and graphemic pattern can be seen in Figures 3 and 4 below, which summarise the dictionary data. For both graphs, the data are grouped into sets, the first set being simple graphemic rimes (V or VC), the second containing mute <e>, the third containing consonants only in the graphemic form, the fifth showing unanalysed forms (minority groupings or those which the alignment algorithm could not handle), and the last set is the total.

The most easily analysable set is that containing simple rimes, i.e. the first four rows in Figure 3 and the first five in Figure 4. For these rimes, Figure 3, which represents a common phonemic analysis of syllable structure, shows no clear relationship between graphemic pattern and stress. On the other hand, Figure 4, which has maximal offset and so is closer to many linguistic analyses of conditions for stress assignment, shows a clear increase in the percentage of stressed syllables with the increase in the number of following consonants. So, ignoring for the moment the effect of syllable position, for a word like <Livorno> we might expect the syllabification to be <Liv-orn-o>, with the second syllable containing more graphemic consonants than the first and so more likely to be stressed; <Novoli>, on the other hand, would have equal rime structures in the first and second syllables (<Nov-ol-i>), so either of these might be stressed.

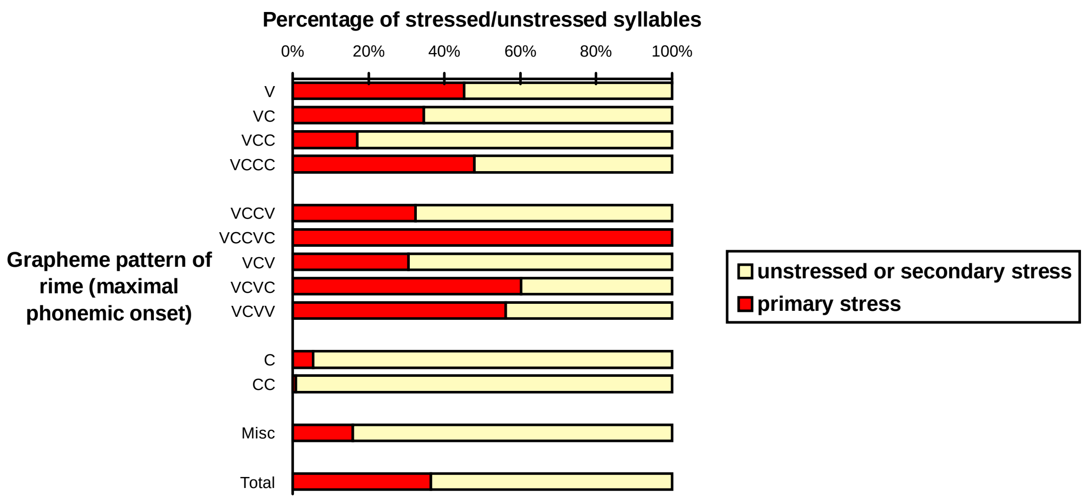

Figure 3: Stressed and unstressed syllables and graphemic syllable type in dictionary entries (divided by maximal phonemic onset)

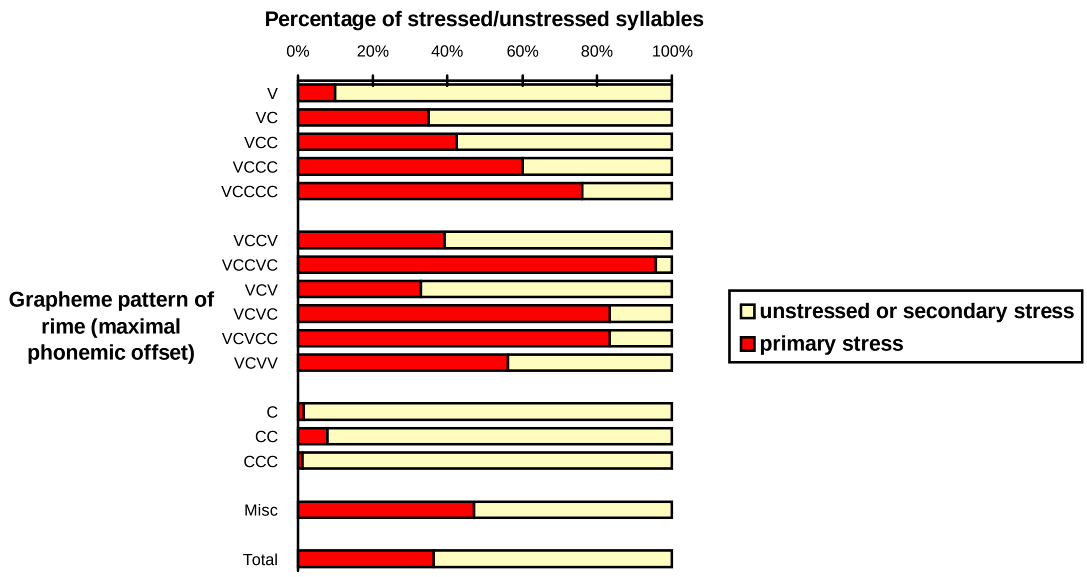

Figure 4: Stressed and unstressed syllables and graphemic syllable type in dictionary entries (divided by maximal phonemic offset)

The second set in Figures 3 and 4 is rather more complex. This set mostly consists of syllables containing mute <e>, for example <bounced>; it can be seen in the graph that the <bounced> group (VCCVC) has the highest percentage of primary stress of all the graphemic syllable types. However, subjects may divide such strings in unknown words into two syllables, changing the structure to VCC-VC, so it is difficult to make predictions about the stress pattern of this set of graphemic syllable structures.

If we group the figures by phonemic rime rather than graphemic rime (Figures 5 and 6), we can draw similar conclusions to those for the first set in Figures 3 and 4 - that there is little evident patterning for maximal onset but a clear pattern for maximal offset.

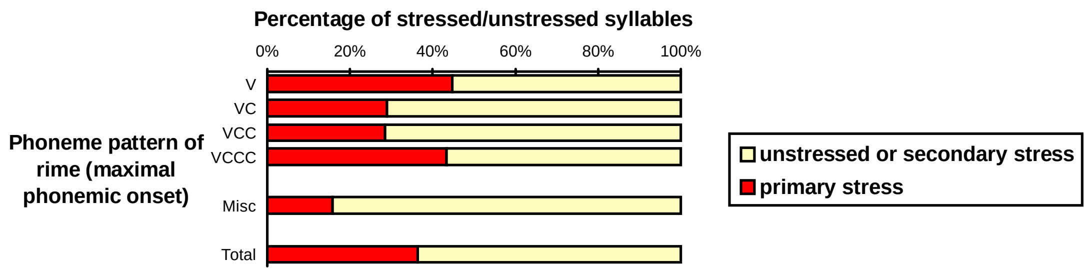

Figure 5: Stressed and unstressed syllables and phonemic syllable type in dictionary entries (divided by maximal phonemic onset)

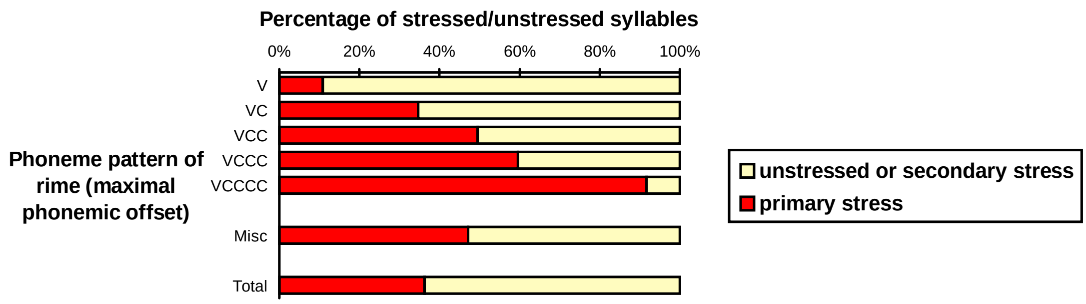

Figure 6: Stressed and unstressed syllables and phonemic syllable type in dictionary entries (divided by maximal phonemic offset)

It seems from this that maximal phonemic offset of syllables is a better predictor of stress than maximal onset, and that the greater the number of consonants in the rime, the greater the likelihood of stress. This applies whether the syllable types are grouped by phonological rime or graphemic rime. The data suggests that subjects reading written words will tend to assign stress to syllables with more consonants in the rime (see Chapter 7, p. 238 ff., for results).

3.4. Foreign words

This section contains a brief section on borrowings, as these exhibit historical processes of nativisation which may appear in the results of the current study. The discussion then moves on to attempted reproductions of foreign words, which given the different motivation and circumstances of their use, may show different features from nativised words.

3.4.1. Borrowings

There are a number of different types of change that may be made to a borrowing from L2 to L1. The influences which shape the final form are linguistic, but the strength of the different influences may be determined by other factors, for instance the route the word takes into the language (written or spoken), the degree of literacy of the borrowers, the degree to which L2 is spoken by the borrowers, the regard or stigma they attach to L2 and so on. There may be differences between the forms of the word used by different speakers; differences can also occur where the loan is taken from more than one source, for example Haugen (1988) notes variation in the borrowed word *box* (his transcriptions):

RP English	→	**Norwegian**	**American English**	→	**American Norwegian**
[bɔks]		[bɔks]	[baks]		[baks]

When words are borrowed into a language they are generally adapted to the phonological system of the borrowing language. Holden (1976: 131) claims that for loanwords to remain phonologically distinct from native words is rather rare: "Most loanwords which show even a minimal degree of acceptance by the target language immediately assume a phonetic shape which, in many respects, is identical to that of native vocabulary".

However, Fries and Pike (1949), in looking at the problem of phonotactics in languages which contain loanwords, note some exceptions. One example they give is Mazateco *siento*, which is a loan from Spanish and is often pronounced with /nt/. This contradicts the usual Mazateco rule voicing stops after nasals, which would make it /nd/. *Siento* is a well-established loan, but this and a few other examples would complicate the phonological description of the language; they therefore propose that these speakers are using "coexistent" phonemic systems. (Analysis of a word as part of a coexistent system, they say, requires not only phonological analysis but comparison with earlier states of the language, comparisons with the language(s) from which borrowings have been made, judgements of native speakers and so on.) From this they draw the following conclusions:

> "A loan sequence of phonemes can be considered completely assimilated when (a) it parallels the sequences occurring in native materials, or is analogous to them; when (b) its occurrence in relation to grammatical boundaries is the same as sequences in native words; and when (c) the words containing it are in common use by the monolinguals; or a loan sequence may be considered completely assimilated when it serves as a pattern for the development of new sequences in the native materials" (op. cit.: 39).

We are still left with the question of what happens prior to this nativisation - is there an intermediate stage in which some foreign features are present, and if so, which ones are likely to remain and which to be discarded? Holden (1976) addresses the question of variations in the treatment of different foreign segments, and notes that different segments, even within the same word, may not become nativised at the same rate:

> "Tentative observations of the process of assimilation of borrowings indicate that distinctive segments assimilate to various native

> phonological constraints at different rates. This must be a reflection of the nature and strength of the target constraints themselves, simply by exclusion: there is nothing else to account for such facts...I further hypothesise that these varying strengths are a direct measure of the relative 'productivity' or viability of phonological rules or constraints in the native system" (op. cit.: 133).

His examples, of loanwords in Russian, show different rates of assimilation for different segments subject to the same rule (/f/ being palatalised before /d/), and also for different rules (vowel-reduction of /o/ occurs before palatalisation of /t/). Holden goes on to give more detailed examples, though still more are needed in order to draw general conclusions. He does note that the sequence of strengths he proposes (velars assimilating faster than labials, which in turn assimilate faster than dentals, except for /l/) is different from the historical sequence proposed by others (velars being palatalised before dentals, and dentals before labials). He also suggests that there is in fact no reason to suppose that historical rules and synchronic rules are equivalent, but the results are inconclusive.

In the results of the current study it will be noted that, although distinct coexistent phonemic systems like those of Fries and Pike (1949) are not proposed, speakers do have access to phonemic systems other than those commonly used in English. These facts must be incorporated into any phonological theory claiming to describe speaker behaviour.

3.4.2. Attempts at (re)producing foreign words

The sections below will firstly discuss the production issues involved in reproducing non-native spoken forms (listening-speaking), then written forms (reading-writing), and finally cross-media tasks (listening-writing and reading-speaking).

One important difference between words which are borrowed into a native language context, and attempts at producing foreign words in a foreign-language context, is the social expectations. Speakers in a foreign-language context are stigmatised if they cannot produce sounds correctly, while for nativised words (and, sometimes, in a language-learning setting) there is pressure in the other direction - one who produces a foreign word in a foreign way in these contexts may be thought pretentious.

Although the linguistic context in the experiments for the current study encourages nativisation of the words (they are produced in an English carrier sentence), the school/experimental setting may make the subjects feel they are being tested on their foreign language skills. The following discussion therefore includes both studies of nativisation and studies of foreign language learners.

Alterations can occur at many stages in this process - for example, in the experiment in this study which uses spoken prompts and written answers we might have accurate perception of the foreign sound followed by an attempt at spelling it using either native or non-native graphemes, or perceptual categorisation of the phone as a native sound, followed by a spelling of that sound. We will see that people do indeed use non-native graphemes when attempting to spell foreign names, and they may also use non-native sound-to-spelling correspondences.

a) Spoken forms

Repetition of unfamiliar words, particularly foreign ones, requires several stages of processing. Service (1992), in addition to the reading-writing experiment mentioned previously, carried out an experiment in which Finnish schoolchildren repeated Finnish and English spoken pseudowords. She found that the Finnish pseudowords were reproduced almost perfectly, while only 65% of the syllables in the English pseudowords were repeated accurately. She claims that "the repetition task is a complex task demanding various kinds of storage and processing resources." (Service 1992: 31-2.) She then suggests that the discrepancy in Finnish and English pseudowords is not only due to articulatory difficulties, but that "It is possible that the familiar-sounding pseudowords created better-quality or longer-lasting traces in the phonological input store and were therefore easier to repeat." (Op. cit.: 44-5.)

However, the method by which reproduction is achieved is beyond the scope of this study; the following discussion will concentrate instead on some of the sub-lexical features of spoken foreign words which may cause difficulty at the production stages of repetition.

◊ *Segments*

It has been observed that some phonemes tend to be preferred over other phonemes. They are more common in the languages of the world, and within those languages they tend to be more frequent than the dispreferred phonemes. These observations have evolved into a theory that the less common phonemes are somehow 'marked', while the more common ones are 'unmarked'. This has also been related to second language learning difficulties, for example Eckman (1977 and 1981), who proposes that:

i. Areas of L2 which are different from and more marked than L1 will be difficult.
ii. The relative degree of difficulty corresponds to the degree of markedness.
iii. Areas of L2 which are different from L1, but are not more marked, will not be difficult.

However, although there has been much debate on markedness hierarchies, there is no comprehensive and universally agreed ranking of different segments or segment types, and the very notion of "different from L1" also causes difficulties; depending on whether the definition is phonetic or phonological, and how much variation is allowed, the division into "similar" and "different" can be made in numerous ways.

Similarity is a crucial issue for much of the discussion of segment production, but a satisfactory definition is elusive. It is evident that, for a given L1 and L2, certain L2 phonemes are nearly always realised by L1 learners as particular L1 phonemes, although the two are not exactly equivalent. However, the rules governing these correspondences are not obvious. For example, while English [θ]/[ð] is nativised into French as [s]/[z], Dutch uses [t]/[d] instead. Interestingly, Canadian French also uses [t]/[d]. Other L2 phonemes may be much more variable in their realisation by learners. As Haugen (1950: 215) says, "neither the speaker himself nor the linguist who studies his behavior is always certain as to just what sound in his native tongue is most nearly related to the model".

We also need to consider the type of change made. Danchev (1988), for instance, looks at the processes of change to what he calls the "umlaut vowels" (/ü/, /ö/ and /ä/[26]). He studies the different ways that they are realised in language contact situations such as second language learning, or creole formation, and notes the following changes:

i. Elimination of distinctive features. For example, in /ü/ either the roundness or frontness may be dropped:

   /ü/ ↗ /i/
   /ü/ ↘ /u/

   He notes that "the input vowels of these changes are more marked than the respective output vowels, this conforming to a familiar general pattern" (op. cit.: 42).
ii. Decomposition and linear realignment of distinctive features. In foreign

[26]Danchev uses these notations as shorthand for /y/, /ʏ/, /œ/, /ø/ and /æ/, either long or short.

language learning, the umlaut vowels may be replaced by a sequence of segments containing the relevant features. So, for example,

/ü/ → /ju/

"The linear realignment of distinctive features is part of the decomposition of difficult (or marked ...) elements in the donor language" (p. 44).

In many cases, however, these changes may be related to difficulty of perception rather than difficulty of production (cf. discussion in Chapter 2, p. 31 of this study).

Danchev's changes are phonological, but accurate repetition of L2 words can also cause problems at the phonetic level of production:

> "Some of the characteristics of foreign-accented speech can be described as simple substitutions of one phonetic segment for another, as in a French-accented 'I sink so'. ... But, clearly, many other aspects of accentedness cannot be captured by any segmental transcription system presently available" (Flege 1980: 100).

The IPA symbols, most commonly used for phonetic transcription, certainly do not describe the full range of variation in, for example, duration; while they will normally be able to differentiate between segments in a set of data, the differences marked will be comparative rather than absolute, and may not be able to handle a large speech corpus if great detail is required. Additionally, the IPA diacritics do not indicate details of timing, for a segment may be long in one phase and short in another.

> " ... we cannot account for foreign accent features strictly in terms of abstract difference in phonemic or phonetic segments ... for even non-segmental differences in temporal implementation carry over from one language to another" (op. cit.: 116).

In Flege's study, for the difficulty found by Arab subjects in producing English /p/, he claims that the problem was not in identifying the phoneme, or the combination of features necessary to produce it, but in adjusting the glottis correctly.

Another issue to consider is word-position. Dissosway-Huff (1981) gave Japanese subjects an English pronunciation test, without telling them that it was designed to test /r/ and /l/. Their pronunciations were evaluated by phoneticians, who found the pronunciations of /r/ 65% acceptable and /l/ 75% acceptable, again with variation according to word-position (for example, /l/ was thought acceptable in 100% of final clusters, while /r/ in final clusters was only 33% acceptable). Although no explanation is put forward for the difference in word-position results, it is clear from these results that word-position must be taken into account when discussing reproduction of L2 sounds.

◊ ***Structure***

Naturally, structural differences between L1 and L2 can cause production problems. Di Pietro (1964) looks at the Italian phones [s], [z] and the English phonemes /s/, /z/ within the framework of Contrastive Analysis. In English the two sounds are different phonemes; in Italian, on the other hand, there are few phonemic contrasts between the two. In Italian, at the beginning and end of words, and before voiceless consonants, we have [s], while before voiced consonants we have [z]. Between vowels, however, usage varies between speakers and sometimes between lexical items, but not with any predictability. Di Pietro notes that with Italian as L2 and English as L1, "the learner tends to unvoice the first member of the clusters [zm zn zl], and adjust them to the English clusters /sm sn sl/, producing something like [ˈsma-niyə] for [ˈzmaː-nia] ... For the clusters [zb zd zg zv] either a "support" vowel is inserted, e.g. [zə-ˈden-nyow] for [ˈzdeɲ-ɲo], etc., or *both* members of the cluster are unvoiced, e.g., [ˈspal-lyow] for [ˈzbaʎ-ʎo], etc." (op. cit.: 225). For English as L2 and Italian as L1, he notes that "the phonemic contrast between /s/ and /z/ is not maintained, especially in initial and final positions" (ibid.).

However, although Di Pietro is correct in saying that "statements of distribution are as important in the contrastive analysis of two languages as the inventory of comparable phones," there are certain factors missing from his analysis. The most important of these is the role of orthography. Di Pietro goes so far in disregarding the topic of orthography that he does not even give the spelling for his examples. In the above cases, though, as well as other examples from English and Italian, we find that the orthography is often misleading, with <s> and <z> used differently in English and Italian and likely to lead to errors for language learners who are aware of the spelling of these words.

There are, however, some structural features of foreign languages which seem to cause no difficulty, for example, production of word-initial [ʃt] by English speakers is not usually problematic; it will be seen in the results of the current study that some non-native spoken sequences cause far more difficulty, whether in perception or production, than others.

◊ ***Suprasegmental features***

Stress

It is fairly common for stress location to change in borrowed words, but this is often the result of lack of knowledge on the part of the native speakers, and a reliance on the orthographic form. There are few studies on the repetition of stress by L1 listeners who are presented with an L2 spoken word, or on the effect of language differences in stress cues on the accuracy of learners' output.

Niemi (1979a) notes the differences between Finnish and English speakers' realisation of English stress in a reading task of nouns and noun phrases, such as *blackbird/black bird*. It was found that the Finnish speakers had difficulty with appropriate use of fundamental frequency, duration and intensity for English stress. It should be emphasised, however, that the experiment involved a reading task, and so the subjects were not given a model to copy. The task also differed from the current study in that subjects were required to produce stress-differentiated word-pairs; the focus of the study was stress cues, and whether the subjects achieved correct stress location was not an issue, since the experiment was designed to encourage the right stress.

Analysis of such cues is beyond the scope of the current work, and the study of stress in repeated spoken forms will be limited to accuracy of location.

Tone

Since some of the prompts in the current study are from Norwegian and have lexical tone, it is necessary to look at difficulties in the production of tone by speakers of non-tone languages. Burnham and Torstensson (1995) studied the ability of English subjects to reproduce Swedish tones. They used bisyllabic words with two different tone patterns, the first pattern falling on the second syllable, and the second pattern with a rise on the first syllable and a rise-fall on the second syllable. They classified the first pattern as foreign (unfamiliar to English speakers) and the second as native (familiar), and found that subjects performed better on the native-type tones. They also found subjects reproduced tones better than Swedish vowels, and that post-pubescent subjects did better than pre-pubescents on tones similar to English speech patterns, and worse on tones dissimilar to English.

Of course, subjects in the experiments in the current study (see later chapters) may not perform as well on tone since they were not specifically asked to repeat tones or pitch patterns which occurred in the prompts, (assuming that

Burnham and Torstensson's subjects were) and the prompts contained a mixture of languages rather than just one as in Burnham and Torstensson's study.

Segment length

Although there are many phonetic and phonological studies of segment length in various languages, there is little work on the reproduction of L2 segment length by L1 speakers.

There is some data on speech errors with long segments, which supports the view taken here that segment length is a suprasegmental feature, rather than a feature inherent to the segment. Stemberger (1984), quoted in Badecker (1996), gives some examples:

Swedish	semmlor		→	[sellmor]
German	zukünftig	[tsu:künftix]	→	[tsü:kunftix]

However, these are productions by native speakers and so may not reflect the errors made in production of segment length by non-native speakers, who are unlikely to have the same mental representations of the segmental and suprasegmental features.

b) Written forms

Reproduction of written forms of foreign words should not cause too many difficulties for languages with similar alphabets. However, foreign written elements such as diacritics or letter sequences may cause some difficulties, and there may also be an effect of phonological activation on the output.

◊ ***Segments***

Service (1992), in the study mentioned earlier of Finnish schoolchildren reproducing Finnish and English written pseudowords (see p. 53), found that copying Finnish pseudowords elicited few errors. For the English words, she found that accuracy was correlated with the individuals' skill in learning English, even allowing for other factors such as motivation or general academic ability. In particular, her results do suggest that phonological processing involved in this task:

> "There was a clear tendency to substitute a consonant with another consonant similar to it in place of articulation and especially in manner of articulation. This tendency was particularly great for the letters whose corresponding sounds are difficult to pronounce for Finns (i.e. "b", "d", and "g")." (Op. cit.: 36.)

However, she says that the problem may be in essence a memory limitation:

> "The reason for copying errors that bring the phonological representation of a foreign pseudoword closer to a familiar phonological shape might not be that the sound-equivalents to the foreign letters cannot be pronounced, but the fact that the less familiar-sounding non-word is more difficult to keep in the phonological store, which also supports copying of visually presented verbal material." (Op. cit.: 45.)

Whatever the explanation, the results certainly support the idea that phonological encoding is involved in a delayed copying task.

In such a task there may also, of course, be errors in reproducing letters with diacritics. These could be due to visual perception, memory, or phonological activation. It is difficult, however, to imagine that there might be specific production difficulties with such graphemes comparable to the difficulties in producing non-native spoken segments.

◊ *Structure*

As noted above, a delayed copying task may produce errors in structure, and this may be particularly so if the strings consist of grapheme combinations which are infrequent and non-existent in English, either due to phonemic activation and incorrect re-transcription, or poor memory for unfamiliar strings. Of course, subjects may already be familiar with some non-native written strings through loan-words or language learning, for example word-initial <Pf> may be familiar if they know some German, and it is likely that this would then cause fewer problems. However, although subjects' foreign language skills can be recorded, it is harder to assess their level of general knowledge, and some strings may be known through other sources than foreign language learning. Additionally, some combinations which do exist in English, such as <xth>, are very rare. With these factors in mind, the results of the current study will be analysed to see whether uncommon grapheme strings have a tendency to be re-written as more familiar ones.

c) The relationship between spoken and written forms

Obviously, attempted pronunciations of an unfamiliar foreign written word often differ from the actual foreign pronunciations due not only to the phonetic realisation of different sounds in L1 and L2, or different phoneme inventories, but due to different grapheme-to-phoneme correspondences. The same is true in reverse for attempted spellings of foreign words. This section briefly examines some examples of these effects.

◊ ***Non-native grapheme-to-phoneme relationships***

There are numerous examples in borrowed words or names of the effect of differences in the grapheme-to-phoneme correspondences of two languages: "Spelling pronunciations may be suspected wherever the reproduction varies from normal in the direction of a pronunciation traditionally given to a letter in the borrowing language" (Haugen 1950: 223). Examples of spelling influencing pronunciation are given by Graham (1955), who discusses changes made to the names of German immigrants in Canada:

> "The spirants [f], if written *v*, and [v] became [v] and [w] respectively in English under the influence of the spelling. Thus, *Volk* [ˈfɔlɪk] (sic) and *Vetter* [ˈfɛtər] became [voulk] and [ˈvɛtə], while *Wever*, *Weinmeyer*, and *Werner* were pronounced with initial [w]. In no instances did German names spelled with initial *v* and *w* retain the German pronunciation in the anglicized forms ... Initial [ts], spelled z in German, became [z] under the influence of the spelling. Thus, Zirk became [zɝk] and Zimmer became [ˈzɪmɚ]" (op. cit.: 262).

Further examples come from Larmouth (1967): "The Finnish grapheme *j* always corresponds to /y/, as in *järvi* [ˈyærvi] (sic).[27] Under pressure from English however, *j* is always pronounced [ǰ] initially, so that the name *Järvinpä*, formerly pronounced [ˈyærvɨnpæ], is now [ˈǰarvɨnpə]." (Op. cit.: 35.)

However, these examples might suggest that changes are always made in the direction of native grapheme-to-phoneme correspondences, whereas there is also evidence of the opposite effect, i.e. use of non-native grapheme-to-phoneme correspondences. For example, Gibson et al. (1962), who were not looking at foreign words at all but at pronounceable and unpronounceable letter strings as indications of reading strategy and the perception of words, found that some of the strings did not look native, and this in itself affected pronunciations: "The sequences of letters ... were such that the S's sometimes brought in phonemes from other languages to make them easier to pronounce" (p. 569.)

There are some implementations of automatic systems to pronounce semi-nativised pronunciations for foreign words. For example, Gustafson (1995a) describes an automatic system for pronouncing foreign written names in Swedish. Firstly, the names are automatically grouped into different origins, not necessarily the correct ones but ones which native Swedish speakers might use. If the origin is unknown, the same text-to-speech rules as for Swedish are used. If the origin is predicted, then language-specific text-to-speech rules are applied to produce language-specific phonemes, which are then converted into

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[27] [y] here represents the sound normally shown in IPA by [j], while [ǰ] represents [d͡ʒ].

the nearest Swedish equivalent. In some cases, foreign sounds are added to the phoneme inventory, such as English [ð] and [θ].

However, for our purposes there are a number of limitations with Gustafson's system. Firstly, while it may produce an acceptable nativised pronunciation for most names, there is no indication that it reflects the behaviour of native speakers. It contains more information about different languages than a speaker would typically know, though this is primarily an issue of scope rather than whether such a system is used by native speakers, since as we will see speakers do sometimes use non-native letter-to-sound rules. However, they are unlikely to use the translation from graphemes into language-specific phonemes, followed by mapping onto native phonemes. Secondly, there are theoretical problems. We again come to the issue of just what is the nearest native equivalent of a foreign phoneme. We are lacking both a linguistic definition of a 'nearest native equivalent', and a practical list used by native speakers.

An interesting area, which will be noted in the results of the current study, is that of "hyperforeignisms" (Janda et al. 1994). They give examples of inappropriate foreign pronunciations assigned to foreign words, for example the Russian *dacha* [dáčà] (sic[28]) pronounced by an American as [dɑ́xɑ̀], as if it were German. They claim that hyperforeignisms are rule-based, and that the phenomenon is "an over-generalisation ... [that] results from acting on an organised perception about a pattern that is thought to hold generally, and hence in particular instances is also assumed to be the case: i.e., a rule." (Op. cit.: 72.) (However, see the comments at the beginning of this chapter on rule-sets and analogy.) Common instances of hyperforeignisms which they note are: suppression of final consonants (as in French), e.g. *ballet*; use of [ʃ] and [ʒ] (thought of as typically French and German), e.g. in *Beijing*; and substitution of [ɑ] for [æ] or "English-sounding [ɑ]", e.g. in *Vivaldi*[29] (of slightly more complex origin). There are also examples of hyperforeignisms in stress, for which see below.

◊ ***Stress in foreign words***

Just as speakers may use different grapheme-to-phoneme patterns for words which they perceive to be foreign, they may also use different stress patterns, such as stressing the final syllable of French words. Janda et al.

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[28][č] represents the affricate [t͡ʃ], while [´] represents primary stress.

[29]Janda et al.'s data is American; this example would not be likely to occur for Scottish speakers.

(1994) give a number of examples of this type of stress assignment, although their examples are actually inappropriate use of non-native patterns (hyperforeignisms). They note that penultimate stress is often used by American speakers for Japanese words (cf. Chapter 2, p. 38), and suggest that this is due to comparison with Spanish and Italian stress patterns. An example is:

Tsujimura Natsuko [tˢɯ͡ʤimuɾa natˢ(ɯ)ko] → [nàtsúkoʊ̯ tsù͡ʤəmʊ́ɹə]

with the order of the name nativised by inversion, various segments either nativised or subject to hyperforeignisms (see above) and stress on the penultimate syllables (represented by [´]).

Another example from Janda et al. is:

Shimon Peres [šímon péʁes] → [šîmo(ʊ̯)n pèɹέz]

using, it is claimed the Spanish rule of stressing the final syllable of a word ending in a consonant, and comparison with some other Hebrew words which are stressed on the last syllable. This, however, leads us back to the question of whether such a process is necessarily rule-based. Janda et al. specifically note the possible comparisons with the French name *Simone* and the Spanish surname *Pérez*, which is generally (although incorrectly) anglicised with final stress. Janda et al. note that this final stressing does not normally occur for Hebrew words ending in a vowel, but this of course could also be explained by the use of analogy. It is possible, though, that they are not intending to make a systematic distinction between analogy and rules; they suggest that, for example "the hyper-Frenchification of *Bikél*, *Fertél*, *Mandél* [with stress similar to French words, based on the <-el(le)> pattern in French] again represents adoption of hyperforeignism as an analogical strategy, rather than a simple phonological process." (Janda et al. 1994: 86.)

3.5. Summary

This chapter has covered the topics most relevant to production in a repetition task for unfamiliar names, where some of these are foreign. These include natural processes affecting spoken language, regularisation of structure, and second language skills.

Although reproduction in the same medium should be fairly straightforward for written words, even this task can lead to errors, and for spoken words we can expect rather more. For words which are obviously non-native, both tasks are of course more difficult.

Of particular interest is the area of cross-media word reproduction, which necessitates that readers or speakers use grapheme-to-phoneme relationships, analogy, or some other means of assigning a pronunciation to a written word, or a spelling to a spoken word. Despite much work in this area, we still do not know for certain the mechanisms by which these tasks are achieved.

Like perception, though, we can expect production of the names in the current study to be influenced by similarity to existing words, whether the names are spoken or written, and whether they are native or foreign.

Chapter 4.

Experimental Design

This chapter outlines the experiments undertaken for this study. Firstly there is a description of the aims of the experiments, and then an account of exploratory experiments which were carried out to examine some of the basic assumptions and methodology needed for the later experiments. Next follows a full description of the main experiments, including the design stage, pilot tests and subsequent modifications, and a summary of the final design and execution.

Finally, before proceeding to the data analysis in the next chapters, there are some brief notes on the transcription of the results, a description of some characteristics of the subjects as ascertained from the questionnaire and other data, and a description of lexicons used in the analysis.

4.1. Aims of the experiments

The experiments were designed to investigate the processes which take place during the perception and production of unfamiliar foreign names, with the aim of increasing our understanding of some of the sub-lexical linguistic mechanisms underlying nativisation. A broader aim was to investigate the place of foreign and unfamiliar words in language behaviour, and the ways in which cross-media output of such words is achieved.

Exploratory experiments showed that subjects' behaviour was to some extent dependent on their perception of the origin of the names. It was therefore decided to tap the subjects' knowledge of what constitutes a foreign name, and to examine how this information affects their pronunciation or spelling of the name.

Contrary to most nativisation studies, which tend to be historical, this study was based on experiments in order to isolate factors which might affect the outcome. Studies of nativisation, whether perception or production, have generally been rule-based, and typically consist of descriptions of discrete processes such as simplification of non-native consonant clusters, or assignment of foreign phones to phonemes. Linguistic thinking, on the other hand, has moved on to a more lexicon-based approach. So, although much of this study depends on sub-lexical analysis, the experiments also here aim for a holistic, lexical analysis of nativisation, with examination of the relative importance of rules, analogy and lexical access in the reproduction of unknown foreign words.

4.2. Exploratory experiments

Before the final design was formulated, exploratory experiments were carried out. There are few studies which examine how subjects pronounce unknown foreign words, so preliminary experiments were needed to investigate whether the perceived origin of a written name had any effect on the pronunciation output, and to ascertain the most productive areas of study and the best means of collecting the required data.

4.2.1. Method

A small experiment was designed to see whether language of origin affects speakers' pronunciations of unknown written surnames. This involved a set of subjects reading a series of written names. The apparent linguistic origins of the names were systematically varied, and in order to do this twenty surnames, and three fillers, were invented. Each of the twenty names was orthographically possible in English, French and German, (this was verified by native speakers) and would normally be pronounced differently in all three languages. Names which were visually similar to other words or names were avoided, to reduce obvious analogies. To force interpretation of the name as one of the three languages, sentence frames were constructed giving a context by title (*Herr*, *Mrs*), first name (*Hildegard*, *Pierre*), place (*Paris*, *Berlin*) or origin (*English*, *French*).

Three lists of twenty-three different sentences were made, the first three sentences containing the filler names for practice, and the other sentences the remaining twenty names. Each list contained a mixture of English, French and German prompts. Each name appeared once on each list, with a different language context on the three lists. Six subjects read each of the three lists onto tape, at one-day intervals to minimise recall of previous pronunciations; each subject was given the lists in a different order. The subjects were all linguistically-sophisticated graduates working with languages, and all were native speakers of English, but as this was a pilot test they were not controlled for other features. Three were Scottish and three were English, and between them, the subjects spoke French, German, Spanish, and Finnish; all knew at least one of these languages and two subjects knew three. Broad phonetic transcriptions were made of the resulting pronunciations.

4.2.2. Results and discussion

The subjects, as well as being linguistically sophisticated, were experimentally sophisticated and most of them soon realised what the goals of the experiment were. This point was noted for subsequent experiments. However, as will be seen below, there were interesting cases in which the subjects did not behave as expected.

Although each subject had an interval of a day between each list, and only read each list once, they did remember some of the names and some of the pronunciations. Subsequent comments from subjects included "It's really confusing because your brain's worked out how to pronounce it the first time, and when it comes up again with a different language you don't know whether to pronounce it the same as the first time or work it out again," and "I remember *Jorvin* from yesterday, when it was German and I said [ˈjɔ.vɪn], and I got confused and said [ˈjɔ.vɛ̃] instead of [ˈʒɔ.vɛ̃] for French."

As the subjects did not all have the same accent, each must be analysed separately, another feature which was controlled in the main experiments. For example, the presence of word-final [ɹ] in Scottish subjects is not evidence that they are attempting a foreign pronunciation, while for English subjects it is. For the broad analysis given below, a pronunciation is classified as:

a) English, if the subject pronounces it using only English sounds (from their native accent) and does not contradict any grapheme-to-phoneme rules of English, for example:

<Jorvin> → [ˈdʒɔ.vɪn]

b) French, or an attempt at French, if the subject uses one or more French sounds and/or French grapheme-to-phoneme rules:

<Jorvin> → [ˈʒɔ.vɛ̃]

c) German, or an attempt at German, if the subject uses one or more German sounds and/or German grapheme-to-phoneme rules:

<Jorvin> → [ˈjɔ.vɪn]

d) Unclassified, if a combination of French and German features appears, or if it is otherwise uncategorisable:

<Jorvin> → [ˈjɔ.vẽ]

According to this broad classification, a response does not have to be a wholly accurate French or German pronunciation to be categorised as French or German - as we can see from the responses above, rhoticity was typically lacking in the responses. This enables the subjects' intentions to be taken into account as well as their language skills.

Complete success in manipulating the responses could not be expected as subjects remembered some previous pronunciations. However, errors in classification were not evenly distributed across the names: although most were pronounced three ways, there were some which were pronounced overwhelmingly as one language. One reason may be the strength or weakness of the language clues in the prompts, and the distance of the language clue in the sentence from the name, leaving the subjects freer to impose their own interpretations on the origins of the names. Additionally, some foreign language features are more well-known than others. For example, it may be that for German, the <J> → [j] correspondence is more familiar than word-final neutralisation of stop voicing. This would make a name like <Jorvin> more likely to elicit a German pronunciation than a name like <Hond>.

The orthographic structure of the name itself is also likely to be of importance. Although the names were all possible in all three languages, they were not equally likely in all three. For example, while <#Eu> appears in <Euphemia>, <Eustace> and so on, it is not a common sequence at the beginning of English names. Some of the invented names therefore seem more amenable to contextual influence than others - the name <Selage>, for instance, was generally pronounced [sɛˈlɑʒ] rather than the more English [ˈsɛ.lɪd͡ʒ], even when it was specifically introduced as English. This suggests that <Selage>, though a possible English name, had strong French features which overrode the sentence cues. Further data would be needed to assess the relative importance of these factors, but examination of the pronunciations given suggests some possible lines of research.

Table 7 shows names for which over 50% of the responses are classified as one language. Where French or German pronunciations are lacking, English is usually the substitute, leading to a high number of classifications as English; for example, <Vonderon> and <Vallart> did not encourage many German pronunciations. They were the only names with initial <V>, and for 12 German prompts of these names only one instance of [f] was elicited. This suggests that the German <V> → [f] correspondence is not very familiar to the subjects. However, <Vonderon> also elicited only English realisations of <r> ([ɹ]); it may therefore be considered by the subjects to be un-German. <Vallart> and <Orbat> did not produce any German features at all, and <Batin> only had one German classification. <Hond> was also low in German pronunciations, as neutralisation rule appears to be lacking for subjects who knew little German. <Stire>, surprisingly, had only one German pronunciation, with <St> pronounced as [ʃt]. This is a well-known correspondence, but was not produced even by all the German-speaking subjects, which suggests that other features of the word may have made it appear non-German.

Name	Classification	Number of times classified as such (out of 18)	Most common pronunciation(s)
Prein	German	10	[pɹaɪn]
Selage	French	10	[sɛˈlaʒ]
Rommer	English	15	[ˈɹɒ.məɹ]
Nautine	English	14	[ˈnɔ.tin]
Orbat	English	12	[ˈɔ.bæt]
Stire	English	11	[staɪə]
Hond	English	11	[hɒnd]
Batin	English	10	[ˈba.tɪn]
Vonderon	English	10	[ˈvɒn.də.ɹɒn]
Vallart	English	10	[ˈvæ.lɑt]

Table 7: Names for which one language accounted for over 50% of classifications (exploratory experiments)

<Rommer> and <Nautine> were overwhelmingly classified as English. For <Rommer> in both French and German the realisation of the <r>'s was crucial to categorisation, but the English [ɹ] was used in nearly all cases. <Prein> was mostly categorised as German, with no French pronunciations, perhaps because <-ein> is not common in French but is very common in German. However, categorisation of the pronunciations of this name is slightly problematic, as there are numerous <-ein> names borrowed into English (such as *Bernstein*) and they tend to have two variants, [-in] and [-aɪn]. This name was probably a poor choice for the experiment for these reasons.

<Selage> elicited pronunciations from all three languages, which suggests that the classification as French is due more to properties of the orthography than to difficulties of realisation in each language, or an absence of

either English or German pronunciations.

Some pronunciations may have been influenced by even more elusive factors. <Puve> had 10 unclassified pronunciations - one subject commented, "[pjuv] sounds silly!"

St. Clair-Sobell (1958), looking at anglicisation of Russian names, notes that people may use, say, a 'French' pronunciation for a Russian name in an attempt at achieving a foreign pronunciation, if that is the only foreign language knowledge they have (cf. the 'hyperforeignisms' of Janda et al. (1994), discussed in Chapter 3, p. 84). This appears to have happened in some instances. Figure 7 shows the total classification of pronunciations by subjects, and it can be seen that, for the first four subjects in the graph there is a tendency for the most common classification to be English, and the next most common classification for each subject to be that subject's best foreign language. However, this effect may be due to prompts in the subjects' less proficient language eliciting English responses. Prompt type therefore needs to be taken into account, to see if French prompts elicit German responses from German-speaking subjects, and vice-versa.

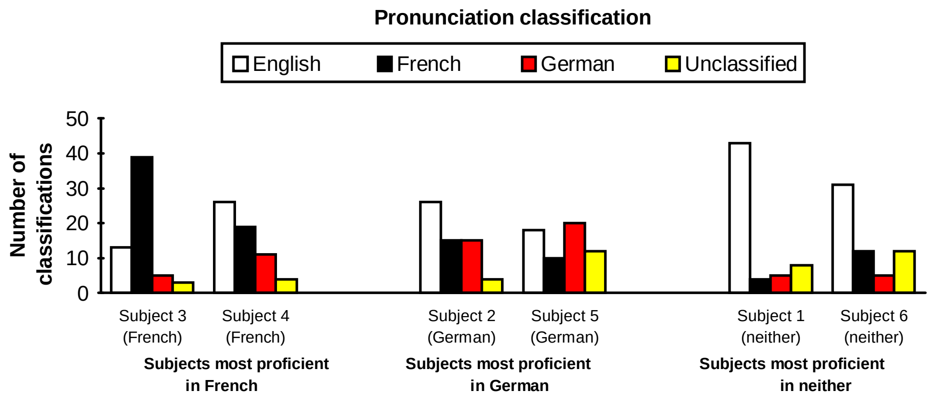

Figure 7: Subjects grouped by their most proficient foreign language, compared to classification of pronunciations (exploratory experiments)

Figures 8 and 9 show the effect of prompt type. In Figure 8 there are some of instances of subjects using their best foreign language as a 'default' foreign pronunciation (responses in the subjects' best languages are shown on the right hand side, i.e. French, for the first two subjects, and on the left hand side, i.e. German, for the second two subjects; the darkest tone shows 'hyperforeignism', while the middle tone shows a foreign response to an English prompt and the lightest tone shows a correct foreign classification). The number of hyperforeignisms in a subject's best language, however, is fairly low except for

Subject 3, who also uses a large number of French responses to English prompts.

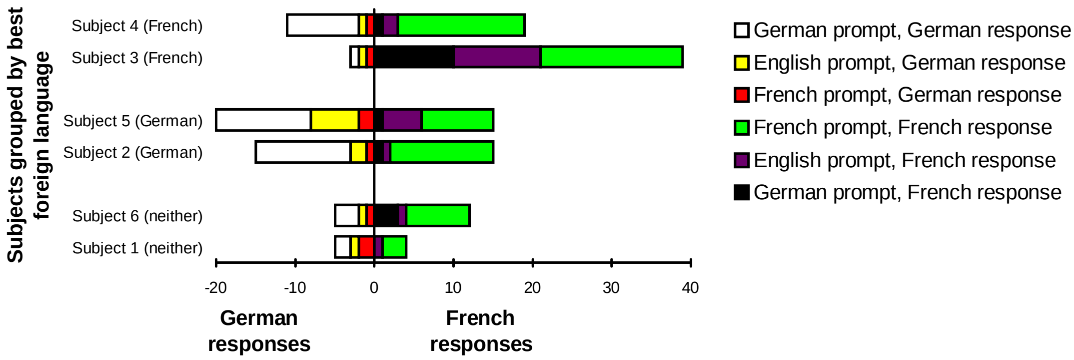

Figure 8: Classification of pronunciations grouped by subjects' most proficient foreign language and prompt type (exploratory experiments)

Figure 9 shows English responses to French and German prompts. It does show a tendency for L2 French speakers to give English responses to German prompts (first two subjects, light tone), though for the German L2 speakers (second two subjects) there are also more English responses to German prompts (light tone) than to French ones (dark tone). By far the most striking feature, however, is the number of English responses to non-English prompts by subjects 6 and 1, whose best foreign language was neither French nor German.

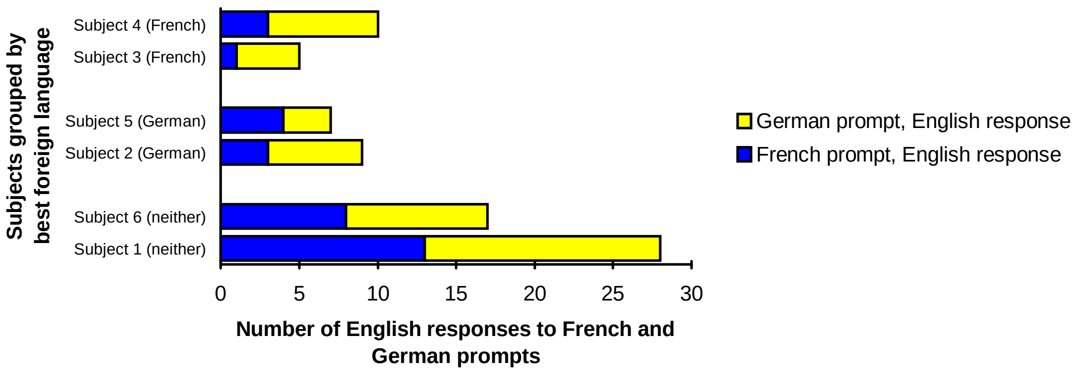

Figure 9. English responses to non-English prompts (exploratory experiments)

The results here suggest that it is important to examine the language skills of subjects in nativisation experiments, even if those skills do not relate directly to the languages studied in the experiments.

4.2.3. General conclusions

The experiment showed that pronunciations vary according to the perceived language of origin of the names, and that this can be manipulated. However, some names appear to be more easily manipulated than others. There are a number of issues arising from this pilot which will be taken up in the later experiments:

i. Some of the responses were not those expected according to the language cues in the prompts. This may be due to the orthographic features of the names, the difficulty of realising them in a particular foreign language, or the lack of knowledge regarding the correct grapheme-to-phoneme correspondences.
ii. Less linguistically-sophisticated subjects might not respond in a similar way.
iii. Subjects presented with foreign words in an experimental situation may feel their language skills are being tested, and behave accordingly, particularly when there are obvious manipulations such as variations in the linguistic context.

To address these issues, a number of features were incorporated into subsequent experiments: subjects were questioned directly as to their judgements of origin; a more natural test was devised; and subjects were drawn from teenage school pupils rather than adult linguists.

4.3. Main experiments

The main experiments for this thesis were constructed using real European town names. The names were to be presented in either spoken or written format, with responses to be either spoken or written, giving four sub-experiments. Subjects were asked for various judgements on the origin of the names, and for production of the names either spoken onto tape or written on answer sheets.

As the experiments did not directly test perception, except for perception of origin, analysis of perceptual processes depends on informed judgments about the relationship between perception and production. For some of the analysis, it is useful to be able to cross-compare the different experimental modes, so that for example, if a segment is poorly reproduced in both the listening-speaking experiment and the listening-writing version, we might conclude that the subjects had difficulty with perception of the spoken form rather than with production.

The following sections describe the main experiments. Firstly, the principal considerations in the experimental design are discussed, then comes a brief description of the pilot tests, then a summary of the final experimental design, and finally some notes on the transcription of the resulting data.

4.3.1. Designing the experiments

These sections will cover the main considerations in the experimental design. First comes an outline of the experiments, with explanations for some of the decisions taken on experimental structure and method, then a rationale for the choice of names and lastly a description of the preparation of the prompts.

a) Outline of experiments

	Experimental mode			
	Listening-speaking	**Listening-writing**	**Reading-speaking**	**Reading-writing**
Introduction and initial instructions	One page of written instructions outlining the experiment.			
Practice test (six examples of Q1, Q2 and Q3)	Subjects complete a short practice test for each question. Answers are checked to make sure subjects have followed instructions.			
Q1. Could these towns be in Britain?	Spoken name prompt, written yes/no answer	Spoken name prompt, written yes/no answer	Written name prompt, written yes/no answer	Written name prompt, written yes/no answer
Q2. Could these towns be in the countries listed?	Spoken name prompt, five written yes/no answers.	Spoken name prompt, five written yes/no answers.	Written name prompt, five written yes/no answers.	Written name prompt, five written yes/no answers.
Q3. On balance, which of these six countries do you think the town is in? ("*Town* is in *country*.")	Spoken name prompt, repeated onto tape in given sentence frame.	Spoken name prompt, written sentence frame completed.	Written name prompt, read aloud onto tape in given sentence frame.	Written name prompt briefly displayed, written sentence frame completed.
Subject questionnaire	Subjects fill in a written questionnaire on background and language skills.			

Figure 10: Structure of final experimental design

The final structure of the experiments, with details for each of the four sub-experiments, is outlined in Figure 10. Early versions were tested on a small number of subjects, and a number of improvements were made to the original versions of the experiment before arriving at this design, which was used for the pilot tests and main experiments. Some of these considerations are discussed below.

◊ ***Wording and organisation of questions***

The combination of questions, and the format of the answers, were designed to tap subjects' judgements and performance at the same time. Separate questions were used for judgements of possible nativeness ("Could these towns be in Britain?"), and possible foreign origin within the category of 'non-native' ("Could these towns be in the countries listed?") in order to examine subjects' perception of the boundaries of what constitutes a native word. The questions were phrased partly with the aim of reducing subjects' awareness of the purpose of the experiment, so explicit questions such as "Do the letters in this word look English?" were avoided. Only the final question ("On balance, which of these six countries do you think the town is in?") required output of the name, which was placed in an English carrier sentence ("*Town* is in *country*.") in order to give an environment sympathetic to nativisation, rather than a foreign language test.

Early versions of the questions differed slightly from those in Figure 10, but after initial tests in which they were sometimes misunderstood the questions and instructions were reworded to make them clearer. During the initial tests the importance of the practice section was increased, with answers and answering strategies being checked and questions from subjects permitted before proceeding to the main experiment.

◊ ***Presentation and timing of experiment***

Experiments were presented on written sheets with instructions and, where appropriate, prompts and/or answer boxes (see Appendix A for the final version). Subjects were guided through the experiment with verbal instructions. The layout of the experiment was designed for clarity, ease of use, and brevity.

Spoken prompts were presented on tape with headphones for the listening-speaking experiment, and without headphones for the listening-writing experiment, to enable use of schools without language-laboratory facilities. Written prompts were presented on the answer sheets for the reading-speaking experiment, and on flashcards for the reading-writing experiment. A number of other options had been considered and rejected for the reading-writing experiment; there were too many prompts for a slide projector or flip-chart; an over-head projector would be difficult to use with consistent timing for each name; and computers were impractical as each subject would need their own. (All the experiments took place at the schools, to minimise inconvenience to staff and pupils.) A tape was used with numbers at the start of presentation of the flashcard, and beeps to cue the start and end of response times. No variation was given in allowed response time for short and long names, which is potentially a weakness. The design of this sub-experiment was seen as the most problematic, as it was difficult to design a realistic task which would allow some phonological processing to take place, rather than simply having the subjects copy the names. There was also no guarantee that subjects would follow instructions and not answer before the bell, though in fact, with verbal instructions as well as written, this did not happen. Typing the names in on a computer would control this, but (in addition to the question of equipment) this would pose problems both in finding suitable subjects with good keyboard skills, and in judging the extent to which common key-combinations affected the answers.

In early tests, it was found that the amount of time necessary for each prompt in the listening and reading-writing versions varied between subjects, and speeded up throughout the experiment. A reasonable average was decided, and tapes of prompts were prepared as described below.

◊ ***Ordering the names***

Initially the towns in Questions 1-3 were randomised by computer, the first sequence that was generated being used, but this resulted in some sequences of similar names. For the final version of the experiments, therefore, several orderings were generated and one was selected which did not have too many pairs of towns from the same country, or groups of three towns from one country. The ordering was different for each of the three questions, so that if subjects glanced through all the questions in advance they would not realise that five of the town names had been changed for Question 3, and so that they could not easily cross-check their answers between questions. Two different orderings were eventually used in each sub-experiment to enable comparison of any potential ordering effects. For the second ordering, the sequence from the same question in the first version was taken, then each half swapped and scrambled, to minimise any effect of position in the test, such as adjacency to other names, or subjects becoming more practised or more tired.

b) Choice of names

All names were taken from the Times Atlas (1992). Greek names were transliterated into Roman letters; this creates a potential problem as there is more than one possible transliteration. In addition, the most obvious graphemic clue to the Greek origin of the names is missing. There is also more than one possible spelling for some other names used in the experiment, and it is possible that a subject might recognise one variant of a symbol or name but not another (for example, alternation between <ö> and <ø> in Norwegian). However, as only one spelling can be used for each name in the experiment, this is unavoidable.

Due to the considerations listed below, the town names used in the experiment are not a representative sample from each language or country. This was particularly true of English - it was difficult to select enough small town names not containing common morphemes. This has implications for phoneme counts and so on; if the English towns in the experiment are compared to English towns in general, they may turn out to have atypical patterns. It is also likely, of course, that subjects will have more trouble pronouncing these names than they would have with typical towns.

The criteria for choosing the names are given below.

◊ ***Languages***

The experiment was restricted to European languages. English was obviously to be included. French and German were included in the expectation that some subjects would have studied these languages; Italian is also familiar to many people, even if they do not speak it; Norwegian and Greek were included as they are less well-known languages in Britain.

As the subjects were from Edinburgh, place names from England were chosen for the English-language names in the expectation that the subjects would be less likely to know these names than Scottish ones; in addition, although the names might originally have come from other European languages, this would be less recent than the influence of Gaelic and Scots on Scottish place names. Welsh and Irish names were rejected as they involve the interference of still more languages. However, in the experiment subjects the towns are referred to as 'British' rather than 'English', to prevent the subjects considering the English names as foreign.

◊ ***Inclusion of foreign features***

It was necessary to include names with foreign phonemes and phonotactics (not occurring in RP English, or in Edinburgh English as this is the accent of most of the subjects); it was not possible, though, to include all phonemes and phonemic patterns from the six languages. Obviously, only town names for which accurate phonetic transcriptions could be obtained were acceptable.

Some names were specifically chosen for their non-English graphemes or diacritics (such as <ç> in French) or combinations of written symbols (such as <schw> in German). In some cases, although a particular orthography is found in some English words, it is untypical, for instance word-internal <kk> in the Norwegian *Dokka* (<kk> occurs in a few English words of foreign origin, such as *trekking* and *chukka*). An interesting example is that of final <-ac>, as in the French town *Meyssac*; it is found in a few English nouns such as *lilac*, but it normally occurs only in adjectives formed from nouns. It will be seen that it is necessary to take grammatical class into account in the analysis of data.

◊ ***Rejection of unsuitable names***

Names which could be easily broken down into potentially recognisable morphemes, such as *-field* in English, or *-berg* in German, were avoided. Names which were very similar to other names or words were also avoided as far as possible, to avoid obvious analogies being available. (Some analogy is unavoidable and will form part of the analysis.)

Border towns whose names obviously originate in the neighbouring country rather than the country within whose borders they currently lie were avoided. (One subject in the initial tests did consider the potential ambiguity of border towns, and wondered whether to use geographical knowledge of neighbouring countries in his answers, but it was not expected that this would be a common reaction.) During the initial pilot tests, some names were found to be unsuitable for other reasons and so were changed: for instance, as mentioned in Chapter 2, one of the original names was <Belin>, which a subject thought was similar to *Berlin*.

◊ ***Filler names***

For authenticity, and to make the experiment less daunting, well-known filler names were included. Initially the only fillers were towns from the six countries. When it was found that elimination strategies were being used in Questions 1 and 2, fillers from other countries were introduced; only fillers from the six countries were used for Question 3, which is a forced-choice response.

c) Preparation of spoken prompts

◊ ***Speaker***

All the prompts were read onto tape by one speaker, a Scottish phonetician, in order to avoid identification of the language of origin by identification of different speakers. It was decided not to use a multi-lingual speaker, as this would cause certain problems:

i) The speaker might bring too many phonetic details to the pronunciations. This would necessitate identification of all the phonetic distinctions involved (VOT, vowel duration and so on[30]), in order to analyse the results of the experiments should the subjects pick up on any of these differences. Such detailed comparison is outside the scope of this study.

ii) The speaker would need to be equally adept at all the languages to avoid bias, and should also be a native speaker of Scottish English. These conditions make obtaining a suitable speaker difficult. A speaker who was expert in some of the languages but not in the others might introduce more bias than one who has the same (moderate) level of pronunciation in each.

iii) As the experiment is being conducted from within an L1 context, it is reasonable to use a speaker who is pronouncing these names as a skilled speaker of the language, but not a native. However, a very anglicised pronunciation is obviously undesirable.

Knowledge of regional and foreign accents is used every day in understanding speech. If, for example, we hear, in isolation the word [fil], with a clear rather than a dark /l/, we may conclude that the speaker is Irish, or perhaps French, and interpret the word as 'feel'. If, however, the speaker continues with an RP accent, we may revise our judgement and conclude, perhaps, that the speaker was using a foreign word. Thus, if we know (or think we know) that the speaker is Irish, [fil] may be judged acceptable as an English word, whereas if the speaker's accent is RP, it may be judged unacceptable. There could be a problem if the listeners are making judgements on a speaker with an accent different from their own, so for this reason a Scottish speaker read the prompts.

Numbers were included on the tapes to cue names, and each name was presented twice for each question.

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[30]See for instance Flege (1980), on Arabic-accented English.

◊ ***Transcriptions and pronunciations***

Phonemic transcriptions of the names and fillers were obtained from a combination of written sources[31] and native speakers, and standardised to IPA (1993). Sequences such as [ts] were transcribed as affricates if this was the normal phonemic analysis for the language in question; Italian double consonants were treated as long segments rather than geminates, as noted in Chapter 2.

The phonetician used these transcriptions as a basis for reading the list of names onto a tape, which was subsequently played to native speakers of the L2s where available, or to speakers of the L2s as foreign languages. These speakers scored the pronunciations as follows:

5	native speaker-quality
4	good native (L2) accent
3	OK
2	sounds foreign (non-L2)
1	sounds English

Only names scored at 4 or above were accepted; others were re-recorded until they were judged to be acceptable. At this stage it was found to be necessary to include some phonetic detail in the transcriptions used for producing the prompts, so as to differentiate between, for example, /t/ in English (aspirated) and /t/ in French (unaspirated). Without including such major phonetic differences, the pronunciations based on the transcriptions sounded unacceptably English. (Filler items from other languages were taken as acceptable if the pronunciation matched the phonemic transcription at level 4 or above, but native speakers were not available for aural judgements.)

Given that one speaker produced all the prompts for the six languages, there are doubtless some aspects of the different languages which were not realised accurately, for example dental vs. alveolar consonants. Where this is the case, the transcriptions used in the analysis reflect the actual prompts, rather than the optimal pronunciation; since the overall accuracy of the prompts was judged acceptable by native speakers, as described above, these inaccuracies can be considered minor and should not affect the results of the experiments. Since the speaker was Scottish, it can be assumed that most such errors were in the direction of Scottish English, and so should not affect subjects' judgements too greatly.

Different phonotactic structures may occur at different rates of speech

[31]Written sources were Duden (1974) and Messinger (1967) for German, Migliorini et al. (1969) for Italian, Pointon (1990) and Wells (1990) for English, and Warnant (1987) for French

(see, for example, Fries and Pike 1949). For this experiment, the rate of speech of the prompts was as kept as constant as possible.

◊ ***Technical details***

In order for valid data to be gathered on the perception of spoken words as English or foreign, the words must be very clear; ideally, subjects should be able to identify every English phoneme or allophone they hear. A sound-proofed recording studio was used to record the prompts onto WORM-drive, so they could be edited on-line before making the full-length tapes. Minor variations in volume between prompts were adjusted. The resulting speech files were all the same length; space for answering was inserted after each name. No allowance for word-length was made in the time allotted for answering.

d) Preparation of written prompts

Spellings were taken from the Times Atlas (1992). For the reading-speaking experiments subjects read the names from their answer sheets, but for the reading-writing experiment, in order to ensure that the names were hidden during the writing phase, flash-cards were used. For clarity, all names were given in lower case, with initial capitals. This has the potential drawback that some letters may be more distinctive than others and so more likely to be noticed or remembered. (This would also occur in upper case, but maybe not with such a wide gap between more and less distinctive letters.) However, clarity was considered more important.

4.3.2. Pilot tests and subsequent modifications

Pilot tests as described above were carried out on 20 subjects (5 for each sub-experiment), from a comparable subject pool to that used for the main experiments (all were aged 15-16, and were from a secondary school in the Edinburgh area).

In addition, a further five subjects filled in a questionnaire designed to confirm their level of familiarity with the town names used in the experiment, to verify that names intended to be unfamiliar were indeed unknown to all or nearly all subjects. Subjects were given the full list of towns on paper[32], including the fillers and practice names. For each town, they were asked whether it was familiar (answering yes or no), and if so, where it was located. They were instructed not to guess.

Although the experiments were generally satisfactory, a few modifications were made before arriving at the final version described in detail below.

◊ ***Name set***

The pilot test contained 70 names, with 18 familiar filler names and an unequal number of names from the 6 countries. As the experiment was slightly too long, the number of names was reduced to 62, with just 2 fillers, and to facilitate analysis an equal number of names (excluding the fillers) was taken from each country.

The answers to the familiarity test were not quite as expected. Some of the supposedly unfamiliar names were recognised by a majority of subjects (*Valençay* and *Pescia* were marked as 'familiar' by three subjects each, though none could locate *Valençay* and only one *Pescia*), while some of the familiar ones were not (*Essen*, for instance, was marked as 'unfamiliar' by all five). Names were rejected as candidates for the final experiments if one or more subjects both claimed to recognise a name and could say which country it was in. Interestingly, 'Britain' was never given as an answer - 'England' was given a few times, and, before it was crossed out, 'Scotland' was listed once.

◊ ***Timing***

After observing subjects completing the pilot test, and watching for any difficulties, the times between prompts were adjusted slightly to allow for comfortable but well-paced answering. As noted above, the overall length of the experiment required shortening - the fastest pilot test was completed in 24 min (for the reading-speaking version), but the slowest was 54 min (reading-writing). This was somewhat demanding for the subjects, and risked over-running available time-slots at schools, so the number of names was reduced.

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[32]Since the purpose of this was to find out if the subjects knew any of the towns rated as unfamiliar, and it was considered that the written names would be more familiar than the spoken ones, a written list was given rather than a tape. However, it is conceivable that some of the spoken names, even if not familiar, might be confused with other spoken names which are familiar (such as 'Aire' [ɛʀ], which might be confused with 'Ayr' [eɹ]).

◊ ***Other***

As the practice test had six towns in Question 3, and six countries, some subjects incorrectly assumed a one-to-one correspondence. The number of examples in the practice test was therefore reduced to four. Minor changes were also made to the questionnaire.

4.3.3. Description of final design

This section summarises the final experimental design. For a sample answer sheet (reading-speaking version), see Appendix A.

◊ ***Name set***

The names used in the experiments are listed in Table 8.

Town	Pronunciation	Country
Bredgar	ˈbɹɛd.gaɹ	Britain
Guist	gʌ͡ist	Britain
Keld	kʰɛlˠd	Britain
Lechlade	ˈlˠɛt͡ʃ.lˠed	Britain
Pelynt	pʰəˈlˠɪntʰ	Britain
Rede	ɹid	Britain
Slattocks	ˈslˠa.tʰəks	Britain
Sollom	ˈsɔ.lˠəm	Britain
Sturry	ˈstʌ.ɹi	Britain
Watton	ˈwɔ.tʰən	Britain
Aire	ɛːʀ	France
Cornus	kɔʀ.nys	France
Laragne	la.ʀaɲ	France
Manosque	ma.nɔsk	France
Maule	mol	France
Meyssac	mɛ.sakʰ[33]	France
Savigne	sa.viɲ	France
Tallard	ta.laːʀ	France
Toucy	tu.si	France
Valençay	va.lɑ̃.sɛ	France
Dreve	ˈdʁeː.və	Germany
Glinde	ˈglɪn.də	Germany
Nahe	ˈna̠ː.ə	Germany
Pfinztal	ˈp͡fɪnt͡s.t̠ʰa̠ːl	Germany
Rötz	ʁœt͡s	Germany
Schapen	ˈʃa̠ː.pʰən	Germany

Table 8: List of names used in experiments

[33] This stop is transcribed as aspirated since the version used in the experiments had noticeable aspiration.

Town	Pronunciation	Country
Schwenke	ˈʃvɛŋ.kʰə	Germany
Stellau	ˈʃtɛ.la̠͡ʊ	Germany
Velen	ˈfeː.lən	Germany
Wolnzach	ˈvɔln.t͡sa̠x	Germany
Ekhinos	ɛˈçi.nɔs̠	Greece
Elatia	ɛˈla.t̪i.a	Greece
Karousadhes	ka.ɾuˈs̠a.ðɛs̠	Greece
Katerini	ka.t̪ɛˈɾi.ni	Greece
Larisa	ˈla.ɾi.s̠a	Greece
Megara	ˈmɛ.ɣa.ɾa	Greece
Psakhna	p͡saˈxna	Greece
Stira	ˈs̠t̪i.ɾa	Greece
Tsamandas	t͡sa.manˈdas̠	Greece
Volos	ˈvɔ.lɔs̠	Greece
Acri	ˈa.kɾi	Italy
Bobbio	ˈbɔ.bːjo	Italy
Copparo	koˈpːa.ɾo	Italy
Fermo	ˈfeɾ.mo	Italy
Firenze	fiˈɾɛn.t͡se	Italy
Greve	ˈgɾɛ.ve	Italy
Livorno	liˈvoɾ.no	Italy
Loano	loˈa.no	Italy
Novoli	ˈnɔ.vo.li	Italy
Osimo	ˈɔ.zi.mo	Italy
Ålesund	ˇɔˑ.lə.sʉn	Norway
Bolkesjö	ˇbɔl.kə.ʃø	Norway
Dokka	ˇdɔ.kːa	Norway
Evje	ˇev.jə	Norway
Hellesylt	ˇhe.lːə.syltʰ	Norway
Jaren	ˇjɑˑ.əɳ	Norway
Kvernes	ˋkvæˑ.ɳeˑs	Norway
Lyngen	ˇlyŋː.ən	Norway
Snåsa	ˋsnɔˑ.sɑ	Norway
Sparbu	ˋspɑːɾ.bʉ	Norway

Table 8 (continued)

◊ ***Spoken prompts***

Names were recorded by a Scottish phonetician, as described above (p. 100 ff.), using a recording studio. Sampling rate was 20 kHz, and a Realistic desk microphone was used. The names were then transferred onto audio tape.

◊ ***Tapes***

Different tapes were prepared for three of the sub-experiments, as described below. Two versions were made for each, with different name orders.

i. Listening-speaking.

   Each name on the master tape was given twice, preceded by the sequence number in case the subject missed one or more questions and lost their place on the answer sheet (the answers to Questions 1 and 2 were written). For Question 1, the names were played in quick succession; for Question 2, which was more complex, a little more time was allowed for answering; for Question 3, a space of 4 seconds was left after the second repetition for subjects to answer.

ii. Listening-writing.

   Again, for all questions the names were given twice, preceded by the sequence number. As Questions 1 and 2 were the same for the listening-speaking and listening-writing experiments, the same timing was used.) For Question 3, as subjects could write while the tape was playing, the timing was faster than for the listening-speaking tape.

iii. Reading-writing.

   A tape was used for this sub-experiment to regulate the timing. The tape had sequence numbers as a cue for each name, both for the experimenter showing the flashcards and as a prompt to subjects to look up from their answer sheets. (More time was allowed for Question 2 than Question 1.) For Question 3, a bell was recorded on the tape shortly after the numbers, to time covering of the flashcards.

◊ ***Written prompts***

For the reading-speaking experiments names were printed on the answer sheets in 9 point Helvetica. For the reading-writing experiment, flash-cards were used with 55 point Helvetica type, and each name was numbered so that subjects could keep track of the right place on the answer sheet. Again, two orderings were used for different subject groups.

◊ ***Subjects***

Thirty subjects completed each sub-experiment. Different subjects were used for each of the four sub-experiments, so they were controlled as far as possible in order to facilitate comparisons. The subject group consisted of school pupils with a limited range of ages (years S2-S6, ages 13-17) and geographical origin, to minimise the variation across subjects (see below p. 110 for criteria for excluding subjects from the results). The subjects were drawn from four secondary schools in the Edinburgh area.

◊ ***Execution of experiments***

For each of the experiments the procedure was as follows:

i. Subjects read the introductory instructions. It was verified before beginning that everyone could hear or see the names clearly, and necessary questions were allowed.
ii. Subjects read the instructions for the practice test and were given brief oral instructions before each question, to guide them through the experiment. They answered the questions, and their methodology was briefly checked to see that they were following instructions. After the practice test further clarification was given if necessary for completion of the experiment.
iii. Subjects completed the main part of the experiment.
iv. Subjects filled in the questionnaire.

◊ ***Details of the four sub-experiments***

i. Listening-speaking.

   Subjects listened on headphones to tapes containing prompts for Questions 1 and 2, and filled in the answer boxes on the answer sheets with ticks, crosses or question marks. They then listened to the tapes containing the prompts for Question 3, and recorded their spoken answers onto tape.
ii. Listening-writing.

   Questions 1 and 2 were as for the listening-speaking experiment, but presented on a tape-recorder without headphones. Clear volume levels were determined before beginning. For Question 3, the names were again presented on the tape-recorder while subjects wrote their answers. They could begin writing at any time.
iii. Reading-speaking.

   Subjects answered Question 1 and then Question 2 on paper at their own pace, and when everyone had finished these two questions, they answered Question 3 onto tape at their own speed, using language laboratory facilities.
iv. Reading-writing.

   For all questions, names were presented on flashcards. As described above, a tape with sequence numbers was used as a cue for each name, both for showing the flashcards and as a prompt to subjects to look up from their answer sheets. For Questions 1 and 2 the names were on display while subjects wrote their responses. For Question 3, a bell followed 2 seconds after the number, at which point the name was covered and subjects were given 7 seconds to write a response; subjects were instructed not to begin answering before the bell.

4.3.4. Preliminaries to analysis

This section describes the transcription of the results, and subject profiles as detailed in the questionnaire, with some comments on subjects' accents. There also some notes on the analysis of the data.

a) Transcription of results

Spoken responses were transcribed in IPA, to a similar level of detail (fairly narrow phonetic) as that used for the transcriptions of the prompts, and most of the analysis is based on these transcriptions. The features included in the transcriptions are: segmental identity, including length marks and other diacritics where necessary; syllabification; and stress and tone. (Tone was mainly used in Norwegian responses, but some other responses had perceptibly different pitch from that expected; this was also transcribed.)

◊ ***Perception and transcription of segments***

Just as the subjects had difficulty in accurately perceiving and interpreting all of the spoken prompts, it would be naive to claim that the responses they gave were transcribed with 100% accuracy. There were some problems in perceiving or categorising sounds, particularly when subjects spoke quietly or quickly. An instrumental analysis was not used in this study due to a number of factors. One of these was the large quantity of data, which made on-line storage for cross-comparisons difficult. Another was the variation in acoustic quality of the data - some was very clear, while other data contained extraneous background noises. Also, a phonetic transcription was felt to be preferable in dealing with the subject matter; acoustic parameters, while revealing other factors than are covered in this study, would not shed light on the main questions here.

The main criteria used in deciding between possible alternative transcriptions were as follows:

i) Is the segment similar enough to the spoken prompt (or original spoken name, if the prompt was written) to justify transcription with the same symbol?

If not, some distinction should be made.

ii) Is the segment similar enough to other tokens by the same speaker to justify using the same symbol?

iii) Length markings were somewhat problematic, since some 'long' segments in the prompts were shorter than other 'long' segments. Length markings were used for responses if the subject produced a segment noticeably longer than would normally be expected; some segments were marked as half-long.

iv) Diacritics were commonly used. They were often used to mark cases when the subject's pronunciation was very slightly different from the prompt, or from other tokens from the same subject.

v) I found it difficult to differentiate some of the distinctions in Edinburgh English which are not present in my own accent, such as /ɔɹ/ versus /oɹ/; Scottish speakers were consulted for judgements on some of these.

vi) Although all the features transcribed for the prompts were present, some were less audible than others. For example retracted /s/, [s̠], was not very different from the normal [s].

vii) The transcriptions are phonetic rather than phonemic, but there was a sometimes a choice between equivalent transcriptions, for instance a lowered [e] or a raised [ɛ]. In such cases the choice of transcription was often arbitrary.

Even with these checks, a major reservation is that I may have been hearing what I expected to hear. In cases where I was uncertain, this was noted in the transcriptions, but there may have been instances where I subconsciously perceived a sound as similar to the prompt and was unaware of any ambiguity.

◊ ***Transcription of syllable structure***

The maximal onset principle was used for dividing both prompts and responses into syllables; the maximal onset used was the maximal possible phonemic onset in the language in question. Occasionally it could be observed from the pronunciation, particularly the phonetic details and timing of medial consonant clusters, that a subject was using an alternative syllabification; this was transcribed as such. For some words, such as *Psakhna* [p͡saˈxna], there is unlikely to be an audible distinction between alternative syllabifications.

A vowel followed by schwa, not forming a diphthong, was taken to be two separate syllables. For instance, the responses to *Evje* [ˇev.jə] and *Elatia* [ɛˈla.t̪i.a], often contained the sequence [i.ə]; these were transcribed as three and four syllables respectively ([ˈe.vi.ə] and *Elatia* [ɛˈlˠa.tʰi.ə]) rather than two and three syllables ([ˈe.viə] and *Elatia* [ɛˈlˠa.tʰiə]).[34]

◊ ***Transcription of stress, pitch and length in spoken responses***

There were some instances in which stress was unclear in the spoken responses, but such cases were marked with queries.

As for tone, although the subjects were doubtless unfamiliar with tones in the sense in which they are used in Norwegian, there is no doubt that in some cases they noticed the pitch patterns in the prompts and tried to reproduce them. In a few other instances, they used marked pitch patterns in their answers even where none was present in the tone. All pitch changes which were noticeably different from default pitch patterns were transcribed, whether these were intentional word 'tones', or due to other factors. As noted above, length was only transcribed in the current data when segments were noticeably longer or shorter than usual for the subjects.

◊ ***Interpretation of written responses***

For most written responses there was no problem in deciphering the writing. In a few answers, however, particularly for confusable segments or sequences such as <ɑ> and <o>, or <rn> and <m>, there was some uncertainty. Such strings were compared to the subject's writing elsewhere, and if a decision still could not be made they were marked as queries.

b) Subject characteristics

Subjects were Scottish school pupils in years S2 to S6, aged 13-17. Four schools participated, and each school took part in two of the four sub-experiments, so each sub-experiment used pupils from two different schools. Data was collected from a total of 30 subjects for each sub-experiment, giving a total of 120, but subjects were rejected if they fulfilled any of the following criteria:

i) Non-co-operation or misunderstanding (more than half of answers blank or inappropriate, and/or more than half of Question 3 answers blank or inappropriate) - 3 subjects

ii) Non-intelligibility of Question 3 responses (more than half of answers unusable) - 0 subjects

iii) Both:

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[34] See p. 114 below for a discussion of the transcription of /l/.

a) first language not English, or bilingual, or subject was born or lived in another country; and

b) at least two maximum scores of 4 in other first/second language - 5 subjects

iv) Born outside Scotland and lived outside Scotland - 9 subjects

Some subjects were rejected on more than one criterion. Details of the sex and age of subjects included in the analysis are given in Table 9.

	Listening-speaking	Listening-writing	Reading-speaking	Reading-writing	Summary
Number of subjects	26	27	24	30	Average 26.75 Total 107
Sex	M 10, F 16	M 7, F 19[35]	M 10, F 14	M 9, F 21	Average M 9 F 17.5 Total M 36 F 70
Average age	14.65	15.28	14.79	14.47	Average 14.79

Table 9: Subject characteristics

◊ ***Differences between subject groups***

Age profiles were significantly different ($p < 0.05$) between the listening-writing subjects and listening-speaking subjects, and listening-writing and reading-writing, with the listening-writing subjects being older than the other two groups.

There were also significant differences between language skills claimed in the Questionnaire (see Table 10 below). For French, subjects in the listening-writing and reading-writing experiments claimed to be better overall than those in the listening-speaking and reading-speaking experiments. Subjects in reading-writing claimed lower German skills than the other three groups.

[35] One subject did not answer this question.

		Listening-speaking	Listening-writing	Reading-speaking	Reading-writing	Average
French skills (averages, scored from 0 to 4)	listening	1.38	1.89	1.67	2.2	1.80
	speaking	1.56	1.94	1.67	2.23	1.90
	reading	1.56	2.30	1.67	2.35	1.99
	writing	1.23	2.06	1.4	2.23	1.76
German skills (averages, scored from 0 to 4)	listening	0.92	0.78	0.75	0.47	0.66
	speaking	0.81	1	0.92	0.5	0.80
	reading	0.77	0.89	0.88	0.47	0.72
	writing	0.81	0.85	0.83	0.47	0.73
Spanish skills (averages, scored from 0 to 4)	listening	0.31	0.07	0.2		0.14
	speaking	0.38	0.07	0.2		0.15
	reading	0.42	0.04	0.25		0.17
	writing	0.38	0.04	0.25		0.16
Italian skills (averages, scored from 0 to 4)	listening	0.08		0.08		0.04
	speaking	0.12		0.08		0.05
	reading	0.04		0.08		0.03
	writing	0.04		0.08		0.03
Gaelic skills (averages, scored from 0 to 4)	listening	0.19	0	0.04		0.06
	speaking	0.15	0.04	0.04		0.06
	reading	0.08	0.04	0.04		0.04
	writing	0.08	0.04	0.04		0.04
Welsh skills (averages, scored from 0 to 4)	listening	0.19				0.05
	speaking	0.19				0.05
	reading	0.12				0.03
	writing	0.08				0.02
Greek skills (averages, scored from 0 to 4)	listening			0.04		0.01
	speaking			0.04		0.01
	reading			0.04		0.01
	writing			0.04		0.01
Japanese skills (averages, scored from 0 to 4)	listening			0.04		0.01
	speaking			0.04		0.01
	reading			0		0
	writing			0		0

Table 10: Language skills of subjects

There were differences in the ordering of perception/production skills claimed by subjects within each experiment. Although none of the differences between means are significant at $p < 0.05$, it is interesting to note that for both French and German three out of the four groups claimed better speaking skills than listening, while all four claimed better reading than writing skills for French; for German, two groups claimed to be better at reading than writing, and one claimed the opposite. This suggests that perception of non-native spoken language caused problems for them.[36] Four schools were used in the experiments, and each sub-experiment had subjects from two schools; there might be differences in the average abilities of pupils at each school, but it is also possible that the subjects rate themselves differently due to differing assessment or encouragement from their teachers.

Language skills varied among other languages, but usually only one or two subjects in total claimed any knowledge of these. Of the other languages included in the current study, a total of 5 subjects claimed some knowledge of Italian, and 1 subject knowledge of Greek.

◊ ***Accents of subjects***

A few specific comments can be made about the accents of the subjects as observed in the English-language part of Question 3, in which they were required to say where the towns were, though this is obviously not a full guide to their speech (see footnote 37). Also, the data from the subjects in the writing experiments does not even furnish this level of information.

Some subjects in the experiments had the optional phonemes /ɑ/ and /ɜ/, while others did not,[37] and at least one subject varied between [a] and [ɑ] in the word *France*. In the transcriptions of spoken data [a̠] was frequently used for a back-sounding /a/ which did not sound as far back as [ɑ], but was further back than the typical Scottish [a]. Use of the optional phoneme /ɛ̝/ by the subjects cannot be determined, and nor can it be ascertained whether any of the speakers

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[36]It should be remembered that this question did not address specific tasks; for example, subjects might find word-segmentation particularly difficult in the foreign languages, but this is not relevant in the current study.

[37]As no separate pronunciation assessment was used, this information has to be obtained from the carrier sentences in Question 3. These, of course, contain the words *France* and *Germany*, which have the relevant phonemes /ɑ/ and /ɜ/. Rhoticity could also be obtained, from *Germany* and *Norway*, while *France*, *Greece* and *Britain*, having post-consonantal /r/, sometimes elicited different realisations such as taps rather than approximants. Glottal stops sometimes appeared in *Britain* and *Italy*. However, due to the variation in use of these within as well as across subjects, we cannot always assume that because such pronunciations occur in the carrier sentences they will also occur in the names; additionally, due to the effect of phonemic environment on use of variable phones or phonemes, we have to use caution in generalising either between carrier sentences and names, or within the name set.

have, as some Scottish speakers do, minimal pairs distinguished by vowel length which is not dependent on the linguistic structure of the word. (In the data here, vowels have been transcribed as long or half long if they are noticeably long, rather than basing transcriptions what would be expected from the phonemic environment.) Subjects varied in the use of final reduced phonemes, such as /e/ - /i/ - /ɪ/ in names such as *Katerini*, while for the final vowel in names like *Evje*, some subjects used /ə/, some /ʌ/ and a number used a centralised /ʌ/-type vowel, transcribed as [ʌ̈].

All the Scottish variants of /r/, i.e. [ɹ], [ɾ] and [ʁ] occur in the English-language part of the data in the current experiments, showing that use of [ʁ] or [ɾ] in the pronunciation of a word is not necessarily an attempt at a foreign sound.[38] Other features of Edinburgh English noted in Chapter 3 (p. 46 ff.) were also observed in the data, for instance the tenseness of some stop realisations, and the use of glottal stops. The lack of a distinction between clear and dark /l/ led to three different transcriptions being used for the data, with [lˠ] for the usual Edinburgh /l/, [l] for segments which were noticeably clear and [ɫ] for segments which were darker than usual.

c) Comments on data analysis

Frequency data of segments and strings in English was needed for comparison with the data obtained in this study. On-line pronunciation dictionaries were therefore used to obtain statistics on the structure of written and spoken English; although there are various publications of frequency information available, they do not cover all the aspects needed here, though some do have the advantage of statistics based on usage as well as lexical incidence.

The on-line pronunciation dictionaries were developed personally for other purposes, to a high degree of accuracy. They contain over 110,000 words with hand-verified transcriptions in RP and part-of-speech tags, and automatic alignments of the phoneme and grapheme strings. The words were selected by a combination of frequency, generation of morphological derivations from the original set, and the addition of a small number of words required for specific tasks. A Scottish version was also available, containing automatically derived pronunciations in Edinburgh English (see Fitt 1997 for a description of the

[38]Use of these variants mostly consisted of [ɹ] before a consonant or a word-boundary, or word-initially, [ɾ] intervocalically or in a syllable initial consonant-cluster, and [ʁ] only rarely.

method used for this); being automatically produced, this dictionary was not as accurate as the RP version and so was used with caution. A pronunciation dictionary of British town names would have been useful, as this might cover possibilities not found in a dictionary of English, but appearing in, say, Scottish town names. However, such lists are not available on-line, which makes searching problematic.

Two different name orders were used in the experiments; comparison of the answers for Question 1 showed no significant differences, so the figures were taken together. Statistical analysis of the data is used where appropriate, but some aspects of the results were not amenable to statistical study and are analysed in other ways.

The analysis of the results in the following chapters is divided into:

- Perception
    - spoken prompts - judgements of origin, linguistic features
    - written prompts - judgements of origin, linguistic features
- Production in same-media experiments
    - listening-speaking - correct responses, linguistic features
    - reading-writing - correct responses, linguistic features
- Production in cross-media experiments
    - 'correct' responses, linguistic features and analogy for reading-speaking and listening-writing

Throughout the results it will be seen that segments and short sequences are most amenable to large-scale analysis. However, there is also a substantial amount of data given on longer sequences and whole responses, which is necessary to understand the broader implications of the results.

Chapter 5.

Results - Perception

This chapter will cover perception of spoken forms, including the perception of the linguistic origin of the name, and perception of the various linguistic parameters, and then the perception of the corresponding features of written words will be described.

5.1. Spoken forms

This section discusses perception in the listening-speaking and listening-writing experiments. Firstly the judgments of origin are analysed along with the linguistic features which might affect these judgements, then segmental perception, structural perception and perception of suprasegmental features are discussed.

5.1.1. Judging the origin

The results dealing with judgements of origin for spoken names will be discussed, and then these will be compared with features of the names to see on what basis subjects make their judgements.

◊ ***Summary: Origin of spoken forms***

Subjects performed well at identifying the country of origin of the names. If we look at the linguistic features which lead to their conclusions, it seems there is probably no one parameter which predominantly influences judgement of origin, but rather a combination. That responses here may well be the result of a cumulative effect fits with the finding that the number of non-native phones in a word is more important than the simple presence or absence of such phones.

While it is possible to examine databases of the various languages to determine their characteristics, this may not correspond to subjects' knowledge, and may not reveal the most salient characteristics for subjects. Cross-comparisons of the languages would also be necessary, since a relatively uncommon feature in a given language might be a strong marker if it only occurs in that one language.

It is important to note that there is confusion between certain languages, for example Greek and Italian. This suggests that subjects might treat words from these languages in a similar way when it comes to producing output.

a) Responses to questions of origin

Town group	Average score per town per subject
British towns	0.86
Non-British towns	0.16
All towns (average)	0.28

Table 11: Perception of origin of towns (listening-writing and listening-speaking), in response to "Could these towns be in Britain?" Possible scores range from 0 (low) to 1 (high).

Table 11 gives the results for Question 1 ("Could these towns be in Britain?") with spoken presentation of towns, grouped here into British and non-British. Answers were scored as 1 for 'yes', 0.5 for 'not sure' and 0 for 'no'. A high score therefore indicates that a town was thought by many subjects to be a possible British town; a low score indicates the opposite. As there were 50 non-British towns and only 10 British towns, and the number of subjects varied slightly across the different experiments, results have been normalised by giving the scores in terms of 'average score per town per subject'; this means the total score for that cell divided by the number of towns in the cell (i.e. 10 for British towns, or 50 for non-British), divided by the number of subjects. So, if all subjects in the experiment answered 'yes' for all the towns in the group, the 'average score per town per subject' would be 1; if they answered 'not sure', or if half answered 'yes' and half 'no', it would be 0.5, and if they answered 'no' it would be 0. This measure, which will be also used for Questions 2 and 3, enables comparison of total scores comprising varying numbers of subjects and/or varying numbers of towns. For Table 11 this means that, although there were more non-British than British towns, the scores can be directly compared.

Comparison of Table 11 with Table 34 later in this chapter shows that, unsurprisingly, subjects identified British towns more accurately through oral presentation than written presentation. Compared to written presentation however, for spoken presentation it is not as simple to break down the factors which lead to judgements of origin. The main difficulty is in classifying the phones - sounds such as [ɳ] in [ˋkvæˑ.ɳeˑs] (*Kvernes*) are obviously non-native, as is the word-initial sequence [kv], but other sounds, particularly vowels, are less clear-cut. This issue will be examined further below.

Results for Question 2 ("Could these towns be in the countries listed?") and Question 3 ("On balance, which of these six countries do you think the town is in?") are given in Tables 12 and 13 respectively. Results which are significantly above chance ($p < 0.05$, 10 towns per country, 53 subjects) in a chi-squared test are shaded. It will be remembered that for Question 2 'Possibly British' was not a possible response, as this question focused on the distinctions between the five foreign languages. This probably accounts for the low average score (0.19) given to British towns; towns from other countries had similar average scores to each other.

	Prompts						
Responses	**British towns**	**French towns**	**German towns**	**Greek towns**	**Italian towns**	**Norwegian towns**	**Average**
Possibly French	0.11	0.55	0.17	0.22	0.27	0.12	0.24
Possibly German	0.30	0.18	0.63	0.15	0.10	0.39	0.29
Possibly Greek	0.13	0.23	0.11	0.47	0.35	0.18	0.25
Possibly Italian	0.09	0.26	0.10	0.50	0.59	0.12	0.28
Possibly Norwegian	0.34	0.23	0.42	0.2	0.18	0.59	0.33
Average	0.19	0.29	0.29	0.31	0.3	0.28	0.28

Table 12: Perception of origin of towns (listening-writing and listening-speaking), in response to "Could these towns be in the countries listed?" Possible scores range from 0 (low) to 1 (high).

Tables 12 and 13 show similar patterns of significance; except for the obvious difference that 'Britain' was a possible answer in Table 13, the only difference is that Norwegian responses to British and German towns were significant in Table 12 but not in 13. All 'correct' identifications have a significantly high figure, i.e. French towns are identified as French, and so on. This shows that the subjects are sufficiently familiar with the properties of the spoken forms of each language to locate a relatively high proportion of the towns correctly, whether this be through phonetic detail, phonemic inventories, phonotactics or stress patterns.

Responses	British towns	French towns	German towns	Greek towns	Italian towns	Norwegian towns	Average
	Prompts						
Identification as British	0.55	0.08	0.05	0.01	0.03	0.09	0.14
Identification as French	0.05	0.46	0.11	0.11	0.13	0.06	0.15
Identification as German	0.14	0.09	0.47	0.08	0.05	0.22	0.18
Identification as Greek	0.07	0.14	0.08	0.31	0.21	0.13	0.16
Identification as Italian	0.02	0.07	0.04	0.31	0.41	0.06	0.15
Identification as Norwegian	0.15	0.13	0.23	0.15	0.14	0.41	0.2
Other (e.g. omissions)	0.02	0.03	0.03	0.03	0.02	0.02	0.03

Table 13: Perception of origin of towns (listening-writing and listening-speaking), in response to "Which country do you think the town is in?" Possible scores range from 0 (low) to 1 (high).

Apart from the correct identifications, the other significant scores in one or both tables are for British town/Norwegian response, German town/Norwegian response, Norwegian town/German response, and Greek/Italian towns and responses. This suggests that the shared features of each of the above language pairs are enough to cause confusion, while shared features of other language pairs are either fewer or not as noticeable to the subjects.

b) Individual phones

Each language of course varies from the others in its phoneme set, and so it is difficult to group languages together on this basis. A strictly phonemic comparison is inappropriate as sounds may function in different ways in different languages; for example, /ɔ/ in Greek is phonetically similar to /ɔ/ in Italian, but the latter stands in opposition to /o/, whereas its Greek counterpart does not. A phonetic comparison is not without theoretical difficulties, however, since the phonetic realisations even of similar sounds in two different languages are unlikely to be exactly the same, and one phoneme in any one language has a range of legitimate phonetic realisations, both allophonically and between different speakers; using phones rather than phonemes therefore introduces arbitrary distinctions. Even a framework which uses degrees of similarity, rather than discrete categories, is not a simple measure for as small a number of tokens as we have here.

	Consonants				British towns	French towns	German towns	Greek towns	Italian towns	Norwegian towns
	manner	place	voicing							
	plosive	bilabial	voiceless asp	pʰ	pʰ 1		pʰ 1			
*[39]			voiceless unasp	p					pː 1	p 1
			voiced	b	b 1				b 1 bː 1	b 2
**		dental	voiceless unasp	t̪				t̪ 3		
		alveolar	voiceless asp	tʰ	tʰ 3		tʰ 1			tʰ 1
*			voiceless unasp	t	t 2	t 2	t 1			
			voiced	d	d 4		d 2	d 1		d 1
		velar	voiceless asp	kʰ	kʰ 1	kʰ[40] 1	kʰ 1			
*			voiceless unasp	k	k 1	k 2		k 2	k 2	k 2 kː 1
			voiced	g	g 2		g 1		g 1	
*	tap	alveolar	voiced	ɾ				ɾ 5	ɾ 6	ɾ 1
	fricative	dental	voiced	ð				ð 1		
		labiodental	voiceless	f			f 1		f 2	
			voiced	v		v 1	v 3	v 1	v 3	v 2
		alveolar	voiceless	s	s 5	s 6				s 6
			voiced	z					z 1	
**		retracted alveolar	voiceless	s̠				s̠ 7		
		postalveolar		ʃ			ʃ 3			ʃ 1
**		palatal		ç				ç 1		
		velar		x			x 1	x 1		
**			voiced	ɣ				ɣ 1		
*		uvular		ʁ			ʁ 2			
		glottal	voiceless	h						h 1

Table 14: Number of consonant phonemes occurring in spoken prompts for each language

[39] A double asterisk indicates that the sound is non-native; a single asterisk indicates that the sound is variably non-native (see discussion).

[40] Although French voiceless stops are generally unaspirated, this segment is marked as aspirated since that is the pronunciation which actually occurred in the prompt.

	Consonants				British towns	French towns	German towns	Greek towns	Italian towns	Norwegian towns
	manner	place	voicing							
	nasal	bilabial	voiced	m	m 1	m 3		m 2	m 2	
		alveolar		n	n 2	n 2	n 6	n 4	n 4	n 3 nː 1
**		palatal		ɲ		ɲ 2				
**		retroflex		ɳ						ɳ 2
		velar		ŋ			ŋ 1			
	approximant	palatal	voiced	j					j 1	j 2
		labial-velar		w	w 1					
*		alveolar		ɹ	ɹ 4					
**	lateral approximant	alveolar	voiced	l		l 4	l 5	l 3	l 3	l 4 lː 1
		velarised alveolar		lˠ	lˠ 6					
**	trill	uvular	voiced	ʀ		ʀ 4				
**	affricate	bilabial/ labiodental	voiceless	p͡f			p͡f 1			
**		bilabial/ alveolar		p͡s				p͡s 1		
(**)		alveolar/ alveolar		t͡s			t͡s 3	t͡s 1	t͡s 1	
**		alveolar/ post-alveolar		t͡ʃ	t͡ʃ 1					

Table 14 (continued)

		Vowels					British	French	German	Greek	Italian	Norwegian
		front/back	rounded/unrounded	height	nasality		towns	towns	towns	towns	towns	towns
	primary	front	unrounded	close	oral	i	i 2	i 2		i 6	i 5	
	primary	front-central	unrounded	close-close-mid	oral	ɪ	ɪ 1		ɪ 2			
	primary	front	unrounded	close-mid	oral	e	e 1		eː 2		e 3	e 2 eˑ 1
	primary	front	unrounded	open-mid	oral	ɛ	ɛ 3	ɛ 2 ɛː 1	ɛ 2	ɛ 5	ɛ 2	
*	primary	front	unrounded	open	oral	æ						æˑ 1
*	primary	central	unrounded	open	oral	a	a 2	a 7 aː 1		a 15	a 3	a 1
	primary	central	unrounded	mid	oral	ə	ə 4		ə 6			ə 6
*	primary	central-back	unrounded	open	oral	a̠			a̠ 1 a̠ː 3			
*	primary	back	unrounded	open	oral	ɑ						ɑ 1 ɑː 1 ɑˑ 1
	primary	back	rounded	open-mid	oral	ɔ	ɔ 2	ɔ 2	ɔ 1	ɔ 3	ɔ 3	ɔ 2 ɔˑ 2
	primary	back	rounded	close-mid	oral	o		o 1			o 10	
**	primary	back	rounded	close	oral	u		u 1		u 1		
**	secondary	front	rounded	close	oral	y		y 1				y 2
**	secondary	front	rounded	close-mid	oral	ø						ø 1
	secondary	central	rounded	close	oral	ʉ						ʉ 2
**	secondary	central	rounded	open-mid	oral	œ			œ 1			
	secondary	back	unrounded	open-mid	oral	ʌ	ʌ 1					
	diphthongs	back/front	unrounded	open-mid/close	oral	ʌ͡ɪ	ʌ͡ɪ 1					
**	diphthongs	central-back/ back	unrounded/rounded	open/close	oral	a̠͡ʊ			a̠͡ʊ 1			
**	nasals	back	unrounded	open	nasal	ɑ̃		ɑ̃ 1				

Table 15: Number of vowel phonemes occurring in spoken prompts for each language

Despite the above comments, if we are to make any progress in examining subjects' perceptions of segments, we need a method of making comparisons and contrasts between sounds which are native, or very similar to native sounds, and those which are foreign. As strictly phonemic and phonetic definitions are problematic, a phonetic feature-based grouping has been used. Tables 14 and 15 above show features which will be used in subsequent analyses; the descriptions are for the actual phone tokens occurring in the prompts. Since length is treated as a suprasegmental feature in this study, long sounds are grouped together with short sounds. All other phonetic features are treated as distinctive. The features form the basic description; the concept of phoneme has been avoided in the description of the data, though subjects' use of phoneme-level information will be noted in some of the following sections.

This phonetic categorisation has certain consequences. The phoneme /r/, for instance, has a number of different realisations across the six languages, and is classified as a fricative in German, or a tap in Italian. These therefore show no correspondence with the Scottish approximant [ɹ], although most of the non-English realisations of /r/ also occur in Scottish English (see Chapter 3, p. 47). Any difference in place for consonants is listed separately, but some are major differences and others, such as Greek [s̠] as opposed to other [s], are less distinct. Differentiation between [ɪ] and [i] caused some difficulty; these are often distinguished by the feature [tense], but as we have already noted (see Chapter 3, p. 65" ff.) this feature is problematic with regard to Scottish English. Because of this, [ɪ] and [i] are here distinguished by place.

Returning to Question 1 in our experiments ("Could this town be in Britain?"), we can examine the sounds in the prompts to see whether words containing sounds which have no equivalent in Edinburgh English are more or less likely to be perceived as non-English.

Tables 14 and 15 form the basis for Table 16, which shows prompts containing sounds for which Edinburgh English has no equivalent with the same feature description (listed as 'non-native phones') and those for which not all subjects would use such a sound (for example, [ɑ]; these are listed as 'possibly non-native phones').[41] This gives us one measure of the 'foreignness' of the prompts.

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[41]Some of the sounds listed as 'non-native' in Table 16 are occasionally used by Edinburgh speakers; some speakers, for example, have a retracted [s̠], but there was no evidence of this amongst the subjects. [ç] may be used as an assimilated fricative in, for example, *human*, but assimilations and fast-speech forms have not been treated as standard realisations of Edinburgh speech.

It should be noted that for affricates word-position has been taken into account, since subjects may have analysed a word-medial sequence such as [t͡s] as two separate sounds, which would be a possible sequence in a number of languages including English. The same affricate word-initially would not have corresponding phoneme sequences in as many languages. [t͡s] is therefore considered non-native in *Tsamandas* [t͡sa.manˈdas̠], but native in *Rötz* [ʁœt͡s] and *Firenze* [fiˈrɛn.t͡se].[42] As for unaspirated stops, Scottish English voiceless consonants are not always strongly aspirated even when they are word-initial or intervocalic; for some subjects, therefore, unaspirated stops may be foreign sounds when they do not follow /s/, but for other subjects this may be the normal realisation.

Country	Town	Non-native phones			Total	Possibly non-native phones				Total	Total score for Q1 (listening)
Britain	*Bredgar*					a	ɹ (2)			3	49
Britain	*Guist*										16.5
Britain	*Keld*										49.5
Britain	*Lechlade*										51.5
Britain	*Pelynt*										45
Britain	*Rede*					ɹ				1	53
Britain	*Slattocks*					a				1	40
Britain	*Sollom*										46.5
Britain	*Sturry*					ɹ				1	53
Britain	*Watton*										53
France	*Aire*	ʀ			1						20
France	*Cornus*	ʀ	y		2	k				1	8.5
France	*Laragne*	l	ʀ	ɲ	3	a (2)				2	2.5
France	*Manosque*					a				1	3.5
France	*Maule*	l			1						38
France	*Meyssac*					a				1	8
France	*Savigne*	ɲ			1	a				1	2
France	*Tallard*	l	ʀ		2	t	a	aː		3	2
France	*Toucy*	u			1	t				1	2.5
France	*Valençay*	l	ɑ̃		2	a				1	3
Germany	*Dreve*					ʁ				1	3.5

Table 16: Spoken prompts containing non-native sounds (based on similarity groupings) and scores by subjects - high score = could be in Britain, low score = couldn't be in Britain

[42] There is some difficulty over classifying affricates as single segments or sequences in a study of this kind, since they may be one thing in their original language but treated as another by the subjects. For this reason, although they are classified here as single segments, they sometimes require a slightly different treatment from segments containing single phones; they are also, where appropriate, discussed under sequential features.

Country	Town	Non-native phones			Total	Possibly non-native phones				Total	Total score for Q1 (listening)
Germany	*Glinde*	l			1						16.5
Germany	*Nahe*					a̠ː				1	9
Germany	*Pfinztal*	p͡f	l		2	a̠ː				1	2
Germany	*Rötz*	œ			1	ʁ				1	13.5
Germany	*Schapen*					a̠ː				1	36.5
Germany	*Schwenke*										0
Germany	*Stellau*	l	a̠͡ʊ		2						2
Germany	*Velen*	l			1						20
Germany	*Wolnzach*	l			1	a̠				1	1
Greece	*Elatia*	l	t̪		2	a (2)				2	2.5
Greece	*Karousadhes*	u	s̠ (2)		3	k	a (2)	ɾ		4	2
Greece	*Katerini*	t̪			1	k	a	ɾ		3	2
Greece	*Larisa*	l	s̠		2	a (2)				2	4
Greece	*Megara*	ɣ			1	a (2)	ɾ			3	1
Greece	*Psakhna*	p͡s			1	a (2)				2	6.5
Greece	*Ekhinos*	ç	s̠		2						0
Greece	*Stira*	s̠	t̪		2	ɾ	a			2	9
Greece	*Tsamandas*	t͡s	s̠		2	a (3)				3	3
Greece	*Volos*	l	s̠		2						5.5
Italy	*Acri*					a	ɾ			2	15.5
Italy	*Bobbio*					bː				1	3
Italy	*Copparo*					k	pː	a	ɾ	4	2
Italy	*Fermo*					ɾ				1	9
Italy	*Firenze*					ɾ				1	2
Italy	*Greve*					ɾ				1	21.5
Italy	*Livorno*	l			1	ɾ				1	0
Italy	*Loano*	l			1	a				1	2.5
Italy	*Novoli*	l			1						5
Italy	*Osimo*										5.5
Norway	*Ålesund*	l			1						20
Norway	*Bolkesjö*	ø	l		2	k				1	18.5
Norway	*Dokka*					kː	a			2	18
Norway	*Evje*										6
Norway	*Hellesylt*	lː	y	l	3						2
Norway	*Jaren*	ɳ			1	ɑˑ				1	41.5
Norway	*Kvernes*	ɳ			1	k	æˑ			2	5.5
Norway	*Lyngen*	l	y		2						15.5
Norway	*Snåsa*					ɑ				1	3.5
Norway	*Sparbu*					ɑː	ɾ			2	2

Table 16 (continued)

Figure 11 shows the relationship between the non-native phones or possibly non-native phones in Table 16 and the responses given by subjects to the question "Could this town be in Britain" in the listening-speaking and listening-writing experiments. If there were a strong relationship we would expect a high correlation between the two scores. There is in fact a correlation in the rank orders at the 0.01 level, but the significance of the correlation is due mainly to the large amount of data and is in fact a fairly weak relationship.

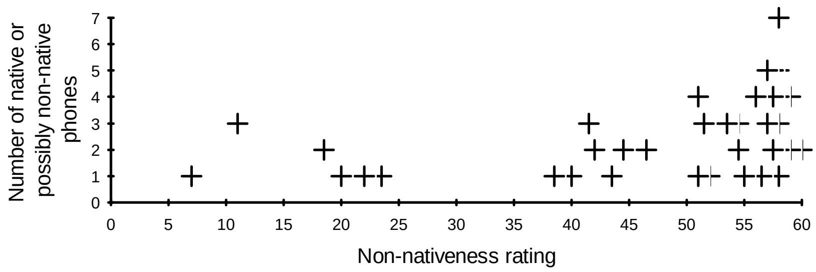

Figure 11: Correlation between number of non-native phones in spoken prompts and non-nativeness rating by subjects

British towns are clustered together - they constitute 9 of the 10 'most native' towns (the other is *Jaren*, in Norway, while the missing British town is *Guist*), and there could be many other factors present in the actual British towns leading to high nativeness ratings.

Foreign towns with no non-native phones (excluding 'possibly non-native phones') were not rated as more native than foreign towns including non-native phones, suggesting that simple presence or absence of non-native phones is not as important as the number of such phones. Even if we look only at non-British towns, the difference between the ratings given to towns containing one or more strictly non-native phones and those not containing any is not significant at the 0.05 level. (If we exclude British towns from the rank-order calculation represented by Figure 11, which includes both strictly non-native and variably non-native phones, the correlation between the orderings is significant at the 0.05 level but no longer at the 0.01 level.)

It is possible, and indeed likely, that the presence of such phones has an effect, but other factors such as stress or phonotactics also play a substantial role. This is likely to be particularly true in the case of genuine British names, whose presence increased the correlations. It is also possible that although the results suggest that the number of non-native segments is important than simple presence or absence, just one particularly salient foreign phone, such as [ʀ], may be enough to trigger a particular response (either the judgement that it is not British, or the more specific judgement that it is French), while multiple foreign phones which are more similar to native ones, such as [s̱], may not have a strong effect. This would mean we need not just a tripartite division into native, variably non-native and non-native phones, but a similarity measure. However, the data here does not directly access perception and so within the context of these experiments similarity is a difficult measure to analyse.

It could be proposed that similarity depends on the number of shared features; however, there are few segments in the data which differ from native segments by more than one feature (the voiced uvular trill, [ʀ], is one such) and so we would need to say which types of feature are most important (place, manner and so on). Given that there are other possible measures, such as acoustic similarity, this does not seem a profitable line to pursue without data which directly tests perception of the nativeness of segments, rather than the nativeness of whole words, as here.

c) Phonemic inventories

It would be difficult for subjects to base their decisions as to the origin of names on a comparison with the overall phonemic inventories or patterning of different languages, as opposed to the presence of particular sounds, since each name contains only a few phonemes. The one obvious pattern which might influence subjects in their decisions as to language of origin is the restricted vowel sets of Greek and Italian; these are very similar to each other, and Greek and Italian showed a high degree of confusability in the responses. There are, however, other similarities between Greek and Italian, such as phonotactic structure (see below) so it is difficult to determine the primary influence on decision-making.

d) Word structure

Phonotactic structure may have influenced the subjects in their judgements as to the origin of the names. For example, Greek and Italian, which were confused by the subjects, both have predominantly vowel-only rimes, with only a restricted set of consonants allowed syllable-finally and with word-ends are even more restricted.

In Table 17 we can see that the names from the different languages differ in syllable type and word length. For syllable type, in French, German, Greek, Italian and Norwegian towns CV syllables (divided by maximal onset) predominate, while for British towns the most common category is CVC. However, while this grouping of sounds into consonants and vowels reveals some generalisations, it misses more detailed aspects of the structure of the different languages which the subjects may be aware of and may have used to reach their decisions. For example, all the Italian names ended in a vowel, while the Greek names ended in a vowel or [s̱]. Additionally, there are of course individual sequences which may influence subjects' judgements; if a name contains the sequence [ʃw], this alone may be enough for the subject to conclude that the name is probably German.

Feature	British towns	French towns	German towns	Greek towns	Italian towns	Norwegian towns
Phonotactics (syllable type)[43]						
V			1	3	3	1
CV	4	10	7	20	17	11
CCV	1		2	2	3	2
VC		1				3
CVC	7	7	5	5	3	4
CCVC	1		2			1
CVCC	4	1	2			1
Consonant/vowel ratio						
	2.06	1.47	1.94	1.13	1.12	1.39
Word length						
1 syll	3	2	1			
2 syll	7	7	9	3	3	7
3 syll		1		4	7	3
4 syll				3		
Average number of syllables	1.7	1.9	1.9	3.0	2.7	2.3
2 phonemes		1				
3 phonemes	1	1	2			
4 phonemes	2	1			1	3
5 phonemes	3	4	4	3	5	2
6 phonemes	2	3	2	4	2	3
7 phonemes	2		2		2	1
8 phonemes				2		1
9 phonemes				1		
Average number of phonemes	5.2	4.7	5.2	6.4	5.5	5.5

Table 17: Syllable type and word length of spoken prompts

The total figures here are rather low, but we can compare them to statistics for the languages taken from wider samples. Carlson et al. (1985) looked at the features of words in five languages, including French, Italian, English and German. Carlson et al. found that the ratio of consonant to vowels was lowest for French and Italian, and highest for German words, a pattern similar to that here but not identical - in the current data English has the highest consonant-to-vowel ratio.

Of course, the town names are not a random selection, and 10 names per

[43]Maximal onset is used here for division of words into syllables. For this table, long vowels, long consonants, diphthongs and affricates are all counted as one unit.

country is a very small amount of data; this means that the data in the current study is not very reliable for an analysis of this kind. It is also probable that some of the difference between this and Carlson et al. can be accounted for in the type of words analysed, as Carlson et al. looked at a much wider spectrum of word types. They performed some morphological analysis on English, but not on German, and it is likely that a large number of German words in their data were compounds, leading to greater length than for other languages containing fewer compounds. There may also be differences in the method of phoneme counting between the Carlson et al. (1985) study and the present work. A comparison of the Carlson et al. study and the present data is presented in Table 18.

	Data set	English	French	German	Italian
Mean word length (in phonemes)	Carlson et al.	5.96[44]	5.2	7.78	6.94
	Town prompts	5.2	4.7	5.2	5.5
Consonant/vowel ratio	Carlson et al.	1.41[45]	1.35	1.71	1.12
	Town prompts	2.06	1.47	1.94	1.12

Table 18: Language structure from Carlson et al. (1985) compared to the current spoken prompts

e) Suprasegmental features

Tone and stress may have contributed to the subjects' judgements on language of origin. Norwegian is distinguished by being the only tone language, and although subjects are unlikely to be aware of the concept of tone languages, they may well know that Scandinavian languages are characterised by a certain kind of pitch movement. Some subjects in the listening-speaking experiment evidently perceived the tones as they attempted to repeat them, but it is certainly not the case that subjects attempting to reproduce the tones all identified the towns as Norwegian. Additionally, since Norwegian is the only tone language in the study, and since all the Norwegian names have tones, the tone cannot be isolated from other factors which might lead subjects to think the names are Norwegian. Furthermore, some subjects interpreted the pitch change of Norwegian towns as Welsh, starting to give the response "X is is Wales" before remembering that 'Wales' was not a permissible choice.

French is the only language in the set with no lexical stress, and other languages may typically have different stress patterns from English. However,

[44]Mean root length (with suffixes removed) was 5.65 for English but was not analysed for the other languages.
[45]This was 1.31 for English roots.

examining the stress patterns of the prompts for comparison with the subjects' judgements of origin is, unfortunately, not revealing, since syllable counts and preferably syllabic structure need to be taken into account when classifying stress patterns, and the names contain a wide variety of structural patterns.

5.1.2. Perception at the segmental level

This section will discuss segmental perception in the spoken prompts, as evidenced by both spoken and written responses.

◊ ***Summary: Segmental perception of spoken forms***

Despite the fact that perception of sounds was not directly tested, in certain instances we can say that spoken segments were perceived correctly, in others we can say that they were misheard (hearing error) and in others we can say that they were miscategorised (error of linguistic classification). All features were affected to some degree. These conclusions provide a useful basis for examining the routes taken from input to output in the listening-speaking and listening-writing experiments, which will be discussed in Chapters 6 and 7. For certain other instances, we can draw no strong conclusions as to the subjects' perceptions. Where a segment such as [ɲ] in the prompts was reproduced by a subject as [nj], we cannot say for certain whether this was a transformation at the perception or production stage.

A high number of spoken segments in the prompts had variable responses in the output, sometimes due to difficulty of perception or production, and sometimes due to legitimate variation in output, such as minor phonetic differences; some of these will be examined case-by-case to determine the cause of the variation.

Many of the miscategorisations are what we would expect from nativisation studies, for instance minimal feature changes in non-native segments to convert to native segments. Others require more complex analysis, particularly in the case of the listening-writing experiment, firstly because subjects may not have access to a legitimate spelling for non-native sounds, and secondly because many written responses are open to different interpretations.

a) Phones and phonemes

We need to make an initial distinction between miscategorisation, which is a linguistic error involving the erroneous categorisation of a sound in terms of the native system, and mishearing, which involves an initial error in hearing the elements of a sound and is not of direct relevance to this study. Some sounds are more liable to be misheard than others, due to their acoustic qualities (see, for example, Miller and Nicely 1955 for consonants). In this experiment there were only acoustic cues, as the prompts were on audio tape, so visual clues such as lip-rounding were missing. It is evident in the data that some prompts had sounds which were misheard more often than others, whether because of the quality of recording, the pronunciation, which may have tended towards another sound (for example the [ə] of *Slattocks* ([ˈslˠa.tʰɔks], Britain) was somewhat [ɪ]-coloured) or other factors. Tape-recordings give particular difficulties, as the acoustic attenuation of tape-recorders mimics the real-world attenuation of nasality, so sounds may be heard as more nasal than in direct speech.

In some cases it is not clear whether a sound was misheard or miscategorised, but it seems likely that, for instance, the [ɣ] of *Megara* [ˈmɛ.ɣa.ɾa] was generally misheard. In cases of miscategorisation into the native system, some of the features of the original sound are preserved: for instance, the French vowel [y] contains the incompatible features, for most English accents, of [+front] and [+rounded]. It is typically nativised by English speakers by changing one of these features or splitting the sound into two phones (cf. Chapter 3, p. 77). In the case of [ɣ] in *Megara*, we would expect to find a combination of the features [+fricative], [+velar] and [+voice] in a nativised response. A voiced velar plosive would give us [g] (orthographic <g>, <gg> etc.), a voiceless velar fricative would give us [x] (<ch> etc.), while a voiced palatoalveolar fricative would give us [ʒ] (<z> etc. - perhaps the least likely due to its distinct acoustic qualities).

In fact, for the listening-writing experiment we have other representations of [ɣ] in *Megara* (Table 19 overleaf). The only feature consistently recognised is voice, and nasality was frequently perceived where it should not have been present. Miller and Nicely (1955: 349) found that voicing and nasality were "much less affected by a random masking noise than are the other features.[46] Affrication and duration ... are somewhat superior to place but far inferior to voicing and nasality." Whether the same results should hold for the conditions in this experiment, with no intentional masking noise but possibly low volume of a particular sound, or tape noise, is not clear; voicing was

[46]It should be noted that nasality typically spreads across segments preceding a nasal sound, and may be more robust because of this.

correctly perceived for [ɣ], but nasality was perceived where it should not have been present. Whatever the reason for this, we can assume that the sound was misheard rather than re-categorised as a similar native sound.

Spelling	Occurrences	Distinctive Features		
n	13	[+voice]	[+alveolar]	[+nasal]
nn	1	[+voice]	[+alveolar]	[+nasal]
nh	1	[+voice] [-voice]	[+alveolar] [+glottal]	[+nasal], [+fricative]
rr	3	[+voice]	[+alveolar]	[+approximant]
r	2	[+voice]	[+alveolar]	[+approximant]
h	4	[-voice]	[+glottal]	[+fricative]
l	1	[+voice]	[+alveolar]	[+lateral approximant]
ll	1	[+voice]	[+alveolar]	[+lateral approximant]
m	1	[+voice]	[+bilabial]	[+nasal]

Table 19: Spelling of [ɣ] in Megara (listening-writing)

Another example of a name which was apparently unclear to many subjects is *Loano* ([loˈa.no], Italy), for which the initial [l] was spelt as:

Spelling	Occurrences
d	20
t	3
th	2
l	1
g	1

Table 20: Spelling of [l] in Loano (listening-writing)

As <l> is the only spelling here which can represent [l], the sound was obviously misheard, and as so many subjects misheard the sound we can assume the prompt was unclear.

Another issue which needs to be explored here is timing. Small changes in length, particularly for continuant consonants, can lead to categorical decision changes. We can see this for the confusable vowels/semi-vowels [u],[o]/[w] and [i]/[j], in the environment preceding other vowels. Words with these sequences are *Loano*, *Elatia, Evje* and *Bobbio*. In the listening-writing experiment, we have the results shown in Table 21. Responses which suggest a change of category from semi-vowel to vowel, or vice-versa, are shaded. Although the graphemic responses are only an indirect clue to the categorisation of the sounds, it can be assumed from the results that for each of the above names, with the exception of *Elatia*, there was some variation amongst subjects as to classification of the sounds as vowels or semi-vowels.

Sometimes graphemes were inserted where there was no corresponding sound. Some cases are ambiguous, such as initial <h>, which may be silent as in *hour*; others are clearly either mishearing or an error in writing, such as <Lareista>, with an extra <t>, for *Larisa* ([ˈla.ɾi.s̠a], Greece). Where there is a consensus amongst the subjects, such as *Glinde* ([ˈglɪn.də], Germany), with 15 subjects putting an epenthetic vowel after the <G>, for example <Galinda>, we should conclude that something in the prompt itself leads to this, whether it is the clarity of the recording or speech, or a more pertinent linguistic problem such as segment identity (the [l] in *Glinde* is clear, whereas Scottish /l/ is normally somewhat dark).

	Represen-tations of [o] in *Loano*		Represen-tations of [i] in *Elatia*		Represen-tations of [j] in *Evje*		Represen-tations of [j] in *Bobbio*	
Graphemic vowel	a	1	e	1	e	4	e	2
	o	5	ee	1	i	18	i	16
	oe	1	i	24			u	5
	u	2						
Graphemic vowel + consonant	aw	1						
	ew	3						
	ow	6						
	ów	1						
	uw	1						
Graphemic consonant	w	6			y	4	y	3
							yy	1
Other (non-response, or unclear)		0		1		1		0

Table 21: Written representations of vowels/semi-vowels in Loano, Elatia, Evje and Bobbio (listening-writing); shaded areas represent a categorical change from the prompt

An interesting problem arises from the use of post-vocalic <r>. Given that the subjects are Scots, with rhotic accents, that the prompts were spoken by a Scottish speaker, and that the foreign languages in the study mostly use graphemic <r> only when an /r/ sound of some description is present in the spoken form, we would not expect subjects to use the spelling <r> unless they actually hear an /r/.[47] We would not expect either mishearing or miscategorisation to lead to <r>-insertion. However, as we will see later in Tables 57 and 58 on p. 233, there are a number of instances in which subjects did in fact write <r> where there is no corresponding spoken /r/ in the prompt. There is a particularly high number of these in *Schapen* ([ˈʃa̠ː.pʰən], Germany), with 19 <ar>'s, 7 <a>'s and 1 <aa>. One interpretation is that subjects are using direct analogy with *sharpen*. Another is that the long [a̠ː] sound is

[47]French of course provides counter-examples, such as final <-er> in *-er* verbs, which represents [e].

uncharacteristic for English, and so the subjects compensate by using a liquid consonant to add length. *Snåsa* ([˹snɔˑ.sɑ], Norway) has 10 <r>'s associated with the final vowel. It may be that the subjects are influenced by RP sound-to-spelling correspondences; although this is not their native accent they will all be familiar with it, and may draw on it when presented with such a mixture of different languages, whether because in a formal environment such as an experiment they use their knowledge of standard pronunciation, or because they are treating RP as a 'foreign language', to be used as a resource in coping with foreign language problems. This is certainly an area for further research.

In trying to identify trends in the perception of sounds, we need to look at instances in the data where a number of subjects follow the same pattern. In particular, if we look at examples where subjects in both the listening-writing and listening-speaking experiments seem to have similar problems, this strengthens the probability that we are looking at perception problems rather than production problems. Appendix B shows the two most common responses, both spoken and written, for each segment in the spoken prompts, listed by town name; Appendix C summarises all the data, grouped by prompt phoneme. As the counts are made individually for each segment, the listing of the data does not reveal anything about the combinations of segments used. However, it enables us to look at common responses for the same segment in different words, and to compare written and spoken responses; use of Appendix B gives us some information about positioning in the word, for instance whether an unaspirated consonant appears before a vowel or another consonant.

Tables 22 and 23 show segments for which either the first or second most common response, if it is given by 4 or more subjects in either the spoken and written sets, is inappropriate or omitted. For the spoken responses 'inappropriate' refers to unnecessary changes of one or more features based on Tables 14 and 15. It is assumed that if a segment in the prompt does not exist in Edinburgh English (with 'exist' covering both native and variably native sounds in Tables 14 and 15), minimal feature changes are necessary. Feature changes which would still be classified as the same phoneme in Edinburgh English, resulting in such alternations as [a] - [ɑ], or [t] - [tʰ], or the various realisations of /r/, have not been included. Likewise, schwa is allowed as a realisation of any unstressed vowel. (For this analysis, since we will be looking at the distinction between mishearing and miscategorisation, it is necessary to use the concept of 'phoneme' in order to define appropriate responses, since within-phoneme changes are not evidence of mishearing.) For phones which do not exist in Edinburgh English, we can look at minimal feature variation which would result in a native segment or segments. For example, [ɲ], the voiced palatal nasal, does not occur in Edinburgh English; minimal variation (change of one feature) could result in a change in voicing (but Edinburgh has no voiceless palatal nasals), in place (to an alveolar or velar nasal), or in nasality (but Edinburgh has no voiced palatal stops). The appropriate response, therefore, would be a feature change in the place of articulation, preferably to the nearest place used in Edinburgh speech. So, we will say that a change in one feature would result in an acceptable response (without a change of phoneme if the original phone exists in Edinburgh English[48]), but that changing two features results in an inappropriate response. (The criterion of only one feature change is somewhat arbitrary, however, particularly since there is more than one way of counting the number of features, for example vowel heights may be treated as scalar or a combination of binary features.)

Other appropriate possibilities for [ɲ] would include splitting into two segments, for instance [nj] - this retains all the features of the original segment, but spreads them across two native segments. As we are treating affricates as single segments, affricates must be treated as non-native unless they appear as affricates in Edinburgh English. In the case of word-medial affricates, however, due to the possibility of analysis by subjects as two separate segments, they are treated as possible in Edinburgh English if both segments exist in this accent. As previously, (p. 123), length is treated as a suprasegmental and so should not be a relevant feature in a segmental analysis. As we shall see below, however, responses for long consonants show that subjects were in fact trying to resolve the length in other ways. Cases involving changes from semi-vowels to vowels, or vice-versa, have not been included.

So, in summary, the following spoken responses are 'appropriate':

a) for a phone which is a possible realisation of an Edinburgh phoneme, that phoneme is the appropriate response (but see footnote 48). All variants of /r/ were permitted as responses for all /r/ input phones;

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[48]There is a slight problem with this definition. In English, unaspirated stops such as [t] are generally allophones belonging to voiceless stop phonemes, in this case /tʰ/; for some Scottish speakers the normal realisation may even be unaspirated. However, for subjects who normally aspirate their stops, an unaspirated stop which precedes a vowel and does not follow a consonant, such as [t] in Tallard ([ta.laːʀ]) may be treated as a voiced stop ([d]); we wish to say this an acceptable response, although it involves a change of phoneme from the voiceless stop to its voiced counterpart. If we look at the reverse case, however, we would wish to say that changing a voiced stop to an unaspirated voiceless stop (such as [d] →[t], as happened in *Dreve*), is inappropriate as it involves a change which should be unnecessary.

b) for a phone which does not exist in Edinburgh speech, one feature change is permitted to result in a native sound, or the features may be spread across two segments;

c) word-position is not taken into account, except for affricates adjoining word-boundaries.

Prompt segments existing in Edinburgh English					
Segment and prompt		**Common inappropriate spoken responses, and feature/other changes**		**Common inappropriate written responses, and feature/other changes**	
pː	*Copparo*			mp	insertion
tʰ	*Hellesylt*	^	omission		
k	*Kvernes*	^	omission	co	insertion
kː	*Dokka*			nc	insertion
b	*Bobbio*			p	[+voice] → [-voice]
bː	*Bobbio*			p	[+voice] → [-voice]
d	*Dreve*	t	[+voice] → [-voice]	t	[+voice] → [-voice]
d	*Glinde*			t	[+voice] → [-voice]
g	*Glinde*	gə	insertion	ge	insertion
g	*Guist*	d	[+velar] → [+alveolar]	k	[+voice] → [-voice]
ɾ	*Firenze*			l	[+tap] → [+lateral approximant]
ɾ	*Larisa*			^	omission
ɾ	*Karousadhes*			n	[+tap] → [+plosive]
ɾ	*Katerini*	lˠ, l	[+tap] → [+lateral approximant], i) [+alveolar] → [+velarised alveolar]	l	[+tap] → [+lateral approximant], *[+alveolar] → [+velarised alveolar]*
ɾ	*Livorno*	^	omission		
f	*Firenze*			v	[-voice] → [+voice]
v	*Schwenke*	w	[+fricative] → [+approximant], [+labiodental] → [+labial-velar]	l	[+fricative] → [+lateral approximant], [+labiodental] → [+alveolar]
v	*Valençay*	f	[+voice] → [-voice]	f	[+voice] → [-voice]
v	*Evje*	b	[+fricative] → [+plosive], [+labiodental] → [+labial]	b	[+fricative] → [+plosive], [+labiodental] → [+labial]
v	*Greve*			n	[+fricative] → [+nasal], [+labiodental] → [+alveolar]
v	*Kvernes*	w	[+fricative] → [+approximant], [+labiodental] → [+labial-velar]		
v	*Livorno*	b	[+fricative] → [+plosive], [+labiodental] → [+labial]		

Table 22: Potentially misheard segments present in Edinburgh English (from Appendix B, listening-speaking and listening-writing); features which may or may not be present are shown in italics; roman numerals refer to different responses within one experiment

Prompt segments existing in Edinburgh English					
Segment and prompt		**Common inappropriate spoken responses, and feature/other changes**		**Common inappropriate written responses, and feature/other changes**	
v	*Savigne*			b	[+fricative] → [+plosive], [+labiodental] → [+labial]
ð	*Karousadhes*	lˠ	[+fricative] → [+lateral approximant], [+dental] → [+alveolar]	l, v	i. [+fricative] → [+lateral approximant], [+dental] → [+alveolar] ii. [+dental] → [+labiodental]
s	*Kvernes*			sk	insertion
s	*Hellesylt*			z	[-voice] → [+voice]
z	*Osimo*			ss	[+voice] → [-voice]
ʃ	*Stellau*	s	[+palato-alveolar] → [+alveolar]		
x	*Wolnzach*	^	omission	^	omission
n	*Firenze*			^	omission
n	*Pfinztal*			^	omission
n	*Wolnzach*	^	omission	^	omission
ŋ	*Lyngen*			n	[+velar] → [+alveolar]
j	*Bobbio*			u	[-vocalic] → [+vocalic], [+palatal] → [+back +rounded +close] or [+palatal] → [+labial-velar]
t͡s	*Firenze*	s	omission	c, s	omission
t͡s	*Pfinztal*	s	omission	s	omission
t͡s	*Wolnzach*	s	omission	s	omission
i	*Larisa*			e	[+close] → [+close-mid]
i	*Firenze*			e	[+close] → [+close-mid]
e	*Evje*	he	insertion		
e	*Firenze*			y, i	[+front-central] → [+front], [+close-mid] → [+close]/[+close-close-mid]
e	*Fermo*	ɛ	[+close-mid] → [+open-mid]	e	[+close-mid] → [+open-mid]
e	*Hellesylt*	ɛ	[+close-mid] → [+open-mid]		
e	*Greve*			y	[+front-central] → [+front], [+close-mid] → [+close]/[+close-close-mid]
eˑ	*Kvernes*	ʉ, ɪ	[-round] → [+round], i. [+open-mid] → [+close] ii. [+open-mid] → [+close-close-mid]	i	[+open-mid] → [+close]/[+close-close-mid]
ɛ	*Meyssac*	e	[+open-mid] → [+close-mid]	i	[+open-mid] → [+close]/[+close-close-mid]
ɛ	*Megara*	e	[+open-mid] → [+close-mid]		

Table 22 (continued)

Prompt segments existing in Edinburgh English					
Segment and prompt		**Common inappropriate spoken responses, and feature/other changes**		**Common inappropriate written responses, and feature/other changes**	
ɛ	*Karousadhes*	ʉ		i	[+open-mid] → [+close]/[+close-close-mid]
ɛ	*Greve*	e	[+open-mid] → [+close-mid]		
ɛ	*Schwenke*			a	[+open-mid] → [+open], [+front] → [+central]
ɛ	*Katerini*	a	[+open-mid] → [+open], [+front] → [+central]	a	[+open-mid] → [+open], [+front] → [+central]
a	*Megara*	ɛ	[+open] → [+open-mid], [+central] → [+front]	e	[+open] → [+open-mid]/[+close-mid], [+central] → [+front]
a	*Stira*			e	[+open] → [+open-mid]/[+close-mid], [+central] → [+front]
a	*Larisa*			i	[+open] → [+close]/[+close-mid], [+central] → [+front]/[+front-central] or insertion (conversion to diphthong)
a	*Valençay*	ɛ	[+open] → [+open-mid], [+central] → [+front]	e	[+open] → [+open-mid]/[+close-mid], [+central] → [+front]
a̠ː	*Schapen*			ar	insertion
ɔ	*Volos*	o	[+open-mid] → [+close-mid]		
ɔˑ	*Snåsa*	o	[+open-mid] → [+close-mid]		
ɔˑ	*Ålesund*	hɔ	insertion	ho	insertion
o	*Copparo*	ɔ	[+close-mid] → [+open-mid]		
o	*Maule*	ɔ	[+close-mid] → [+open-mid]	u	[+close-mid] → [+close]
ə	*Dreve*			a	[+open] → [+mid]
ə	*Nahe*	^	omission	l	[+vocalic] → [-vocalic], [+central +mid] → [+alveolar +lateral approximant]
ə	*Jaren*	^	omission	^	omission
ə	*Hellesylt*			^	omission
ə	*Bolkesjö*			^	omission
ə	*Evje*			er	insertion
ə	*Ålesund*			^	omission
ʉ	*Ålesund*	^	omission	e, o	i, ii. [+close] → [+close-mid]/[+open-mid], ii. [+round] → [-round]

Table 22 (continued)

Prompt segments not existing in Edinburgh English					
Segment and prompt		**Common inappropriate spoken responses, and feature/other changes**		**Common inappropriate written responses, and feature/other changes**	
t̪	*Katerini*	p^h	[+dental] → [+labial], [-voice] → [-voice +aspiration]	p	[+dental] →[+labial], *[-voice] → [-voice +aspiration]*
ɣ	*Megara*	h	[+velar] → [+glottal], [+voice] → [-voice]	n h	i. [+velar] → [+alveolar], [+fricative] → [+nasal] ii. [+velar] → [+glottal], [+voice] → [-voice]
ʁ	*Rötz*			l	[+fricative] → [+lateral approximant], [+uvular] → [+alveolar]
l	*Hellesylt*	^	omission	^	omission
l	*Wolnzach*	^	omission	^	omission
l	*Loano*	n	[+lateral approximant] → [+nasal][49]	d	[+lateral approximant] → [+plosive]
p͡f	*Pfinztal*	f, v	omission ii. [-voice] → [+voice]	f, v	omission ii. [-voice] → [+voice]
p͡s	*Psakhna*	s	omission	s	omission
t͡s	*Tsamandas*	s	omission	s	omission
u	*Karousadhes*			a	[+close] → [+open], [+rounded] → [-rounded], [+back] → [+central]
y	*Lyngen*	e	[+close] → [+close-mid]/[+open-mid], [+rounded] → [-rounded]	e, a	[+rounded] → [-rounded], i. [+close] → [+close-mid]/[+open-mid] ii. [+close] → [+open], [+front] → [+central]
ø	*Bolkesjö*			ire	(vowel change unclear) insertion
œ	*Rötz*	ʉ	[+front] → [+back], [+open-mid] → [+close]	u	[+front] → [+back], [+open-mid] → [+close]
a̠͡ʊ	*Stellau*			a	omission

Table 23: Potentially misheard segments not present in Edinburgh English (from Appendix B, listening-speaking and listening-writing); features which may or may not be present are shown in italics; roman numerals refer to different responses within one experiment

For the written responses, 'inappropriate' means that the grapheme or graphemes are not existing or probable representations of the spoken form, whether of the original phone or a phone with minimal changes to the original, as outlined above - this might result in <ny> or <ng> for [ɲ]. It should be noted that what we might think are equivalent written and spoken responses, such as [w] and <w>, are not always so; the latter is an appropriate response to [v] in

[49]Both the spoken and written responses only involve changes to one feature, and as such should not be included here by the criteria listed; however, it was decided to include them as the obvious change would be to a velarised /l/. This perhaps suggests that "lateral approximant" and "nasal stop" should be two features each, creating more distance between, say [l] and [d] in number of features than between [l] and [lˠ]. Formalising the distance between segments is, however, a difficult task, whether in terms of features or using other parameters.

Schwenke, as written <w> may represent spoken [v], while spoken [w] is not appropriate as this involves an unnecessary change of a native phoneme (we are not taking word-position and phonotactics into account here, or the analysis might well be different in this instance).

Using the above guidelines, 'inappropriate' responses, taken from Appendix B, are listed in Tables 22 and 23, in the expectation that they will reveal cases where the answers show that the subjects in both listening-speaking and listening-writing experiments had difficulty in hearing the prompt accurately, rather than problems in categorising sounds.

One thing we can see from these tables is that the same segment does not always feature in both the inappropriate spoken response column and the inappropriate written response column. In some cases this may be due to chance, i.e. there may not have been quite enough examples to fulfil the criteria. For schwa, there were far more omissions in the written answers, for example in [ˇhe.lːə.sylt^h] → <Hell_syt>, than in the spoken answers. One possibility is mishearing on the part of the transcriber, due to expectations based on the form of the prompts. Schwa is an easily deleted segment in spoken language, so phonological processes are unlikely to be the explanation for schwa retention in spoken responses and deletion in written responses. Schwa causes another problem of analysis, in that it may be represented by any written vowel. This means that we cannot always be certain of vowel perception in the listening-writing experiment - for example, an [o] vowel written as <a> may have been perceived as [a], but it may also have been perceived as [ə] and assigned, perhaps randomly, the spelling <a>.

For long consonants, we can see that some subjects in the listening-writing experiment did perceive the extra length as they wrote extra (nasal) segments (see also Tables 56 and 64 in Chapters 6 and 7). Omission was very common, particularly in clusters and affricates, but also of vowels, resulting in omission of syllables. Change of place in vowels to an adjacent place was also very common.

The changes made to segments present in Edinburgh accents can be summarised as in Table 24. For segments not present in Edinburgh accents the summary is given in Table 25. It seems that voicing is, after all, frequently incorrectly heard, despite Miller and Nicely's findings (see p. 131). For more information about the above changes, we need to look also at the context in which they occur, for which see later in this chapter.

Segment type in prompt	Changes made in response (in order of frequency)
short oral stops	voicing, insertion of a vowel where the stop was part of a cluster, place
long oral stops	insertion of nasal segment, voicing
taps	manner (alveolar tap usually changed to lateral approximant), omission
fricatives	manner, voicing, omission, place/insertion
nasals	omission, place
approximants	change from consonant to dissimilar vowel (only one example)
affricates	omission
primary vowels	height, frontness, insertion (addition of a consonant), omission/roundedness
secondary vowels	height/roundedness (only one example)

Table 24: Changes made to spoken segments present in Edinburgh English

Segment type in prompt	Changes made in response (in order of frequency)
short oral stops	place/voicing (only one example)
fricatives	place, manner/voicing
lateral approximants	omission, manner
affricates	omission, voicing
primary vowels	height/frontness/roundedness (one example)
secondary vowels	height, frontness, roundedness
diphthongs	omission (one example)

Table 25: Changes made to spoken segments not present in Edinburgh English

For spoken segments which had widespread agreement in the responses, we can assume that perception, in terms of both hearing and linguistic categorisation, was not a problem. For segments with more variation in the responses, however, there may have been perceptual difficulties. Table 26 shows segments for which the most common response in either speaking or writing, or both, accounts for less than two-thirds of the total possible (i.e. less than 18/27 for listening-writing, and less than 18/26 for listening-speaking). (Out of 325 prompt segments, 173, or 56%, fall into this category. 126 had variant answers in listening-speaking, and 112 in listening-writing; 65 of these had variants in both experiments.) The table should therefore help to reveal which segments had 2 or more common answers; we can also see whether this is true for both reading and writing (probably a perceptual issue) or for one response medium alone (probably a production, or conversion, issue). As the table shows, some native sounds which should not have caused problems, such as [v], had varying output. These will only be mentioned briefly here as our focus in these paragraphs is on the recategorisation of non-native sounds.

Seg-ment	Prompt	Two most common spoken responses	Two most common written responses
pː	*Copparo*	pʰ p	p mp
t̪	*Elatia*	tʰ t̪	
t̪	*Katerini*		t p
t̪	*Stira*	t t̠	
tʰ	*Pfinztal*	tʰ t	
tʰ	*Watton*		t tt
t	*Tallard*	d t, tʰ	d t
t	*Toucy*	tʰ d	
kʰ	*Meyssac*	kʰ ʔ	c ck, k
k	*Acri*		k c, ch
k	*Bolkesjö*		k ch, c
k	*Kvernes*	^, g	co good, go, ge, g
k	*Manosque*		k que
k	*Slattocks*		c x
kː	*Dokka*	kʰ ɳ	nc c
b	*Bobbio*		b p
bː	*Bobbio*	b bː	b p
d	*Dreve*	d t	d t
d	*Lechlade*		d, de
g	*Glinde*		g ge
ɾ	*Acri*	ɾ, ɹ	
ɾ	*Copparo*	ɾ ɹ	
ɾ	*Fermo*	ɹ ɹ̆, -, ɾ	
ɾ	*Firenze*	ɾ ɹ	
ɾ	*Greve*	ɾ ɹ	
ɾ	*Karousadhes*	ɾ ɹ	
ɾ	*Katerini*	lˠ l	l r
ɾ	*Larisa*	ɾ ɹ	r ^
ɾ	*Livorno*	ɹ ^	
ɾ	*Megara*	ɾ ʁ, ɹ	
ɾ	*Sparbu*	ɹ ɾ, ^	
ɾ	*Stira*	ɾ ɹ	
f	*Velen*		f v
v	*Evje*	b v	b v
v	*Greve*		v n
v	*Kvernes*	v w	b v
v	*Livorno*	v b	
v	*Savigne*		v b
v	*Schwenke*	v w	l, w
v	*Valençay*	f v	f v
ð	*Karousadhes*	ð, lˠ	l v
s	*Cornus*		se s
s	*Kvernes*		s sk
s	*Meyssac*		s ss
s	*Valençay*		s c
z	*Osimo*		s ss
s̠	*Larisa*		s ss
s̠	*Volos*		s se
ʃ	*Schwenke*		sch s
ʃ	*Stellau*	ʃ s	s sch
ç	*Ekhinos*	x h	ch h
x	*Psakhna*	x k	ch c
x	*Wolnzach*	x,^	ch ^
ɣ	*Megara*	h ɾ	n h
ʁ	*Dreve*	ʁ ɹ	
ʁ	*Rätz*	ʁ ɹ	
m	*Sollom*		m mn
n	*Pfinztal*		n ^
n	*Wolnzach*	^ n	^ n
ɳ	*Kvernes*	ɹn n	n, rn
ɲ	*Laragne*	n ŋ	gne n, nge
ɲ	*Savigne*	n ɲ	ne n
j	*Bobbio*	i j	i u
j	*Evje*	i j	
ɹ	*Sturry*	ɾ ɹ	
l	*Ålesund*	lˠ l	
l	*Elatia*	lˠ l	
l	*Glinde*	ɫ lˠ	
l	*Hellesylt*	^ lˠ, ɫ, l	
l	*Laragne*	lˠ l	
l	*Larisa*	lˠ l	
l	*Loano*	l, n	
l	*Lyngen*	lˠ ɫ	
l	*Maule*	l ɫ	le ll
l	*Novoli*	lˠ l	
l	*Pfinztal*	lˠ l	
l	*Stellau*	lˠ l	
l	*Tallard*	lˠ l	l ll
l	*Volos*	lˠ l	
l	*Wolnzach*	ɫ ^	l ^
lˠ	*Keld*	lˠ ɫ	
lˠ	*Lechlade*	lˠ ɫ	
lˠ	*Lechlade*	lˠ ɫ	
lˠ	*Sollom*	lˠ ɫ	
lː	*Hellesylt*	lˠ l	l ll

Table 26: Variable answers to segments in spoken prompts (from Appendix B (listening-speaking and listening-writing); ^ represents an omitted segment in the response, - is attached to a 'missing' segment included in an adjacent segment. More than two responses indicates equal frequencies

Seg-ment	Prompt	Two most common spoken responses	Two most common written responses
ʀ	*Aire*	ɹ ʀ	r re
ʀ	*Cornus*	ɹ ɹ̆	
ʀ	*Laragne*	ɹ ɾ	
ʀ	*Tallard*	ɹ ʀ	r re
p͡f	*Pfinztal*	f v	f v
t͡s	*Firenze*	t͡s s	ts tz, c, s
t͡s	*Pfinztal*	s t͡s	s, tz
t͡s	*Rätz*		tz ts
t͡s	*Wolnzach*	s t͡s	s ts
t͡ʃ	*Lechlade*		tch ch
i	*Acri*		i ee
i	*Ekhinos*		i e
i	*Firenze*	ɪ i	e, i
i	*Katerini*		i e
i	*Larisa*		i e
i	*Livorno*	i ɪ	e i
i	*Novoli*		i ie
i	*Osimo*	i ɪ	
i	*Rede*		ei ee
i	*Stira*		ee e
i	*Toucy*		ee i
e	*Evje*	e he	e a
e	*Fermo*	ɛ e	e ai
e	*Firenze*		e, y, i
e	*Greve*		y ia, e, i, ai
e	*Hellesylt*	ɛ e	
e	*Lechlade*		a ai
eˑ	*Kvernes*	ʉ ɛ, ɪ	e i
eː	*Dreve*	e eː	e a
eː	*Velen*		e a, ai
ɛ	*Elatia*	ɛ ɪ	
ɛ	*Greve*	ɛ e	
ɛ	*Karousadhes*	ɛ ʉ	e i
ɛ	*Katerini*		a e
ɛ	*Megara*	e ɛ	
ɛ	*Meyssac*	ɛ e	
ɛ	*Valençay*		e, é
ɛː	*Aire*	ɛː ɛ	e ai
æˑ	*Kvernes*	a, a̲	
a	*Bredgar*	a̲ ɑ	
a	*Dokka*	a ɳ	
a	*Elatia*	a ə	
a	*Karousadhes*	a a̲	
a	*Laragne*	ə a	
a	*Megara*	ɛ a	a ah
a	*Stira*	a ə	
a	*Tallard*	ə a	
a	*Tsamandas*	ə a	
aː	*Tallard*	a, a̲	
a̲ː	*Nahe*	a aː	a ah, i
a̲ː	*Pfinztal*	a aː	
a̲ː	*Schapen*	a aˑ	
ɑ	*Snåsa*	ɑ a	awa
ɑˑ	*Jaren*	a̲ ɑˑ	
ɑː	*Sparbu*	a, a̲	
ɔ	*Bolkesjö*		a o
ɔ	*Volos*	ɔ o	
ɔˑ	*Ålesund*	ɔ hɔ	o ho
ɔˑ	*Snåsa*	ɔ, o	
o	*Copparo*	o ɔ	
o	*Loano*		ow, w
o	*Maule*	o ɔ	o u
o	*Novoli*	ə o	o ou, u
u	*Karousadhes*	o ə	o a
u	*Toucy*		ou u
ə	*Ålesund*	ə ɪ	^ i
ə	*Bolkesjö*		^ i
ə	*Dreve*	ə œ	e a
ə	*Evje*	ə a	a er
ə	*Glinde*	ə ʌ̈	a e
ə	*Hellesylt*	ə ɪ	
ə	*Lyngen*		e a
ə	*Nahe*	^ ə, lʏ	e l
ə	*Pelynt*	ə ə̆	a o
ə	*Schwenke*		a e
ə	*Sollom*	ə ɔ	e o
ə	*Velen*		e i
ə	*Watton*		o e
y	*Cornus*	ʉ jʉ	eu oo
y	*Hellesylt*	ʉ y	u ui
y	*Lyngen*	ɪ e	e a
ø	*Bolkesjö*	ø ɜ	ire a, u
œ	*Rätz*	ʉ ɜ, œ	u eu
ʉ	*Ålesund*	ə ^	e o
ʉ	*Sparbu*	ʉ ə	u oo
a̲͡ʊ	*Stellau*	ʌ͡ʊ a͡ʊ	a ow, au, o
ʌ͡i	*Guist*		ei i, ie
ɑ̃	*Valençay*	ɑ̃ ɔ̃, ɔn	on an

Table 26 (continued)

We can now look at probable cases of miscategorisation, or variation in categorisation. A good example of the problem of categorising spoken foreign sounds is *Tallard* ([ta.laːʀ], France). The French /t/ is voiceless but unaspirated, and is therefore part-way between initial pre-vocalic English [tʰ] (voiceless aspirated) and [d] (voiced); in the spoken-written experiment 10 subjects wrote <t> for *Tallard*, while 17 wrote <d>. One difficulty with the listening-writing figures, however, is that we cannot say for certain that subjects miscategorised the sound; it may be that they perceived it and analysed it correctly, but lacked a grapheme to represent it and so had to choose between <t> and <d> at the writing stage. However, the spoken data supports the analysis - there are similar results for spoken responses to both *Tallard* and *Toucy* [tu.si]. (Although Scottish [tʰ] tends to be phonetically rather tenser than its RP counterpart, and is often not as aspirated, making it in some instances more like a French [t], this does not seem to have favoured classification of French [t] as a /t/ phoneme.) If a written form were also available to the subjects, as is often the case in language-learning situations, [t] in these environments would doubtless be nativised as [tʰ], but having only an aural source leads to problems of categorisation. (It should be noted, though, that some voiceless unaspirated segments which would be expected to fall into this category, such as [k] in *Cornus*, did not show the same kind of variation in the responses.)

Some segments showed similar variation in results with no apparent justification. For example, the initial [b] of *Bobbio* was represented as both <b> and <p> in the answers; it may be, however, that the [b] of the prompt was not as voiced as we might expect. Some of the variation in voicing which may be due to categorisation may also be due to the subject's own pronunciations - [pː] in *Copparo* was sometimes pronounced with aspiration and sometimes not; however, as we have already noted, Scottish voiceless stops are not always aspirated, so this may be due to variation amongst subjects' pronunciations. (It did not, though, occur for every such segment; the output for *Tallard* and *Toucy*, for instance, argues against this interpretation.)

Palatal nasals elicited varying responses, with a variety of places in evidence. Means of representing these are lacking in writing, unless the subjects are aware of the French spelling <-gne>, or perhaps the Spanish <ñ>, while for spoken output, as mentioned previously there are a number of likely nativisations for [ɲ], such as change of place or splitting into two segments; this could therefore be a production rather than a perception problem. As responses to palatal nasals varied considerably, it is worth looking at more than just the commonest (see Appendix C). Out of 54 responses, there were 14 using <gn> with or without an <e> or other additional graphemes; 13 contained the sequence <ng>, either because they failed to remember the French spelling or because they had heard a velar nasal. However, the single most common spelling was <ne>, suggesting either a spelling problem or hearing/categorisation as [n]. Of the 52 spoken responses, the most common was [n] (21 instances); there were 13 [nj], with or without a subsequent vowel, 7 palatal nasals, of which two had a following schwa, and 7 responses which included velar nasals.

Velarisation, or lack of it, on lateral approximants was largely ignored; subjects mostly pronounced these segments as somewhat velarised, and wrote them as <l> or sometimes <ll>. This was also true of minor variations in the place of consonants, such as dentalised or retracted alveolar consonants.

Sometimes there is one obvious native counterpart to a non-native sound, such as [ç] in *Ekhinos* ([ɛˈçi.nɔs̠], Greece), which was mostly spelt <ch>, the most common spelling for Scottish English [x] (Table 27). Figures for the spelling of [x] in the on-line dictionary of Scottish pronunciations are given in Table 28 for comparison. Most of these words are names, of either Scottish or German origin; it should be noted, though, that the dictionary does not contain certain words which are relatively common in Scotland, such as *dreich*.

Spelling	Occurrences
ch	12
h	9
kh	3
th	2
kih	1

Table 27: Spelling of [ç] in Ekhinos (listening-writing)

Spelling	Occurrences
ch	36 (45)
gh	4 (5)

Table 28: Spelling of [x] in Edinburgh English (as taken from the on-line dictionary).[50] *Non-bracketed figures indicate separate lexemes; bracketed figures indicate the overall total including plurals, etc.*

Despite the high use of <ch> it is not possible to tell whether the subjects perceive the sound as [x], or whether they perceive it correctly as [ç] and use the most appropriate spelling they can. (It is even possible that they perceived [ʃ],

[50]The use of [x] in these words was attested by an Edinburgh informant.

which can also be spelt as <ch>). It should be noted that there were no responses using <gh>, while there were a number of responses not attested as representing [x] in Scottish English. Table 27 has a large number of instances of <h>. All of these <h>'s were written intervocalically, and in a dictionary check which found 605 orthographically intervocalic <h>'s, 555 of these represented [h], while the other 50 were silent (for example 'Cohen').[51] Conversely, out of 551 intervocalic [h]'s in the phonemic string, all but 6 were spelt <h>; the remainder were <gh> (as in 'Callaghan'), <j> ('Navajo') or <x> ('Quixote'). This suggests that a number of subjects either heard or categorised the [ç] as [h], rather than the expected [x]. By the feature classification in Table 14, these responses both involve one change of feature, i.e. place, although [x] is nearer in place than [h]. It also should be noted that the feature classification of [h] as a voiceless glottal fricative is open to question; some analyses, for example Ladefoged (1985) treat it as an approximant, which would then be a two feature difference between [h] and [ç]. However, he also points out (p. 62) that [h] actually varies in place, and is the voiceless equivalent of the following sound, in this case [i], which would make it a palatal and so very similar to [ç]. On the other hand, 16 subjects in reading-speaking converted this sound to [x] while only 3 used [h].

	Occurrences	
Spelling	***Psakhna***	***Wolnzach***
ch	17	11
c	4	0
k	2	0
ck	2	0
x	1	0
r	1	5
que	0	1
gh	0	1
g	0	1
h	0	1
q	0	1
(blank)	0	6

Table 29: Spelling of [x] in Psakhna and Wolnzach (listening-writing)

[51]Compounds using hyphens, such as 'opera-house', were not included in this search as the vowel did not directly precede <h> in the orthographic string. For the phonemic search, such compounds were included as the vowel did directly precede [h] in the spoken form. The phonemic search was performed on a Scottish version of the lexicon so that [r] was pronounced before [h], so [h] in words like 'warhead' was not treated as intervocalic.

	Occurrences			
Spelling	***Ekhinos***	***Psakhna***	***Wolnzach***	**On-line Dictionary**
ch	44%	63%	41%	90%
gh			4%	10%
other	56%	37%	56%	

Table 30: Spelling of [ç] in Ekhinos and [x] in Psakhna and Wolnzach (listening-writing), compared to spelling of [x] in the on-line dictionary

For comparison, [x] in *Psakhna* ([psaxˈna], Greece), and *Wolnzach* ([ˈvɔln.t͡sa̠x], Germany) were spelt as shown in Table 29. The high use of <ch> is similar to that for *Ekhinos*, but <h> is only used once this time. Out of 54 responses, 29 use dictionary spellings appropriate for Scottish [x], suggesting that for the other 25 subjects either identification with Scottish [x] is tenuous, or the subjects are not adept at spelling this sound. Subjects in reading-speaking produced similarly variable results; 27/52 used [x], the second most common response was omission and the third was [k]. The written data are summarised for comparison with dictionary entries in Table 30.

Some of the examples of variation above appear to be variation in production, for example the spellings <ch>, and <tch> for [t͡ʃ] in *Lechlade*. It is noticeable that although, as previously noted, <r> has a number of different pronunciations in the various languages in the study, subjects seemed to group them together, generally spelling them as <r> or <rr>, and pronouncing them as an /r/-type sound [ɹ], [ɾ], [ʀ] and so on. This may be because they use various /r/'s themselves, particularly taps and approximants, it may be due to their knowledge of foreign languages, or it may be due to linguistic similarity of the segments, for instance structural usage.

There was some confusion, as mentioned above, between semi-vowels and vowels, such as [j] and [i]. The consonant [v] also had a high number of variable responses, usually with the place recognised but the manner, or sometimes the voicing, not categorised correctly. [s] had a large number too, but mostly in spelling, which is accounted for by doubling. However, the double <ss> for *Osimo* suggests that these subjects misheard the prompt, as this is not a usual spelling for [z].[52] Alternatively, it could have been suggested by analogy with *Aussie*, though there were only four <Au> spellings and these did not co-occur with <ss>. The <sch> spellings for *Schwenke* and *Stellau* presumably reflect knowledge of German spelling, and so tell us about the perceptions of the names

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[52]This correspondence occurs in 70 words in the on-line dictionary, mostly forms related to *possess* or *dissolve*. The most common spellings for [z] are <s> (7090) and <z> (3890).

as a whole rather than simply these segments (see also Chapter 7, p. 226).

Some of the variation included in Table 26 is actually structural rather than segmental, and appears under a segmental analysis due to the practice adopted of grouping inserted segments in the response with an adjacent segment, for example [k] in Kvernes is represented as having the written responses <co>, <good>, <go>, <ge>, and <g>, but these are presumably caused by the sequence [kv] rather than the [k] segment itself.

Variation in the vowels, both for native and non-native ones, was usually minor. Much of it consisted of reduction to schwa, or length variations (for spoken responses), or legitimate spelling variants for written responses. Changes often involved a shift to an adjacent segment in the vowel space. Although non-native vowels were nativised by some subjects (for example [œ] → [ɜ] or [ʉ] in *Rätz*), other subjects did manage to reproduce these; this tells us that not all subjects had difficulty in perceiving the vowels. Some subjects wrote this vowel as <u>, which we might take to be the written form of [ʉ]; however, as [œ] has no obvious spelling which reflects unambiguously its pronunciation, we cannot be certain how these subjects perceived the vowel.

5.1.3. Structural perception

This section will discuss structural issues in the perception of the spoken prompts.

◊ ***Summary: Structural perception of spoken forms***

In the spoken prompts, two separate elements were perceived in non-native sequences better than in non-native affricates, although there was not a wide enough variety of examples to be sure that this was not coincidence. Longer clusters in general had a greater number of errors than shorter clusters, more than would be expected from simply having extra segments. Since this occurred in both the listening-speaking and listening-writing experiments, it is likely to be due to perceptual difficulties, though it could also be caused by simplification at the output stage.

Syllable structure and number of syllables appear to have been accurately perceived in most cases, since the output of the listening-speaking experiment generally retains the same syllable structure and syllable count as the input.

a) Phonotactics

Non-native cluster	Example	Spoken responses		Written responses	
kv	*Kvernes*	v	5	cob	3
		gw	4	geb	3
		kv	4	goodb	3
		gv	2	cop	2
		ʍ	1	gv	2
		gəb	1	gab	2
		gəv	1	gob	2
		gəw	1	qu	2
		gɪb	1	cab	1
		kʰəb	1	gw	1
		kʰɑɹb	1	gh	1
		kʰɪb	1	gohp	1
		ɣʍː	1	gohb	1
		other	2	guv	1
				köb	1
				quv	1
ʃv	*Schwenke*	ʃv	9	schl	6
		ʃw	6	schw	4
		ʃʍ	2	sw	3
		ʃm	2	schv	3
		ʃf	1	schm	2
		ʃlˠ	1	sh	2
		s̠w	1	sl	1
		ʃɪn	1	sm	1
		ʃɪv	1	swv	1
		t͡ʃv	1	sch	1
		blank	1	shv	1
				snm	1
				swh	1
ʃt	*Stellau*	ʃt	16	st	17
		st	5	scht	7
		s̡ˈt	1	sht	2
		ʃˈt	1	shc	1
		s̠t	1		
		other	2		

Table 31: Non-native clusters in spoken prompts

Non-native affricate	Example	Spoken responses		Written responses	
t͡s	*Tsamandas*	s	22	s	20
		t͡s	2	ts	4
		dž	1	st	2
		other	1	sh	1
p͡s	*Psakhna*	s	18	s	19
		p͡s	4	ps	4
		t͡s	2	sp	1
		k̚s	1	spt	1
		other	1	st	1
				sc	1
p͡f	*Pfinztal*	f	13	f	17
		v	7	v	8
		p͡f	2	w	2
		ʔ͡v	1		
		θ	1		
		vˈ	1		
		v̥	1		

Table 32: Non-native affricates in spoken prompts

Native as well as non-native consonant clusters were not always correctly perceived in the listening experiments. To take the non-native ones first, the only consonant clusters which occurred in the prompts which could not occur in Edinburgh English are given in Table 31 above. Table 32 shows affricates, since these may have been perceived by subjects as a sequence of segments (cf. footnote 42 on p. 124). Only those in positions which violate the structural constraints of English are shown here, for example word initial [t͡s] from *Tsamandas* is included, but word-final [t͡s] in *Rätz* is not. There were no single segments whose word-position was non-native (as would have happened if, for instance, [ŋ] had appeared word-initially), and none of the sequences contain non-native segments.

Non-native affricates seem to have been frequently perceived as one phone, generally the second, i.e. the first element (the stop) was omitted. It may be that the timing suggests a single phone, or it may be that stops are perceived less well than fricatives due to their acoustic qualities. Another explanation is that, due to two of the affricates having two segments with the same place of articulation, there were fewer features to hear and so subjects could assume they heard only one segment. However, this explanation does not hold for *Psakhna*, which has two different places of articulation but whose stop was mostly omitted. The [k] stop in the [kv] sequence of *Kvernes*, which also consists of stop + fricative, was mostly perceived, suggesting that there may actually be a difference between the affricates and the sequences.

All the consonantal clusters which we have analysed as two segments seem generally to have been perceived as two elements. However, two of the examples consist of [ʃ] plus a consonant; it may be that subjects are familiar with this type of sequence from German, and additionally, it is well known that [ʃt], [ʃm] and so on are easy to perceive and pronounce for English speakers. ([ʃt] is even used as a realisation of /st/ in casual speech for some accents of English in environments before [j], for example in *stupid*.) If subjects were familiar with German, however, they might also be familiar with the affricate [p͡f], which they did not seem to perceive as well.

Many of the segments in possible English consonant sequences were incorrectly perceived or not perceived at all. Native or near-native clusters in the prompts are given in Table 33. 'Near-native' clusters refer to those in which one or more phones may differ from an English sequence, but if we allow mapping to the nearest native phoneme we have a native sequence. Although, as discussed earlier, 'the nearest native phoneme' is a complex issue, most of the cases here are straightforward, for instance [gl] (German) → [glˠ]. This allows inclusion of sequences which contain minor segmental differences from English sequences, but essentially the same structure. However, to allow examination of particular problems posed by un-English segments in sequence, the sequences are grouped into native (all segments always present in Edinburgh English for all speakers), variably-native (segments present some of the time, or for some speakers, such as the various realisations of /r/), and near-native (includes segments not present in Edinburgh, such as clear [l]). Again, affricates are included in Table 33 since the subjects may have treated them as sequences of segments, particularly in the case of non-native affricates.

		Spoken responses (n = 26, blank, queried or muddled output omitted)				**Written responses (n = 27, blank, queried and muddled output omitted)**				
Native string	**Example**	**response in expected range**	**vowel epen-thesis**	**not all repro-duced**	**all present, some altered**	**response in expected range[53]**	**vowel epen-thesis**	**not all repro-duced**	**all present, some altered**	**ambi-guous**
#slˠ	*Slat-tocks*	sɫ 3 sl 2 slˠ 19 s'lˠ 1				sl 25			stl 1 schl 1	
#sn	*Snåsa*	sn 25			ʃn 1	sn 25 'sn 1			zn	
#sp	*Sparbu*	sp 23			ʃp 1	sp 27				
#st	*Sturry*	st 26				st 27				
dg	*Bredgar*	dg 24			dk 1	dg 23 d-g 1		g 2	kg 1	
nd	*Tsa-mandas*	nd 24 n̆d 1				nd 25		d 1	td 1	
nd	*Glinde*	nd 24 n̆d 1		d 1		nd 18		d 1 t 1	nt 2 ntt 1 pt 1 tt 3	
ŋkʰ	*Schwen-ke*	ŋkʰ 21 ŋk 2			ŋg 2	nc 3 nk 23 nqu 1				
nt͡s	*Firenze*	nd͡s 1 nds 1 nt͡s 9 nʔs 4		ns 9		nts 4 ntz 2		ts 4 tz 2 z 1 nc 5 ns 5	nch 1 nst 1 rtz 1	nz 1
nt͡stʰ	*Pfinztal*	nʔstʰ 1 nt͡st 4 nt͡stʰ 6	nst 6 nstʰ 7 n̬stʰ 1		ŋkstʰ 1	ntst 3 ntzt 1	ts 1 tst 2 tzt 9 nst 10		nstt 1	

Table 33: Native or near-native clusters in spoken prompts

[53]It is possible, of course, that some of these graphemes really represent other sounds which the subjects thought they heard, for example <dg> can represent [dg] but also [d͡ʒ].

		Spoken responses (n = 26)				Written responses (n = 27)				
Native string	**Example**	**response in expected range**	**vowel epen-thesis**	**not all repro-duced**	**all present, some altered**	**response in expected range**	**vowel epen-thesis**	**not all repro-duced**	**all present, some altered**	**ambi-guous**
t͡ʃlˠ	*Lech-lade*	ʔ͡ʃlˠ 2 t͡ʃɫ 7 t͡ʃl 1 t͡ʃlˠ 14 t͡ʃl̪ 1				chl 10 tchl 12 tschl 1 tschsl 1			tctl 1	xl 1 tscsl1
vj	*Evje*	vj 2			bi 9 bĭ 1 bj 4 vi 5 vĭ 2 dðj 1	vy 1			thi 1 bby 1 bi 10 be 4 by 2 dgi 1 ggni 1 lli 1 ndi 1 nni 1 vi 2	
xn	*Psakhna*	xn 15 xːn 1			kn 5 χn 1 gn 1 xɲ 1	chn 17			cn 4 ckn 2 kn 2 xn 1 rn 1	
ks#	*Slat-tocks*	ks 24		k 1		cs 13 cks 4 ks 3 x 5			xt 1 sks 1	
lˠd#	*Keld*	ɫd 4 ɫd̥ 2 ld 2 lˠd 12 lˑd 1 lˠd̥ 2 l̥ˠd 1 lːd 1		ɫ 1		ld 24 lde 1			lt 2	
ntʰ#	*Pelynt*	ntʰ 23 ntʰ 1				nt 19 nte 2		t 6		
sk#	*Man-osque*	sk 22 sk̚ 1 s̠k 1		s 2		sc 3 sch 1 sk 15 ske 1 sq 1 sque 6				
st#	*Guist*	st 24 s't 1				st 21 ste 3 sdt 1 stë 1 szt 1				

Table 33 (continued)

		Spoken responses (n = 26)				Written responses (n = 27)				
Var-iably native string	**Example**	**response in expected range**	**vowel epen-thesis**	**not all repro-duced**	**all present, some altered**	**response in expected range**	**vowel epen-thesis**	**not all repro-duced**	**all present, some altered**	**ambi-guous**
#bɹ	*Bredgar*	br 1 bʁ 1 bɾ 4 bɹ 19				br 26		b 1		
#dʁ	*Dreve*	dɾ 2 dɹ 3 dʁ 5 dʀ 1 dr 1			bɾ 1 d̪w 1 gʁ 1 pɹ 1 tɹ 1 tʁ 4 tʀ 1 tr 3	dr 14			tr 11 br 1	
#gɾ	*Greve*	gʁ 1 gɾ 17 gɹ 5 gɹʷ 1			kχ 1	gr 25			dr 1 cr 1	
kɾ	*Acri*	kɾ 6 kʁ 1 kɹ 8 kɹʷ 1 gɾ 2 kr 1			kl 1 kŋ 1 xɹ 1 x'ɾ 1 kɰ̢ 1	cr 5 crr 1 ccr 1 chr 5 kr 7 khr 1	cc 1 ch 1 k 2		ncr 1 pr 1 rc 1	
ɾb	*Sparbu*	ɾb 4 ɹb 14		b 5	ɾm 1	rb 24			rtb 1 mb 1 rd 1	
ɾm	*Fermo*	(ɛə)m 2 (eə̆)m 1 ɾm 3 ɹm 11 ɹ̆m 2 ɹ̆mː 1 ə̆ɹ̆m 1	lʏɛm 1		lm 1 nm 1	rm 22			rlm 1	rem 1
ɾn	*Livorno*	ɾn 3 ɹn 13 ɹ̆n 2 rn 2 (o˞)nˈ 1		n 1 nˈ 1	nː 3	rn 24		n 2	rkn 1	

Table 33 (continued)

		Spoken responses (n = 26)				**Written responses (n = 27)**				
Near-native string	**Example**	**response in expected range**	**vowel epen-thesis**	**not all repro-duced**	**all present, some altered**	**response in expected range**	**vowel epen-thesis**	**not all repro-duced**	**all present, some altered**	**ambi-guous**
#gl	*Glinde*	gɫ 9 gl 3 glˠ 8	gəlˠ 2 gəl 2		gʁ 1	gl 11	ga 4 ge 6 gho 1 gil 4		'cl 1	
#s̠t̪	*Stira*	st 15 st̪ 6 sˑt̪ 1 s̤t̤ 1 s̠d̪ 1		θ 1		st 27				
bːj	*Bobbio*	bj 2 bˑj 2 bːj 4			bi 12 bˑĭ 2 bːĭ 2 bː.ɲ 1	by 3			be 2 bi 3 bu 2 bpi 1 lpi 2 lpu 1 mpi 2 mpu 1 pi 7 pu 1 pyy 1 rpi 1	
lk	*Bolkesjö*	ɫg 1 ɫk 3 ɫkʰ 14 lkʰ 1 lˠk 4 lˠkʰ 2				lc 4 lch 2 lk 9 lqu 1 llk 1		ch 1 g 1 l 2 ll 1	lt 1 rch 1 rck 2	
lnt͡s	*Woln-zach*	lˠnt͡s 1 ɫnt͡s 1	ˈlˠɔnd͡s 1	ɫs 5 ɫˑs 1 lˠs 1 ɫz 1 ns 2 ɫʔs 1 ɫt͡s 2 lˠt͡s 1 lt͡s 3 ɫds 1 ɫns 2 nd͡z 1 nds 1				ns 4 ls 2 lls 1 lts 5 ltz 2 lns 3 llns 1	nsk 1 nst 1 lks 1 lm 1 lnst 1 ltsn 1 rts 2	lnz 1

Table 33 (continued)

		Spoken responses (n = 26)				Written responses (n = 27)				
Near-native string	**Example**	**response in expected range**	**vowel epen-thesis**	**not all repro-duced**	**all present, some altered**	**response in expected range**	**vowel epen-thesis**	**not all repro-duced**	**all present, some altered**	**ambi-guous**
ʀn	*Cornus*	ɹn 9 ɹnʲ 1 ɾ̣n 1 ɹ̆n 3 ɹ̆nː 1 ʀnʲ 1 ʀn 1 ʀ̤nʲ 1	vən 1 rən 1 vəɲ 1		ɡn 1	rn 22	rrin 1		ln 2 rgn 1	rren1
ltʰ#	*Hellesylt*	ɫtʰ 2 ɫ̩tʰ 2 ltʰ 2 lˠtʰ 1		lˠ 1 ʔ 1 t 1 tˑʰ 1 t̪ʰ 1 tʰ 11 (none)1		lt 2 lte 1		t 19 te 3	nd 1	
Native affri-cates	**Example**	**response in expected range**	**vowel epen-thesis**	**not all repro-duced**	**all present, some altered**	**response in expected range**	**vowel epen-thesis**	**not all repro-duced**	**all present, some altered**	**ambi-guous**
t͡ʃ	*Lech-lade*	t͡ʃ 23 ʔ͡ʃ 2				ch 10 tch 12 tsch 1 tschs 1			tct 1	tscs 1 x 1
t͡s	*Pfinztal*	t͡s 10 ʔs 1		s 13 s̬ 1	ks 1	ts 5 tz 10		s 10 t 1	st 1	
t͡s	*Woln-zach*	ʔs 1 d͡z 1 d͡s 1 ds 2 t͡s 8		s 12 z 1		ts 7 ts(meta-thesised with <n>) 1		(none)1 s 11	tz 2 ks 1 st 2 sk 1	z 1
t͡s	*Firenze*	ʔs 4 d͡s 1 ds 1 t͡s 9		s 9		ts 8 tz 5		c 5 s 5	ch 1 st 1	z 2
t͡s#	*Rätz*	ʔ͡s 4 t͡s 22				ts 10 tse 1 tz 13 tze 1			tst 1	tes 1

Table 33 (continued)

As the table shows, there may be perception errors even in the case of native sequences. For the fully native sequences, there is a much higher proportion of errors in longer strings (more than two phones in sequence, with affricates counting as two phones) than shorter strings. In *Firenze*, for example, [nt͡s] was apparently perceived as two segments by 9/26 subjects in the listening-speaking experiment (omission of [t]), and 17/27 in the listening-writing experiment (10 omissions of <t>, 6 of <n> and 1 of both <n> and <t>). For *Pfinztal*, [nt͡stʰ] was lacking the medial [t] in 14/26 spoken responses and 10/27 written, <n> in 11 written responses and both <n> and the cluster-final <t> in 1 written response. For two-phone strings *Pelynt* had the highest number of omissions (6 omissions of <n> in listening-writing).

Affricates, listed near the end of the table, had a high proportion of omissions of one phone, but these affricates mostly occurred in combination with other consonants; *Rätz* had no omissions, in contrast to the non-native affricates which were not in clusters but frequently had the second phone omitted. It should also be noted that *Lechlade*, despite having a comparable number of phones to *Firenze*, had no omissions. The affricate in *Lechlade* is of course native, and this may be one reason why it is accurately perceived - it is probably perceived as two segments rather than three, and falls into the low error two-phone group rather than the high error three/four phone group. Additionally, one reason for the omissions of the [t] in *Firenze* may been because it was categorised by the subjects as a transitional element between the [n] and the [s], and so not of segmental status.

Other errors than omission in the native group are rare. They include change of place (*Bredgar* [dg] → <kg>), change of voicing (*Glinde* [nd] → <nt>) and change of manner (*Psakhna*) [xn] → [gn]), and a very small number of metatheses and additions. The one exception to the low error rate in the two-phone group is *Evje*. The [j] was often perceived as [i] in both the listening-speaking and listening-writing experiments, and the [v] appears to have been misheard as various segments, including [b], [d], [ð] and [n]. The change from [j] to [i] may have been a case of mishearing, or of misjudging the duration (see p. 132), or it may be that subjects preferred the structure [vi] to [vj] - the latter would be restricted in English to the environment before /u/ or /ə/ (e.g. *view*, *behaviour*) or a morpheme boundary (*graveyard*). Of course, it does precede a schwa in *Evje*, which weakens the structural argument.

The 'variably non-native' sequences were those containing potential realisations of /r/, i.e. [ɹ], [ɾ] and [ʁ]. These did not produce major problems, except mishearing of some segments such as [d] in *Dreve*, which seem to be segmental problems rather than structural ones. It should be noted that some errors did not result in nativisation, but in different non-native sequences, such as [kχ] for [gɾ] in *Greve*, and [kɯ̢] and <khr> for [kɾ] in *Acri*.

The 'near-native' sequences, despite being very similar to fully native sequences, did seem to produce slightly more structural errors (with the small number of example words, it is not possible to say whether the error is in fact due to the type of sequence or the particular sequences in the study). *Glinde*, for example, had 4 epenthetic vowels in the spoken responses and 15 in the written, suggesting perception of a vowel in the cluster. Unfortunately there are no similar structures to suggest whether this was a property of the individual prompt token or a general problem with initial clusters containing clear [l]. *Bolkesjö* and *Hellesylt*, with a clear [l] preceding a consonant, did not produce a similar result, and *Wolnzach* only had one example of epenthesis. *Hellesylt* did have a very high number of omissions of the [l], possibly due to it being an unfamiliar segment and so incorrectly perceived, or due to other factors such as duration leading subjects to think there was only one consonant in the cluster. With both the [l] and the [tʰ] being alveolar, it is also possible that the features of the two segments were not distinct enough for two separate phones to be perceived. *Wolnzach* also had a large and complex set of omissions for both written and spoken output; out of 53 responses, 11 omitted the [n] and the [t], 6 the [l] and the [t], 15 the [n] only, 6 the [t] only and 2 the [l] only. (Only 2 subjects reproduced 4 correct segments in their responses; a further 2 reproduced them all but not in the correct order, and there were a handful of segments wrongly recorded amongst the written answers.) Such wide variation in omitted segments suggests that no one segment was problematic, but that either the duration of the cluster was such that subjects perceived less than four, that they could not remember all four, or that the complexity was such that they failed to perceive the whole cluster accurately. It should also be noted (see for example Zwicky 1972: 291) that reduction of CCC clusters to CC in fast speech is not uncommon, and reduction of the cluster in *Wolnzach* for the listening-speaking experiment is actually following a natural production process. *Bobbio* encountered the same problem as *Evje*, with [j] apparently perceived as a vowel by most subjects. Again, the sequence [bj] only occurs before /u/ or /ə/, but in this case the following vowel is not one of these. We have the additional complication that, if [bː] were perceived as [bb] rather than [b], this only occurs at a morpheme boundary (e.g. *crib-biting*), and the sequence [bbj] is not found at all word-internally in the on-line dictionary. *Cornus* had a small number of cases of epenthesis in the consonant cluster, suggesting perception of a vowel in the transition between the two consonants, perhaps due to the high level of sonority of the [ʀ], or possibly perception of extra length, but this is only speculation.

b) Syllables

Some of the responses altered the syllable structure of words, as in the examples of epenthesis or omission noted above. In some cases these changes altered the syllable count. It is difficult to be certain of the syllable structure intended for written responses, since there is a lot of ambiguity in the graphemes used; <on>, for example, might represent a nasal vowel, or an oral vowel followed by a nasal consonant. However, we can look at both structure and syllable count for spoken responses. Figures 20-26 in the next chapter show that the syllable count was generally preserved, so we can assume it was accurately perceived; Table 47 in the next chapter, where it is discussed in more detail, shows that the syllable structure was also mostly preserved, even when segment identity was altered.

5.1.4. Perception of suprasegmental features

This section will cover perception of stress, tone and segment length.

◊ ***Summary: Suprasegmental perception of spoken forms***

Tone was perceived well by some subjects but either not perceived or ignored by others.

Stress was mostly perceived correctly. It was accurately reproduced in the listening-speaking experiment, though for the listening-writing experiment no conclusions can be drawn about stress perception.

Segment length seems to have been poorly perceived, or if it was perceived then it was not generally reproduced. However, some indications of extra length can be seen in the output of both the listening-speaking and listening-writing experiments, showing that some subjects did perceive the extra length. In a number of cases, though, the extra length was interpreted as sequences of different segments.

a) Stress

Stress was, with few exceptions, correctly reproduced in the listening-speaking experiment, from which we can assume it was generally correctly perceived. Stress errors, however were not randomly distributed (see Chapter 6, p. 195 for more details). As similar stress patterns to the listening-speaking errors appeared in the reading-speaking experiment, it is likely that at least some of these errors are influenced by production considerations, rather than poor perception, or that similar factors influence both, for example syllable weight

As for the listening-writing experiment, most of the written responses give no clues about stress perception, and though there are some graphemic patterns which tend to be associated with stress (such as doubled consonants), these are unreliable indicators.

b) Tone

It is difficult to make any firm statements about how, or even whether, the Norwegian tone was perceived, except in so far as it led to imitations in the listening-speaking experiment. Obviously, tone has no potential output in the listening-writing experiment. The fact that there were some attempts to repeat the tones (see Chapter 6, p. 200) is evidence that the pitch changes were perceived by at least some subjects, and these changes may of course have been perceived by more subjects than reproduced them. There were also some examples of non-default pitch in response to names other than Norwegian; this will be discussed later in the chapter.

c) Segment length

A number of words had long vowels or long consonants in the spoken prompts. Although the long consonants are treated here as long segments (as is generally done for Norwegian; practice varies for Italian), they could have been treated as a sequence of segments, in which case they would have been grouped with other non-native sequences, rather than as suprasegmental features. Geminate consonants would also be considered to some extent non-native, as they are not found in the middle of monomorphemic English words (though they may be found in polymorphemic words, such as *bookcase*). Length is not phonemically distinctive in English for either consonants or vowels; although Edinburgh English has minimal pairs distinguished by vowel length these are generally conditioned by the morphemic and/or phonemic environment. A search of the on-line dictionary revealed very few adjacent vowels even at morpheme boundaries, and those that did exist were mostly diphthongs (such as *dry-eyed*), for which there is of course a perceptible transitional stage between the end of the first diphthong and the start of the second.

It can be seen in Table 47 in the next chapter, and the ensuing discussion, that the long segments in the listening-speaking experiment were generally reproduced as short segments, though there were a few examples of repeated length. There were also some instances of long segments in response to short segments. This suggests either that length was not usually perceived accurately, or that, as it is not generally distinctive in English, little attempt was made to reproduce it in the responses.

However, in the sections on representation of segment length in the listening-speaking and listening-writing experiments (see Chapter 6, p. 203 and Chapter 7, p. 250), there is evidence that long consonants were sometimes perceived as longer in duration than single short segments, as they were sometimes reproduced as two segments of different identity, such as [kː] → [ŋkʰ] or [bː] → <mp>.

5.2. Written forms

This section discusses perception in the reading-speaking and reading-writing experiments. The judgements of origin are analysed and compared to judgements of origin for the spoken prompts, and then the perception of single graphemes and grapheme combinations are analysed.

5.2.1. Judging the origin

This section presents the results of the judgements of origin of written names, and discusses the features on which these judgements might be based.

◊ ***Summary: Origin of written forms***

As with the spoken prompts, subjects did well in determining the language of origin of the written names and, interestingly, the languages which were confused with each other were the same in the two modes of presentation. There was some correlation between subjects' judgements and single graphemes or grapheme combinations, but for grapheme inventories there was not enough information for the subjects to use. Syllable type was too variable for the subjects to use in all cases, though it may well have been important for Greek and Italian, and particular sequences may have been strong indicators for certain languages.

a) Responses to questions of origin

Town group	Average score per town per subject
British towns	0.65
Non-British towns	0.24
All towns (average)	0.31

Table 34: Perception of origin of towns (reading-writing and reading-speaking), in response to "Could these towns be in Britain?" Possible scores range from 0 (low) to 1 (high).

	Prompts						
Responses	British towns	French towns	German towns	Greek towns	Italian towns	Norwegian towns	Average
Possibly French	0.25	0.51	0.23	0.19	0.32	0.18	0.28
Possibly German	0.43	0.23	0.66	0.19	0.18	0.47	0.36
Possibly Greek	0.18	0.31	0.18	0.54	0.35	0.27	0.31
Possibly Italian	0.17	0.30	0.18	0.41	0.56	0.16	0.3
Possibly Norwegian	0.38	0.26	0.44	0.27	0.25	0.53	0.36
Average	0.28	0.32	0.34	0.32	0.33	0.32	0.32

Table 35: Perception of origin of towns (reading-writing and reading-speaking), in response to "Could these towns be in the countries listed?" Possible scores range from 0 (low) to 1 (high).

	Prompts						
Responses	British towns	French towns	German towns	Greek towns	Italian towns	Norwegian towns	Average
Identification as British	0.36	0.17	0.05	0.02	0.05	0.04	0.12
Identification as French	0.12	0.37	0.12	0.09	0.15	0.1	0.16
Identification as German	0.21	0.09	0.51	0.08	0.08	0.29	0.18
Identification as Greek	0.09	0.15	0.08	0.37	0.14	0.18	0.17
Identification as Italian	0.05	0.1	0.06	0.25	0.41	0.06	0.16
Identification as Norwegian	0.15	0.11	0.18	0.17	0.14	0.3	0.18
Other (e.g. omissions)	0.03	0.01	0.01	0.02	0.03	0.03	0.02

Table 36: Perception of origin of towns (reading-writing and reading-speaking), in response to "Which country do you think the town is in?" Possible scores range from 0 (low) to 1 (high).

Question 1 ("Could these towns be in Britain?") for written presentation of the stimuli (reading-speaking and reading-writing experiments) led to the responses shown in Table 34 above. Although British towns performed better than others, the gap is not as wide as for the spoken prompts (cf. Table 11).

For Question 2 (Could these towns be in the countries listed?) the results are summarised in Table 35; for the final decision in Question 3, for which subjects were asked "On balance, which of these six countries do you think the town is in?", the results are shown in Table 36. Results which are significantly above chance ($p < 0.05$, 10 towns per country, 54 subjects) in a chi-squared test are shaded.

The number of towns identified correctly is significant for both Question 2 (Table 35) and Question 3 (Table 36). The other significant scores are: British town/German response, British town/Norwegian response, German town/Norwegian response, Italian town/Greek response (Table 35) and French towns/British response (Table 36), and Greek town/Italian response and Norwegian town/German response (both tables). In Table 35, in contrast to Table 12 on p. 118, showing the responses to spoken prompts, the average score for British towns is not particularly low despite 'British' not being a possible response. This may be due to the lower distinctiveness of written than spoken prompts across the different languages, though by this argument the scores given to towns from other countries should be higher also.

	Prompts					
Responses	**British towns**	**French towns**	**German towns**	**Greek towns**	**Italian towns**	**Norwegian towns**
Identification as British	S3 W3	W3				
Identification as French		S2 S3 W2 W3				
Identification as German	S2 W2		S2 S3 W2 W3			S2 S3 W2 W3
Identification as Greek				S2 S3 W2 W3	S2 S3 W2	
Identification as Italian				S2 S3 W2 W3	S2 S3 W2 W3	
Identification as Norwegian	S2 W2		S2 W2			S2 S3 W2 W3

Table 37: Significantly high responses to Questions 2 (2) and 3 (3) for spoken prompts (S) and written prompts (W)

A comparison of the responses to the two kinds of prompts is given in Table 37. It can be seen that the pattern of responses is very similar for the different modes of presentation. (Question 2 does not appear in the first row for either mode as "Britain" was not a possible response.) This suggests that subjects' awareness of the features of each language is at a similar level for both written and spoken forms.

b) Graphemic inventories

Non-native graphemes led, understandably, to classification of a word as foreign. Five towns contained non-English graphemes: <Ålesund>, <Bolkesjö>, <Rötz>, <Snåsa>, and <Valençay>. The five towns containing non-native graphemes have the lowest score of all the groups (cf. also Table 34).

Town group	Average score per town per subject
Towns containing non-native grapheme	0.04
Towns not containing non-native grapheme	0.33

Table 38: Perception of origin of towns with non-native graphemes (reading-writing and reading-speaking), in response to "Could these towns be in Britain?" Possible scores range from 0 (low) to 1 (high).

There is only a small number of each grapheme in the names from each language, and not all possible graphemes are represented in the data, so the frequency of grapheme use is probably not a useful clue for subjects as to the language of origin.

c) Word structure

We can also look at the how frequent the grapheme sequences of the names are in English, to see how this compares to the nativeness ratings. For these purposes a grapheme sequence was defined as a series of two or more letters, which may include an initial or final word boundary. This means, for example, that <Aire> would be grouped into sequences as follows:

2 letter sequences	#a	ai	ir	re	e#
3 letter sequences	#ai	air	ire	re#	
4 letter sequences	#air	aire	ire#		
5 letter sequences	#aire	aire#			

Case was not taken into account. Each occurrence of <#a>, <ai> and so on in the on-line dictionary previously described would then score 1 in the analysis of two-letter sequences; each occurrence of <#ai>, <air>, etc. would score 1 in the analysis of three-letter sequences, and so on. Including word-boundaries in the analysis allowed some effect of position, although this only covered initial and final letter sequences. Word-frequency was not taken into account. For each analysis, the frequency counts were arranged in groups of 0-9, 10-99, 100-999 and so on, and the summed scores were divided by the number of sequences in the name, so that each word had the same potential total. In this way, words with sequences which are rare or non-existent in English should have low scores, while words with common English sequences should have high scores.

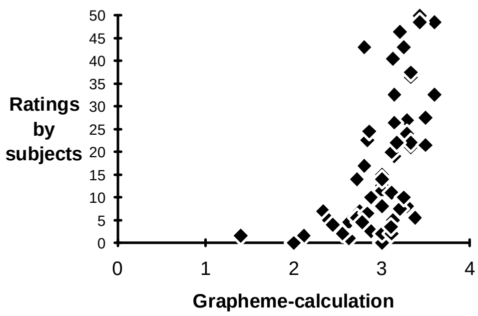

Figure 12: Two-grapheme sequences and nativeness ratings by subjects

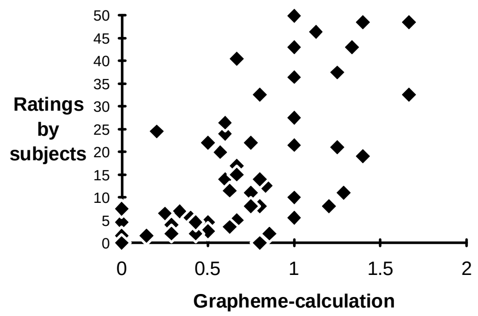

Figure 14: Four-grapheme sequences and nativeness ratings by subjects

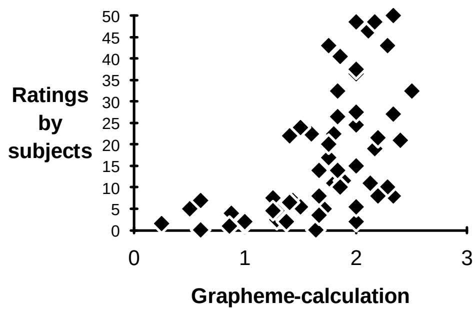

Figure 13: Three-grapheme sequences and nativeness ratings by subjects

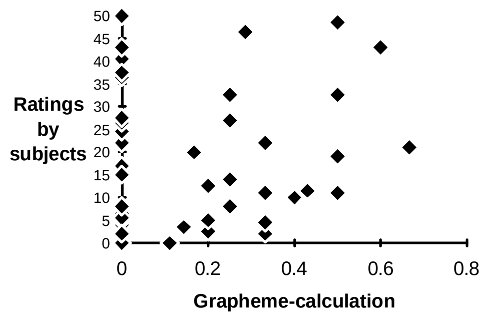

Figure 15: Five-grapheme sequences and nativeness ratings by subjects

Figures 12-15 above show these scores plotted against subjects' responses to Question 1 (written presentation). It can be seen that there is some correlation between the two sets of scores; the orderings of all the sets of figures are significant at $p < 0.05$, using Spearman's rank correlation method. However, five-grapheme sequences are not especially informative, as the likelihood of a particular sequence occurring is low, even if it forms an orthographically regular pattern in English.

As for discriminating between the five possible foreign languages, as well as distinguishing between native and non-native names, it is possible that subjects gain clues from the position of individual graphemes; for instance, <#j>

(as in <Jaren>) is more common word-initially in German and Norwegian than in English. Of course, grapheme combinations may also give information as to the language of origin; it is possible that some, if not all, subjects are aware that <#ps> is a possible word-initial combination in Greek, from borrowings such as *psychic*.

Feature	British towns	French towns	German towns	Greek towns	Italian towns	Norwegian towns
Graphotactics (syllable type)[54]						
V			1	3	3	1
CV	3	6	4	16	16	8
CCV	3		2	4	3	5
CCCV			1	1		
VC						2
CVC	1	3	3	4	3	2
CCVC	3	1	1	1		2
CCCCVC			1			
CVCC	3		3			3
CCVCC		1	1			
CVVCC	1					
CCVCCC	1					
CVV		3		1		
CCVV			1		1	
CVC/V[55]			1			
CVCV[56]	2					
CVCCV[56]		2				
VVCV[56]		1				
CVVCV[56]		1				
CVCCVV[56]		1				
Consonant/vowel ratio						
	2.05	1.13	2.02	1.26	1.11	1.7
Word length						
4 graphemes	2	1	2		1	1
5 graphemes	1	2	2	2	4	3
6 graphemes	4	1	1	3	2	2
7 graphemes	1	4	2	2	3	2
8 graphemes	1	2	3	1		1
9 graphemes	1			1		1
10 graphemes						
11 graphemes				1		
Average no. of graphemes	6.1	6.4	6.2	7.0	5.7	6.2

Table 39: Syllable type and word length of written prompts

[54]Maximal phonemic onset is used here for division of words into syllables.

[55]This refers to 'Nahe', in which the <h> may be interpreted as relating to a consonantal or vocalic pronunciation.

[56]These syllables contain silent vowel graphemes, and could have been interpreted by the subjects as two syllables; in the reading-speaking experiments both interpretations appeared).

Table 39 shows the graphemic syllable types and consonant/vowel ratios in the prompts. (The graphemes <y>, <h> and <w> were counted as consonants or vowels depending on the surrounding graphemes.) It can be seen that there is rather more variety in the graphemic syllable structures than phonemic syllable structures (Table 17). There is a certain amount of grouping in the figures, but not enough to account for the subjects' responses. For example, English and German have similarly high consonant-vowel ratios, but Norwegian, which the subjects confused with German, is rather lower. Similarly, Greek and Italian have low ratios, but so does French, which was not confused with Greek and Italian by the subjects. Of course, these generalisations miss important details, for instance <Schwenke> (German) not only contained the only four-grapheme onset, but the particular sequence of letters was probably recognisable to many of the subjects as a German string, either through formal learning or in names such as *Schwarz*. Furthermore, subjects had a greater knowledge of some languages than others; this may have been one reason why French was not confused with Greek and Italian as much as Greek and Italian were with each other. One pattern which does emerge from the table, however, is that Greek and Italian had a much higher proportion of CV syllables than the other languages; this may account for the judgements of origin of these towns.

For comparison, word length as measured by Carlson et al. (1985) is given below:

	Data set	English	French	German	Italian
Mean word length (in graphemes)	Carlson et al.	7.09[57]	7.62	8.69	7.39
	Town prompts	6.1	6.4	6.2	5.7

Table 40: Language structure from Carlson et al. (1985) compared to the current written prompts

The comments that were made previously about the word selection in Carlson et al.'s spoken data also apply to the written data.

5.2.2. Perception of single segments

This section presents results relating to segmental perception in the spoken prompts.

[57]Mean root length (with suffixes removed) was 6.68 for English, but was not analysed for the other languages.

◊ ***Summary: Segmental perception of written forms***

Among potential reasons for errors in re-transcribing single graphemes (not taking graphemic environment into account) are visual misidentification, memory problems, and the activation of a pronunciation which then interferes with retranscription. It is likely that all of these occurred, though many of the errors can be explained in multiple ways. Data from reading-speaking is not strong enough to support the pronunciation-activation hypothesis for single segment errors, but neither does it rule it out. Also, it should be remembered that the method of presentation in the two experiments was different, with prompts being covered at the production stage for the reading-writing experiment, but on display during production for the reading-speaking experiment; this might lead to different strategies being preferred for the different experiments. Diacritic errors were common in the reading-writing experiment; we can say that diacritics appear to be perceived separately from the graphemes they accompany, since errors in one are not always accompanied by errors in the other. Finally, for the reading-writing task errors generally increased as the word progresses, but accuracy improved again over the final segments.

a) Whole graphemes

Errors made in the reading-writing experiment are listed in Appendix D. It is evident that many of the errors are visual, as the shape of the grapheme in the stimulus and that in the erroneous response are similar, for example <l> → <i>; if a subject had phonologically processed a written word, without a visual error, they would be very unlikely to make such a mistake, and memory difficulties, or output processes do not explain most of these errors. Some errors may or may not be due to misreading, like <a> ↔ <o>; this common mistake is probably due to visual similarity, but as they are both vowels and can have the same pronunciation, for example <o> → <a> in <Wolnzach>, phonological processing is a possibility (see Chapter 2, on the perception of written forms, for discussion of phonological activation during reading). If the written letter occurs elsewhere in the word, as in for example <Manasque> as a response for <Manosque>, it may be a memory error rather than a visual error. Other errors have, or may have, the same pronunciation as the stimulus, but a quite different visual form, (such as <e> → <ai>) which suggests phonological interference.

Output corresponding to single graphemes, with inputs listed in the font used for presentation, is shown in Table 41. This table shows correct output and simple substitutions; other errors, such as transposition or omission, or double-segment input with single output, are not included. Omission or alteration of diacritics is considered to be a separate category of error, rather than a grapheme substitution. No substitution errors were made in initial (upper-case) segments, so these are not included. (In fact, the only errors in an initial segment were for <Å> in <Ålesund>; cf. results from Hotopf (1980) and Wing and Baddeley (1980), discussed on p. 54). It is clear that there were very few substitution errors - they account for just 1% of output (total errors, counted on the basis that every input segment with incorrect output constitutes one error, account for 6%).

As noted above, many of the errors appear to be visual. However, using Bouma's visual similarity groups (see p. 23), only 27/92 substitution errors fall within the same visual similarity group. The groups might be disputed for their rigidity of classification, since for example <k> and <x> have more in common visually than, say, <k> and <c>, but <k> and <x> have no relationship in the letter-similarity groups.

Input grapheme	Frequency of correct output	Substituted output grapheme	Frequency	Other errors (omissions etc.)
a	1124	e	11	56
		o	5	
		d	2	
		u	2	
å	13			17
b	89	d	1	0
c	230	a	1	8
		r	1	
ç	22			8
d	247	c	1	21
		k	1	
e	1181	o	1	48
		y	1	
		a	8	
		ai	1	
f	28	l	1	1
g	139	d	1	9
		z	1	
h	202	m	1	15
		n	1	
		a	1	
i	493	e	1	16

Table 41: Single grapheme input and corresponding correct output or simple substitution errors (reading-writing)

Input grapheme	Frequency of correct output	Substituted output grapheme	Frequency	Other errors (omissions etc.)
j	55	i	1	3
		y	1	
k	189	c	1	16
		h	1	
		x	3	
l	667	i	10	38
		z	1	
		t	1	
		v	1	
		j	1	
		h	1	
m	117	n	1	2
n	721	o	1	54
		r	2	
		y	1	
		m	1	
o	743	a	9	23
		i	3	
		e	2	
ö	44			16
p	120			0
q	30			0
r	664	n	1	25
s	566	z	1	13
t	393	i	1	26
u	284	d	1	14
		e	1	
v	202	y	1	7
w	28			2
x	0			0
y	195	n	1	14
z	115			5
total	8901		92	457

Table 41 (continued)

Graphemes were omitted in a number of instances in the reading-writing experiment (see Appendix D), and it is notable that the same ones were omitted by a number of subjects, which suggests that this is not random misreading, but is due to either the graphemic context or the pronunciation assigned by the subjects. Graphemes omitted more than twice in the reading-writing experiment are shown in Table 42, along with comparable omissions in reading-speaking to see whether phonological activation might have caused these spellings. Most did have omissions in reading-speaking as well as reading-writing, but <Hellesylt> and <Karousadhes> were the only names in the set which had more than one reading-speaking omission, so it is difficult to either support or refute the hypothesis that phonological activation caused the errors.

Prompt (omitted grapheme underlined)	Omissions in reading-writing experiment	Omissions in reading-speaking experiment
Hellesylt	7	4
Karousadhes	7	12
Laragne	3	1
Pfinztal[58]	5	1
Schwenke	3	1
Tsamandas	3	0
Valençay	5	not possible to distinguish definitely between pronunciations of <Valençay> and <Valençy>

Table 42: Frequency of omission of graphemes (reading-writing and reading-speaking)[59]

b) Diacritics

There were a number of errors in the diacritics in the reading-writing experiment (5 for <Rötz >, 7 for <Valençay>, 9 for <Bolkesjö>, 14 for <Snåsa> and 17 for <Ålesund>, out of 30 subjects). As can be seen in Appendix D, the only other errors which had a frequency of 7 or more were omission in <Hellesylt> and <Karousadhes>. These totals do not include completely transposed diacritic+segment errors, such as <Bölkesjo >. Although, as would be expected, in most of these cases the diacritic was simply omitted (34 out of 52 diacritic errors), there were a number of instances in which it was altered and/or relocated to another segment, for example <Velancäy>. It is probable that such errors were caused by the inaccurate transcription of the diacritic in the prompt, rather than being random insertions, since there were no insertions of diacritics in response to words not containing diacritics in the prompts.

There were 14 changes in which the diacritic was altered but remained on the same segment, for example <å> → <á>. There were 3 diacritic relocations and 2 combined relocation/alteration errors, so errors of diacritic alteration were much more frequent than location errors. These alterations did not consist of transformations to visually-similar segments (for example, <ç> was not perceived as <g>), suggesting that their status as segment+diacritic was

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58 Due to the phonemic ambiguity of the <z> here, responses such as [ˈfɪnt.səlʏ], in which the [t] might be related to either the <z> or the <t> of the prompt, have not been included.

59 Only instances in which the graphemes on either side have a corresponding grapheme or phoneme in the correct location, i.e. omission of a single grapheme, are included here.

correctly identified, and that the diacritics themselves were either misperceived or misremembered at the writing stage. Further research on grapheme and diacritic shapes would be needed to verify this.

c) Word position

Some have suggested (e.g. Wing and Baddeley (1980), cf. Chapter 3, p. 54) that certain word positions are more susceptible to error than others, so the data was analysed for this effect. The average number of letters per word is 6.27, so all segmental positions were been normalised so that the first segment was position 1 and the last was position 6. Wing and Baddeley report more errors in the middle of the word than at the ends, but this was not evident in the current data. It does seem, however, that errors increase slightly towards the end of the word.

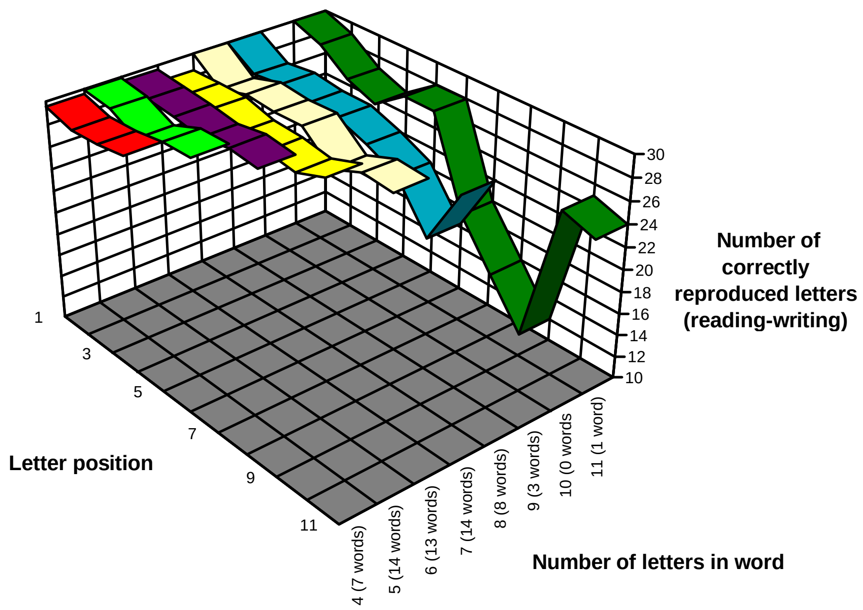

Figure 16: Segmental position and accuracy of response, grouped by word-length (reading-writing)

Taking the different word-lengths separately (Figure 16 above) makes the picture a little clearer - performance tends to decline throughout the word, before improving for the final segments, but the effect was minimal, except for longer words which are represented by only a few examples.

5.2.3. Structural perception

This section gives the results relating to perception of graphemic sequences, including analysis of syllable divisions.

◊ ***Summary: Structural perception of written forms***

In at least some cases in the reading-writing experiment, there is evidence of phonological activation of the written string. From the data, however, it is impossible to say whether phonological activation automatically takes place or is an optional strategy. Frequency of letter combinations does not affect accuracy of perception or production, although simple presence/absence of these combinations in the dictionary does appear to affect accuracy. Pronounceability is potentially an important measure for ease of perception, but this cannot be analysed objectively without further experiments.

Some written words had varying syllable counts in the output of the reading-speaking experiment. In some cases this was due to ambiguity in the grapheme-to-phoneme correspondences in the string (for example <Loano>, or words with potentially mute <e>) while for others it was due to non-English written sequences (for instance <Psakhna>) which were resolved by different subjects in different ways. It is debatable, however, whether this is a matter of perception of the written string, or of production.

a) Combinations of graphemes

Looking at the data in Appendix D, a number of questions emerge. For instance, in the case of single grapheme substitutions (Table 41), the errors are not randomly distributed across words. Three subjects wrote <x> for <k> in <Ekhinos>, but this did not happen in any of the other 6 words containing <k>. There were also a large number of errors around <dh> in <Karousadhes>, and <khn> in <Psakhna>.

The responses were examined to see whether subjects did better at reproducing sequences which are common in the dictionary; the number of errors in strings from 1 to 5 graphemes was compared to the frequency of lexical occurrence of the original strings. However, the data does not support the supposition that infrequent strings had a higher error rate (cf. similar results in the literature, discussed on p. 25). If we divide the data simply into sequences which either do or do not occur in the dictionary, the results are significant ($p < 0.05$) for strings of 2, 3, 4 or 5 graphemes (including a word-end as a 'null' grapheme). On removing strings containing non-native graphemes from the calculations the results are significant for 3, 4 and 5 graphemes (there are now only 2 bigrams which do not occur in the dictionary).

Some of the strings which do not occur in the dictionary are nevertheless simple to pronounce, for example <Dok>; indeed, some of these might be considered easier to pronounce than some which do occur in the dictionary, such as <hna>. The 'pronounceable' strings not occurring in the dictionary do seem to be reproduced more accurately than the set of 'unpronounceable' strings appearing in the dictionary. <Dok>, for example, is reproduced correctly 30 times out of 30, while the figure for <hna> is only 13. Pronounceability may well be more important than string frequency, but it is a rather subjective measure. It is made more complex by the fact that a sequence may have a more obvious pronunciation following the addition of more segments from the word, for example <dga> is less pronounceable than <edga>. It should also be remembered that subjects did manage to assign a pronunciation to the written words (reading-speaking experiment) in nearly all cases, so by this crude definition all the strings in the experiments are 'pronounceable'.

It has been noted (see p. 59) that those who are poor spellers, particularly young children, may reduce consonant clusters in spelling. Nasals before oral stops are particularly prone to omission in younger children. These tendencies may account for some of the omissions in Table 42, though the children in this study are somewhat older. This was also a reading-writing test, rather than a dictation test, so it is not clear whether the two phenomena are related.

There are a few responses to sequences in the reading-writing experiment which point strongly to phonological activation and then re-transcription. These include <Hellesight> and <Hellesyte> for <Hellesylt>; there were pronunciations in the reading-speaking experiment for which the last syllable was similar, for example [sʌ͡iʔ]. Note that omissions of <l> in reading-speaking also suggest that phonological activation may have been responsible for the high number of omissions of <l> in reading-writing. (Written errors for which there were corresponding pronunciations in the reading-speaking experiment are marked with asterisks in Appendix D.) Responses such as <Pifinztal> for <Pfinztal>, or <Psakhena> and for <Psakhna> may be due to phonological intervention, or they may be due to regularisation of the graphemic string. There are also a large number of cases for which the pronunciation of the error may or may not be different from the pronunciation of the original string (for example <Copparo> and <Copparro>), making it difficult to say whether phonological activation and re-translation was the root of the error.

Some of the errors result in strings which are not regular either phonologically or graphemically, and are in fact worsened by the alterations, such as <Laichanlde> for <Lechlade>, <Ginlde> for <Glinde> or <Pskhanna> for <Psakhna>. It would be interesting to see whether these subjects are generally "poor spellers", as discussed in the literature, but we have no independent measure of spelling ability for the subjects.

b) Syllables

From the results we can draw some conclusions about the way subjects divided the written words into syllables, particularly from the reading-speaking experiment. However, the word-structures are too varied for us to formulate strong hypotheses about subjects' approach to syllables. The main categories of graphemes or grapheme combinations which resulted in variable answers are given in the following sections.

◊ ***Vowel sequences***

Words with two or more adjacent graphemic vowels can potentially have varying numbers of syllables:

<Loano> → [ˈl^{ɣ}o.no] or [l^{ɣ}oˈa.no]

Instances of these are <Bobbio>, <Elatia>, <Guist>, <Karousadhes>, <Loano>, <Manosque>, <Maule>, <Stellau>, and <Toucy>.

Of these, the vowel sequences in <Karousadhes>, <Maule>, <Stellau>, and <Toucy> generally correspond to single syllables in English and pronunciations reflect this. On the other hand, the vowel sequences in <Bobbio> and <Elatia> do not normally correspond to single vowel phonemes in English. Exceptions are words with /ʃ/ or /ʒ/ such as *Horatio*, *nation* and *acacia*, in which the <i> might be considered part of the consonant rather than the vowel. There were in fact a number of cases of <ti> in <Elatia> pronounced as [ʃ], giving 3 syllables rather than 4 ([ɛˈl^{ɣ}e.ʃʌ] rather than [ɛˌl^{ɣ}a.ti.ʌ]). In both <io> and <ia> sequences the <i> sometimes represents a vowel (typically /aɪ/ or /i/, e.g. *biology*, *caviar*) and sometimes the glide /j/ (*onion*). The <i> in <Bobbio>, however, was always pronounced as a vowel, giving a two-vowel sequence; as noted previously, [bj] only occurs before /u/ or /ə/ in English, rather than [o] as here. The <i> of <Elatia> was nearly always pronounced as a vowel or merged with <t> to give [ʃ].

The sequences in <Guist>, <Manosque> are variable - <ui> and <ue> can be phonologically V (*biscuit*, *blue*), VV (*fluid, affluent*), CVV (*tuition*, *Samuel*) or CV (*linguist*, *avenue*), and final <ue> can of course be silent. Some of these appear in the responses: <G<u>ui</u>st> has [gwist] and [gist], though no CVV or VV as in [ˈgjʉ.ɪst], [ˈgʉ.ɪst]; <Manosq<u>ue</u>> has [maˈnɔs.ke], [maˈnɔsk], [maˈnɔ.skwə] and [mːaˈnɔ.skjü], though no VV or CVV or as in [maˈnɔ.skʉə], [maˈnɔ.skjʉə]. This leaves <Loano>, which has 12 bisyllabic answers ([ˈl^{y}o.no] type), and 2 of the [ˈlwa.no] type, 7 trisyllabic ([l^{y}oˈa.no] type), and 3 others with inserted consonants.

◊ ***Silent <e>***

Town	Mute <e> in response (no vowel phoneme present)	Pronunciation of <e> (vowel phoneme present)	Other (inappropriate pronunciation of letter or adjacent two letters, answer unclear etc.)
Air<u>e</u>	20	3	1
Grev<u>e</u>	19	5	0
Drev<u>e</u>	18	6	0
Maul<u>e</u>	17	5	2
Lechlad<u>e</u>	16	7	1
Glind<u>e</u>	15	8	1
Red<u>e</u>	15	9	0
Nah<u>e</u>	14	9	1
Kvern<u>e</u>s	7	13	4
Firenz<u>e</u>	6	17	1
Hell<u>e</u>sylt	6	14	4
Laragn<u>e</u>	6	13	4
Savign<u>e</u>	6	15	3
Schwenk<u>e</u>	6	15	3
Karousadh<u>e</u>s	5	11	8
Ål<u>e</u>sund	4	15	5
Evj<u>e</u>	3	17	4
Bolk<u>e</u>sjö	0	13	11
Kat<u>e</u>rini	0	23	1

Table 43: Potentially silent <e>: pronunciations given in reading-speaking experiment

To be silent, <e> in English must be word-final, or followed by an <s> or <d> which is potentially within the same syllable (<Kvern<u>e</u>s>), or followed by a syllable-initial consonant (e.g. <Hell<u>e</u>sylt>). It must not be the first vowel in the word. This gives us: <Air<u>e</u>>, <Ål<u>e</u>sund>, <Bolk<u>e</u>sjö>, <Drev<u>e</u>>, <Evj<u>e</u>>, <Firenz<u>e</u>>, <Glind<u>e</u>>, <Grev<u>e</u>>, <Hell<u>e</u>sylt>, <Karousadh<u>e</u>s>, <Kat<u>e</u>rini>, <Kvern<u>e</u>s>, <Laragn<u>e</u>>, <Lechlad<u>e</u>>, <Maul<u>e</u>>, <Nah<u>e</u>>, <Red<u>e</u>>, <Savign<u>e</u>>, and <Schwenk<u>e</u>>. Figures for these are shown in Table 43 above.

It was supposed that there might be some connection between the pronunciation of potentially silent <e> and judgements of the word as native and non-native. We might think, for instance, that a pronunciation such as [ˈɹe.də] for <Rede> would be associated with a non-native judgement, while [ɹid] would be native. However, on examination of the perceived origins of the above words this was not the case. Even omitting the least native-looking words,[60] such as <Bolkesjö>, which might confuse subjects, the pronunciations and perceived origins of the remaining names (<Aire>, <Dreve>, <Greve>, <Glinde>, <Lechlade>, <Maule> and <Rede>) do not support this supposition.

◊ ***Non-English consonant clusters***

Some of the variations in pronunciation given to non-English consonant clusters, i.e. those not typically used in that position in English words,[61] do not affect the number of syllables assigned to a word, though they may still affect syllabic structure, for instance <sj> in <Bolkesjö> was pronounced as [sj], [ʃ], [z], [sd͡ʒ] and so on). <Kvernes>, <Pfinztal>, <Psakhna> and <Tsamandas> are the only names containing clusters which have the potential to alter the syllable count, though of course any sequence may do so if subjects make errors.

Town	All consonants pronounced (as a cluster)	One consonant dropped	Metathesis of consonants	Metathesis of consonant and vowel	Epenthetic vowel	Other (answer unclear, etc.)
Kvernes	11	3	0	0	7*	3
Pfinztal	9	9	0	0	3*	3
Psakhna	8	8	0	4	2*	2
Psakhna[62]	12	0	0	2	6*	4
Tsamandas	7	9	0	5	3*	0

Table 44: Non-English written consonant clusters: pronunciations given in reading-speaking experiment; starred pronunciations altered the syllable count

Table 44 above shows that, although there were a number of ways of resolving the consonant clusters, only 21 out of 108 clear responses altered the syllable count at this point (some of the pronunciations altered the syllable count at different points in the word, for unconnected reasons).

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[60] This was determined by reference to results from Question 1, "Could this town be in Britain?", for written prompts.

[61] Some may be used in a subset of English words, for example <#Ps> is used in loan-words from Greek.

[62] In this case "all consonants pronounced means, in effect, some combination of <k>, with or without an <h> component, and <n>.

5.3. Summary of perception

Subjects did well at ascertaining the origin of the names, even for relatively unfamiliar languages. It was not possible, however, to determine the features which led to these judgements. Certain origins were confused, and the same pattern of confusions (British-German-Norwegian and Greek-Italian) was evident for both spoken and written prompts.

Some spoken segments were evidently misheard, while others were miscategorised; there was a wide variation in output for some prompts. Syllable count and stress, on the other hand, were accurately perceived. The data supports the analysis of affricates and long segments as single units, as compared to sequences of two segments. Non-native suprasegmental features, such as tone and lack of stress, were poorly perceived.

For written forms there were relatively few errors of perception. Most errors seemed to be visual, though there was some evidence of errors due to phonological activation and re-transcription. Diacritic errors were common, and the type of errors suggest that the diacritics were perceived separately from the graphemes they accompanied. Accuracy of perception was not affected by the frequency of grapheme combinations in the dictionary, but it was affected by location within the word.

Chapter 6.

Results - Production in Same-media Experiments

This chapter briefly discusses some general issues in the production of unfamiliar words, before moving on to the reproduction of words within the same medium. This covers the reading-speaking and then the listening-writing experiment, with the analysis broken down into various linguistic features.

6.1. General production difficulties

This section presents some results showing the effects of the basic problems which characterise production and the linguistic analysis of production variation.

◊ ***Summary: General production difficulties***

There is variation both in the difficulty of the prompts and the skill of the subjects. Word-length seems to have affected difficulty, although there are other factors which are not independent of word-length, such as language of origin and structural complexity. All subjects made errors in reproducing words, whether written or spoken, though the range of variation across subjects in reading-writing was greater, with some having relatively high error rates and some having very low error rates. It must also be remembered that 'error' needs to be defined, and may vary according to the focus of the analysis. The types of errors made and their possible causes will be discussed in more detail in the following sections.

6.1.1. Word-length

Some production problems are potentially due to memory; these would presumably increase with length of words. Of course, a number of different measures can be used for measuring the length of a word, such as syllable count, phoneme count and so on. Additionally, some accounts (for example Caplan et al. 1992) have suggested that it is not number of segments per se that causes difficulty, but phonological complexity. Since the prompts were not matched for length, frequency of segments, graphemic and phonological complexity and so on there is a complicated interaction of the different measures in each prompt. As a brief example, however, the relationship between error rate and word length is shown for reading-writing, with word length measured by grapheme count.

It can be seen in Figure 17 that there is a decrease in the ratio of correct segments per word as word-length increases, though the difference is not great. Also, there are no 10-letter words and only one 11-letter word. A more serious problem in this analysis is that the word-length varied across languages (cf. Table 39 in the previous chapter; Greek had the longest names and Italian the shortest). It is to be expected that prompts from different languages would vary in difficulty of reproduction due to familiarity of letter sequences or complexity of syllable structure. For these reasons not too much importance is attached to the apparent trend, but it is worth considering when examining the data in more detail.

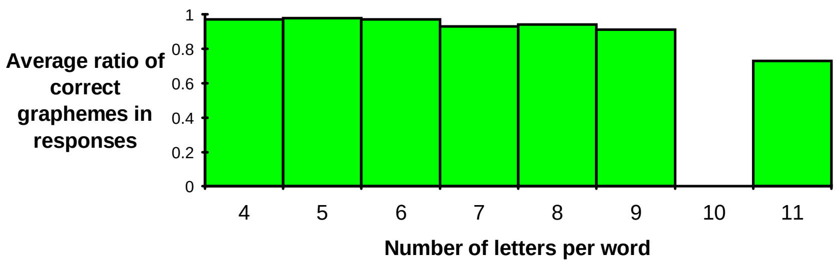


Figure 17: Rate of errors per word compared to word length (reading-writing)

6.1.2. Subject variation

Subjects can be expected to vary in levels of skill. In the reading-writing experiment, for example, it can be seen (Figure 18) that subjects obviously differed in ability at completing the task accurately. However, all subjects made some errors. The error rate is much more even in Figure 19 (listening-speaking). Unlike the reading-writing experiment, there were some segments which all subjects found difficult to reproduce.

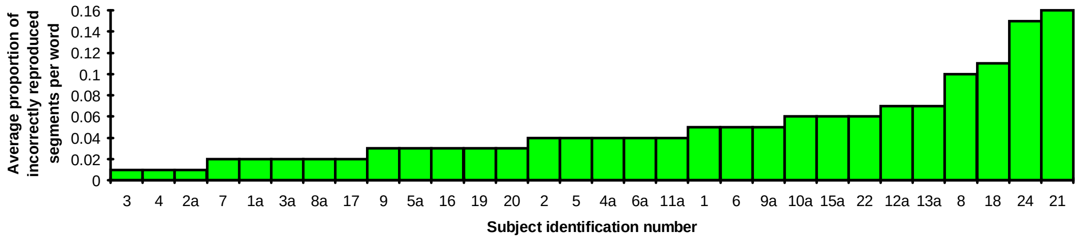


Figure 18: Distribution of errors across subjects (reading-writing)

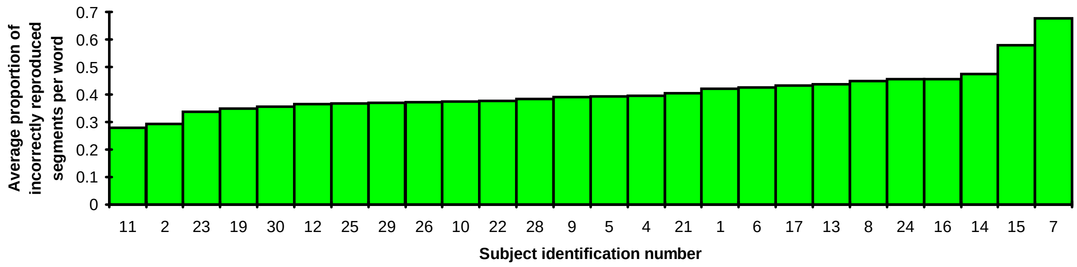


Figure 19: Distribution of errors across subjects (listening-speaking)

6.1.3. Error classification

Finally, there are problems in actually classifying errors. For example, one response to the spoken prompt *Copparo* [koˈpːa.ɾo] was [kʰoˈpʰa.ɾo], while another was [kʰɔ̃mˈpʰa.ɾo]. If we look at the long [pː], we can see that neither of the responses reproduces it correctly. Both are aspirated instead of unaspirated, and neither is long. The second response could be seen as more incorrect than the first, as it contains an additional [m] before the [pʰ]. However, as mentioned previously, some subjects use nasals to represent length which they perceive correctly but misinterpret. Now we might want to say that the second response is actually more accurate than the first, as it represents the length of the [pː] in the prompt. The definition of 'error' therefore depends very much on the parameter being analysed.

6.2. Reproduction within the same medium - spoken

This section presents the results of the listening-speaking experiment. The first part discusses the notion of correct responses, and shows the variation in accuracy across the prompts. Then a more detailed analysis is used, looking at segments, structure and suprasegmental features.

6.2.1. Responses matching original pronunciation

This section discusses 'correct' responses in the listening-speaking experiment.

◊ ***Summary: Responses matching original pronunciation in listening-speaking mode***

There are methodological problems in establishing what is a 'correct' reproduction of a spoken word. As various languages are used in this study, and were to be evaluated on the same basis, phonetic equivalence was used rather than phonemic, which resulted in a strict definition and meant that some pronunciations for British towns which would normally be considered acceptable had to be scored as incorrect. Segmental accuracy varied greatly across prompts. Syllable counts, and to a lesser extent segmental counts, were generally correctly reproduced, as was stress. As for trends across countries, French and Norwegian had low suprasegmental accuracy due to the different nature of their stress/tone systems. Additionally, it was found that knowledge of a language does not necessarily correlate with the level of accuracy in reproducing words from that language. Simple vowel systems have an important part to play here, as vowels constitute a high proportion of the segments; if the vowels resemble native ones the proportion of correct segments in the output will be strongly affected.

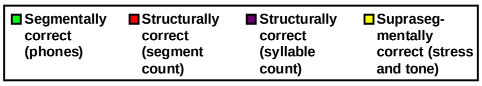
a) Correct responses

A certain amount of care is needed in judging which responses were the same as the original prompt in the listening-speaking experiment. Because the transcriptions were made at a fairly detailed phonetic level, some of the recorded differences may have been due to small variations in vowel quality, or slight differences in consonant articulation. Taking all these variations to be errors, very few responses would be judged the same as the input. Additionally, very few responses repeated accurately the suprasegmental features, where these differed in type from English ones (French prompts with no lexical stress, and Norwegian ones with tone). So, three separate analyses were performed, looking at whether responses were 'segmentally correct', 'structurally correct' and 'suprasegmentally correct', though there is of necessity some overlap between these. There is a certain amount of difficulty in proposing workable definitions of these, but the system used is given below:

i. 'Segmentally correct.' Segments had to be the same as those in the prompt. It is impossible to use a phonemic definition of 'sameness', since 'phoneme' is a language dependent concept and cannot be used to cover tokens from different languages. If we were to permit even that variation which occurs within Edinburgh phonemes, this would allow, for instance, all realisations of /r/ to be correct responses for all /r/ inputs. While this might be a good solution for British towns, it would also necessitate marking, say, an approximant [ɹ] instead of a tap [ɾ] as correct for Italian towns. As this definition is so strict, rather than the judgement of correct/incorrect being applied to the whole word, a score is calculated for each word based on the number of correct segments - one incorrect out of 8 would result in a score of 0.875. Insertions and omissions are also counted as segmental errors, since the input and output segments are not the same.

ii. 'Structurally correct'. There were two parameters within this analysis, involving segment count and syllable count. Segment identity did not have to be preserved, and nor was syllable structure preservation a requirement, since in some cases segmental changes might result in apparent syllable structure changes, for example [p͡saˈxna] → [p͡sakˈna]. Segments did have to bear some relation to the prompt, however, for the segment count; vowels could not be realised as consonants, and vice-versa, though some leeway was permitted for approximants. Segmental changes resulting in different numbers of syllables, such as [ˈbɔ.bɪ.jo] → [ˈbɔ.bi.o], were treated as structurally different. Since affricates, diphthongs and long phones are analysed in this study as single segments, a change from an affricate or a diphthong to a simple phone, or a difference in length, is not treated as a structural error, but a segmental error. However, since subjects may have treated affricates and sequences as the same, a change from an affricate or long phone to two separate segments was also treated as structurally correct, for example, [t͡s] → [ʔs] or [pː] → [mp].

iii. 'Suprasegmentally correct'. For this analysis only the stress and/or tone of the original prompt were analysed. For these to be correct, though, there had to be the same number of syllables in the response as in the prompt. Although segment length is generally treated in this study as a suprasegmental feature, it was not included in this part of the analysis as the different ways of representing length are more accurately covered by the previous two analyses.



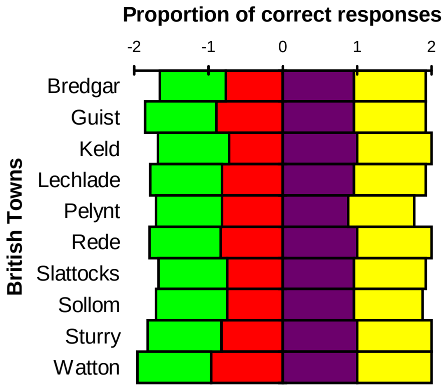


Figure 20: Responses matching original pronunciation (listening-speaking): Britain

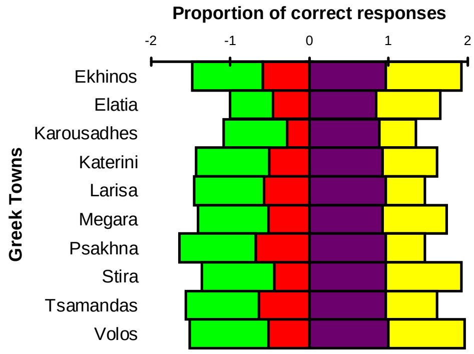


Figure 23: Responses matching original pronunciation (listening-speaking): Greece

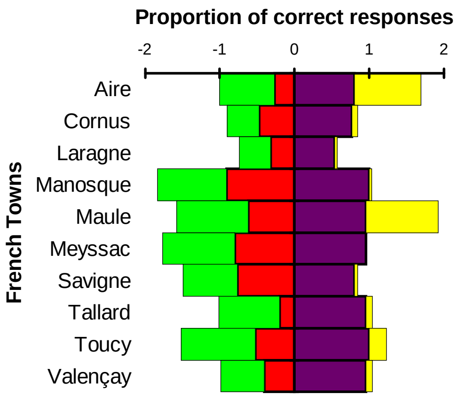


Figure 21: Responses matching original pronunciation (listening-speaking): France

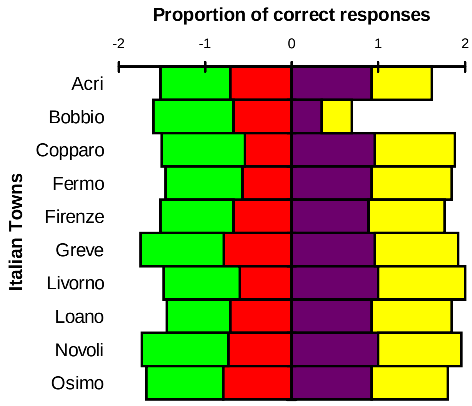


Figure 24: Responses matching original pronunciation (listening-speaking): Italy

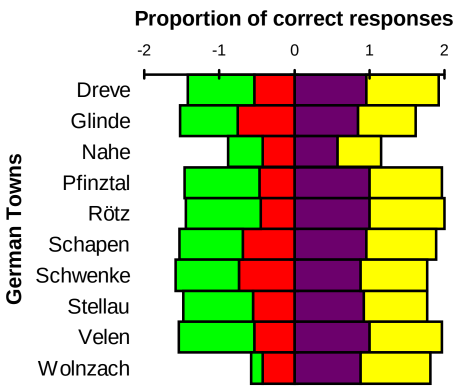


Figure 22: Responses matching original pronunciation (listening-speaking): Germany

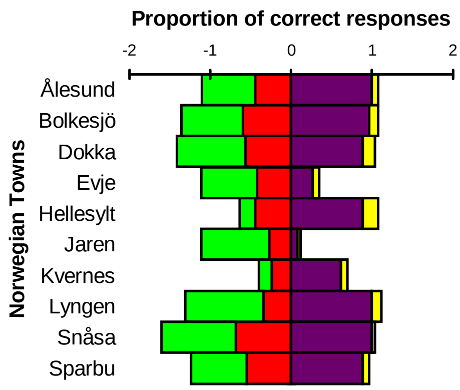


Figure 25: Responses matching original pronunciation (listening-speaking): Norway

It can be seen (Figures 20-25[63]) that few towns were repeated accurately across all parameters and all subjects. Of course, the definitions for 'correct' are fairly strict, especially for segmental accuracy, and also non-answers and incoherent pronunciations were scored as errors, so these account for some 'incorrect' responses. Additionally, accuracy of perception was lower for some prompts than others and naturally affected the output. For British towns, much of the variation in segmental accuracy was due to use of different realisations of certain phonemes; for example, the British prompts contained approximants for /r/, so all taps in the responses to British towns had to be scored as incorrect whereas a phonological analysis would rate them as correct.

Despite these misgivings, however, some trends do emerge. Some words caused particular difficulty on certain parameters. *Tallard*, for example, had low segmental accuracy; it contained a number of segments which differ enough from Edinburgh English that they were not reproduced accurately by many subjects, for instance [t], [l] and [ʀ]. *Wolnzach* had a low score for segment count, due to the complex medial consonant cluster which was rarely reproduced with the full number of consonants, while *Bobbio* had a low score for syllable count, since the two syllables were changed to three by a large number of subjects, who reproduced [bːjo] as [bi.o]. These issues are discussed in more detail in the following sections.

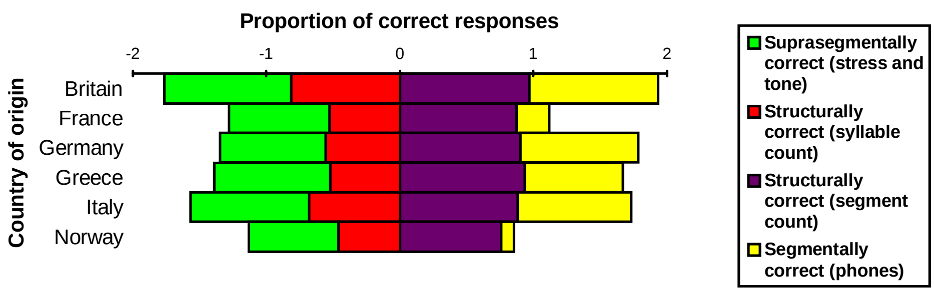


Figure 26: Summary of responses matching original pronunciation (listening-speaking)

As for overall trends across countries (Figure 26), the main point to note is the lack of suprasegmentally correct responses in French and Norwegian towns. This of course is due to the use of suprasegmental systems which differ noticeably from English; French has no word stress (most of the 'correct' responses were in fact monosyllables), while Norwegian has lexical tone, which

[63]It should be noted that these figures use negative axes, as mentioned in the notational conventions at the beginning of this thesis, in order to display four parameters clearly on one graph; the absolute values should be read. Each parameter is actually scored on a proportional scale from 0-1.

only a few subjects reproduced accurately. British towns naturally came out best on all scores, while Norwegian ones fared the worst on all scores. Despite the subjects knowing French and German better than the other foreign languages, Italian towns had higher segmental accuracy; this is largely due to the greater overlap between Italian phones and Edinburgh ones; the only Italian phones in the prompts which do not exist in Edinburgh accents are the long consonants, the affricate [t͡s] and clear [l], while French and German have a number of vowel differences and some additional consonants not in most subjects' normal repertoires, such as [ʀ] and [ʁ]. The segmental score for Greek towns was also not much lower than for French towns; again, we can ascribe this to the lack of new phones - a number of consonants are different from Edinburgh English, but no vowels.

6.2.2. Segmental output

This sections discusses segmental reproduction of spoken prompts.

◊ ***Summary: Segmental output of listening-speaking mode***

The analysis here does not fully answer the question of how to define similarity of segments and whether some features are more important than others, nor how to predict which phone will be the favoured response for a given foreign segment. There is a wide amount of variation in spoken responses to spoken prompts, which is influenced by phonetic similarity, phonetic context, phonemic considerations, suprasegmental factors and of course the initial perception of the sound. Foreign segments were not always nativised, and some non-native phones were produced in response to spoken native segments. The variety of responses given show that any prediction as to the segmental changes which will be made by native speakers to foreign words can only ever be probabilistic.

a) Phones

Many of the differences between the non-native sounds and native ones are slight, and it is not always easy to determine whether subjects are repeating features such as dental rather than alveolar place of articulation, or the precise vowel quality. Even if the features are repeated, we cannot know for certain whether this is intentional - more data would be needed from each subject to determine their normal range of variation.

Appendix C shows spoken responses grouped by segment, not taking phonetic environment into account. Table 45 below shows those which are considered here to be non-native or potentially non-native (cf. Tables 14 and 15 in the previous chapter).

While some of these, such as [u], are nearly always reproduced as a native phone or combination of phones (in this case [ʉ]), others, such as [ø], are not nativised to the same extent. Some of this may be due to language teaching, and some due to the lack of similarity with native phones (cf. Flege's theories, discussed in Chapter 2). Some typical nativisation solutions are to be found within the responses. For example, responses to [y] alternated between [ʉ], which is further back, and [i], which is less rounded. Unfamiliar affricates were often reduced to one segment (though this may be a perception rather than production problem, as discussed previously), while other phones had their features split across multiple segments, for example [ɑ̃] → [ɔn]. Some had less predictable responses, possibly due to perceptual difficulties with particular prompts; the high proportion of [o] in response to [u], for example, is matched by a high number of written <o> responses for the same prompt (*Karousadhes*), which suggests that the change has a perceptual origin.

There was, of course, a certain amount of variation in the responses which can be attributed to the use of phones which are phonemically equivalent in Edinburgh. For the various types of /r/, for example, while the most common response in each case was that used in the prompt, there was a high level of use of other types of /r/ common in Edinburgh; it is clear that these are identified as similar sounds. (It is interesting to note that for [ʀ], which is not generally found in Edinburgh, was also identified as /r/; the most common response was [ɹ]). Some examples are rather more complex. For example, [t], as found in *Toucy* and *Tallard*, is an English allophone of [tʰ] in certain environments, but not of [d]. A high proportion of responses, however, used [d] (cf. Chapter 5, p. 144 on perception of this sound). The status of [t] - [tʰ] is not really equivalent to that of [ɹ] - [ɾ] - [ʁ], since the former is strictly conditioned by phonetic environment and so less likely to be accurately reproduced in other contexts, while the latter is influenced but not determined by environment.

	Most common responses (over 10% of total)							
Vowels not present in Edinburgh English								
u	ʉ	22	o	8	ə	6		
y	ʉ	16	ɪ	13	y	8		
ø	ø	8	ɜ	4				
œ	ʉ	5	œ	3	ɜ	3		
a̠͡ʊ	ʌ͡ʊ	11	a͡ʊ	5	a	3	a̠͡ʊ	3
ɑ̃	ɑ̃	7	ɔn	5	ɔ̃	5		
Consonants not present in Edinburgh English								
t̪	tʰ	37	t	16	t̪	9		
s̪	s	153						
ç	x	16	h	3				
ɣ	h	15						
ɲ	n	21						
ɳ	ɹn	20	n	20				
ʀ	ɹ	38	ʀ	16				
l	lˠ	240	l	103	ɫ	78		
p͡f	f	13	v	7				
p͡s	s	4	p͡s	4				
t͡s	s	60	t͡s	49				
Vowels not always present in Edinburgh English								
æ˞	a	6	a̠ɹ	6	aʀ	4		
a	a	498						
aː	a	8	a̠	8	aː	6		
a̠	a	21	a̠	4				
a̠ː	a	24	aː	7				
ɑ	ɑ	10	a	5	a̠	4		
ɑ˞	a̠	15	ɑ˞	3				
Consonants not always present in Edinburgh English								
p	p	24						
pː	pʰ	13	p	5				
t	t	83	d	22	tʰ	19		
k	k	94	kʰ	92				
kː	kʰ	10						
ɾ	ɾ	132	ɹ	83				
ɹ	ɹ	71	ɾ	22				
ʁ	ʁ	19	ɹ	13				

Table 45: Responses to phones with no or variable equivalents in Edinburgh English (listening-speaking)

There were also a number of foreign segments produced in response to native segments (see Appendix C). Some examples are [ç] for [ʃ], [ɲ] for [n] and [œ] for [ʉ]. Of course, these sounds may have been poorly perceived by the subjects in question, and their use was undoubtedly encouraged by the nature of the experiment; it is questionable whether such segments would occur in response to a native sound in a natural situation.

Some of the 'errors' in reproduction were due to minor phonetic variation - slight variations in velarisation of [l], small differences in vowel height and so on were all transcribed and contribute to the variation. Additionally, there were effects of context, particularly on vowels and consonant clusters. One such example is the first [a] in *Tallard*. This was clearly perceived as [a] - this was the second most common response for the segment in the listening-speaking experiment, and was used nearly unanimously in the listening-writing experiment (see Appendix B), but the most common response in listening-speaking was [ə]. This can only be attributed to vowel reduction associated with lack of stress; such factors show the importance of considering the word as a whole.

6.2.3. Structural output

This section presents results pertaining to the output of phone sequences and syllables.

◊ ***Summary: Structural output of listening-speaking mode***

Responses in the listening-speaking experiment show that subjects sometimes managed to reproduce non-native clusters, while in other cases they produced non-native clusters in response to a prompt which did not contain problematic sequences. Of course, listening-speaking was a difficult task and some of the latter may have been due to confusion and error, or to poor perception; some may also have been due to natural fast speech processes or to hyperforeignism, but more data is needed to investigate these hypotheses.

Subjects generally preserved the number of syllables in the input, and for the most part produced similar syllable structures to the input. Grouping of affricates and long consonants with short consonants proved the most appropriate analysis for this data, but, as noted above, this may or may not be the best breakdown for a wider range of data. The data did not support the hypothesis that syllable structure changes would result in an increase in CV syllables, the universally most favoured syllable type.

a) Phonotactics

Table 31 in the previous chapter shows responses to non-native spoken consonant clusters in the listening-speaking experiment, while Table 32 shows non-native affricates. Tables 33 lists native and near-native sequences and affricates. These show, by comparison with the listening-writing responses, that some changes made in the output were in fact probably perceptual problems, as they occurred for both modes of response. Of course, in some cases similar output constraints apply in speaking and spelling, and this might affect the output. For example, [pf] is not an allowable initial sequence in English, and neither is <pf>, so both might be subject to either vowel epenthesis or omission of one consonant. Responses to non-native consonant clusters do show, however, that not all subjects followed these constraints; bearing this in mind, 'constraints' is perhaps too strong a term when applied to subject behaviour.

There were, additionally, a handful of non-native sequences produced for names which did not have them in the prompts (Table 46). These were either consonant clusters, consonants combined with vowels in a sequence not found in English, or consonants in a syllable position which they do not occupy in English. (Sequences which were non-native only because one of the segments was non-native are not included here, but under the segmental analysis, and long segments are treated under length.) Whether these sequences were planned at a phonological or other abstract level, however, or were 'errors' arising between the planning and output stages, for instance due to the difficulty of articulating an unfamiliar word, or corrections, hesitations and so on, is a matter for speculation. It is also possible, of course, that the input was incorrectly perceived.

Town	Prompt	Response	Non-native sequence
Livorno	liˈvoɾ.no	lˠiˈvjœɹ.no	vjœ
Wolnzach	ˈvɔln.t͡sa̠x	ˈvɔɫ.sah	h#
Jaren	ˇjɑˑ.əɳ	nja̠n	nja̠
Lyngen	ˇlyŋː.ən	˜lˠjø̠ŋ.ən	lˠjø̠
Sparbu	ˋspɑːɾ.bʉ	ˈʃpaɹ.bə spa̠ɹ.bjø	#ʃp bjø
Rede	ɹid	hɹid̥	hɹ
Acri	ˈa.kɾi	aˈkŋ	kŋ

Table 46: Non-native sequences not in response to non-native input (listening-speaking)

There is, however, a third possibility in addition to planned output and error, which should be briefly mentioned. It has been observed that sequences which are not found in English canonical forms may be found in fast speech (Bolozky 1977 gives as an example [#pt] in *potato*); these are not one-off accidents, nor perhaps are they planned. They are surface realisations resulting from fast speech rules (or removal of constraints in fast speech, depending on the theoretical viewpoint taken). The transcriptions in Table 46 are of course phonetic, and correspond to single tokens such as [ˈpte.to] rather than the dictionary form /pəˈte.to/. Unfortunately, there is far less work on phonetic sequences than phonological ones, so more studies would be needed to see whether the sequences listed above are similar to ones which might appear in different speech styles.

It is worth drawing attention to the output [ʃp] for [sp] in *Sparbu*; while this can be explained in the same manner as the other responses in Table 46, it is also possible that this is a hyperforeignism; if this is the case, we would need to conclude that hyperforeignisms can occur in response to speech input as well as written input.

b) Syllables

Table 47 shows the syllable structures in the input of the listening-speaking experiment, and the syllable structures in the responses, with maximal phonetic onset used for syllable divisions. In grouping the structures, short vowels, long vowels and diphthongs are all treated as single segments. Short consonants, half-long and long consonants and affricates are also treated as single segments. For consonants in English, length is generally distinctive at the point at which a consonant becomes as long as two consonants, e.g. at a syllable boundary such as *cheque-card*, (cf. *Dokka*). The affricates in the data, with the exception of that in *Lechlade*, also correspond to two separate consonants in English, for example *guts* (cf. *Firenze*). However, analysis of the data showed that the most common responses to both long consonants and affricates were in fact single segments, suggesting either that the subjects perceived them as such or that in the process of production they dropped one consonant, even in cases where the two had distinct identities. The boxed groups in the table show syllables which are, under this analysis, equivalent in structure, so for instance CːV and CV are listed in separate rows but are in the same group.

Structure of response	Syllable structure of input																									
	v	vˑ	vc	vːc	cv	cvˑ	cvː	cv͡v	cːv	c͡cv	ccv	ccvˑ	ccvː	cːcv	cvc	cvˑc	cvːc	cvcː	c͡cvc	cvc͡c	ccvc	ccvːc	cvcc	cv͡vcc	c͡cvcc͡c	total
v	135	17	14		6																					172
vˑ	3	3																								6
vː			2																							2
vc	6	1	29	10											2											48
vːc				9																						9
v͡vc				1																						1
cv	13	4	2		1324	1	42	5	59	47	7	1		2	16		1	1	5				1			1531
cvˑ					5	1	4										1		1							12
cˑv					5		1		6						1											13
cˑvˑ					1																					1
cvː					2		17		1		1						1									22
cv͡v					3		3	19			1	1			3		1									31
cːv					6				4																	10
c͡cv					6					18									5							29
ccv					4					1	155	24	15	2								3				204
ccvˑ												6														6
ccvː													10									2				12
ccv͡v											3															3
cˑcv											4			2												6
cːcv											1			3												4

Table 47: Syllable structure input and output (listening-speaking). Response structures equivalent to input structures are shaded and boxed; most common responses, if these differ from the input, are lightly shaded.

Structure of response	Syllable structure of input																									total
	V	Vˑ	VC	VːC	CV	CVˑ	CVː	CV͡V	CːV	C͡CV	CCV	CCVˑ	CCVː	CːCV	CVC	CVˑC	CVːC	CVCː	C͡CVC	CVC͡C	CCVC	CCVːC	CVCC	CV͡VCC	C͡CVCC͡C	
CC					3						1				6											10
CVC			3	2	35		6			6		5			486	18	32	20	9						2	624
CVˑC															4		1	1								6
CVːC							2								2		10	1								15
CV͡VC															1											1
CVCˑ															1			1					2			4
CˑVC										1	1				1	2							33			38
CˑVːC																	1									1
CVCː					2									1	1											4
CVːCː							1																			1
CːVC							1									2										3
C͡CVC										1									5							6
CVC͡C																				48						48
CV͡VC͡C																				2						2
CCVC						1						4			10		2	1			68	17				103
CCVːC																						2				2
CːCVC															1											1
CCːVːC												1														1
C͡CCVC																					1					1
CCC																							2			2
CVCC					2	19									10								106		11	148
CVˑCC						2										1							1			4
CV͡VCC																								24		24
CˑVCC																									1	1
CVCCˑ																							1			1
CVCˑC																							1			1
CˑV͡VCC																								1		1
CVCːC																							1			1
CVCC͡C															1										7	8
C͡CVCC͡C	3																								3	3

Table 47 (continued)

Structure of response	Syllable structure of input																									total
	V	Vˑ	VC	VːC	CV	CVˑ	CVː	CV͡V	CːV	C͡CV	CCV	CCVˑ	CCVː	CːCV	CVC	CVˑC	CVːC	CVCː	C͡CVC	CVC͡C	CCVC	CCVːC	CVCC	CV͡VCC	C͡CVCC͡C	
CCVCC					1																					1
CVCCC	2																								2	2
V-CV				1																						1
VC-CVC															1											1
CV-V					3									11												14
CV-Vː					1																					1
CˑV-V														2												2
CːV-V					14									2												16
CV-CV					1							1			2											4
CV-CVˑ												1														1
CːV-CV															1											1
CV-CVC												5			2						6		1			14
CV-VC				1	3										2	1										7
CV-CCV															10											10
CV-CCVC															2											2
CVː-CCV															1											1
CVCˑ-CCVC															1											1
omitted	14		22						1						1								1			39
queries	12	1	5	2	81	2	1	2	7	4	8	3	1	1	29	2	2	1	1	2	3	2	6	1		179
no. of syllables in prompts	8	1	2	1	58	1	3	1	3	3	7	2	1	1	23	1	2	1	1	2	3	1	6	1	1	
total responses	208	26	52	26	1508	26	78	26	78	78	182	52	26	26	598	26	52	26	26	52	78	26	156	26	26	

Table 47 (continued)

Looking at Table 47, it can be seen that most responses preserved the number of syllables in the input (cf. data in Figures 20-26 above, showing the 'correct' responses in the listening-speaking experiment). Out of 3484 syllable inputs (134 syllables in the prompts, for 26 subjects), there were only 39 cases of two syllables being merged into one, and 76 instances of an extra syllable being inserted.[64] Out of 25 syllable types, the most common response structure preserved the input structure in 10 cases; of the other 15, 13 fell within the same group (i.e. with differences only in consonant length, etc.). This is heavily dependent on the classification of affricates and long consonants as structurally equivalent to short consonants; of the 7 prompt syllable types containing long consonants or affricates, 5 had as the most common response a structure reducing them to single short segments, for example [c͡cvc] → [cvc]. The other two were [cːcv] for *Bobbio*, discussed below (p. 194), and [cvc͡c], in which the affricate was mostly preserved. The syllable inputs for this were from *Lechlade*, which contained the only native affricate, [t͡ʃ], and *Rätz* , which contained [t͡s] in a position which does not violate the structural constraints of English.

Of course, if there had been a higher number of non-native affricates which did not violate the structural constraints of English, the results might have been rather different, with more affricates preserved. The results might also have been different if there had been more consonant combinations which violated English structure, such as [kv] in *Kvernes*. However, the pattern of results may have been primarily due to the fact that the affricates mostly contained consonants with similar places of articulation, while the consonant sequences did not and so were more easily perceived as two separate consonants; alterations in the output might then favour insertion of a vowel rather than omission of one consonant. (See also the section on structural perception of spoken forms, p. 148 ff. in the previous chapter.) So, we can say that this analysis is appropriate for the data here but without a broader study looking at a greater number of patterns, it is difficult to say whether grouping affricates and long consonants with short consonants is generally the best analysis.

The remaining syllables contain high proportions of changed syllable counts. These are *Jaren*, commonly changed from 2 syllables to 1, and *Bobbio*, often changed from 2 syllables to 3. Jaren was typically changed from [˘jɑˑ.əɳ] to [ja̠ɹn], due partly to the two adjacent vowels not forming very distinct syllables in

[64] Merged syllables are listed in Table 47 under the stressed input syllable. The other syllable from the input is recorded as 'omitted'.

this particular prompt, and partly due to features of the [ə] and [ɳ] being confused and realised as two consonants. In *Bobbio*, a small segmental change from [j] to [i] results in a quite different syllable structure, increasing the number of syllables and altering the consonant-vowel patterning. Of course, this also highlights deficiencies in the rather crude separation of segments into consonants and vowels; a featural analysis, for instance, would give rather more groupings and be more revealing in the case of such relationships. However, a more detailed classification would require more data for the analysis of under-represented structures.

It had been expected that structural changes would result in more CV syllables in the output than the input, as this is a universally favoured syllable type. However, an examination of the input and output syllables shows an increase of only 1.5% in CV syllables, from 1508 to 1531. Including all syllables in the CV group (CVˑ, CVː and so on), the change is actually a decrease of 8.5%. It should be noted, however, that nearly all groups decrease since some syllables are omitted and some are queried; while some new syllables are introduced the new two-syllable structure is only counted as one entry; these split syllables are shown as hyphenated responses in Table 47. The only groups showing an increase are CCVC, split syllables (for which there was of course no similar structure in the prompts) and a very small number of CCVCC and CVCCC syllables. The total decrease due to queries and omissions is 6%, less than the decrease for the CV syllable group, which certainly does not support the hypothesis that changes would produce more CV syllables than before. The greatest decrease was for the VC group, but the sample size here was smaller. In order to determine whether there are any general tendencies, a wider variety of data would be needed since small groups can be dominated by responses to just one or two prompts.

6.2.4. Suprasegmental output

This section discusses the repetition of stress, tone and segment length in the spoken prompts.

◊ ***Summary: Suprasegmental output of listening-speaking mode***

Stress was reproduced very accurately in the listening-speaking experiment, and the majority of errors were confined to just a few names. Some of the words which had incorrect stress were also given the same stress pattern in the reading-speaking experiment; there are a number of possible reasons for this, including prevailing stress patterns in English and the rime structure of the syllables. Lack of stress (in French words) was not reproduced as accurately; stress patterns assigned to French prompts were unrelated to the perceived origin of the names.

Tone was not always reproduced, and most attempts at tone were produced by a small minority of subjects. Over a quarter of the attempts at tone differed from the pitch contour of the original prompt.

Long segments were repeated in a minority of cases, and there were a small number of instances of long consonants being realised as two different short segments. There were also some examples of two different short segments combining to give one long segment. There was a small number of long segments produced in response to short segments in the prompts.

a) Stress

Town (stressed vowel underlined)	Prompt	Number of responses stressed as original	Alterations	Frequency
Psakhna̲	p͡s aˈxna	13	*Psa̲khna*	11
La̲risa	ˈla.ɾi.s̠a	13	*Lari̲sa*	10
Tsamanda̲s	t͡sa.manˈdas̠	17	*Tsama̲ndas*	7
A̲cri	ˈa.kɾi	18	*Acri̲*	4
Karousa̲dhes	ka.ɾuˈs̠a.ðɛs̠	20	*Ka̲rousadhes* *Karousadhe̲s*	1 1
He̲llesylt	ˇhe.lːə.syltʰ	21	*Hellesy̲lt*	2
Do̲kka	ˇdɔ.kːa	21	*Dokka̲*	1
Kateri̲ni	ka.t̪ɛˈɾi.ni	21	*Ka̲terini*	1
Me̲gara	ˈmɛ.ɣa.ɾa	22	*Mega̲ra* *Megara̲*	1 1
Spa̲rbu	ˋspɑːɾ.bʉ	22	*Sparbu̲*	1
Bo̲lkesjö	ˇbɔl.kə.ʃø	23	*Bolkesjö̲*	1
Coppa̲ro	koˈpːa.ɾo	24	*Co̲pparo*	1
No̲voli	ˈnɔ.vo.li	25	*Novo̲li*	1

Table 48: Stress changes (listening-speaking)

As already mentioned, there were very few errors in reproducing stress in the listening-speaking experiment. Even where the syllable count or structure was altered, stress was generally kept on the vowel which was stressed originally, for instance [gəˈvaɹ.nɪs] for [ˋkvæˑ.ɳeˑs]. There were some unclear cases, such as [vɔˈlʏɔn.d͡sa] for [ˈvɔln.t͡s a̠x], in which it is difficult to determine whether the first or second vowel in the response corresponds to the stressed vowel in the prompt. However, excluding such unclear cases, ones in which the stress pattern could not be determined, prompts or responses with no stress and ones in which the whole answer was blank or muddled, only the responses in Table 48 had altered stress.

Town (stressed vowel underlined)	Pronunciation in original language	Number of responses stressed as original	Other patterns (stressed vowel underlined)	Frequency
L<u>a</u>risa	ˈla.ɾi.<u>s</u>a	0	Lar<u>i</u>sa	23
Psakhn<u>a</u>	p͡sa'xna	0	Ps<u>a</u>khna Psakh_na	16 6
Tsamand<u>a</u>s	t͡sa.manˈda<u>s</u>	3	Tsam<u>a</u>ndas Ts<u>a</u>mandas	17 4
M<u>e</u>gara	ˈmɛ.ɣa.ɾa	4	Meg<u>a</u>ra	19
Pel<u>y</u>nt	pʰəˈlˠɪntʰ	4	P<u>e</u>lynt	18
N<u>o</u>voli	ˈnɔ.vo.li	4	Nov<u>o</u>li	17
B<u>o</u>lkesjö	ˇbɔl.kə.ʃø	6	Bolk<u>e</u>sjö	17
Ekh<u>i</u>nos	ɛˈçi.nɔ<u>s</u>	9	<u>E</u>khinos	13
Karous<u>a</u>dhes	ka.ɾuˈ<u>s</u>a.ðɛ<u>s</u>	10	K<u>a</u>rousadhes Kar<u>ou</u>sadhes	6 5
<u>O</u>simo	ˈɔ.zi.mo	12	Os<u>i</u>mo	8
Kater<u>i</u>ni	ka.t̪ɛˈɾi.ni	18	Kat<u>e</u>rini	3
Kv<u>e</u>rnes	ˋkvæˑ.ɳeˑs	18	K_vernes Kvern<u>e</u>s	2 1
Fir<u>e</u>nze	fiˈɾɛn.t͡se	19	F<u>i</u>renze	5
L<u>e</u>chlade	ˈlˠɛt͡ʃ.lˠed	20	Lechl<u>a</u>de	4
V<u>e</u>len	ˈfeː.lən	20	Vel<u>e</u>n	4
B<u>o</u>bbio	ˈbɔ.bːjo	20	Bobb<u>i</u>o	4
H<u>e</u>llesylt	ˇhe.lːə.syltʰ	20	Hell<u>e</u>sylt	3
<u>Å</u>lesund	ˇɔˑ.lə.sʉn	20	Å<u>l</u>esund	1
Copp<u>a</u>ro	koˈpːa.ɾo	21	C<u>o</u>pparo	3
<u>A</u>cri	ˈa.kɾi	21	Acr<u>i</u>	2
Sch<u>a</u>pen	ˈʃ<u>a</u>ː.pʰən	21	Schap<u>e</u>n	1
Sl<u>a</u>ttocks	ˈslˠa.tʰəks	22	Slatt<u>o</u>cks	2
S<u>o</u>llom	ˈsɔ.lˠəm	22	Soll<u>o</u>m	2
Liv<u>o</u>rno	liˈvoɾ.no	22	L<u>i</u>vorno Livor_no	1 1
El<u>a</u>tia	ɛˈla.t̪i.a	22	Elat<u>i</u>a	1
St<u>i</u>ra	ˈ<u>s</u>t̪i.ɾa	22	Stir<u>a</u>	1
Br<u>e</u>dgar	ˈbɹɛd.gaɹ	23	Bredg<u>a</u>r	1
St<u>e</u>llau	ˈʃtɛ.l<u>a</u>͡ʊ	23	Stell<u>au</u>	1
W<u>o</u>lnzach	ˈvɔln.t͡s<u>a</u>x	23	Wolnz<u>a</u>ch	1
L<u>y</u>ngen	ˇlyŋː.ən	23	Lyng<u>e</u>n	1

Table 49: Stress variations (reading-speaking)

It is informative to compare these results to the stress patterns in the reading-speaking experiment. Table 49 shows words in the reading-speaking experiment with altered stress, analysed using similar criteria to those in Table 48,[65] i.e. ignoring syllable counts and looking only at which vowel carried the stress.

It is interesting to note that although the prompt was different in the two experiments, in one case written and in the other spoken, the same tendencies appear in output stress. The three names which contained most mistakes in the listening-speaking experiment (*Psakhna*, *Larisa* and *Tsamandas*) are also the top three in the reading-speaking experiment for stressed vowels which did not match with those stressed in the original language.

From the dictionary data examined earlier, the most favourable environment for stress location appears to be similar in both writing and speaking (cf. Chapter 3, p. 67 ff., with Figure 4 for graphemic environment and Figure 6 for phonemic environment); if the input environment were the explanation, this would require that the environment can influence perception of stress in spoken words. As noted in Chapter 3, some perceptual elements of stress, such as increased duration, are similar to some of the perceptual effects of syllable weight, so perception may well have some influence. On the other hand, it may be that stress placement can be influenced by the phonemic[66] environment in the output string.

Of course, two of the three names with most stress errors in listening-speaking, *Psakhna* and *Tsamandas*, have input stress patterns which are unusual in English, with stress on the final syllable, and it may be simply that certain stress patterns are so prevalent in English that they exert a strong influence on the output. For singular nouns in the dictionary (Table 4, Chapter 3), bisyllabic words had a stressed final syllable in only 8% of cases, while for trisyllabic words the figure was 4%. *Pelynt*, the other name with final stress in the original language, is not far behind in the list for reading-speaking (Table 49), although in the listening-speaking experiment it did not cause any problems. This may have been because the acoustic stress cues for the spoken *Pelynt* prompt happened to be stronger than for *Tsamandas* and *Psakhna*, or it may have been because the phonemic environment of *Pelynt* is more favourable for final stress than *Psakhna* and *Tsamandas*. If we look at the consonantal

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[65]This results in a slightly different analysis from that used in later sections analysing stress in the reading-speaking experiment, where syllable counts were required to match; this was so that there was an unambiguous relationship between written input and spoken output.

[66]'Phonemic' is used here to avoid the potential confusion between 'phonetic' and 'acoustic'; it is appropriate, in any case, when discussing syllable weight, as this is a phonemic concept, although of course the phones from other languages are not in general treated as phonemes in this study.

element of syllable weight, i.e. the number of spoken consonants in the rime, with syllables divided by maximal phonemic offset (cf. Figure 6 in Chapter 3), the final syllable in *Pelynt* is heavier than the penultimate, while for *Psakhna* and *Tsamandas* the penultimate syllables are heavier than the finals.

Of the other names in the listening-speaking experiment, only *Acri*, *Karousadhes* and *Hellesylt* have a stress change from more than one subject. These also appear in Table 49, although not as high in the list.

	Stress pattern of responses								
	UUU	UUS	USU	SUU	UU	US	SU	Mono-syllable	Rejected response
Savigne	1		4			21			
Toucy					6		20		
Laragne	2	1	6		1	14		1	1
Manosque					1	22	3		
Meyssac					1	5	17		3
Cornus		4	1		1	18	1		1
Tallard					2	16	5		3
Valençay	2		13	9					2

Table 50: Stress in responses to multisyllabic French prompts (listening-speaking); U = unstressed syllable, S = stressed syllable; correct stress patterns are shaded

If we look at the prompts with no stress (French, Table 50), we see that subjects are not quite so good at accurate reproduction. Of eight multisyllabic French words, for 26 subjects, only 17 responses were unstressed; the bisyllabic words were mostly given final stress (96 out of 182 responses), with some penultimate stress (46 responses). *Valençay*, with 3 syllables, had 2 unstressed responses, 13 penultimate stresses and 9 final stresses.

The predominance of final stress shows that subjects are not averse to stressing the final syllable, which was suggested above as one of the possible explanations for responses to *Psakhna* and *Tsamandas*. The French words contained no consonant clusters except for medial [ʀn] in *Cornus* and the final [sk] in *Manosque*, so by this measure most of the words would have no contrast in syllable weight between final and penultimate syllables. In this situation English stress rules would still assign stress to the penultimate syllable, but the pressure on subjects to do so might be less strong. However, if we are looking at phonemic patterns for an explanation, *Cornus* contradicts the hypothesis; despite the medial cluster it mostly had final stress in the responses.

Two bisyllabic words, *Meyssac* and *Toucy*, were given mostly penultimate stress, as was *Valençay*. We can again find possible phonological explanations for this; *Toucy* and *Valençay* had the only open final syllables, making the penultimate syllable heavier, particularly for *Valençay*, whose nasal vowel which some subjects perceived and/or reproduced as a vowel plus a nasal consonant. There was little difference in stress patterns, though, between responses with nasal vowels, and those for which the nasal vowel was realised as a vowel plus one or more consonants. *Meyssac* is more difficult to account for. It is possible that subjects found it more difficult to stress a final syllable ending in a stop such as [k] than a continuant such as [s], or that subjects associate the vowel [ɛ] in the first syllable of bisyllabic words with stress,[67] or that the acoustic stress cues in this particular prompt were not strong and so were poorly perceived, but without further evidence this is merely speculation.

Figure 27: Stress patterns assigned to French names compared to judgements of origin (listening-speaking)

The perceived French origin may of course have had an effect; we might suppose that names thought to be French would be more likely to have no stress or final stress, given that French words are often realised in English with final stress (cf. *bon voyage*, etc.). If we look at the perceived origins of the French prompts, however, and compare these to stress patterns in the output, we can see there is little relationship between the perceived origin and the stress pattern used (Figure 27). The only stress pattern showing a different set of judgements of origin from the other stress patterns, that of antepenultimate stress, contradicts the hypothesis but relies on data from just one word, *Valençay*.

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[67]If we compare stress patterns from the RP (i.e. non-rhotic) on-line dictionary, for bisyllabic words with a single medial consonant, we have: a total of 7953/10753 vowels in the first syllable were stressed (999 of the unstressed vowels in the first syllable are schwa, and 759 are [ɪ], leaving 7953/8815 other vowels, or 90%); 648/662 [ɛ] in the first syllable were stressed, or 98%. It does seem as though [ɛ] is particularly unlikely to be stressed in this environment. On the other hand, comparable figures for [a] (*Tallard*, *Laragne* and *Savigne*) are 946/999 stressed or 95%, which is only slightly lower than for [ɛ]. It is interesting to note that most of the 14 words with unstressed [ɛ] in the first syllable are actually foreign place or personal names, such as *Penang*, and many of the words with unstressed [a] are loanwords, such as *rapport*.

b) Tone

When describing the responses, 'tone' is used to indicate a pitch or intonation pattern which is noticeably different from what would normally be expected in the subject's accent. In the following tables, 'similar tone to prompt' is used to describe an approximation to the Norwegian tone; this is interpreted fairly generously given the subjects' inexperience with tones. 'Attempt at tone' means a pitch pattern which is not the same as the subject's normal speech, but is not very similar to the original Norwegian word, and 'no attempt at tone' indicates the subject's normal pattern has been used. For the listening-speaking experiments, we have the representations of tone in Norwegian words shown in Table 51. In this table, 'rejected responses' are those for which no answer, or a completely incomprehensible answer, was given; 'similar tone to prompt' .

Spoken prompts		Spoken responses			
		Similar tone to prompt	Attempt at tone	No attempt at tone	Rejected responses
Ålesund	ˇɔˑ.lə.sʉn	2	1[68]	23	
Bolkesjö	ˇbɔl.kə.ʃø	4	1	21	
Dokka	ˇdɔ.kːa	4		19	3
Evje	ˇev.jə	4		22	
Hellesylt	ˇhe.lːə.syltʰ	6	1	19	
Jaren	ˇjɑˑ.əɳ	3	1	20	2
Kvernes	ˋkvæˑ.ɳeˑs	2	2	20	2
Lyngen	ˇlyŋː.ən	3	2	21	
Snåsa	ˋsnɔˑ.sɑ	1	3	22	
Sparbu	ˋspɑːɾ.bʉ	2	2	20	2

Table 51: Repetition of tone (listening-speaking)

Tables 52 and 53 are grouped by subject and country response respectively, in order to see if there is any pattern to the responses containing tones. It is evident that some subjects contribute disproportionately to the tone responses, with 12 subjects attempting tone in responses; just 3 subjects account for 52% of responses with tones. There is little to suggest that perceived country of origin affected tone in the responses; 14% of 'Norwegian' responses were given some kind of tone, while 19% of responses placed in other countries used tone. The figures for responses with tone do not constitute a large data set.

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[68] A tone was used for the whole response (i.e. "Ålesund is in Norway").

Subject	Spoken responses			
	Similar tone to prompt	Attempt at tone	No attempt at tone	Rejected responses
1.	3	2	5	
2.	1		5	4
4.[69]			10	
5.	6	4		
6.			10	
7.	2		8	
8.	4		6	
9.			10	
10.			10	
11.			7	3
12.			9	1
13.			10	
14.		3	7	
15.	8		2	
16.		1	9	
17.	4	1	5	
19.			10	
21.	3		7	
22.			10	
23.			10	
24.			10	
25.		1	9	
26.			9	1
28.		1	9	
29.			10	
30.			10	

Table 52: Repetition of tone (listening-speaking), by subjects

Country in response	Spoken responses			
	Similar tone to prompt	Attempt at tone	No attempt at tone	Rejected responses
Britain	4	1	18	
France	2		13	1
Germany	7	3	45	
Greece	5	1	21	
Italy	2	1	11	1
Norway	10	6	98	
Other	1	1	1	7

Table 53: Repetition of tone (listening-speaking), analysis of country responses

For comparison, Table 54 shows words which elicited responses with a tone (or pitch) which was noticeably different from what would normally be expected (again, n = 26). As can be seen, the number of such responses is very

[69]Subject 3. was omitted on the basis of the questionnaire.

small, and two are of dubious status, as is noted in the last column. The high pitch in some of these may simply be an exaggerated stress feature.

Spoken prompts		Spoken responses containing tones: Response	Country response	Subject	Notes
Sollom	ˈsɔ.lʸəm	ˈsɔ¯lʸəm	H	5	high pitch on last syllable
Stellau	ˈʃtɛ.la̠͡ʊ	ˈʔʃtɛˊʔlʸa	D	5	either rising pitch or stress on last syllable
		ˋʃtɛ̝.la̠͡ʊ	I	17	slight pitch change, stress on first syllable
Glinde	ˈglɪn.də	ˈʔglɪˊʔda	H	5	could be stress on last syllable, rather than stress on first and rising pitch on second
Meyssac	mɛ.sak	mɛˊsakʰ	N	9	high pitch on second syllable

Table 54: Non-Norwegian words with 'tones' in responses (listening-speaking)

c) Segment length

The above section on syllable structure contains some discussion on segment length (see also Table 47). It would appear that for the most part long segments in the input were not preserved in the output, but were reduced to short segments.

	Long segments in prompts	Half-long segments in prompts	Short segments in prompts
Long responses	63	1	27
Half-long responses	17	15	40
Total segments	13	5	307

Table 55: Summary of length input and output (listening-speaking)

However, length was preserved in some cases (Table 55). It is clear that long prompts were more likely to elicit long segments than were short prompts (combining long and half-long, we have 21% long responses for the long prompts, and 1% long responses for short prompts). Impressionistically, some of the long responses for short prompts appeared to be due to hesitation by the subjects, and some may have been influenced by adjacency to long segments in the prompts, for example [ˉ́lʸeː.gə̆n] as a response to [ˇlyŋː.ən].

In a minority of instances a long consonant was represented by two different consonants in the output, for example [kː] → [ŋkʰ] in *Do<u>kk</u>a*. The responses to long consonants are given in Table 56 (cf. Chapter 7, Table 64 for listening-writing responses). Realisation of a long segment as two short ones did not appear to happen with long vowels. Interestingly, there were a few examples of the reverse process, i.e. two input consonants being transformed into one long consonant, for example [ɾn] → [nː] in *Livorno* (3 subjects). Since length is treated in the current study as a suprasegmental rather than a segmental feature, it might be more consistent with the overall framework to analyse these transformations from long segments to two short segments as insertions; however, this fails to capture the relationship between input and output. Of course, the transformations might be random insertions, but it is difficult to determine this by comparison with the figures with the proportion of random insertions in the data as a whole, since the totals here are rather low.

	[bː] in *Bobbio*		[pː] in *Copparo*		[kː] in *Dokka*		[lː] in *Hellesylt*		[ŋː] in *Lyngen*	
	Data	**No.**	**Data**	**No.**	**Data**	**No.**	**Data**	**No.**	**Data**	**No.**
Long/ half-long	bː bˑ	7 4	pˑ pˑ^{h}	1 1	kˑ kˑ^{h} kː	2 2 1	lː	1	ŋˑ	1
Multiple segments	ɪ̆b	1	mp mb mp^{h}	2 1 1	gt^{h} gð ŋk^{h} k^{h}t kh	1 1 1 1 1				
Short	b	13	p^{h} p b	13 5 1	k^{h} k x	10 1 1	l^{ɣ} l ɫ	17 4 3	ŋ n g	21 2 1
Other		1		1		4		1		1

Table 56: Representation of long consonants (listening-speaking)

It should be noted that no acoustic measures were made, due to the variety of segments in the prompts, the variety of speakers, and the limitations of the recordings. All length transcriptions therefore rely on aural comparisons.

6.3. Reproduction within the same medium - written

This section discusses the results of the reading-writing experiment. The overall error-patterns across the names are presented, and then an analysis is made of the error types and their likely causes.

6.3.1. Responses matching original orthography

◊ ***Summary: Responses matching original orthography in reading-writing mode***

Diacritics and word length affect the likelihood of subjects achieving a response which is 100% correct. There is a considerable amount of variation across words, however, for which we need a more detailed analysis.

a) Incorrect responses

As might be expected, the error rate in the reading-writing experiment was fairly low. (Errors are listed in Appendix D.) It will be recalled that the correct responses for listening-speaking were shown as proportions of words, and an illustration of the proportion of correct graphemes in reading-writing was given in Figure 17. However, because of the low error rate in reading-writing, the responses here were simply grouped into completely correct, or containing errors (Figures 28-33), in order to show more clearly which words caused difficulty. Correct answers are shown on the positive axis, and other answers on the negative axis.

The errors are not randomly distributed; British and Italian towns have the lowest error rate and Norwegian the highest. Of course, characters with diacritics exist in French, German and Norwegian, making the graphemes potentially more difficult; this, however, does not explain the relative difficulty of Greek towns. Greek towns were on average longer than towns from other countries (see Table 39, Chapter 5), making them more error prone in a simple correct/incorrect analysis. If we look at the scores for particular Greek towns, though, it becomes obvious that the results are skewed by very poor results on three towns.

Aside from names containing diacritics, those with less than 2/3 of answers completely correct are: <Pfinztal>, <Karousadhes>, <Psakhna>, <Tsamandas> and <Hellesylt>. These are all longer than average, and contain sequences of 3 or 4 graphemes (word-ends are counted as a null grapheme) which are non-existent or rare in the on-line dictionary; familiarity of letter sequences will be explored further below.

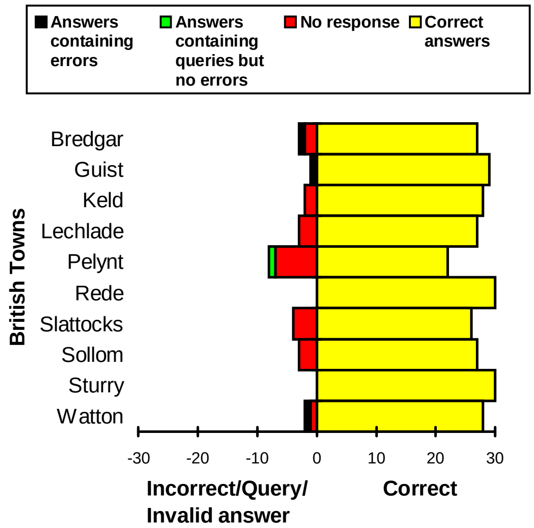

Figure 28: Responses matching original orthography (reading-writing): Britain

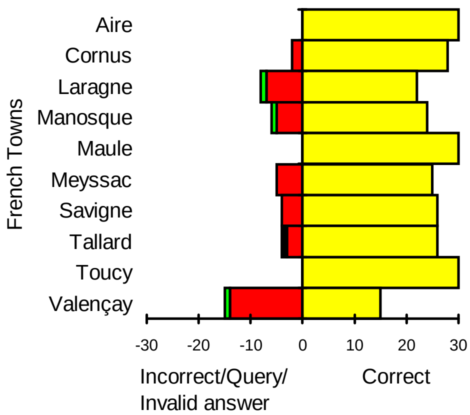

Figure 29: Responses matching original orthography (reading-writing): France

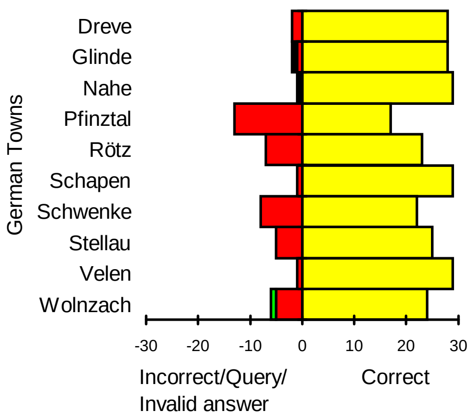

Figure 30: Responses matching original orthography (reading-writing): Germany

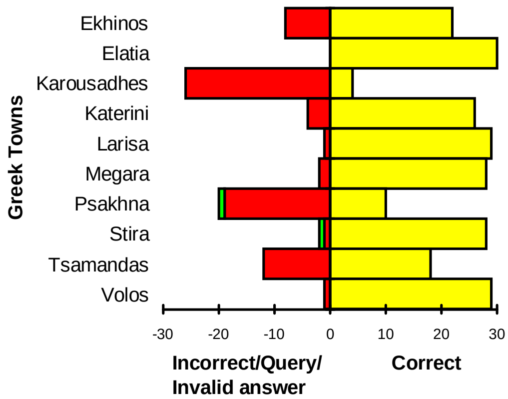

Figure 31: Responses matching original orthography (reading-writing): Greece

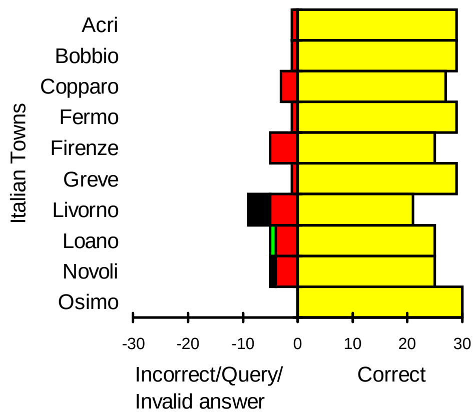

Figure 32: Responses matching original orthography (reading-writing): Italy

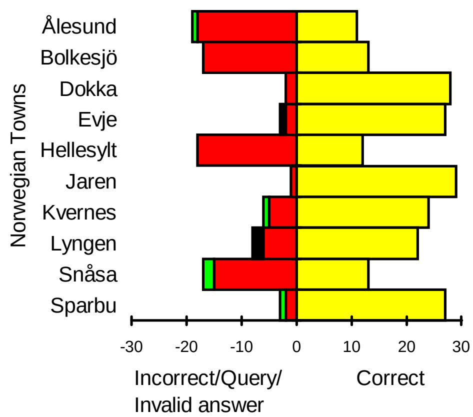

Figure 33: Responses matching original orthography (reading-writing): Norway

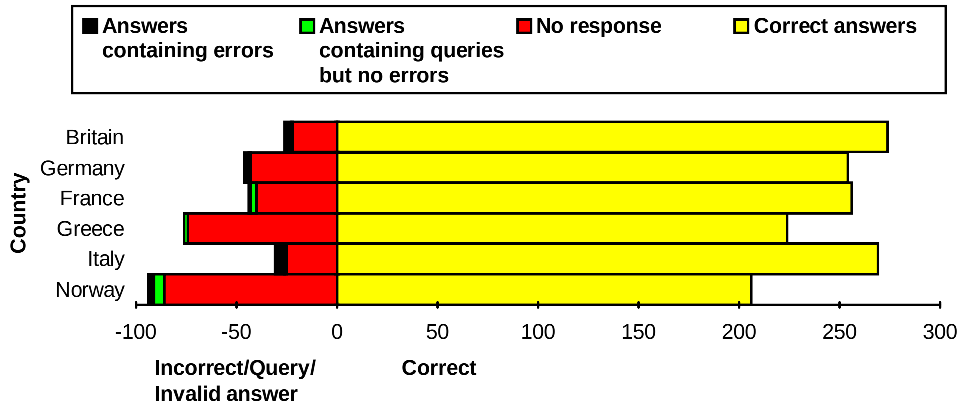

Figure 34: Summary of responses matching original orthography (reading-writing)

Figure 17 earlier in the chapter shows an increase in error rate per grapheme for longer words, and if we look at the responses matching the original orthography, which is how Figures 28-34 are scored, we see an even clearer pattern (Figure 35), so word-length is likely to be behind some of the errors apparent in the five names listed above.

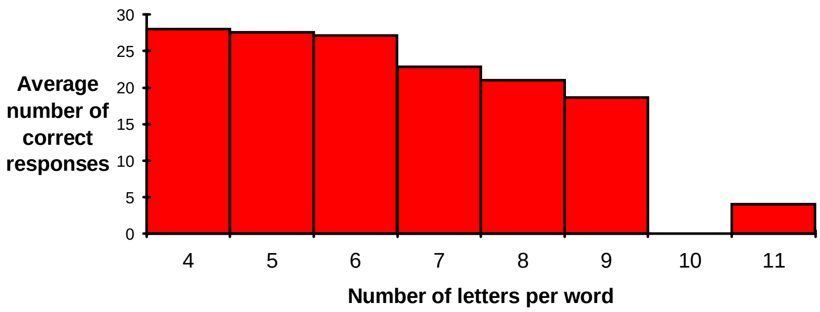

Figure 35: Word length compared to responses matching original orthography (reading-writing)

6.3.2. Segmental output

This section discusses the reproduction of single graphemes.

◊ ***Summary: Segmental output of reading-writing mode***

There are very few segmental errors in the reading-writing experiment which are directly attributable to production problems rather than to perception or other causes. Frequency of graphemes did not affect accuracy of output, whether through perception or production, and although diacritics had a high number of errors this may well have been due to perception or memory errors rather than production; more investigation is needed to see if this was in fact the case. Some errors may have originated in phonological activation of the graphemic string followed by a re-spelling based on the phonological string, but since single grapheme errors have many other potential causes it is difficult to be certain whether this was the case.

a) Single graphemes

A fairly detailed description of many of the errors in the reading-writing experiment is given in the section on perception of written words, in Chapter 5, "5.2.2. Perception of single segments" and "5.2.3. Structural perception", p. 166 ff. It is likely that most errors in reading-writing have their origin in either poor perception, poor memory (since the task involved writing after the name was covered), phonological activation and subsequent confusion as to the original spelling, or 'slips of the pen', i.e. unintentional and random mistakes. Some may also result from the substitution of familiar segments or sequences for unfamiliar ones. In this and the following section, discussion will concentrate on errors relating to production rather than errors originating in faulty perception, poor memory or random mistakes. Likely production errors are those using phonological activation and re-generation of the spelling; it is also possible that replacement of sequences or segments with more familiar ones could be due to production habits rather than perception.

Such errors constitute a small proportion of the incorrect responses, which themselves are not numerous. Taking first the familiarity of single segments, while some letters are more common than others, it is unlikely that this would be a cause of output errors except in extreme cases such as words with diacritics. It was indeed found that single grapheme frequency scores calculated for each word did not relate to the number of correct responses (cf. below, p. 209 ff., for sequences). Even for diacritics, it is difficult to say whether production is in fact at fault or whether the error originates at the perception stage; diacritic errors have already been discussed under perception (see Chapter 5, p. 170).

This leaves us with phonological activation. This too has been discussed under perception, where it was noted that there are only a very small number of errors which seem likely to have been caused by phonological activation and re-transcription of the pronunciation, although other such errors may exist since a number of mistakes have uncertain origin. In Appendix D, errors for which similar output could be found in the reading-speaking experiment are marked with an asterisk (see Appendix D for a more detailed description of the marking used). Some of these marked errors suggest phonological activation; however, as noted earlier under perception, some may be coincidental. For example, in both experimental modes, the same perceptual error could have been made. Also, errors in the two experiments may have separate causes, for instance perception in reading-writing and a slip of the tongue in reading-speaking.

For most errors potentially pointing to phonological activation as a cause, the data is ambiguous; for example, omission of <h> in <Karousades> for <Karousadhes> may have been due to the fact that it was assigned a pronunciation [d], reinterpreted as <d>, but it could have been caused by poor perception due to the adjacent upstrokes of the <d> and the <h>, or simply memory error in a long word. Overall, it is easier to justify an analysis based on phonological activation and re-generation of spelling for multiple-letter sequences such as <sight> in <Hellesylt> than for single letters, as there are fewer competing hypotheses. These will be examined in the next section.

6.3.3. Structural output

This section presents results relating to the reproduction of letter combinations.

◊ ***Summary: Structural output of reading-writing mode***

For analysis of structural problems in the reading-writing experiment, a larger data sample would have been helpful as there were relatively few errors. This makes it difficult to perform a systematic analysis and to pinpoint the causes of errors.

Some errors showed similar patterns to speech errors, such as transposition of segments and retention of graphotactic restraints on output, but some responses violated the spelling patterns of English (and indeed of the other languages in the study). Some of the errors may have been due to phonological activation and re-transcription, but like segmental errors, it is difficult to be certain whether this was the case; also, a phonological basis for spelling errors conflicts with the unpronounceability of some of the output, but this could be due to poor spelling skills, or the use of visual strategies rather than phonological ones by poor spellers. Frequency of letter sequences did not affect the likelihood of accurate whole-word reproduction, but for some words there was evidently a relationship between bigram frequencies and error location within the word; bigram frequencies of erroneous responses were higher than those in the original names, though not significantly so. More research in this area might prove interesting, as it suggests that in some circumstances there may be a lexical influence or familiarity effect on the reproduction of written words.

a) Combinations of graphemes

Some of the errors (see Appendix D) are of the same type as are made in speech, such as transposition of segments. It might be expected that transposed segments would be of the same type (i.e. both consonants, or both vowels), but this does not appear to be the case, for example <Psakhan> for <Psakhna>. This suggests that these errors do not necessarily originate from phonological mistakes, but are due to other reasons, possibly regularisation of the graphemic string or simply poor memory. (They might also be due to a completely erroneous phonological activation, which happens to result in a graphemic transposition when re-transcribed.) There are some transpositions which do switch similar segments, such as <Stallocks> for <Slattocks>; note that in this example the doubling is retained on the medial consonants, where it is graphemically appropriate, rather than moving both <t>'s to after the <S>. This exhibits similar processes to speech errors; the segments are transposed, but are produced appropriately for their new context.

As mentioned above, some sequences in the output do appear to point to phonological activation and re-transcription as the source of the error, such as <Hellesight> or <Hellesyte> for <Hellesylt> ([sʌ͡it] was produced for the last syllable by more than one subject in the reading-writing experiment). However, although the cause is easier to identify in such cases than in single grapheme errors, there are still very few for which we can unequivocally point to phonological activation as the origin. For many multiple-grapheme errors, the result, such as <Boleysk> for <Bolkesjö>, is unrelated to any likely pronunciation of the input, though of course it may be related to an erroneous pronunciation assigned by an individual subject. So, the best we can say is that phonological activation appears to be at the root of some errors.

We might expect subjects to alter sequences which are graphemically unusual, either because they do not conform to normal graphemic patterns and so are 'improved' during either perception or production, or because they are difficult to pronounce and so are transformed if and when phonological activation takes place. However, some of the erroneous responses are not at all pronounceable in normal English, for example <Pskhanna>, <Wolnzarh> or <Ginlde>. This would appear to argue against phonological activation of any kind for these responses, although it may simply be the case that these subjects are poor spellers and do not have a strong grasp of acceptable grapheme sequences in English, or of phoneme-to-grapheme relationships. (See the discussion in Chapter 3 on different spelling strategies in good and poor spellers, in which it was noted that Lennox and Siegel (1996) found that poor spellers had a poor grasp of grapheme-to-phoneme correspondences, and tended to use visual similarity instead.) Given the multilingual nature of the experiment, we could hypothesise that the subjects do not feel constrained by considerations of English spelling, but even so examples such as <Pskhanna> are more deviant than we would expect. Also, there are examples of non-English spellings, whether correct or incorrect, being assigned to Britain, for example <Kvernes>. As we have seen before, subjects do not always associate non-English features with non-native origin, though this may be partly confusion due to the predominance of non-English names in the data, and the limited response time. Some responses do suggest the use of non-English spelling rules or analogy with non-English words, for example <eau> in <Stelleau>, though this could be considered a marginal pattern in English as it is used in loan words such as *bureau*.

Letter sequences were examined to see which were common in English (cf. Figures 12-15 in the previous chapter), resulting in grapheme scores for bigrams, trigrams and so on for each word. These were then compared to the whole-word error rate, to see if words with more frequent letter combinations were more accurately reproduced, but this did not appear to be the case. This result is not surprising, since it was shown in the discussion of perception (Chapter 2) that frequency of letter combinations in the input does not affect accuracy of output. For some words with a high error rate, however, the errors did tend to be clustered around the point of lowest frequency sequences, for instance the last syllable of <Hellesylt> (Figure 36), the <y> of <Pelynt> (Figure 37) or the two consonant clusters of <Pfinztal> (Figure 38). (Bigram frequency for each letter is scored as the sum of the two bigrams in which the letter participates, so for <P> in <Pfinztal> this will be <#p> and <pf>, while for <f> it will be <pf> and <fi>, and so on.)

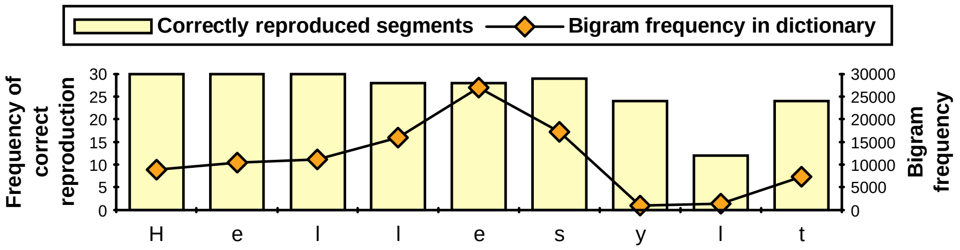

Figure 36: Error location in <Hellesylt> (reading-writing) compared to bigram frequency

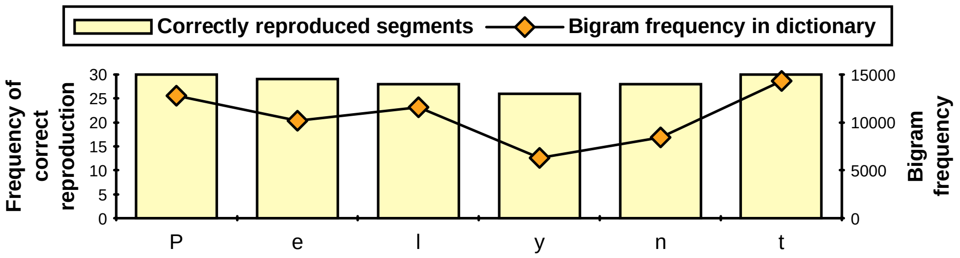

Figure 37: Error location in <Pelynt> (reading-writing) compared to bigram frequency

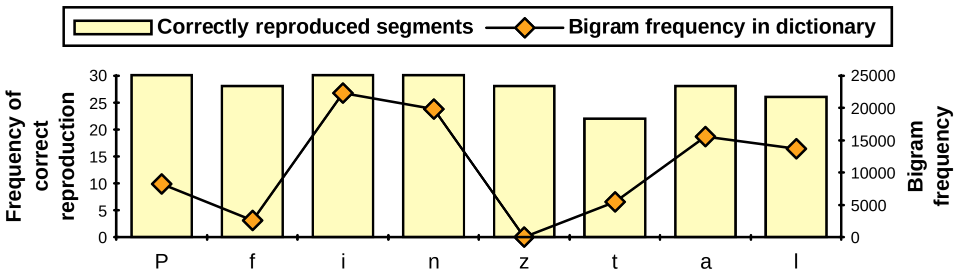

Figure 38: Error location in <Pfinztal> (reading-writing) compared to bigram frequency

Some other examples are less clear; <Ekhinos> (Figure 39) does show a dip in correct scores around <k>, for which <ek> and <kh> combine to give a low bigram frequency, but there is no similar dip around the <o>, despite the late word position being more prone to error (cf. Figure 16, Chapter 5). On the other hand, if we look at the trigram frequencies, the <o> has a total frequency of 3952, compared to just 6 for the <k>, which might explain the difference in accuracy of output.

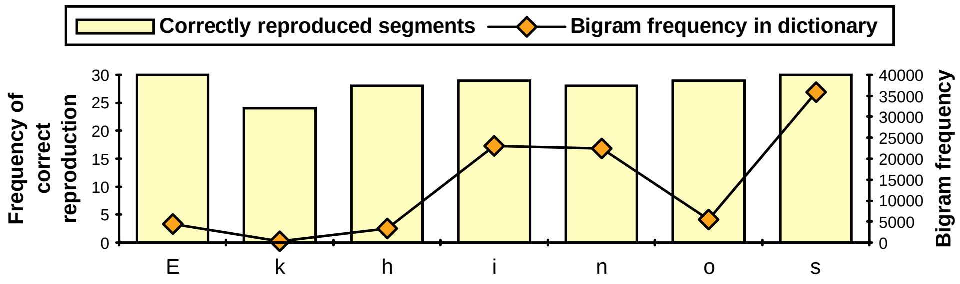

Figure 39: Error location in <Ekhinos> (reading-writing) compared to bigram frequency

Since the bigram frequencies across the data do not reflect accuracy of whole-word reproduction, we evidently need a more sophisticated analysis, possibly with more error data, to investigate whether there is any effect and in what circumstances, but it seems a fruitful area for future study. It also suggests that lexical comparisons may after all have an effect on the reproduction of written words.

A related, but slightly different, question is whether the sequential frequencies in the erroneous output are higher than those in the input, i.e. whether mistakes tend to result in more frequent patterns. This was examined for bigrams, and it was found that incorrect responses did indeed have a higher average bigram frequency than the input strings. (Bigram frequencies were taken as raw figures from the on-line dictionary, and word-end plus initial or final letter treated as a bigram; no other positional information was included.) The increase was in the order of 4%, or 3% not including words with diacritics. The direction of change suggests a tendency to make responses conform more closely to English letter patterns, though the figures were not significant at $p < 0.05$.

A comparable check of a random selection of around 1000 words from the on-line dictionary showed an average bigram frequency count 24% higher than the name set of 45 names which did not contain diacritics, but for which erroneous responses were recorded; this difference was significant. This percentage did not alter greatly, and in fact increased slightly, when the dictionary set was reduced to words of 4-11 letters. A bigram count of 960 randomly-generated strings of 4-11 letters was also performed (the strings were produced were truly random, with no account taken of letter-frequency or positional likelihood); the average bigram frequency for these strings was only 34% of the above name set. These results are as expected: random strings have lower bigram frequencies (based on occurrences in an English dictionary) than the experimental name set, which in turn have lower bigram frequencies than

English words. The erroneous responses had slightly higher bigram frequencies than the name set but lower than English words.

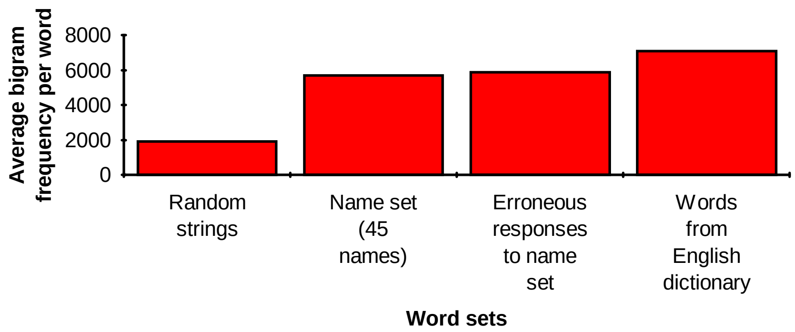

Figure 40: Average bigram frequencies for different word-sets, including responses in reading-writing experiment

b) Syllables

There is little to be said about syllables in the reading-writing experiment, since any evidence about subjects' intended representation of syllables in the output, if any, is very conjectural. In some cases, such as <Megara> → <Megard>, we can assume that the output changed the number of syllables, but structural concerns are unlikely to have been the motivation for this error as there is nothing difficult in the original sequence. There were in fact very few changes made to syllable counts which are attributable to structure. One example is <#Pf> in <Pfinztal>, which had the erroneous response <#Pif>; other errors were <#Pl> and <#P>, but these do not change the number of syllables. Likewise <#Tsa> in <Tsamandas> had two responses of <#Tas>, which alters the structure but not the number of syllables.

6.4. Summary of same-media production

Some variation in output is due to general factors such as word-length or subject ability, rather than sub-lexical detail.

A definition of 'correct' proved to be problematic for the listening-speaking experiment, with all definitions which were theoretically consistent being deficient in some way. The strict definition used, which required identical rather than similar output, resulted in the low segmental accuracy of the responses; accuracy of output did not reflect the subjects' supposed knowledge of the different languages. Structural features were reproduced more accurately than segmental ones, while suprasegmental features were reproduced accurately except where they differed in type from native features, such as the lack of lexical stress in French. For all parameters, the output was not always as expected; foreign features were not always nativised, while some native features were reproduced as non-native ones. Syllabic changes did not seem to 'improve' the input in the direction of simpler, or less marked, CV structures.

There were of course far fewer errors in the reading-writing experiment. Some words had a particularly high error rate, with errors clustered around the low-frequency bigrams, but for other words the bigram frequency did not affect the output. Diacritics and word-length had an effect on the accuracy of reproduction, and there was some evidence of phonological activation of the written prompts interfering with the output.

Chapter 7.

Results - Production in Cross-media Experiments

The reading-speaking and listening-writing experiments are particularly important in the examination of the processes which take place when we reproduce unfamiliar words, since they require the subjects to 'translate' from one medium to another, instead of merely copying the input as best they can, and it is of crucial interest to this study to see how subjects arrive at their responses. The section begins with a discussion of 'correct' responses, followed by analysis of the various parameters. Within these sections results from the two experiments are taken separately.

While much of the discussion will of necessity concentrate on individual parameters and small parts of words, since this is the only way to make generalisations about such varied output as the experiments produced, it is also important to bear in mind that the various parameters are closely interlinked for each response. For example, in the reading-speaking responses different stress patterns may be associated with different vowel quality, a feature which is only apparent when examining the whole-word output. Or, in the listening-writing experiment, a spoken segment in one part of a word may lead a subject to the supposition that a word is, say, French, which in turn may influence the spelling used for a different part of the word. So, some mention is made throughout of the effects of context and larger word-portions, and a separate section, "Word and part-word analogy", is included at the end of the chapter for further consideration of these effects.

7.1. Responses matching original name

This section will compare the output of the cross-media experiments to the name in the original languages, i.e. to the written form for the listening-writing experiment, and the spoken form for the reading-speaking experiment.

◊ ***Summary: Responses matching original names in cross-media experiments***

The cross-media experiments naturally caused particular difficulty as regards 'correct' responses, under the definitions used here. For the reading-speaking responses a multi-part analysis was used to highlight problem areas; two of these are evidently stress in French and tone in Norwegian, as was also the case for the listening-speaking experiment. Despite subjects' lack of schooling in these languages, Italian and Greek towns had relatively high scores in both reading-speaking and listening-writing, possibly due to their simple vowel systems and relatively simple syllable structures, and the straightforward grapheme-to-phoneme correspondences.

7.1.1. Reading-speaking

Obviously, subjects cannot be expected to produce a response which is phonetically the same as the name in the original language if they have only seen the written form of the name. However, it is interesting to see where the differences lie and how they compare with responses in the listening-speaking experiment (Chapter 6, Figures 20-26). The definitions of 'segmentally correct', 'structurally correct (segments)', 'structurally correct (syllables)' and 'suprasegmentally correct' are as before (p. 181), and the data is illustrated in Figures 41-47. Again, figures are shown as proportions, with data scaled from 0-1 (absolute values) for each parameter.

We can see that even fewer suprasegmental responses were correct for French and Norwegian towns than in the listening-speaking experiment; the only correct ones, in fact, are for French monosyllables in which stress is irrelevant. There are also, naturally, more towns which have a low accuracy for stress patterns than in listening-speaking, for instance *Pelynt*. Of course, there are a number of features which inevitably led to 'errors' for all or most subjects. Subjects could not be expected to know, for instance, that the <d> of *Ålesund* is silent, so they tended to make 'errors' on the segment count for this word. Segmental accuracy is often lower, too, even for British towns, and there is a different hierarchy of accuracy in the two modes of presentation. For example, *Guist* was produced in listening-speaking with high segmental accuracy, but was lower in reading-speaking as no subject used the vowel [ʌ͡i]. The syllable count also showed more variation in reading-speaking, with words such as *Rede* sometimes pronounced as two syllables, an 'error' which did not occur in the listening-speaking experiment.

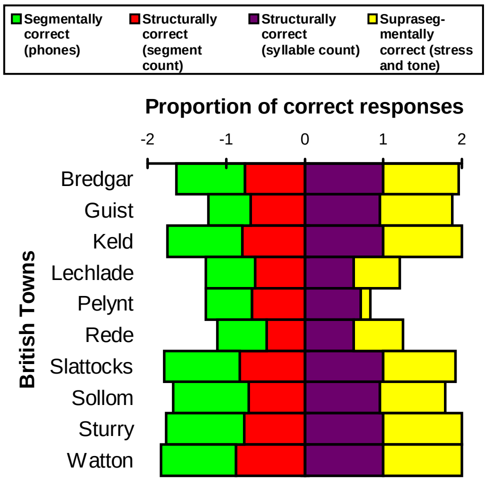

Figure 41: Responses matching original pronunciation (reading-speaking): Britain

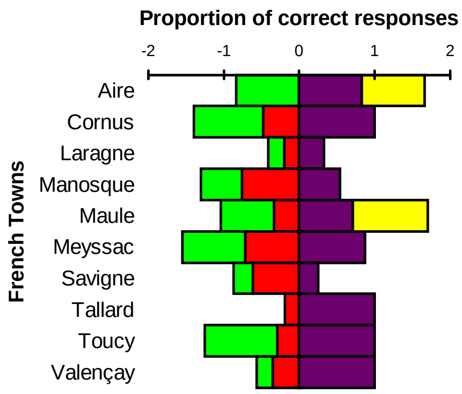

Figure 42: Responses matching original pronunciation (reading-speaking): France

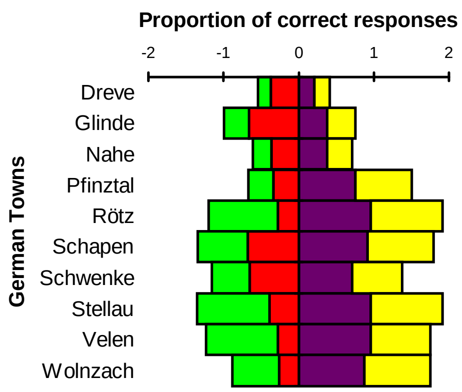

Figure 43: Responses matching original pronunciation (reading-speaking): Germany

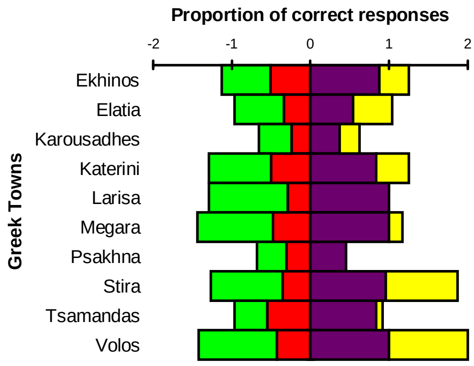

Figure 44: Responses matching original pronunciation (reading-speaking): Greece

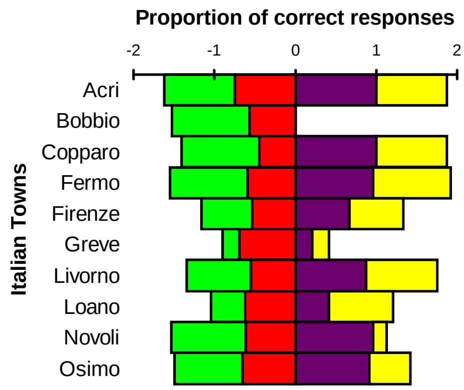

Figure 45: Responses matching original pronunciation (reading-speaking): Italy

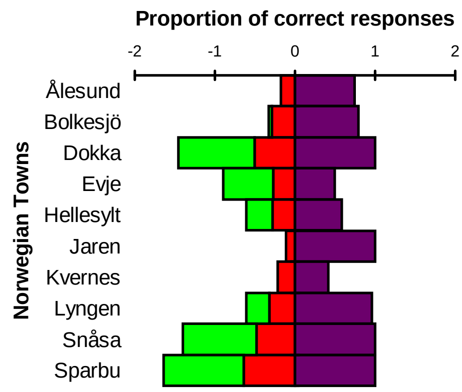

Figure 46: Responses matching original pronunciation (reading-speaking): Norway

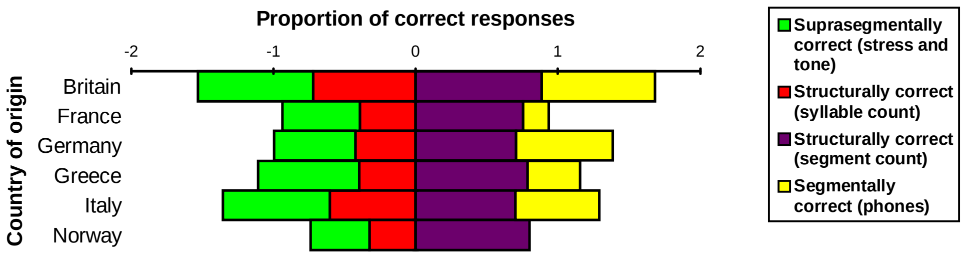

Figure 47: Summary of responses matching original pronunciation (reading-speaking)

There are, surprisingly, a few cases in which scores are higher for reading-speaking than for listening-speaking. One example is the syllable count for *Cornus*, which was produced with 100% accuracy (all responses had two syllables) for reading-speaking, but 77% (i.e. 6 erroneous responses) for listening-speaking. Only one of these was an unclear response; the other five all had additional syllables, mostly inserted between [ʀ] and [n], perhaps due to perception of the unfamiliar trill as being a consonant-vowel combination. The syllable count score was also higher for *Jaren* in reading-speaking than listening-speaking, since visually it is clearly two syllables, but the syllable count of the spoken prompt was not so clear. The medial cluster in *Wolnzach* was also reproduced better in the reading-speaking experiment than listening-speaking, where it had a number of omissions, suggesting that difficulty in reading-speaking was due to perception of the spoken prompt; this leads to a higher segmental count score for *Wolnzach* in reading-speaking.

Again, Italian and even Greek towns fared better than expected compared to French and German, which were far more familiar languages for the subjects. As well as the simple vowel systems, as discussed before, they tend to have a simpler grapheme-to-phoneme system than the other two languages, particularly French, which has a number of silent letters such as <d> in *Tallard*. Italian, in fact, had the smallest difference in segmental accuracy between the two experimental conditions (68% in listening-speaking compared to 60% for reading-speaking). The greatest difference was for French (53% and 39%).

7.1.2. Listening-writing

For comparison with the reading-writing data in Chapter 6, 'correct' responses for this section have been restricted to those matching the original orthography (Figures 48-54).

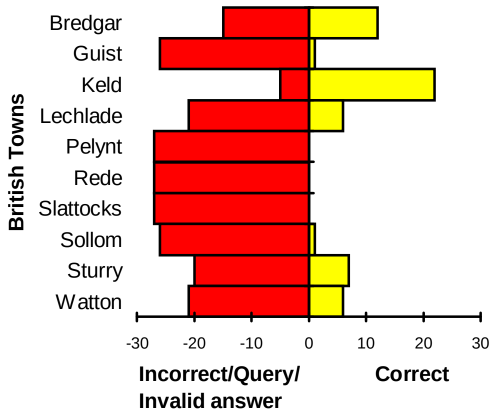

Figure 48: Responses matching original orthography (listening-writing): Britain

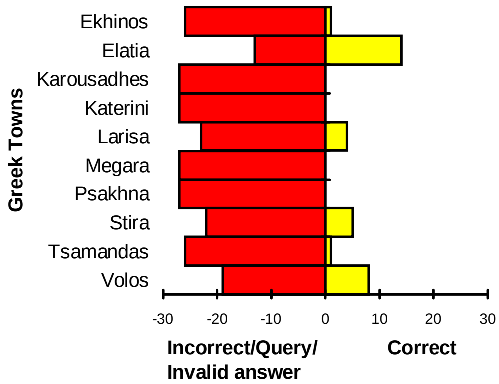

Figure 51: Responses matching original orthography (listening-writing): Greece

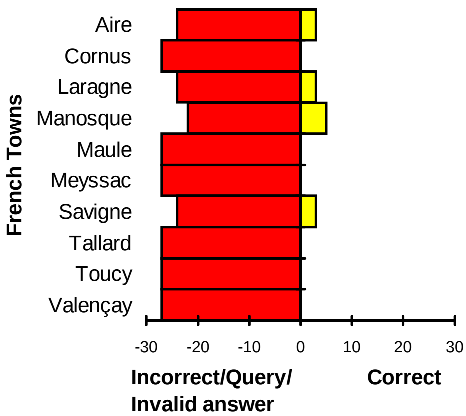

Figure 49: Responses matching original orthography (listening-writing): France

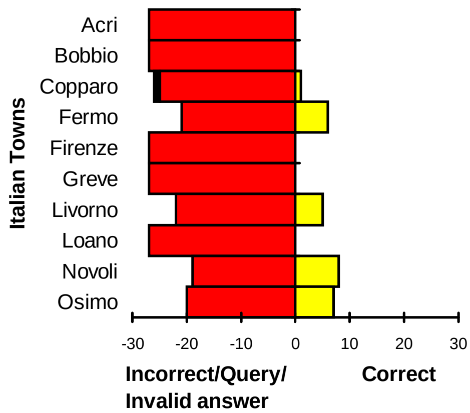

Figure 52: Responses matching original orthography (listening-writing): Italy

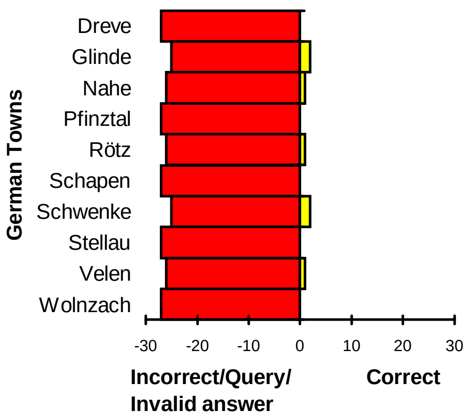

Figure 50: Responses matching original orthography (listening-writing): Germany

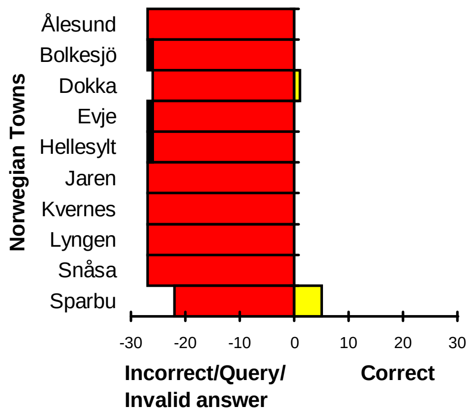

Figure 53: Responses matching original orthography (listening-writing): Norway

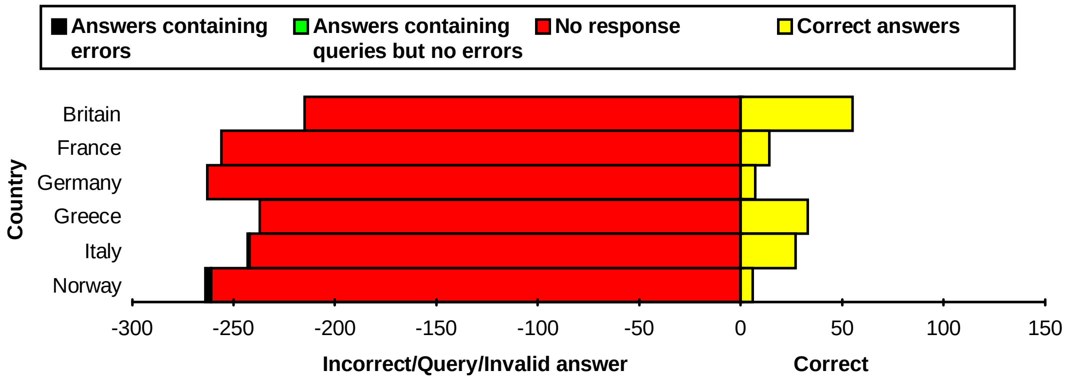

Figure 54: Summary of responses matching original orthography (listening-writing)

For a listening-writing task this is a strict definition of 'correct', firstly as it is a whole-word measure, so the figures show the number of completely matching responses rather than being based on the proportion of matching graphemes, and secondly because there are of course many possible written answers which would be reasonable interpretations of the spoken input.

It can be seen that even British towns, though having the greatest number of matching responses, do not fare particularly well. Although most subjects knew either French or German (23 claimed some knowledge of French, and 11 some knowledge of German, while none knew any of the other languages in the study) there were fewer 'correct' responses for these countries than for Greece and Italy. Indeed, German towns did little better than Norwegian. However, it should be remembered that the towns were not selected randomly; the selection specifically avoided towns with transparent morphology (see Chapter 4), which greatly narrowed the choice of British town names in particular, and familiar names were avoided. Had a random selection been made, the score for British towns would doubtless have been much higher as familiar morphemes such as *-field* would have appeared in the name set. We could speculate that the relatively good performance on Greek and Italian towns is due either to a simpler sound-to-spelling correspondence, or one which matches more closely the most common or most 'basic' sound-to-spelling correspondences of English ([a] → <a>, [ɛ] → <e> and so on), but analysis across a wider range of names would be necessary to investigate this.

7.2. Output of segments and segment combinations

This section will examine segments and sequences in the cross-media experiments. It is not always possible to separate segmental and structural issues in the translation from written words to speech, or spoken language to writing. Firstly, one segment in the input may correspond to two or more in the output and vice versa, for example [ʃ] → <sch> or [ks] → <x>. Secondly, there is often ambiguity as to the phonetic identity of written segments or combinations of segments. For example, written <e> is often not pronounced in speech, so if *Cornus* [kɔʀ.nys] is reproduced as <Correneuse> we could analyse this response as two syllables, or three or even four. For these reasons this section covers segmental, structural and syllabic issues.

◊ ***Summary: Segmental and structural output in cross-media experiments***

In the cross-media experiments, subjects mostly used grapheme-to-phoneme and phoneme-to-grapheme correspondences that are common in the dictionary. Many of the responses showed similar percentages of relationships between phonemes and graphemes to those found in the dictionary, though the inputs here are not controlled enough for systematic comparisons. Some subjects used correspondences which are foreign or rare, and some used ones that do not exist either in English or in any of the other languages in the study.

Although there was a suggestion of association between the perceived language of origin of the names and the choice of phoneme or grapheme in the output, the relationship was anything but clear. Use of foreign language features varied widely according to the individual correspondence involved, some perhaps being better known than others. There may have been more complex associations involved for particular prompts, including analogy with other words, either native or foreign, but at present this can only be speculation. Some responses were contradictory, with for instance a 'British' response to origin but a pronunciation or spelling more appropriate for German, suggesting there is more to the process than simply switching from one strategy of answering to another.

In the listening-writing experiment, the syllable count was generally preserved, where this can be determined. In the reading-speaking experiment, there was a high degree of consensus on the syllable count (though in a few cases this was not in agreement with the original language). Where the syllable count varied substantially, this was mostly due to a few types of orthographic pattern, such as non-native consonant clusters.

7.2.1. Spoken output

a) Minimal graphemic units

Performing an overall analysis of the pronunciations assigned to written segments or segment combinations was more difficult than for spoken prompts, since there was not always a one-to-one correspondence between the graphemes in the prompts and the phones in the output. However, an analysis was made of segment pronunciation using the smallest possible units (see Appendix E). This created a few difficulties, since while some letter combinations, such as <ll> in <Tallard>, were treated as a single segment by all subjects and could thus be listed as a two-letter combination, others, such as <oa> in <Loano>, were pronounced as two phones by some subjects and only one by others. Since it was considered undesirable to give two different listings for one input string, and information would be lost by separating such letters, they were left as letter-combinations in the analysis. Consonant clusters which were potential affricates, or in which one was often dropped, were also treated this way.

More difficult was the case of mute <e>, since it is typically separated from the vowel we would consider it relates to, as in <Lechlade>, and again, in some cases subjects did pronounce it as a separate vowel. It was decided to treat this by marking the graphemic vowel preceding it with an additional bracketed (e), and the potentially mute <e> itself as (e). So, the units in <Lechlade> would be l, e, ch, l, a(e), d and (e). A distinction was made between vowels whose pronunciation would typically be altered in an English pronunciation by use of mute <e>, like <Lechlade>, and ones which would not; for example, if the second <e> in <Kvernes> were not pronounced this should have no effect on the first <e>. This second type was marked as {e}. Of course, the pronunciation of many other segments too was affected by context, and this will be taken into account in the discussion. A summary of the criteria for grouping letters, along with the actual responses, is given in Appendix E.

Looking at the results, the majority of pronunciations for single graphemes are the obvious phone, for example <b> is pronounced as [b], <c> as [k^h], [k] or [s], <d> as [d] and so on. All written consonants are represented in the data input apart from <x>, and the only ones for which the second or third most popular response was fairly high in frequency (over 10% of the total responses) were, with the phones listed in decreasing frequency:

<c>	[k^{h}], [k] or [s]
<j>	[d͡ʒ], [j] or [ʒ]
<p>	[p^{h}] or [p]
<r>	[ɹ] or [ɾ]
<s>	[s] or [z]
<t>	[t] or [t^{h}]
<w>	[w] or [v]

10% was chosen as a cut-off point since this captures the common variants and omits those produced by only a small minority of subjects. The unaspirated responses to <p> and <t> are simply positional variants following [s], and the responses to <r> are both variants of /r/ in Edinburgh, as already discussed. For <c> and <s>, the responses are also normal as these grapheme-phoneme relationships are common in English. In the on-line dictionary, the most common single-grapheme relationships for <c> are /k/ (79%), /s/ (20%) and /t͡ʃ/ (0.1%). For <s> they are /s/ (58%), /z/ (40.5%), [ʒ] (0.5%) and [ʃ] (0.5%). These figures do not take context into account, and of course a large number of /z/ will occur in plural and verb morphemes. However, they roughly reflect the responses given in the reading-speaking experiment. Only reasonably common patterns in the dictionary were common in the responses, although the other patterns were also observed from a minority of subjects. There was, incidentally, a much higher use of [s] for <ç> than for <c>, suggesting that subjects are aware of the pronunciation of this letter.

For <j> the figures are [d͡ʒ] (96.5%), /j/ (1.5%) and /ʒ/ (1%), while for <w> they are /w/ (99%) and /v/ (0.5%). In these cases fairly rare patterns from the dictionary were common in the responses. The obvious explanation for this is that the words were perceived to be foreign, and [j], [ʒ] and [v] are known to be more common realisations of <j> and <w> in foreign words than [d͡ʒ] and [w]. These segments are from <Jaren>, <Evje>, <Watton>, <Wolnzach> and <Schwenke>, and the country responses associated with the pronunciations are shown below (Figures 55 and 56). Although the responses were somewhat mixed, we can see that for <j>, [j] responses only occurred for Germany, Italy and Norway, (this was the dominant response for Germany); for <w>, [v] was used only for Germany and Norway. There were some <j> → [ʒ] responses for all countries except Britain and Italy. This does suggest that subjects were using different grapheme-to-phoneme associations for different languages, though it is surprising that there were not more examples of [ʒ] for France, a correspondence which ought to be familiar to many subjects due to their claimed knowledge of French.

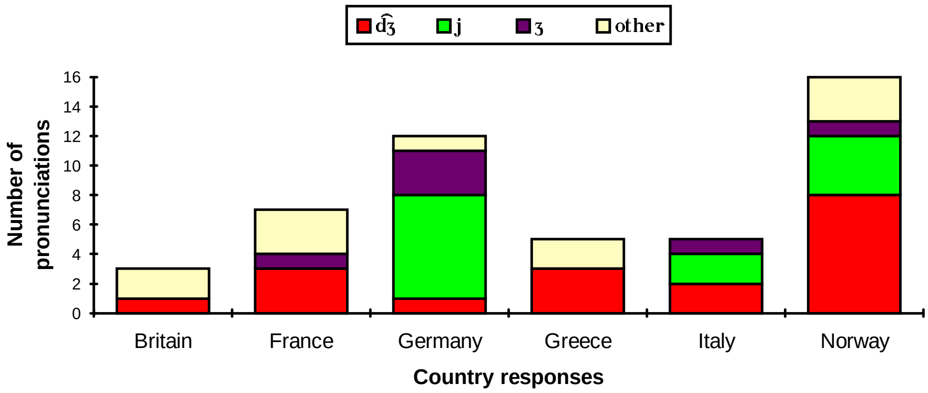

Figure 55: Responses to <j> (reading-speaking), ordered by country response

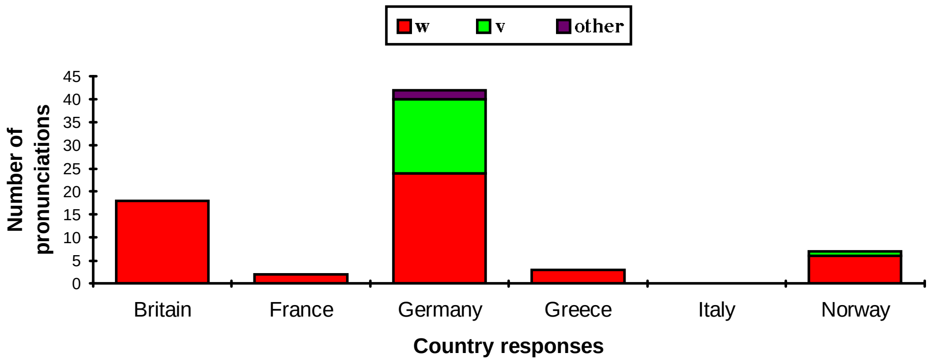

Figure 56: Responses to <w> (reading-speaking), ordered by country response

Many of the multi-grapheme consonant units in Appendix E also showed little variation above the 10% threshold, and elicited obvious pronunciations, for example [b] for <bb>. The consonant groups were <bb>, <ch>, <ck>, <dg>, <dh>, <kh>, <kk>, <kv>, <ll>, <pf>, <pp>, <ps>, <rr>, <sch>, <sj>, <ss>, <ts>, <tt> and <tz>, and of these the only ones with more than two responses with a frequency of over 10% were:

<ch>	[kʰ], [x] or [t͡ʃ]
<kh>	[kʰ] or [x]
<pf>	[f] or [p͡f]
<ps>	[s], [p͡s] or [pʰa~]
<rr>	[ɾ] or [ɹ]
<ss>	[s] or [z]
<ts>	[s], [t͡s] or [tʰa~]

with ~ annotating a metathesised segment. Additionally, <kv> and <sj> elicited a wide variety of low frequency responses. Most of the above variants are easily explained - <rr> is realised as common Edinburgh /r/ variants; <#Pf>, <#Ps>, and <#Ts> were word-initial, making them untypical in English, and so in some cases they were reduced to one phone. This was also true for <#Kv>. All these responses, in addition to cluster reduction, had some examples of epenthesised vowels, for example [k^{h}ɛv] for <kv>; <sj> (which was word-internal) was also a non-native graphemic sequence, only occurring at morpheme boundaries in the on-line dictionary, such as *misjudge*. More difficult to explain is <ss>. This graphemic sequence was, however, given as a response to [z] in *Osimo* by 7/26 subjects in the listening-writing experiment. In the earlier discussion of this (see Chapter 5, p. 147) it was suggested that the subjects misheard the prompt, but the use of [z] for <ss> in <Meyssac> suggests that subjects thought it was a valid relationship. (See also footnote 52, Chapter 5, p. 147, and p. 233 below for the spelling of *Meyssac* in the listening-writing experiment.) As for <ch> (<Lechlade> and <Wolnzach>), an overwhelming number of country responses (69%) were for Germany, which is likely to have influenced use of [k^{h}] and [x] over the more usual English [t͡ʃ]; however, since there was only one response of Britain this cannot be confirmed. 67% of subjects placed <Ekhinos> and <Psakhna> (the two examples of <kh>) in Greece, so again comparison with other countries is difficult (this time there were no British responses). It is difficult to say, in any case, what a British pronunciation would be; this combination mostly occurs at morpheme boundaries, where it would be pronounced [kh], though there are a few other examples in the on-line dictionary such as *khaki* and *Khan* (/k/) and <Khomeini> (/h/). These, together with the lack of identifiable morphemes and the assumed foreignness of the words, may have influenced the predominance of the [k^{h}] and [h] pronunciations. The same, incidentally, was true of <dh> in <Karousadhes>, which was mostly pronounced [d]; again, there were no British responses for this name in the reading-speaking experiment. The native use of this combination is restricted to morpheme-boundaries, and is mostly pronounced /dh/, though there are some place-names and personal names, such as *Oldham*, which are pronounced /d/. Loan-words such as *dhoti* and *jodhpurs* are pronounced with /d/.

Interestingly, <#Sch> was overwhelmingly pronounced [ʃ]; in the on-line dictionary, for 258 examples of <sch> including both word-initial and word-internal sequences, approximately 38% were pronounced [ʃ], but 48% were pronounced [sk].[70] A high proportion of those pronounced [ʃ] were loanwords, including names, such as *Fleischmann* or *festschrift*, and it is of course likely that subjects were, consciously or subconsciously, using the foreign pronunciation of this sequence, particularly for <Schwenke> which contains an

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[70] A large number of these, though, were derivatives of *school*.

obviously non-English graphemic sequence. (All but 2 subjects in the reading-speaking experiment placed <Schwenke> in Germany, and all but 5 placed <Schapen> in Germany.) There are also some of apparent hyperforeignisms in the data (cf. Janda et al. 1994, discussed in Chapter 3, p. 84); these do not appear in the above discussion as they were of relatively low occurrence. One example is omission of a consonant pronunciation for <s> in *Cornus*. This was judged as Greek, but suppression of final consonants, as in French, is one of Janda et al.'s hyperforeignisms.

The single vowels, naturally, were more variable than the single consonants. If, again, we use the 10% cut-off point, all had multiple variants:

<a>	[a] or [ə]
<å>	[a] or [e]
<e>	[ɛ], [ə] or [e]
<i>	[i] or [ɪ]
<o>	[ɔ] or [o]
<ö>	[o] or [ɔ]
<u>	[ʉ], [ʌ] or [ə]
<y>	[i], [ɪ] or [e]

These graphemes do not include those followed by a consonant and mute <e>, which were counted separately; if they had, a different selection of variants would have been likely. This also makes comparison with the dictionary data problematic, since the dictionary alignments are organised in a different way, with mute <e> not taken into account. However, it can be seen that the responses are within the expected range of phones.

The vowel groups <ay> and <ey> were pronounced as expected, while <au>, <oa>, <ou> and <ui> had common variants. <au> was pronounced [ʌ͡ʊ], [o] and, less predictably, as [ʉ]; <oa> had single unit and two-vowel pronunciations; <ou> was pronounced as [ʉ] and [u], (which can be considered trivial variation); and <ui> was generally either the single vowel [i] or the sequence [wi]. This sequence <ui> is something of a problem. The pronunciation /wi/ occurs in only a small minority of <ui> words in the dictionary, such as *suite* and *ennui*. Likewise, only a few words have /i/, and these are all spelt <qui>, such as *quiche*, or <Gui> (*Guillaume*, *Guiana and Guido* being the only examples). There are a variety of other pronunciations, but for the spelling <gui> the most common are /gjʉ.i/ (as in *ambiguity*), /gwɪ/ (as in *anguish*), /gʌ͡i/ (*guide*), and /gɪ/ (*guild*); however, these were not common in the responses. This suggests that subjects' responses are not based simply on dictionary frequency. *Uist* was a potential place-name analogy, but the pronunciation /jʉ.i/ did not occur at all. Only 3 subjects in this experiment placed *Guist* in Britain (which is its actual location), and it is interesting to speculate whether the pronunciations would have been different if it had been presented as a British town. However, it will be recalled from the preliminary experiments in Chapter 4 that although some names were easily subjected to this kind of manipulation of pronunciation, others were more resistant; additionally, the subject groups for the main experiment were less linguistically sophisticated than those in the preliminary experiments, so this might make manipulation of pronunciation depending on origin even more difficult.

If we look at the spoken vowels associated in the data with mute (e), in a structure where the mute (e) potentially affects the pronunciation (such as <Greve>), we have the vowel results in Figure 57, shown as percentages of responses associated with each country. Vowel responses are grouped as follows:

Symbol	**Meaning**	**Example**
V	vowel pronunciation associated with mute (e)	[i] for <Greve>
v	vowel pronunciation not affected by mute (e)	[ɛ] for <Greve>
(x)	a vowel for mute (e) itself	[ə] for <Greve>
()	no vowel for mute (e)	[] for <Greve>

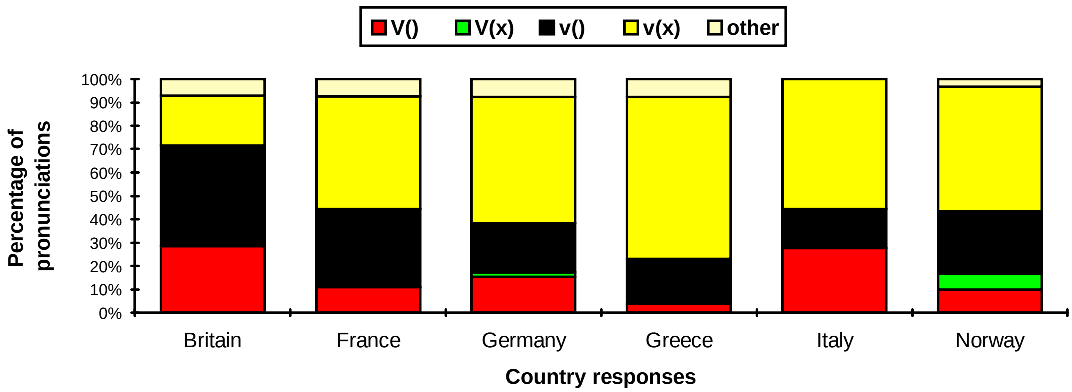

Figure 57: Responses to vowels preceding mute (e) (reading-speaking), and country responses. V represents a vowel pronunciation associated with mute (e), v a vowel pronunciation not affected by mute (e); (x) represents a vowel present for mute (e) itself, () represents no vowel for mute (e)

We would expect V() pronunciations (e.g. [ed] for <Lechlade>) to be associated with British responses, and v(x) (e.g. [adə] for <Lechlade>) to be associated with other countries, but unfortunately the pattern is not so clear. Some of the categories were very small, for instance V() for Britain had a frequency of 4 (the total frequency for the experiment was 168), so statistical analysis has not been performed. The type of response varied widely by prompt, with <Katerini>, for example, having only v(x) responses, and <Greve> having 50% v() responses and 29% V() responses. Some of this is evidently due to the immediate phonetic or graphemic environment, for example whether it is followed by a word boundary, or a stressed syllable, and so on, and further data would be needed for a more thorough analysis. Some of the influences may be subtle; <Dreve>, for example, obtained a slightly different pattern of responses from <Greve>. With only 2 examples of this graphemic rime, it cannot be determined whether this is random variation or whether the preceding consonants do have an effect on the perception of the written word and the resulting pronunciation.

For the mute {e} pronunciations (words such as <Kvernes>, in which presence or absence of a spoken vowel for the second <e> should not affect pronunciation of the first vowel), it can be seen that a large proportion of these {e}'s (41%) were in fact dropped. The vowels preceding mute {e} were fairly predictable; the pronunciations sometimes varied from those given for the vowels listed as single vowels, but since the environments differ too this is not of particular importance.

The consonant/vowel and vowel/consonant graphemic groups in Appendix E show little of any consequence. However, it is of interest to look at the grouped graphemes for which the same sequence occurred elsewhere in the prompts, but was never treated as a unit. <en> occurred in <Firenze>, <Jaren>, <Lyngen>, <Schapen>, <Schwenke>, <Valençay>, and <Velen>, but only in <Valençay> and <Lyngen> was it pronounced as a nasal vowel rather than a vowel plus an nasal consonant, or some other string. The obvious hypothesis is that <Valençay> was recognised as French (this was the case for 16/24 subjects) and pronounced as such, and that <Lyngen> was for some reason thought to be French (8/24 subjects) and so was also given nasal vowels. However, we have only 3 instances of nasal vowels for <en>, 2 for <Valençay> (both 'French' responses) and 1 for <Lyngen> ('Norwegian' response), so it is not possible to draw any conclusions from these. It should also be noted that there were a large number of 'France' responses for the other names, none of which was given a nasal vowel.

b) Graphemic combinations

Much of the discussion on combinations of segments has been covered in the previous section, as some grapheme sequences were pronounced as a single phone, which necessitated treating these graphemic combinations as units. However, there are a few further comments which can be made.

Some subjects produced non-English spoken consonant clusters in response to non-English written clusters (see Table 44, Chapter 5) rather than, as might be expected, omitting one or other consonant or inserting a vowel (though this type of response was also found). <#Ps>, as in <Psakhna>, is a particularly interesting case as <#ps> occurs in a number of loan-words in English and is almost never pronounced [ps], but rather [s] as in *psychic*, yet 5 subjects used the pronunciation [ps]. There were also some non-English spoken clusters in response to common English written clusters, such as the use of [ʃt] for <#St> in <Stira> (judged as Italian) - this was probably a hyperforeignism based on German.

There were also positional variants which did not fall above the 10% threshold used above due to their occurrence in only a small number of prompts. For instance, <n> was, predictably pronounced as [ŋ] in <Schwenke>, but as there were a large number of other words with <n> which did not precede a velar consonant this feature is lost in the above discussion.

Vowel reduction was common in unstressed syllables, although not as common as might be expected. One explanation for this is the formal experimental environment, but vowel reduction also varied by prompt. In <Sollom>, for example, only 5 subjects used a schwa[71] in the unstressed syllable, the others using full vowels; it was not universally thought foreign, so this is not an explanation, and nor did the judgements of 'British' correspond with the use of schwa. Schwa was also uncommon in <Slattocks>,[72] and 6 subjects even used [ɔ] for the unstressed second syllable of <Watton>. In closed syllables, schwa was more common for unstressed <e> than for unstressed <o> (see also Table 57 below for evidence that subjects used the phoneme-to-grapheme correspondence [ə] → <e> more often than [ə] → <o> in the listening-writing experiment.)

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[71]Reduced vowels were sometimes realised as [ʌ], [ä] and so on as well as schwa, but these pronunciations were not often used for <o> in the data.

[72]There are a number of /-ɔks/ pronunciations for bisyllabic <-ocks> words in the dictionary, but generally following obvious morpheme boundaries, such as *stopcocks*.

7.2.2. Written output

Appendices B and C show the responses to the different segments in the listening-writing experiment. Additionally, there is substantial discussion of the spelling of spoken segments and sequences under perception of spoken forms (Chapter 5, p. 130 ff.).

a) Consonants

Although a wide variety of written representations were used for the various spoken consonants, most of these fell within the predictable range (such as <c>, <k> and so on for [k]) or can be explained by errors of perception (such as <p> for [b]; see earlier sections for discussion of perception). Non-native consonants also had, for the most part, predictable responses. [ɲ], for example, was mostly spelt <ne>, <gne> or <n>, [l] was spelt <l> or <ll>, and so on. There was some use of non-native consonants or consonant groups to represent non-native or even native consonants, for example two subjects used <ß> for the final sound of *Tsamandas* ([t͡sa.manˈdas̠], Greece, one of whom placed it in Germany and one in Norway. Combinations which are not used in English or any of the other languages also appeared, for example <tscs> for [t͡ʃ] in *Lechlade* [ˈlˠɛt͡ʃ.lˠed]. Some of the more unusual spellings may have been due to faulty perception, simple error, or difficulty in finding a suitable output.

Some output is evidently due to the use of non-native correspondences, for example <sch> was used for 26% of the responses to [ʃ], despite being used for /ʃ/ in the dictionary only 1% of the time, or 4% for word-initial segments. Three subjects used <sch> in *Bolkesjö*, and for word-initial [ʃ] 16 subjects used <Sch> in *Schwenke*, 7 in *Stellau* and 2 in *Schapen*. The high use of <#Sch> in these three names is perhaps due to classification as German and subsequent use of the German correspondence [ʃ] → <sch>; 20 subjects placed *Schwenke* in Germany, and 19 did so for *Stellau*, while *Schapen*, which had the lowest use of <#Sch>, had only 5 responses of 'Germany'. Rather than a single-segment correspondence, it is also possible that the cluster [#ʃv] may have been transcribed as a unit, either by use of German spelling rules for clusters or through lexical analogy, [#ʃv] in *Schwenke* being directly associated with other (German) words using [#ʃv] and the spelling <#Schw>, while [#ʃ] as in *Schapen* is less strongly associated with <#Sch> words since there are many competing words from English containing [#ʃ]. However, for word-initial [#ʃt] the written form <#Scht> is erroneous, so lexical analogy is a less likely explanation for the

Stellau data. Other possible explanations for <Schtellau> are use of the German [ʃ] → <sch> correspondence without the realisation that it is context-dependent, or lexical analogy with German words containing only [#ʃ], not [#ʃt], or words containing non-initial [ʃt], such as the borrowed Russian word *borscht*.

Some non-native correspondences which from the evidence of the other experiments were well-known to subjects were not widely used in the listening-speaking experiment, for example [j] → <j>. This could be partially explained by perceived origin (16/27 subjects thought *Jaren* was in Britain) or perception (a majority of subjects classified [j] in *Evje* and *Bobbio* as a vowel) but more evidence is needed.

Some representations were only used for certain prompts. For instance, there were 9 examples of [m] in the prompts, but <mn> was only used for *Sollom* and appeared 10 times. This could be due to association with *solemn*, which has the same pronunciation, but it should be noted that although there were 6 <e>'s co-occurring with <mn>, the spelling <umn> was used 4 times, possibly by analogy with *column* or *autumn* rather than the more obvious analogy with *solemn*. This name was the only one with word-final [m].

A number of consonants were inserted where there was no corresponding consonant in the input, for example <rk> in response to [ɾ], or <st> in response to [s], but it is difficult to say whether these were due to misperception or were intended to be silent consonants. Particularly widespread were the use of <h> preceding a vowel, as in <Helatia> for [ɛˈla.t̪i.a], and <r> following a vowel, as in <Snosor> for [ˋsnɔˑ.sɑ]. It is quite likely that they were not intended to represent silent letters, since similar features also appeared in the listening-speaking experiment. This would suggest either misperception or some kind of 'regularisation' of the input string which might apply to both written and spoken responses.

Affricates and other consonant sequences, both native and non-native, were sometimes written as single letters, such as <s> for [t͡s], or with inserted vowels, and so on; these are discussed in more detail under perception (see Chapter 5, p. 148 ff.).

b) Consonant doubling

Pfinztal, *Tallard*, etc. were given single <l> by some subjects and double <l> by others, while *Stira* had double <r> from some subjects and single from others, and so on; most of these alternatives were appropriate, though some were unusual, such as <ll> in <Wollnzach>. Generally both patterns can be found in the dictionary: *Stellau* ([ˈʃtɛ.la͡ʊ], Germany), for instance, has an open stressed vowel followed by [l], which is normally <ll> as in *Ellen*, but there are also numerous examples of single <l> in this environment, such as *Alan*. (Responses were <ll> 22, <l> 4 and <rr> 1.) *Meyssac* ([mɛ.sak], France) is another such example, with 17 <s> and 10 <ss>. This prompt was unstressed, but was repeated in the listening-speaking experiment with initial stress by 17 subjects and final stress by 5. In the listening-writing experiment we might therefore expect mostly <ss> spellings, as in *lesser*, since intervocalic single <s> following a single stressed graphemic vowel is generally pronounced as [z], as in *present*. However, there are some counterexamples with [s] in the dictionary, such as *presage*.

c) Schwa

In English, any orthographic vowel may represent schwa, though some do so more commonly than others. Even digraphic vowels, such as <ou> in *harbour* may be pronounced as schwa. Therefore, if subjects accurately perceive a schwa in the prompts, they may transcribe a variety of vowels. Looking at the raw data (see Table 57), 16 schwas were present in the prompts, giving 432 responses. 13 of the schwas represented original orthographic <e>, while 3 names had <o> in the original spelling. <e> was in fact the most common response (199) followed by <a> (69) and <i> (66). There were 64 occasions on which no grapheme was transcribed (as in [pʰəˈlˠɪnt] <Plint>), while the other single vowels came next, with <o> having 32 responses and <u> 15.

Spelling	Occurrences	Spelling	Occurrences
e	119	eux	3
a	69	ea	3
i	66	ar	3
omitted	64	no response	3
o	32	eu	3
u	15	ua	2
er	12	eur	2
r	9	ll	2
l	6	Other	19
		Total	432

Table 57: Written representation of schwa (listening-writing)

It is difficult to say whether the responses reflect a general correspondence of [ə] → <e>, in preference to [ə] → <a> and so on, as data of this kind is difficult to obtain. Schwa is particularly problematic, as many words with schwa have variants either with full vowels (such as *obey*) or with syllabic consonants (such as *chasm*), so to determine the statistical likelihood of schwa representing <e> would require large amounts of speech data, rather than simple dictionary citations as have been used in this study.

d) Other vowels

Spelling	Occurrences for non-final [a]		Occurrences for final [a]	
a	543	(91%)	127	(78%)
à			1	(1%)
a'	1	(0%)		
'a	1	(0%)		
a (+space)	3	(1%)		
aa	1	(0%)		
aar			1	(1%)
ah	3	(1%)	14	(9%)
ahk	1	(0%)		
ai	4	(1%)	1	(1%)
air	1	(0%)		
ar	5	(1%)	5	(3%)
as			1	(1%)
e	11	(2%)	8	(5%)
ei	3	(1%)		
er	1	(0%)	1	(1%)
et			1	(1%)
ha	3	(1%)		
i	5	(1%)		
ia			2	(1%)
o	2	(0%)		
ou	1	(0%)		
ow	1	(0%)		
y	1	(0%)		
(blank)	3	(1%)		
Total	594		162	

Table 58: Spelling of final and non-final [a] (listening-writing)

There are of course numerous ways of representing the same vowels in English (see Venezky 1970). Spelling in the responses varies according to position in the word, for example *Psakhna* ([psaˈxna]). Both the vowels in the prompt were the same, yet the first was unanimously transcribed <a>, while the second had 21 <a>'s but also 5 <ah>'s and 1 <as>. This was possibly an attempt to emphasise the fact that the sound is unreduced, since final [a] does not normally occur in English (in the dictionary it is only found in loan-words such as *voilà*); final <a> is not especially uncommon in English, but generally represents schwa. (A large proportion of words with <a#> are names such as *Albania* or *Clara*, suffixes such as *-phobia* or borrowed words such as *ikebana*, which suggests that for a study such as this it might be worth analysing the graphemic, phonemic, and sound-to-spelling patterns of names separately from other words, though even if distinct differences were found, we would also need further experiments to see if people do in fact treat names differently from other words.) Table 58 above shows figures for graphemes used to represent final and non-final [a] (not including long [aː] or [a̠]). Although <ah> represents final [a] more often than non-final [a], the totals for both are small. What the table does show is a much higher proportion of <a> spellings for non-final [a] than for final [a].

Again, there were some vowel spellings in the responses which are not used or only minimally used in English. Some were more or less appropriate for other languages, such as <é> or <ais> for [e], while others were not, such as <oux> for [ə] or <oeu> for [o]. Table 59 shows as an example the occurrences of <é> in the responses. Although the majority of these appeared in names which the subjects thought were French, there were a few in towns believed to be in other countries; these are possibly examples of hyperforeignism.

Town			Spellings	Country Response
Novoli	[ˈno.vo.li]	(Italy)	Norvulé	Italy
			Nouvlée	France
Dreve	[ˈdʁeː.və]	(Germany)	Tréve	France
Greve	[ˈgrɛ.ve]	(Italy)	Grethé	France
Meyssac	[ˈmɛ.sak]	(France)	Mésac	France
Ekhinos	[ɛˈçi.nɔs̠]	(Greece)	Éheneux	France
Firenze	[fiˈrɛn.t͡se]	(Italy)	Firensé	Italy
			Firensé	France
			Firencé	France
Toucy	[tu.si]	(France)	Tousée	France
			Tousé	France
Fermo	[ˈfer.mo]	(Italy)	Férmo	Italy
Valençay	[va.lɑ̃.sɛ]	(France)	Valonsé	France
			Fellonsé	France
			Falansé	France
			Falonsée	France
			Valancé	France
Evje	[ˇev.jə]	(Norway)	Éthia	France
			Ébeu	France

Table 59: Occurrences of <é> in responses (listening-writing)

Town			Spellings	Country Response
Glinde	[ˈglɪn.də]	(Germany)	Glindé	Norway
Katerini	[ka.t̪ɛˈɾi.ni]	(Greece)	Kataliné	Italy
Velen	[ˈfeː.lən]	(Germany)	Félin	Norway

Table 59 (continued)

7.2.3. Syllables

While the syllable count is not of great concern in this study, it does tell us something about perception of the input (see Chatper 5, p. 148 ff. and p. 172 ff. for structural perception), and also about variation in output, which will highlight prompts for which subjects found different solutions.

Where it can be determined, the input syllable count was generally preserved in the listening-writing experiment. There are a high number of ambiguous responses, however, mostly due to potentially mute <e>. Instances where it was not preserved include *Bobbio* and *Jaren* (see Chapter 6, Table 47 and the ensuing discussion for responses to these in the listening-speaking experiment). *Kvernes* and *Glinde* both had epenthetic vowels leading to a change in syllable count, as discussed under perception. The [o] of *Loano* was often treated as a glide (written as <w>), while the schwas in *Hellesylt* and *Ålesund* were frequently omitted, leading to a reduction in syllable count.

Table 60 shows syllables in the reading-speaking experiment. As only syllables are being examined, not segments, responses have only been rejected if the syllable count is unclear, or no response was given. For most prompts there was a high degree of consensus on the syllable count. Cases where the syllable count varied substantially mostly involved potentially mute <e> (for example <Rede>; cf. Table 43 in Chapter 5), difficult affricates or consonant sequences leading to some use of epenthetic vowels (such as <Pf> in <Pfinztal>; cf. Table 44 in Chapter 5), or vowel combinations (such as <oa> in <Loano>; cf. Chapter 5, p. 174). For some words, such as <Kvernes>, the presence of more than one of these features led to a range of syllable counts, and in a few cases, such as <Karousadhes>, the range was increased by the complexity or length of the string, which led to errors.

Prompt and number of syllables in name in original language		No. of responses with 1 syllable	No. of responses with 2 syllables	No. of responses with 3 syllables	No. of responses with 4 syllables	No. of responses with 5 syllables	No. of blank or unclear responses
Keld	1	24					
Guist	1	23					1
Rötz	1	23	1				
Aire	1	20	4				
Maule	1	17	7				
Rede	1	15	9				
Acri	2		24				
Bredgar	2		24				
Cornus	2		24				
Dokka	2		24				
Jaren	2		24				
Slattocks	2		24				
Snåsa	2		24				
Sparbu	2		24				
Sturry	2		24				
Tallard	2		24				
Toucy	2		24				
Volos	2		24				
Watton	2		24				
Fermo	2		23	1			
Lyngen	2		23	1			
Sollom	2		23	1			
Stellau	2		23	1			
Stira	2	1	23				
Velen	2	1	23				
Schapen	2		22	2			
Meyssac	2		21	2	1		
Wolnzach	2		21	3			
Pelynt	2	2	18	3			1
Pfinztal	2		17	5			2
Schwenke	2	6	17	1			
Lechlade	2		15	9			
Manosque	2		13	7	4		
Evje	2	6	12	4	1		1
Psakhna	2	1	12	8	2		1
Kvernes	2	6	11	6			1
Glinde	2	15	9				
Laragne	2	1	9	14			
Nahe	2	15	8				1
Dreve	2	17	6	1			
Savigne	2	1	6	17			
Greve	2	19	5				
Bobbio	2			23	1		

Table 60: Syllable count in input and output (reading-speaking)

Prompt and number of syllables in name in original language	No. of responses with 1 syllable	No. of responses with 2 syllables	No. of responses with 3 syllables	No. of responses with 4 syllables	No. of responses with 5 syllables	No. of blank or unclear responses
Copparo 3			24			
Larisa 3			24			
Megara 3			24			
Novoli 3			23			1
Valençay 3			23	1		
Livorno 3			22	1	1	
Osimo 3			22		1	1
Ekhinos 3		2	21	1		
Bolkesjö 3		1	20	2		1
Tsamandas 3		2	20	2		
Ålesund 3		5	17			2
Firenze 3	1	7	16			
Hellesylt 3	2	7	14	1		
Loano 3		14	10			
Katerini 4			4	19	1	
Elatia 4		1	9	13		1
Karousadhes 4		2	8	10	2	2

Table 60 (continued)

7.3. Output of suprasegmental features

This section looks at stress, tone and segment length in the cross-media experiments.

◊ ***Summary: Suprasegmental output in cross-media experiments***

The question of stress assignment (reading-speaking) is an interesting one. Penultimate stress was strongly favoured, but this was partly due to the syllable structure of the names. Some words did not conform to linguistic theories of syllable-weight and stress assignment; this may be partly explained by perceived country of origin, or by analogy with other words, but the results were inconclusive on this point. The strongest factor analysed was the number of consonants in the rime (maximal phonemic offset) of a given syllable compared to the rimes of other syllables in the word; this is of course one aspect of syllable-weight. It is notable that maximal offset was a much stronger indicator (as suggested by some of the theories relating syllable weight and stress) than the maximal onset structure more commonly used in phonology.

Tone was of no interest in these two experiments.

Long consonants were sometimes reproduced as two different graphemes in the listening-writing experiment, usually a continuant and a stop, though this may be a perceptual rather than a production process. Some long segments were produced in the reading-speaking experiment, probably due to hesitation.

7.3.1. Stress

Little can be determined about representation of stress in the listening-writing experiment, or the effect of stress on spelling; for this kind of data paired prompts would be preferable, with varying stress patterns. Because of this, the results below concentrate on the reading-speaking experiment. In order to help determine the motivation behind the stress assignments, and take into account the graphemic form, all responses for which the response string did not 'match the prompt' were discounted from the results. 'Matching the prompt' refers to a possible pronunciation of the orthography, where 'possible' is defined in relation to English and the other languages in the study - a liberal interpretation is made of grapheme-to-phoneme correspondences, i.e. they have to be conceivable, rather than extant. Epenthesis or omission were permitted if they occurred in relation to a non-English grapheme/phoneme sequence and were a reasonable solution to a pronunciation problem (e.g. <#Ps> → [p^{h}ə.s], [s] etc.), or were part of a natural phonological process, for example elision of [ə] in, say, [fəˈrɛnz] to give [frɛnz] (representing <Firenze>). Examples of rejected responses are:

<Snåsa >	→	[ˈsan.sə]
<Velen>	→	[vil^{ɣ}]
<Loano>	→	[l^{ɣ}oˈna.no]

Monosyllabic responses were also, of course, ignored.

The number of syllables in responses for each word varied from 1 to 4. Responses can be grouped as follows:

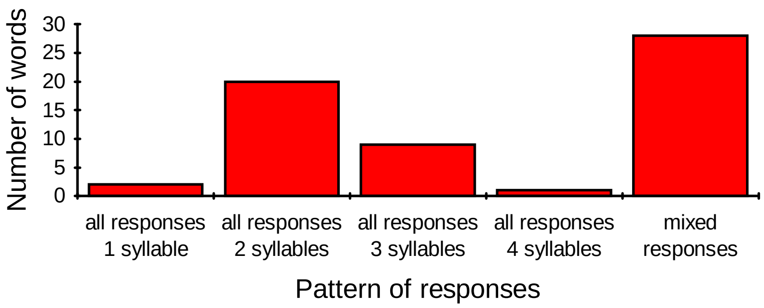

Figure 58: Words grouped by the number of syllables in responses (reading-speaking)

Of the multisyllabic words for which all responses had the same number of syllables (the middle three columns in Figure 58) the stress patterns fall as shown in Figure 59. (The 'other' category includes rejected responses and those in which the stress could not be confidently determined.[73]) It can be seen that there is a clear preference for penultimate stress.

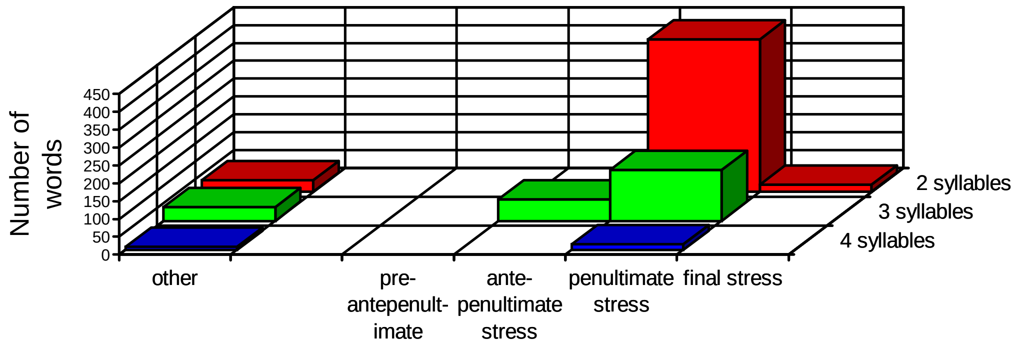

Figure 59: Stress patterns in responses (reading-speaking)

a) Bisyllabic words

Of the 20 words which had only bisyllabic responses, all had a clear preference for penultimate stress.[74] A number of words had one response with final stress. The words which elicited final stresses from more than one subject are as follows:

Town	Penultimate stress	Final stress
Cornus	17	6
Velen	19	4
Sollom	20	3
Slattocks	19	2

Table 61: Final stresses in bisyllabic words (reading-speaking)

(For this and following data in this section, there were 24 subjects, and 'other' responses account for the difference in totals.) These words still have a low incidence of final stresses, but are worth further examination. Unfortunately for

[73]In some cases stress was unclear. For some subjects in particular, a number of these involved a rising tone, normally associated with stressed syllables, which seemed to occur on the second syllable of a bisyllabic word, in conjunction with extra emphasis on the first syllable. Baker and Smith (1976), who also used Scottish subjects, also note some difficulty in determining stress placement, though they ascribe this to a careful reading style.
[74]This is described as 'penultimate' rather than 'initial' as it fits the overall description better.

any of the theories of syllable weight and stress discussed in Chapter 3, the application of final stress cannot be explained by syllable structure, since final syllables of English nouns do not take stress in most theories, and for others lax final vowels do not take stress (e.g. [ɔ] in *Sollom* [səˈlˠɔm] and *Slattocks* [slˠaˈtʰɔks]; though note comments throughout this thesis on the difficulty of using the feature [tense] in Scottish English). They must therefore be treated as exceptions. But, why should a number of subjects treat an unknown word as an exception? It should be noted that graphemically and phonologically these names do not form a separate class from others in the set, such as <Tallard>, <Volos> or <Schapen>. Also, the phonemic strings used for the responses with penultimate stress and those with final stress in Table 61 do not differ substantially except in the use of vowel reduction.

Two explanations suggest themselves. One is the operation of analogy, and another is that the perceived origin of the words influenced the stress patterns. The longest dictionary matches for <Sollom>, with word-ends included in the count and case ignored, have a 4-letter overlap, for example, <#solvent>, <Apollo> and <shalom#>. *Shalom* of course has final stress, and is a possible analogy, though there is a more obvious analogy in <#solemn>, which is a much more common word and is in fact homophonous with *Sollom*, a British town. In any case, it is possible that *shalom* formed the basis for the few pronunciations using final stress. For <Velen>, the longest dictionary match is <Helen#>, with penultimate stress, though the predominance of [e] in the first syllable suggests this was little used. There are some matches with final stress, for example <relent>; however, although one finally-stressed response used [ɛ] for the second vowel, the other 3 used [e], making *relent* an unlikely basis for the pronunciations. For <Cornus> there are no obvious analogies which would lead to final stress (matches include <#cornucopia> <#corner>, and <#corny>), nor for <Slattocks> (<buttocks#>, <#slattern> and so on). See, however footnote 72 above for vowel quality in <Slattocks>); a tendency to keep a full vowel in the second syllable might make this syllable more prone to stress.

As for perceptions of origin, it might be thought that towns which were judged to be French would be given final stress. The proportions are as shown in Figure 60 below. A much higher percentage of French responses have final stress than responses from other countries, with the exception of <Slattocks>, but since the numbers in each category are so low they are inconclusive. (See also Figure 27 in the previous chapter, which suggested no relationship between perceived French origin and stress output in the listening-speaking experiment.)

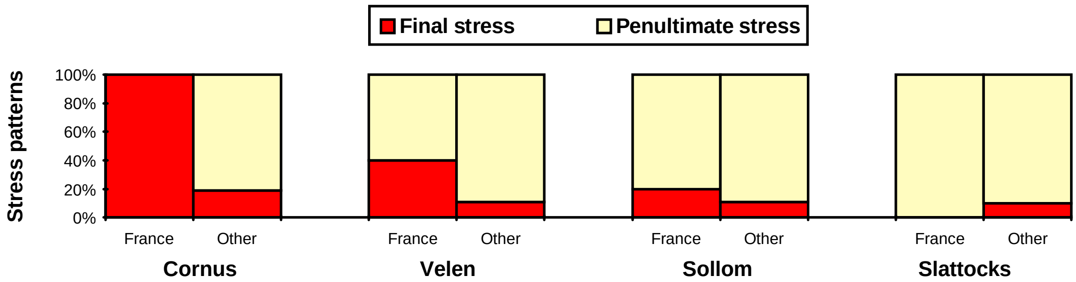

Figure 60: Illustration of stress and perception of origin for <Cornus>, <Velen>, <Sollom> and <Slattocks> (reading-speaking)

b) Trisyllabic words

Stress patterns assigned to trisyllabic words are less homogenous, but more interesting. They can be grouped as shown in Table 62. The following discussion covers some of the possible explanations for the stress patterns.

	Antepenultimate stress	Penultimate stress	Final stress
Mostly antepenultimate stress			
Bobbio	20	3	0
Osimo	11	8	0
Ekhinos	10	8	0
Mostly penultimate stress			
Larisa	0	22	0
Livorno	1	20	0
Megara	3	19	0
Copparo	3	19	0
Valençay	4	17	0
Novoli	3	16	0
Bolkesjö	5	10	0

Table 62: Stress patterns in trisyllabic words (reading-speaking)

The antepenultimate stress assigned to <Bobbio>, e.g. [ˈbɔ.bi.o] could be explained by Chomsky and Halle (1968: 75) by proposing that the [i] derives from a lax vowel and so is unstressed (cf. discussion of *various*, p. 66). However, such a suggestion is unsatisfactory in a word for which we cannot realistically assume a derivation, unless we propose analogy with existing words with lax vowel derivations. (Note also that in Scottish English the tense/lax distinction is even more problematic than in other accents of English, as discussed in Chapter 3, p. 65). If we attempt to include the tense/lax distinction in a surface analysis, there would be no distinction between the tense vowel [i] and the tense vowel [a͡e], although there does appear to be a relationship between the vowel quality and stress, since in all but one case of antepenultimate stress, the vowel of the second syllable was [i], whereas in 2 out of 3 cases of penultimate stress it was a diphthong. A length distinction, rather than tenseness, would give an opposition of [i] to [a͡e] to provide a possible explanation. In analyses relying only on syllable-final consonants to determine syllable weight, as the second syllable in [ˈbɔ.bi.o] is open it is weak and therefore unstressed, but the second syllable in pronunciations such as [bɔˈba͡e.o] is also weak. As for analogy, the longest dictionary matches were <#bobbing>, <#Bobbie> etc.; only *bio* had the word-final string <bio#>, though since it does match the phonetic forms of the responses with penultimate stress it could be considered a possible basis for the [bɔˈba͡e.o] pronunciations.

A problem arises from <Osimo>, with a tendency to antepenultimate stress, and <Larisa>, <Megara> and <Novoli>, with penultimate stress favoured. There is no obvious difference in phonemic or graphemic structure between <Osimo> and the other three except the lack of an initial consonant, which is universally held to be of no account. Vowel identity in the responses does show certain tendencies. 10/11 of the subjects giving penultimate stress to <Osimo> used [i], and 13/20 responses for <Larisa> with penultimate stress also had [i], while 7/11 responses to <Osimo> giving antepenultimate stress used [ɪ], suggesting a relationship between the vowel in the penultimate syllable and the stress pattern. [ɪ] and [i] can be distinguished by the feature [tense], since even in Scottish English [ɪ] is indisputably lax, which would confirm the hypothesis that tense vowels are associated with stress. However, there were four examples of *Osimo* with [i] and antepenultimate stress, and seven examples of *Larisa* with [ɪ] and penultimate stress, which contradict the theory, though this pronunciation of *Larisa* could have been influenced by the homographic Russian personal name. Also worth noting are the consonants used for <Osimo>. They fell into two clear categories: 7/8 subjects using penultimate stress pronounced <s> as [s], i.e. [ɔˈsi.mo], while 9/11 of those using antepenultimate stress pronounced <s> as [z], i.e. [ˈɔ.zɪ.mo]. We could say that this suggests a different syllable structure for the two groups, ([ɔˈsi.mo] and [ˈɔz.ɪ.mo]), leading to different stress assignment; however, if we apply stress assignment from right to left, the structure of the first syllable should be of no consequence.

The longest dictionary matches for <Osimo> are <generalissimo#> and <pianissimo#>, which do have antepenultimate stress but are rather rare.

Another possibility is that some subjects associated <Osimo> with <Oslo>, and so stressed *Os*, though the country responses do not support this hypothesis; a number of responses were for Norway, but these did not show a higher incidence of antepenultimate stress than the other responses. On the other hand, the lack of Italian responses for <Osimo> (2/19), compared to <Larisa> (12/22), <Novoli> (14/19) and <Megara> (6/22) may have had an effect. Church (1986: 2423) points out that "*cálculi* / *tortóni* ... should have the same stress pattern since they have the same sequence of stops, liquids and vowels. However, *tortóni* violates the English main stress rule (which is derived from Latin) and takes penultimate stress like most other Italian loan words".

Longest matches for <Larisa> are rather unhelpful (<polarisation>, etc.); word final matches include <Lisa#> and <Pisa>, with penultimate stress but different consonants from *Larisa*, which mostly used <s> → [s]. Word initial matches included <#lariat>, <#Larry>, and so on. <Megara>, despite large numbers of <mega-> words in the dictionary, such as <#megaphone>, all with primary or secondary stress on *meg*, was mostly stressed on the second syllable. <-ara#> words in the dictionary (<Niagara#>, <Barbara#>, etc.) were mostly not stressed on the penultimate syllable, though some were (<mascara#>, <McNamara#>), and most accounts agree that the end of the word is more important in assigning stress than the beginning. <Novoli> had few likely matches with penultimate stress; matches found include <Tivoli#> <Tripoli#>, <#novel> etc., with antepenultimate stress. Data for these words is therefore not suggestive of direct lexical analogy.

<Livorno> and <Valençay> can be explained by any of the phonological accounts above; for Chomsky and Halle (1968: 82), the second syllables form strong clusters, while for other accounts the second syllable is closed and therefore stressed. <Bolkesjö> could also be explained in this way, since nearly all subjects pronounced <sj> as a sequence of segments, such as [sd͡ʒ] or [zj], rather than a single segment such as [ʃ]. Disappointingly, though, there was no difference in the syllabic structure of the four responses which had antepenultimate stress, weakening the argument. These words do not have very likely analogies in the dictionary; best matches for <Livorno> include <Livorno> itself, and <porno#>. For <Valençay> we have <#valentine>, and if we ignore the diacritic, we have <#valency>, <#Valencia> and so on. <Bolkesjö> has <Folkestone>, <#Bolton>, <banjo#> etc.

<Copparo> and <Ekhinos> again are a problem. <Ekhinos>, if pronounced with [i], would be more likely than <Copparo> to have stress on the

penultimate syllable according to Chomsky and Halle's Main Stress Rule, and should be similar to the <Megara> group. However, while <Copparo> does fall into this group, <Ekhinos> had mostly antepenultimate stress. The two graphemic consonants may have had some influence on <Ekhinos>, but if so they should also have affected <Copparo>; additionally, stress assignment is generally agreed to proceed from right to left. <Copparo> did only have one phonetic consonant to represent <p>, while <Ekhinos> sometimes had two for <kh>, yet this does account for the difference as the number of consonants in the <Ekhinos> pronunciations does not correspond to the distribution of stress.

c) Quadrisyllabic words

Only one word was universally quadrisyllabic, <Katerini>. All subjects whose stress pattern was clear gave this penultimate stress.

d) Mixed answers

As for the words already discussed, penultimate stress was predominant in words which elicited varying numbers of syllables in the responses (Figure 61).

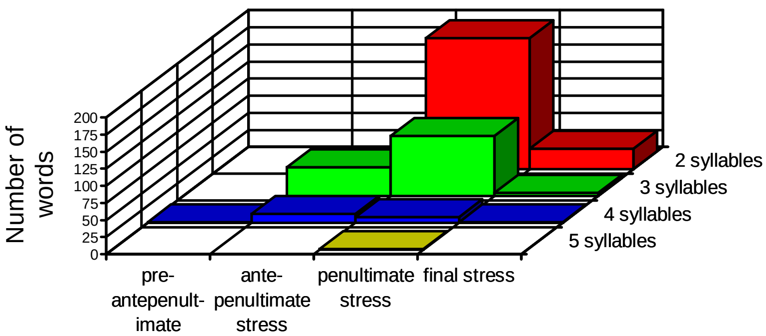

Figure 61: Stress patterns in mixed responses (reading-speaking)

Since the principles of stress assignment have been examined above in relation to words with consistent syllable counts, and similar considerations apply here, stress in the individual words represented by Figure 61 will not be discussed.

e) Effect of syllable-final consonant clusters on stress

The dictionary data shown in Figures 4 and 6 in Chapter 3 suggested that if words were syllabified with maximal phonemic offset, rimes with more consonants showed a stronger tendency to be stressed. The stress patterns from the reading-speaking experiment were analysed in the same manner, again using maximal offset rather than the maximal onset used elsewhere for data transcriptions. (The experimental data here includes responses with mismatches between the orthography and phonology, unlike the previous section, but disregards queries and unstressed words. Vowel + schwa combinations in the responses, such as [iə] and [a͡ɪə], are here treated as diphthongs and triphthongs, rather than constituting two separate syllables, for direct comparison with the dictionary data.)

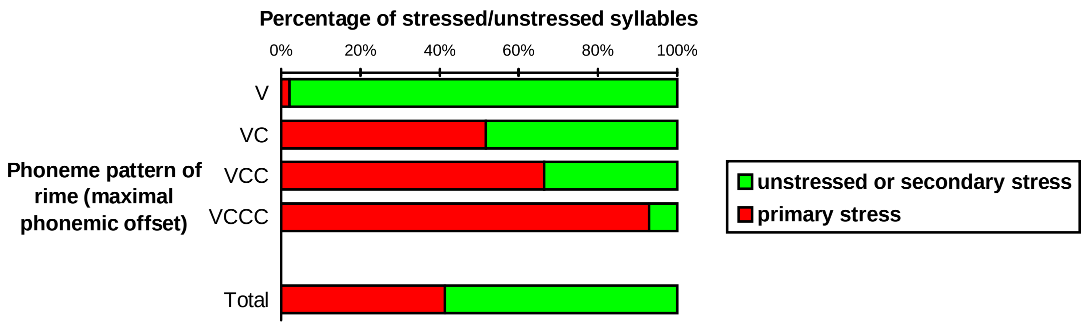

Figure 62: Stressed and unstressed syllables and phonemic syllable type in responses to reading-speaking experiment divided by maximal phonemic offset)

It can be seen that the patterns emerging in Figure 62 are very similar to those in Figure 6, Chapter 3. As before, maximal onset (Figure 63) does not give such clear results.

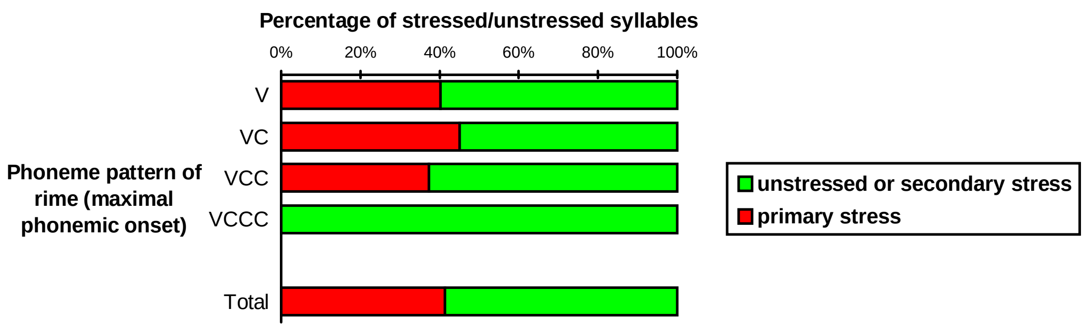

Figure 63: Stressed and unstressed syllables and phonemic syllable type in responses to reading-speaking experiment divided by maximal phonemic onset)

We now need to verify that this is independent of the types of syllable structure which happen to occur at each location, i.e. that the relationship between rime structure and stress is causal. In Figure 64 we can see that penultimate syllables, which were the most commonly stressed in the responses (see Figures 59 and 61 above), also had the highest proportion of phonemic rimes containing two or more consonants (VCC and VCCC).

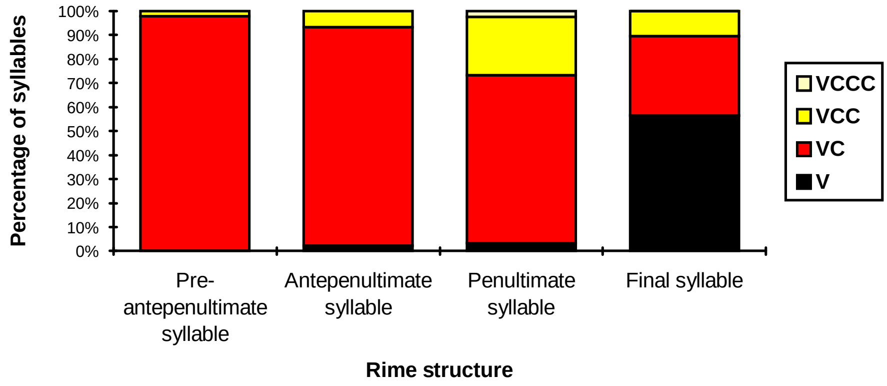

Figure 64: Rime structure and syllable position in responses to reading-speaking experiment - all responses with 2-4 syllables (figures in percentages), maximal offset

In order to examine the hypothesis that the number of consonants in the rime influences the likelihood of the syllable being stressed, whatever the position in the word, a 'rime score' was calculated. Each syllable rime was given 1 point for every consonant it contained. So, a vowel-only rime would be 0, while a cluster of two consonants would be 2. Then, to take account of the relative patterns of each rime in the word, the totals of the other syllables were subtracted. The resulting figure was the 'rime score'. For words of more than two syllables, the other syllables were weighted so that for rimes of equal structure, the rime score for any one syllable was 0, and the total for each word was 0. So, rimes which have more consonants than others in the same word will have positive numbers, those with the same number of consonants as others will have a score of zero, and rimes with fewer consonants than other syllables will have negative scores. We can then see if positive scores are associated with stressed syllables, and negative scores with unstressed syllables.

Table 63 shows some examples of calculations. For each syllable in a three-syllable word the consonant counts in the other syllables are divided by 2 so that the total score for each word is zero; for four-syllable words they are divided by 3.

Response (syllabified with maximal offset)	**Syllable pattern**	**Calculation for antepenul-timate syllable**	**Calculation for pen-ultimate syllable**	**Calculation for final syllable**	**Rime score of antepen-ultimate syllable**	**Rime score of penul-timate syllable**	**Rime score of final syllable**
ˈplˠe.ɹntʰ	V-VCC		0 - 2	2 - 0		-2	2
ˈfelˠ.ən	VC-VC		1 - 1	1 - 1		0	0
bɔɫkʰˈɛz.d͡ʒo	VCC-VC-V	2 - 1/2 - 0/2	1 - 2/2 - 0/2	0 - 2/2 - 1/2	1½	0	-1½

Table 63: Example calculations of rime scores (maximal offset)

Firstly, the rime score was calculated for each syllable position in each word type (bisyllables, trisyllables and quadrisyllables; words with more syllables than this were not included as there were very few). The data is shown in Figures 65-73.

Adding the scores for the different syllable-positions within each word-type (bisyllables, trisyllables and quadrisyllables) shows the pattern even more clearly (Figure 74). The higher the rime score, the higher the probability that the syllable will be stressed. So, the more consonants in the rime, as compared to other syllables in the word, the more likely it is that the syllable will be stressed. (As the data within each group have a roughly normal distribution, centring around rime score 0, the percentages for the highest and lowest rime scores of each group are the least reliable; thus, although the data for trisyllabic rime score 2 and quadrisyllabic rime score 1 appear to contradict the general trend in Figure 74, these percentages are based on 2 and 1 examples respectively.)

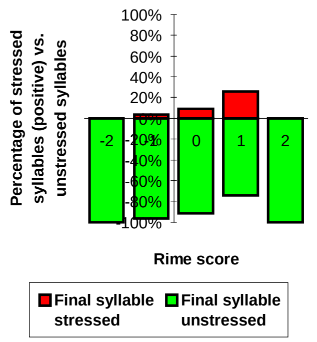

Figure 65: Rime scores and stress for final syllable of bisyllabic responses (reading-speaking, maximal offset)

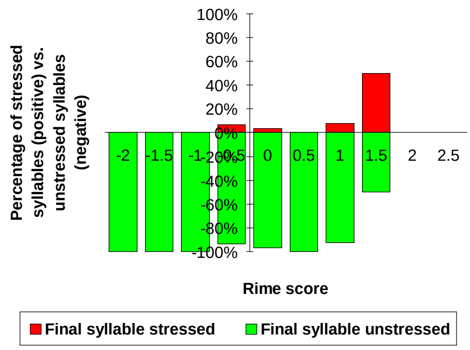

Figure 67: Rime scores and stress for final syllable of trisyllabic responses (reading-speaking, maximal offset)

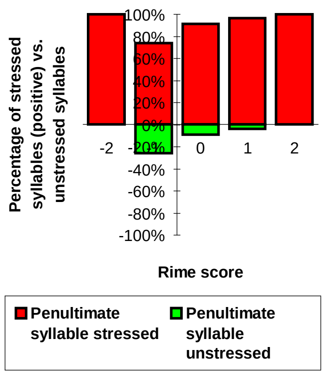

Figure 66: Rime scores and stress for penultimate syllable of bisyllabic responses (reading-speaking, maximal offset)

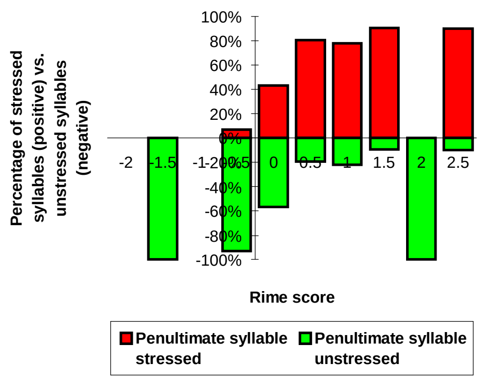

Figure 68: Rime scores and stress for penultimate syllable of trisyllabic responses (reading-speaking, maximal offset)

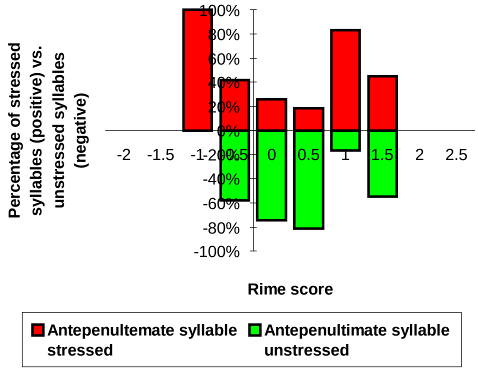

Figure 69: Rime scores and stress for antepenultimate syllable of trisyllabic responses (reading-speaking, maximal offset)

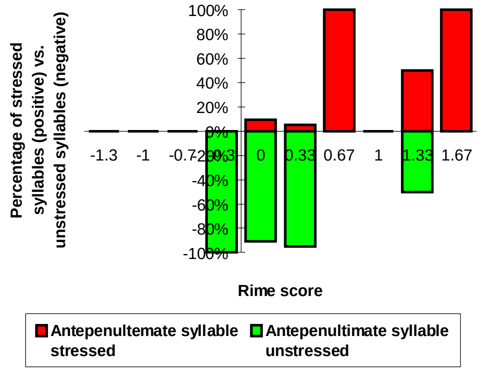

Figure 72: Rime scores and stress for antepenultimate syllable of quadrisyllabic responses (reading-speaking, maximal offset)

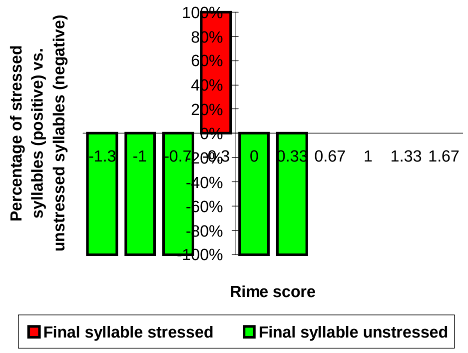

Figure 70: Rime scores and stress for final syllable of quadrisyllabic responses (reading-speaking, maximal offset)

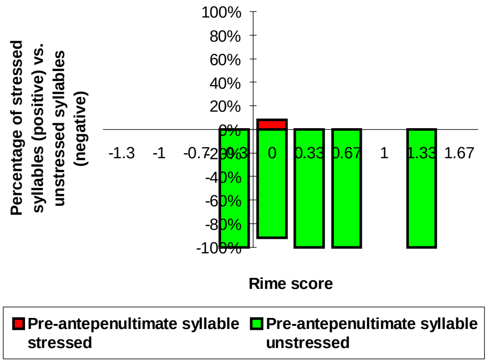

Figure 73: Rime scores and stress for pre-antepenultimate syllable of quadrisyllabic responses (reading-speaking, maximal offset)

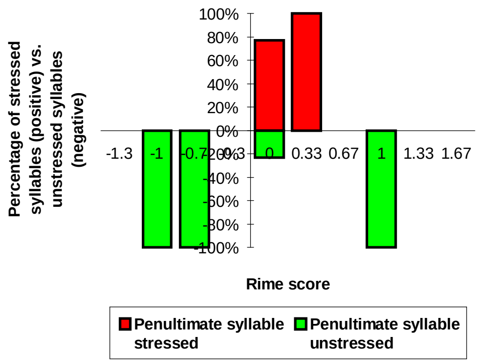

Figure 71: Rime scores and stress for penultimate syllable of quadrisyllabic responses (reading-speaking, maximal offset)

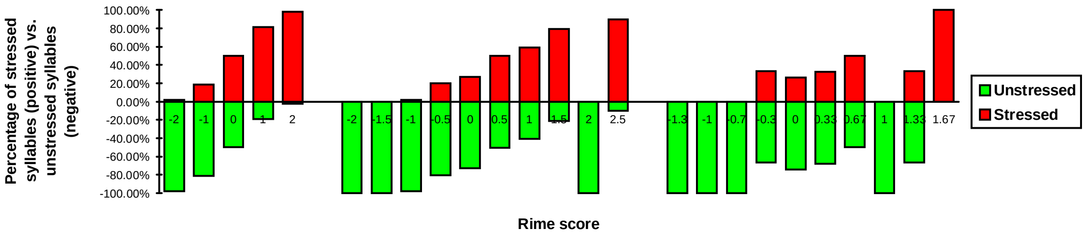

Figure 74: Rime scores and stress for bisyllabic, trisyllabic, and quadrisyllabic responses (reading-speaking, maximal offset) - percentages

It should be noted that in a rime-score analysis, as opposed to a simple consonant count as in Figure 63, data using maximal onset also supports the hypothesis that the greater the number of consonants in the rime, compared to other syllables, the more likely the syllable is to be stressed. However, for maximal onset the pattern is not revealed across whole word-groups, as in Figure 74, but only within each individual syllable-count/stress pattern analysis, as in Figures 65-73.

7.3.2. Tone

Of course, there is no way of representing tone or pitch in written language, so we cannot usefully say anything about tone in the listening-writing experiment. In the reading-speaking experiment we could look at pitch levels or movements which differed from the default patterns; this data would be useful for comparison with the 'tones' which were apparently reproduced in the listening-speaking experiment. However, there were no definite examples of such pitches. In a handful of responses there was high pitch on the second syllable, making it difficult to determine the stress location, but this is within the expected range of Edinburgh pronunciations.

7.3.3. Segment length

For the listening-writing experiment, in many cases it is not possible to tell whether the subjects are attempting to reproduce the long sounds. For consonants, a word-medial double-consonant spelling such as <kk> or <nn> can represent a single spoken segment in English, rather than a geminate. However, double consonant spellings which represent two different sounds, such as word-medial <mp>, suggest that the subjects are realising the duration of a long segment across two segments. There are five long consonants in the data:

Italian *Bobbio* [ˈbɔ.bːjo] and *Copparo* [koˈpːa.ɾo], and Norwegian *Dokka* [ˈdɔ.kːa], *Hellesylt* [ˇhe.lːə.sylt^h] and *Lyngen* [ˇlyŋː.ən].

	[bː] in *Bobbio*		[pː] in *Copparo*		[kː] in *Dokka*		[lː] in *Hellesylt*		[ŋː] in *Lyngen*	
	Data	**No.**	**Data**	**No.**	**Data**	**No.**	**Data**	**No.**	**Data**	**No.**
Probably long	mp bp lp rp	3 1 3 1	mp np rp	6 1 1	nk nc	5 8			gn	2
Ambiguous			pp	1	kk	1	ll	10		
Probably short	p b	9 10	p	17	c ch ck	7 1 5	l r	14 1	g ng	20 5
Other			blank	1			blank	2		

Table 64: Representation of long consonants (listening-writing)

As Table 64 shows, the long consonant often manifests itself as a continuant, such as a nasal or a liquid (<l> or <r>) plus a stop (cf. Table 56 in the previous chapter for similar results in the listening-speaking experiment). The use of two graphemes to represent a long segment, such as [bː] → <mp>, is perhaps a perceptual rather than an output process; there is no constraint prohibiting the use of <bb>, and a geminate in a word such as <webbrowser> would be represented by <bb>. Unfortunately there are no short consonants in similar environments for comparison except the [p] in *Schapen* ([ˈʃa̠ː.p^{h}ən], Germany), which is represented as <p> (25 times) and <pp> (2 times), but with 19 instances of a preceding <r> (see Chapter 5, p. 133 for discussion of <r> insertion in names such as *Schapen*). The <r> in *Schapen* could be related to the long vowel, but see below.

Since a wide variety of written representations are used for vowels, and the environments vary across prompts, it is not possible to determine whether subjects used different vowel spellings for long or half-long vowels. For example, in Appendix C long [a̠ː] has a high percentage of <ar> spellings compared to [a̠], but all these are for the word *Schapen*, and none for the other two prompts containing this long vowel. Information on the environment, and perhaps the exact acoustic qualities of the segment in the different prompts, are probably needed for a meaningful comparison.

For the reading-speaking experiment, a number of long segments were produced spontaneously. As noted previously, there were 27 long and 40 half-long segments in response to short prompts in the listening-speaking experiment; for the reading-speaking the figures are 58 long and 29 half-long.

Subjectively, much of the extra length in reading-speaking responses seemed to be due to hesitation. To investigate this hypothesis, the responses with extra length were examined to see whether they were poorer overall than responses without extra length, but results were inclusive. Segments with extra length were not distributed randomly throughout the responses; there is no evidence of a relationship between long segments and spelling per se, but it may be that names which subjects found more difficult, such as <Karousadhes> and <Nahe>, elicited more long segments due to hesitation.

7.4. Word and part-word analogy

Analogy can be seen to operate at several levels, depending on what we define as analogy and what, if anything, we consider to be rule-based. For example, subjects who use <-y> rather than <-i>, in spelling the final vowel of *Novoli* (listening-writing), could be considered to be applying an English graphemic rule or pattern, or it might be thought that they are using analogy with words such as *happily*. Given that, in a strong view of analogy, any and all units in the experiments, whether spoken or written, might be considered to be produced through analogy, this analysis will concentrate on larger structures. Further discussion of analogy versus grapheme-to-phoneme rules is given the next chapter.

◊ ***Summary: Word and part-word analogy***

There are many cases in both the listening-writing and reading-speaking experiments which suggest an analogical basis for subjects' responses; on the other hand, there are examples which argue against this. The experiments were not designed as an explicit test of the use of analogy or lexical cohorts, so the results can only provide pointers to areas for further exploration. However, it evident that grapheme-to-phoneme rules, or phoneme-to-grapheme rules, based on the conversion of segments or short sequences, are inadequate as the sole explanation of the output in these experiments.

It has already been noted in previous sections that subjects use non-native grapheme-to-phoneme and phoneme-to-grapheme correspondences in their responses; although there are only a few examples, it is apparent that in some cases subjects also use whole foreign words or morphemes as the basis for their answers.

7.4.1. Listening-writing

There are a number of examples of known morphemes being used to transcribe spoken names. For example, the first syllable in *Bredgar* ([ˈbɹɛd.gaɹ], Britain) was given the spelling <Bred> by 14 subjects, but <Bread> by 8 subjects. Of course, it is difficult to say whether the subjects were spelling this word by direct analogy with the word *bread*, or by the use of spelling rules gleaned from a wide variety of words, which would allow [ɛ] → <e> (commonly), or [ɛ] → <ea> (less commonly). However, for 14 [ɛ] prompts, giving 378 responses, there were 292 <e>'s while the only <ea>'s were the 8 responses for *Bredgar*, suggesting that analogy with *bread* is the cause. One subject actually divided the word in two, as <Bread-Gar>, making the analogy more apparent. A dictionary search of monosyllables gave 739 [ɛ], with <ea> representing [ɛ] 51 times. Twenty of these (40%) preceded [d] (for example *tread* and *thread*). Of the 739 words, only 55 had a [d] following the [ɛ], showing that <ea> is used for [ɛ] disproportionately often in the environment preceding [d]. *Bredgar* had the only [ɛd] sequence in the data, so we cannot see whether the direct analogy with *bread* or the analogy with the group of words containing [ɛd] is of more importance to the results. Alternatively, of course, the sequence could be produced by a phoneme-to-grapheme rule for [ɛ] which is influenced by context.

Some cases show less consensus in the results. *Fermo* ([ˈfeɾ.mo], Italy) elicited 9 instances of <Fair->, suggesting analogy with *fair*, and *Lechlade* ([lˠɛt͡ʃ.lˠed], Britain) had 9 of <-laid>, suggesting analogy with *laid*. As Table 65 shows, <ai> was not commonly used to represent [e] in other words. Ideally, though, a control set is needed, consisting of names specifically chosen to test the extent of the influence of analogy on spelling. In particular, the [ɾ] may have had some effect - the spelling <Fermo>, for Edinburgh English, would generally represent [ˈfɛɾ.mo], while <Fairmo> would represent [ˈfeɾ.mo], so <Fairmo> is a more accurate representation of the prompt.[75]

[75] Of the listening-writing responses to *Fermo*, one was actually <Fairmount>, one was <Fairmond> and one was <Farmont> (all with perceived French etymology). This suggests the use of analogy elsewhere in the word too, particularly since the sequence [mo] cannot be reasonably represented in English by any of these spellings. However, the spellings of the word-parts do not all match the perceived French origin.

Spelling	[e] in ***Fermo***	[e] in ***Lechlade***	[e] in ***Hellesylt*, *Greve*, *Firenze* and *Evje***
a	2	11	7
ai	10	10	2
ais			1
ay		1	
e	12		50
e?i			1
ea		2	1
ee			2
ei	1	2	2
er			3
eux			1
ey			1
ha			1
hai			1
he			3
i	2	1	7
ia			3
ie			2
iy			1
y			17
no response			2
Total	27	27	108

Table 65: Spelling of [e] (listening-writing)

Aire, despite being pronounced [ɛːʀ], had 8 spellings of <Ai> for the vowel, and 1 of <Hei>, although these should represent [e] not [ɛ]. (<Err>, the only spelling in the responses which accurately represents the vowel in the prompt for Edinburgh English, was used only twice.) The Scottish town *Ayr*, interestingly, is homophonous with *air* in Edinburgh English, but <Ayr> was only used once, and <Ayre> once, while <Air> appeared 5 times. A*ir* is of course a more common word than *Ayr*, but it appears in other examples that subjects prefer name spellings over ordinary words. One such case is [ɹid] (*Rede*), for which the vowel spelling in the listening-writing experiment was 17 <ei>, 6 <ee>, 2 <ea> and 2 <ie>. Although *read* is by far the most common of these words, it does not share the same word class as *Rede*; the other spellings do, at least if we classify surnames and place names as the same category. Another example is *Sturry*; most subjects correctly placed this town in Britain, and the obvious analogy from the dictionary for the phonological string is *hurry*, or perhaps *curry* or *slurry*; both <-rrey#> and <-ey#> are much less common in the dictionary than simply <-y#> spellings. However, <Sturrey> was the preferred spelling (17 subjects), while <Sturry> accounted for only 7 responses. In other, admittedly foreign, words ending in [i], the spelling <-y> was preferred over <-ey>. A possible candidate for the <-ey> spelling is *Surrey*, which shares the same category as *Sturry*.

A number of instances of <-shire> appeared in the responses. *Bolkesjö* ([ˇbɔl.kə.ʃø], Norway) was given 6 <-shire>'s (5 placing it in Britain and 1 in Italy) despite containing a non-English vowel and no final [ɹ], which would be used in a Scottish pronunciation of *-shire*.[76] Incidentally, only 6 subjects thought this town was in Britain; whether the group using the spelling <-shire> decided it was in Britain and so gave it a British spelling, or first wrote the name and then decided it had to be in Britain cannot be determined.

Sollom (['sɔ.lˠəm], Britain) was, unsurprisingly, spelt <Solemn> by 6 subjects (cf. discussion on p. 232). Four other subjects used <-umn>, although final <-mn#> is relatively rare in English, a search of the on-line dictionary (over 110,000 words) producing only *autumn, column*, *condemn*, *contemn, damn, goddamn*, *hymn*, *limn*, *precondemn*, *solemn* and *unsolemn*, compared to over 1700 words with final <-m#>. *Autumn* and *column* do contain schwa, like *Sollom*, but it is still an unusual choice of spelling.

In some cases it is particularly open to question whether the use of real-word spellings is simply coincidence. For example, <Yarn> for *Jaren* ([ˇjɑˑ.əɳ]), which accounted for 22/27 responses in the listening-writing experiment, is of course an English word, but the native pronunciation resembles the Norwegian only vaguely, and we have to wonder whether subjects simply used the nearest equivalents they could in the phoneme-to-grapheme relationships they know; as mentioned before, however, subjects are generally aware of the [j] → <J> relationship in Germanic words, but only 3 chose this representation. A large proportion, though (16/27) did in fact place this town in Britain, despite the obvious non-native features. Again, the country response may have been decided after writing the name, and influenced by the spelling rather than the pronunciation.

Another possible coincidence is the place name <Mull>, which appears (4 times) as a response to *Maule* ([mol]), as do the words <Mole> (12 times) and <Moll> (2 times) and even <Mule> (1 time). The difficulty, since none of these spellings are remarkable in themselves, is in knowing whether subjects are using the spellings taken from these words, or whether they are building a

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[76] It should be pointed out, however, that there were other consonants than <r> inserted at the end of this word; 7 subjects spelt the name with a final <n>, and 1 with a final <m>; it is possible, therefore, that a number of subjects did perceive a consonantal element at the end of the word.

spelling from smaller units, which happens to result in real-word homographs.

In some cases, non-native phoneme-to-grapheme rules are a possible counter-explanation to analogy. *Manosque* ([ma.nɔsk] had 5 <-osque> spellings, which could be due to analogy with *mosque* (*mosque* and *kiosk* are the only [-ɔsk] words in the dictionary), but it may alternatively be due to use of the <-que> spelling as a 'foreign' phoneme-to-grapheme correspondence.

There are also apparent counterexamples to the use of analogy. For instance, many subjects did not use the <-ton> spelling for *Watton*, despite 21/27 perceiving it as British and <-ton> being very common in British place names, though possibly not as common in Scotland as elsewhere in the country. Ten did use a <-ton> spelling, and 6 <-tton>, but 11 used other spellings.

7.4.2. Reading-speaking

It is difficult to determine with any certainty in the reading-speaking experiment whether responses are using analogy, largely because there are few prompts for which a substantial graphemic sequence resembles a real word, and for which some possible spoken responses would resemble this real word and others would not. <Hellesylt>, for example, contains the word *hell* and all but all but one pronunciations for this name used [hɛlˠ]; however, the obvious grapheme-to-phoneme pronunciation for the string <hell> is also [hɛlˠ]. An additional problem is in determining which words from the lexicon would provide the most likely matches; there may be many factors, such as length of match, word-position, syllabification, or general graphemic context, which make some words better matches than others. Of course, frequency and word-category are also likely to play a part, as well as individuals' word-associations. So, given that the relative importance these factors is unknown, it should be stressed that the following is a discussion of some possibilities rather than a comprehensive analysis.

One name with a potential differentiation in pronunciations based on analogies is <Tallard>, which contains, amongst other things, elements from *tall* and *mallard*; all subjects, however, pronounced the word to rhyme with *mallard*, suggesting that if analogy is at work, rather than grapheme-to-phoneme rules, the longer match is favoured over the more common word. In between these two, length-wise, is *Tallahassee*; this is also a longer match than *tall*, but given that it is so infrequent, we might question whether it is a likely candidate for analogy.

<Loano> contains the obvious *loan*; [lʸon-] pronunciations appear 11 times, but there are 6 [-o.a-] pronunciations which have no potential analogical origin. It is possible that the perceived foreign origin of the name influenced the [-o.a-] pronunciations (there are a number of <-ano#> words in the dictionary, mostly of foreign origin, such as <oregano> and <soprano>), but again, we cannot be sure of subjects' mental processes in producing a pronunciation.

For stress patterns divorced from phoneme strings, there are of course many models, such as *panorama* for the response [ˌpʰa.səˈkʰa.nʌ] (prompt <Psakhna>), or *Havana* for [pʰaˈska.nʌ̈], so given the varied data we could produce potential stress analogies for all responses; although it is possible that subjects may model their stress patterns on other words, the data is not enlightening on this point. (See p. 238 ff. above for a discussion of potential stress analogies for some individual words.)

As with the listening-writing experiment, there are some apparent counterexamples to analogy. The longest match for <Bredgar> in the on-line dictionary is <Edgar>, which of course is also a name and so appears very suitable as a basis for forming a pronunciation for <Bredgar>. However, the great majority of subjects used full vowels in the second syllable, which suggests they were not basing their pronunciations on *Edgar*. <Lechlade> elicited only 4 [t͡ʃ] for <ch> in the reading-speaking experiment. In a lexical or analogical model it is difficult to see why this should be, when the longest matches in the on-line dictionary containing <ch> (admittedly all based on the verb *lech*) are pronounced with [t͡ʃ]. However, there were only 2 judgements of 'British' for <Lechlade>, and 15 of 'German', which may explain why the most common pronunciation for <ch> was [x]. There is also, of course, the Polish name *Lech Wałesa*, (not in the dictionary) which may have formed a basis for [lʸɛx-] pronunciations.

<Copparo> is a potential counter-example in the domain of stress. The longest matches for this were words beginning with <#copp->, such as <copper> and <coppice>, all having stress on the first syllable, yet the majority of responses in the reading-speaking experiment stressed the second syllable. Of course, the penultimate stress patterns may have been influenced by the perceived Italian origin of the name (by 17/24 subjects). This in turn suggests that comparisons may be found in names such as <Genaro>. Of course, in proposing analogies which were not specifically primed or controlled, there is usually some word which may have served as an analogy; the difficulty is in determining whether it in fact did so.

It is also possible that letter-to-sound rules might override lexical associations. There are a number of words with <stir> in the dictionary, which might form models for <Stira>, but it is evident that they did not from the pervasiveness of [i] pronunciations for the first vowel. <Elatia> elicited some pronunciations found in the dictionary (e.g. [ɪˈlʸe.ʃʌ], cf. *relation*), but there were others (e.g. [ɛˈlʸa.tʰi.ä]) which suggest more strongly grapheme-to-phoneme rules. In some cases, however, both analogy and letter-to-sound rules would produce the same results, yet subjects did not follow the predicted patterns. For example, there was a very low rate of [-iv] pronunciations in both <Dreve> and <Greve> (12/48), even amongst subjects who thought they were in Britain.[77] The best dictionary match is <breve>, which of course is an uncommon word, but there are shorter matches such as <Eve> or <Steve>, and letter-to-sound rules for English would also predict [-iv]. <Rede> follows the same pattern; despite both dictionary entries (<accede>, <Swede>, etc.[78]) and letter-to-sound rules suggesting [-id], this was a minority pronunciation (6/24 subjects).

7.4.3. Knowledge of foreign languages

As noted throughout, it is evidently the case that people try to apply their knowledge of foreign languages in processing unknown foreign names. As well as the use of foreign grapheme-phoneme relationships, it can sometimes be seen in the use of foreign morphemes, words or part-words.

Like the grapheme-to-phoneme correspondences, use of part-words generally results in output resembling the original name, but sometimes there are errors in the relationship between the two. For example *Livorno* ([liˈvoɾ.no], Italy), was written by one subject as <Les Vorno> and by another as <Les Vernos>, and placed in France; the subjects were evidently using their knowledge of French to interpret the name, though the output was not an accurate reflection of the pronunciation for French. (All other subjects, incidentally, used legitimate representations of [i], spelling it <i>, <e> or <ee>.) Another example is *Fermo*, as noted above (footnote 75).

With varying degrees of accuracy, *Laragne* ([la.ʁaɲ], France) was spelt as <La Reigne>, <La Range> and <La Ranne>, though as most subjects put the town in France, and most used <La> for the first two letters, albeit not followed

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[77] C.f. p. 175, where it was noted that there seemed to be little effect of country of origin on pronunciations involving potentially mute <e>.

[78] The only word final <-ede#> counterexample to the [-id] pronunciation was <suede>.

by a space, there is less of a contrast between the two-word and one-word responses than was the case for *Livorno*. There was also a spelling of <Lorraine>, from a subject perceiving the name as French.

7.5. Summary of cross-media production

It is difficult to define either 'reasonable' or 'correct' responses in cross-media tasks, due to the potential variability in grapheme-phoneme correspondences. With the strict definition used, Italian and Greek towns emerged with high scores, probably due to their simple vowel systems, syllable structure and grapheme-phoneme relationships.

The grapheme-phoneme relationships appearing in the responses were mostly those common in the dictionary, although others did appear, particularly non-native ones. The relationship between perceived word origin and the use of foreign features was, however, unclear, with foreign features often used inappropriately, or appearing even for words perceived to be British.

Stress assignment in the reading-speaking experiment was rather complex, involving syllable weight (in particular the number of consonants in the phonemic rime), language of origin, and possibly other factors which could not be ascertained. Analogy with particular words had little effect.

Analogy appeared to be used for some prompts but not for others; there were examples of analogy with foreign words as well as British ones. There was some suggestion of word-category effects, but there were also contradictory examples.

Chapter 8.

Discussion and Conclusions

The results from the previous chapter, along with specific examples, will be used to look at the role of foreign words in language behaviour, and to address the questions of how we store, access and use lexical and sub-lexical information.

This chapter begins with an outline of a suggested language framework, and then summarises the results from Chapters 5-7. Then the implications of the results are discussed, and the conclusions are given. Lastly some suggestions for further research are listed.

8.1. Linguistic framework

		a. Language model	**b. Cognition**	**c. Language knowledge**
		an abstract model of the way language, and individual languages, are structured	structures for language storage in the brain, and cognitive processes; skills and preferred strategies	includes vocabulary and pronunciations, semantic information, etc.
i. Universal level	covers all speakers	language universals	universal cognitive structures	
ii. Community level	generalises across speakers in a language community	description of a particular language	cognitive processes and structures common to a group of speakers	shared language knowledge
iii. Individual level	personal variation	description of idiolect	individual cognitive level	individual language knowledge

Table 66: Linguistic framework

The survey of the literature and the results of the experiments suggest that we need to analyse language and language behaviour at several levels.

Table 66 illustrates a realistic and practical framework for describing linguistic structure and language cognition. In particular, this framework enables us to differentiate between cognitive processes and language knowledge, and between language behaviour as shown by a community of speakers and an individual speaker. The following discussion will take place within this descriptive framework.

8.2. Summary of analysis

Due to the length of the results, the main findings from the various analyses from Chapters 5-7 will be summarised here before proceeding to the discussion.

Subjects did well in identifying the country of origin of the spoken prompts, although it was not possible to pinpoint the features which enabled them to do this; it is likely that they used a combination of features. Certain origins were confused with each other - Greek/Italian for all questions, British/German/Norwegian towns were given possible German and Norwegian origin for "Could these towns be in the countries listed?", and German towns/Norwegian origin for "Which country do you think the town is in?"

For the written forms, subjects again managed to identify a significant proportion of origins. The languages causing confusion were the same as for spoken prompts, except that French town/British identification was significant for "Which country do you think the town is in?", while Italian town/Greek identification was not.

Perception of spoken prompts was fairly accurate for structural features, although errors increased with the complexity of consonant clusters; errors of perception were more common in individual segments, with one segment being either misheard or miscategorised as another. This is consistent with results in the literature for nonword repetition. Long consonant clusters were more prone to perceptual error than short ones, but there was also a tendency for affricates to be perceived as single segments, possibly due to the two segments having the same place of articulation. The perception of stress location was also mostly correct, with most errors occurring for French, which has a different type of stress usage. Segment length and tone fared less well, though some subjects did distinguish these. This suggests that while non-native suprasegmental and segmental attributes may be difficult for speakers to perceive accurately, non-native structural features are rather easier; for native words, errors in segmental perception are more likely than difficulty with structural or suprasegmental features.

Perception of written forms is somewhat difficult to determine from these experiments. It does appear, however, that there are relatively few errors, and many of these are visual; there is also some evidence of phonological activation leading to errors in the reading-writing task. Frequency of letter combinations does not affect perception, though there were some structural causes of error, such as location in the word - the error rate in reading-writing was highest just before the end of the word.

Analysing spoken language production over several languages has certain inherent problems, such as whether the phonetic or phonemic level, or some other description, provides the most appropriate analysis. However, a number of results emerged. Foreign features of words were not always nativised, and foreign features were sometimes produced spontaneously. This held true for segments, non-native clusters and stress, but less so for other suprasegmental features. Some of these spontaneous productions may have been errors, but many appear to be examples of hyperforeignism, with a salient foreign feature either used in the wrong language, or used in an inappropriate and overgeneralised context in the right language. Structure was mostly preserved in spoken output, in terms of both the number of syllables and the number of segments, with long consonants and affricates best analysed as single units. Stress was usually reproduced accurately, with most errors confined to a few words and many of these errors influenced by rime structure, for example *Psakhna* ([p͡saˈxna]) is stressed on a weak final syllable. French prompts also caused difficulties due to lack of stress. Tone was poorly reproduced, as were long segments, but long segments were sometimes realised in other ways, for instance as two short segments. For the listening-speaking task, subjects mostly performed better on the 'easy' languages (Greek and Italian) than the familiar ones (French and German). Of course, we are still lacking a rigorous definition of 'easy' in language production, or even a way of formalising the degree of difference between L1 and L2.

For written production, foreign graphemes led to errors for the reading-writing experiment, though this may have been due to perception rather than production as some foreign graphemes were produced spontaneously in the listening-writing experiment. Some output errors in reading-writing may have been due to automatic activation of pronunciations, and some errors, such as transposition, appeared to be similar to speech errors. However, others resulted in unpronounceable output. For some words there was a relationship between bigram frequencies and error location within the word, but more investigation is necessary to determine the conditions in which this occurs.

Responses in the cross-media experiments mostly contained grapheme-to-phoneme and phoneme-to-grapheme correspondences common in the dictionary. Sometimes, however, the correspondences used in the output were rare or foreign, and sometimes they did not exist at all in any of the languages in the study; some of the correspondences which do exist in these languages were correctly applied and some were not. Some of the responses suggested the use of analogy with particular words. Stress assignment in the reading-speaking experiment did not always conform to linguistic theories of syllable-weight and stress assignment, though the strongest factor analysed was the number of consonants in the rime, which is one aspect of syllable-weight. There was some effect of linguistic origin, but the results were inconclusive on this point. Some stress patterns suggested the use of analogy with particular words, but for most there were too many competing candidates to draw any conclusions. Overall, analogy appeared to be a strong factor in creating output for certain prompts, while for others grapheme-to-phoneme rules seemed to be preferred; word-class was also relevant in some cases and not in others. Analogy with foreign words and morphemes was also used, though these examples formed a small minority.

8.3. Implications of the results

8.3.1. The integration of foreign words in language frameworks

This section will highlight the necessity of considering foreign words as an integral part of language.

It has already been noted (see Chapter 2) that a considerable degree of variation exists between completely native words (or names) and completely foreign ones; it is certainly artificial to draw a line between them. This in itself suggests that we should integrate foreign words and features somewhere in the native speaker's basic mental representations of language, rather than treating them as a separate category. Even calling them marginal, in a language with such variation as English, is unsatisfactory, as some uncommon native features may be rarer than some borrowed features. Furthermore, as speakers evidently use their knowledge of foreign languages in assessing and reproducing unfamiliar words, we need to account for this in our linguistic models.

It is evident that a model such as Trubetzkoy's, in which speakers perceive a foreign language through the "phonological sieve" of their native language (see Chapter 2, p. 31 of the current study), is insufficient. Most of the world's population have at least some knowledge of foreign languages, whether through language contact in their community, travel, formal study or the media. Although, for a variety of linguistic and sociolinguistic reasons, nativisation may indeed take place at various stages from perception through to production, this is not as comprehensive nor as consistent as the "phonological sieve" seems to suggest.

However, despite the haziness of the boundaries between native and non-native words (cf. Scholes 1966, noted in Chapter 2, p. 29) it is evident from the results of the experiments that subjects have a high degree of success in ascertaining not only the nativeness of unknown names, but also the particular language of origin, at least for western European languages. Results were good for both spoken and written forms, and for familiar and unfamiliar languages. There was confusion between certain languages, mainly amongst the Germanic group and Greek/Italian. Although French and Italian are both Romance languages, they were not confused, possibly because French has noticeably different features from Italian (for instance syllable structure and vowel typology, which are both much more similar between Italian and Greek than Italian and French) or because French is more familiar to subjects. The success in identification shows that subjects have a certain level of knowledge of European languages, even for those they consider to be unfamiliar. It is therefore possible that the reproduction of words from even 'unfamiliar' foreign languages will be affected by judgements of origin.

The confusions suggest that Figure 2 from Chapter 2, p. 28, which is the framework used for judgements of origin in this study, is not the same as that used by the subjects. If we wish to account for perceived similarity of languages in our hierarchy, we would need something more like the following:

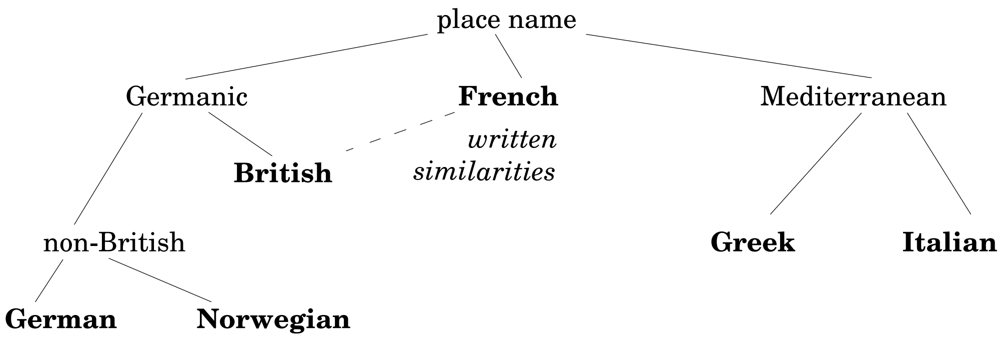

Figure 75: Subjects' judgements of place names

It is interesting to note that in the experiments there was little difference in significantly high judgements of origin for the spoken prompts and the written prompts, although the two obviously contain somewhat different features; this may be because the subjects had had equal exposure to the writing and speech of each language, or it may be because they did not rely only on the prompt as given, but compared it to possible spoken or written versions and took these into consideration in their judgements. Some features, of course, bear a considerable resemblance in the spoken and written forms, for example the consonant/vowel opposition, and to some extent syllable structure.

It was expected that the judgements of origin would relate to the pronunciations and spellings used by the subjects in the cross-media experiments to reproduce the words, as happened in some cases in pilot studies. However, there are only a few instances of a strong relationship between the judgement of origin and the output. Even where a response used non-English features, such as the German <ß> in <Corrinuß> for *Cornus* (listening-writing, in a response assigned to Germany), other features were not always appropriate, such as the use of initial <C> rather than <K>.

Additionally, there are a number of cases of hyperforeignism. For example, in the current study, the same German consonant spelling <ß> was also used, by a different subject, for *Tsamandas* - <Samandaß> - which the subject placed in Norway. It should be remembered, however, that subjects confused the origin of Norwegian and German towns; it may be that this influenced the above answer, if the subject associated features of German towns with those of Norwegian ones. It may also be the case that the experimental structure encouraged hyperforeignism by juxtaposing names from several different languages, potentially leading to confusion. For the experiments using reproduction in the same medium (listening-speaking and reading-writing) foreign features were often reproduced, and again, there were some instances of foreign features which did not relate to foreign features in the prompts.

These results suggest that native and foreign languages are not discretely divided in the minds of the speakers. Rather than the coexistent phonemic systems of Fries and Pike (1949), however, it seems that something more integrated and versatile is required. In terms of our linguistic framework above, the only level at which different languages might be fully separable is in the language model, which would include abstract descriptions of the way different languages are structured. As for how groups of speakers, or individual speakers, use language, it is evident that they are aware that different features belong to, or are typical of, certain languages, but they do not always separate these different features in their own language use. It seems to require a considerable degree of skill and practice in manipulating the different parameters to separate these consistently in language production (bilingual subjects might have given quite different results). For ordinary speakers, such awareness as they have of "coexistent systems" may well be derived from knowledge of associations in and across the lexicon, rather than the use of separate components for native and foreign languages.

8.3.2. Implications for perception

Spoken segment identification was less robust than other spoken parameters, such as segment count, stress and so on, although non-native suprasegmental features were also poorly perceived. We could therefore suggest that the different layers are perceived separately, and merged after perception, with the segment identification level more prone to inaccuracy; of course, there are more potential errors for segment identification than, say, stress, which has a more limited set of possibilities. Alternatively, it may be that some layers are not perceived at all, but derived from others. This appears particularly likely in the case of syllables, since the optimal syllable structure definition varies according to the application; for stress assignment, maximal offset is preferable, while for judging the origin of words, typological generalisations are easier with maximal onset. For English speakers faced with unfamiliar written words, syllables must be derived from the segment sequences, since one word may have a number of different possible syllable counts, which fits in with the proposal of derivable rather than inherent syllable structures.

On the other hand, while the syllable structure and boundaries may be derived, the fact that perceptual errors were concentrated in segment identity could be seen as supporting the view that syllables are the primary unit of perception. In Chapter 3 it was noted that Hartley and Houghton (1996: 1) found that "most errors in nonword repetition are phonemic substitutions which preserve the syllabic structure of the target" and this was also found here. However, it may be the case that what is perceived most clearly is a framework of slots. Stress and number of syllables were mostly well perceived, as was segment count; these could form the basic structure for perception. The identity of the segments would then form the basis for the syllable structure.

However, this conflicts with accounts of spoken word recognition which show left-to-right processing, since if lexical access begins as soon as the first elements are spoken, the structural and suprasegmental framework cannot be used as the basis for perception. As noted elsewhere, some studies suggest lexical access through features (see Marslen-Wilson and Warren (1994), noted in Chapter 2, p. 13) This might explain why long sequences of spoken consonants show more errors than expected in the number of consonants perceived compared to short sequences; features would be more interchangeable amongst consonants than between vowels and consonants. For one consonant in the input, there is a possible split of the features across two consonants, but more than that becomes unlikely; the more features, however, the greater the possibility of confusion. In a segmental account of perception, the increased confusion for long sequences would be far less than for a featural account. A featural account would also explain why long segments were generally perceived as short (they share the same features) and affricates, which have shared place, were often perceived as a single phone. On the other hand, it would not explain why some subjects represented long consonants as two different short consonants. One possibility here is a conflict with a suprasegmental layer of perception which would include information such as duration, and would be independent from the featural perception.

It was not possible within this study to investigate the perceived similarity of sounds as there were many interrelated factors. However, the analysis did highlight the difficulties with performing such a comparison across a number of languages. The main problem in assessing similarity from the point of view of a linguistic description is finding an appropriate level amongst features, phones and phonemes. Features of course beg the question of which features to use in the first place, and how to define them. It is difficult to produce a feature list which, by a simplistic measure such as the number of features in common, will reveal the similarity or dissimilarity of different sounds, and more research would be needed on this. In terms of phones we should be on surer ground; either two phones are identical or they are not (this assumes production by one speaker, reducing acoustic variation). However, we then have no possibility of a hierarchy of similarity, simply a same/different dichotomy. The phonemic level is in many ways the most appropriate for analysing similarity, since this is evidently what speakers use in many cases to classify sounds (for instance the various /r/ realisations, which are dissimilar both as phones and in terms of features).[79] However, in a cross-language study it is difficult to frame an appropriate phonemic description, given that phonemes are language dependent; if we base our description on the native language only, we have the problem of how to deal with sounds which are not part of the native language. Furthermore, there are suggestions in the literature, for example Vitz and Winkler (1973), discussed in Chapter 2, p. 16) that some elements, such as vowels, contribute disproportionately to judgements of word similarity. (This could be one explanation for the confusion of Greek and Italian origins, although this confusion also occurred in the written forms.) This could affect both types of segmental comparison. Also, in all these frameworks there is the added complication of context, which of course can affect perception.

The results do not contribute to the debate on the means of access to a mental lexicon, for example whether this is in terms of features or phonemes. However, they do contradict findings which emphasise the importance of word-beginnings. If analogy relies on lexical access of similar words, we cannot explain such results as <Balkishire> for the Norwegian *Bolkesjö* ([ˇbɔl.kə.ʃø]). In a model with left-to-right processing, and elimination of non-matching word candidates, we could not match the last syllable of this word with other such syllables in the lexicon. We could say that <shire> results not from analogy but from phoneme-to-grapheme rules, but this is an improbable suggestion given the pronunciation, and the fact that <shire> was used by 6 subjects. Or, we could say that analogy does not follow from lexical access as used for familiar spoken words, but uses a different means of activating lexical items; at present, though, it is difficult to see what this 'different means' might be.

For written words, it is notable that there were no perceptual errors in the initial letters (cf. Hotopf (1980)'s slips of the pen, discussed in Chapter 3, p.

[79]This also relates to another feature, the role of orthography in perceived similarity of sounds by literate speakers. While we would not wish to include orthography in a neatly defined model of spoken language perception, it is difficult to see how to avoid doing so. This illustrates the potential conflict between an idealised language description and speaker behaviour.

54) Errors were greatest about 2/3 of the way into the word, and decreased again for the final letter or letters. It has been shown in various studies (see, for example, Radeau et al. (1992), discussed in Chapter 2, p. 21) that we do not process written words from left to right, yet there seems to be evidence of a superiority effect for word-beginnings. Of course, for the words in the current study the initial letters were differentiated by the use of capitals, which may have aided recognition, but the improvement in the final letters suggests that the effect may also be due to saliency of word-boundaries. This may well be a visual predisposition rather than a linguistic one, given that boundaries are important in visual perception generally.

The presence of errors due to phonological activation of written forms, although few, supports claims that perception of written words initiates phonological encoding. Since this takes place for unfamiliar as well as familiar words, it is evidently not a question of a simple match between the written form and a stored lexical item, but involves either grapheme-to-phoneme rules or lexical activation of similar words, or a combination of both. The fact that this takes place even when it is not necessary for completion of the task suggests that phonological encoding is automatic. On the other hand, errors in reading-writing which result in unpronounceable output seem to contradict this view, but such errors could be due to poor production, rather than a part of perception.

Diacritic errors in reading-speaking, which consisted of omission, alteration of the diacritic, or transposition onto a different segment, suggest that the diacritics were perceived as separate elements from the graphemes; there were no instances of a grapheme+diacritic unit being misperceived as a different grapheme, nor of a grapheme being misread as a grapheme+diacritic. It would be interesting to see whether native speakers of languages with diacritics make the same kind of errors, or perceive the grapheme+diacritic as an indissoluble unit.

8.3.3. Implications for word storage

Although word storage has not been addressed directly in the results, the suggestion for the integration of native and foreign language elements obviously has consequences for mental representations of language. For example, if we assume that foreign phonemes may be included in the normal lexicon, this complicates the phonology of the language. As suggested above, we might well find that there is a continuum of features from native to foreign, with some uncommon native features, such as the phonemic string /vr/ in *vroom*, being less common in the lexicon than foreign features. If needed, separate systems could be derived from lexical associations; this would be consistent with the results in this and other studies suggesting that speakers do not have clearly defined or consistent boundaries for such systems.

It has already been suggested that some features, such as syllable structure, may not be specified in the lexicon but are derived if needed. On the other hand, in an integrated model we would need to include information such as word-origin at the lexical level, since we do not have separate lexicons for words of different origin. Of course, for rare words, some levels of description, such as the origin, or the pronunciation, may be missing in the representations of some speakers.

In a model such as we are proposing, with the use of analogy, and words accessed through other words, we also need a network linking the entries. It is not suggested that this is static, but rather that it varies by speaker and across time, as elements become associated or dissociated. (The time factor is well-supported by recency effects in the literature.) If we are proposing that features such as word origin or category may be used in forming output of unfamiliar words, then a preferred model would have these features easily accessible, and able to form networks of their own.

8.3.4. Implications for production

a) Same-media tasks

Reproduction was not always accurate even for the native language, whether spoken or written. This is not surprising given that we sometimes make errors in saying or spelling even familiar words. As for non-native words, it is not clear from the results which segments or types of segment are most likely to be nativised; more examples of each segment type, in different contexts, would be required for this kind of analysis. There were many examples of hyperforeignism; as noted above, this may have been encouraged by the experimental design. Some foreign features were spontaneously produced, which was unexpected in the same-media experiments, particularly for prompts which contain only native features. This contradicts the reasonable expectation that a same-media repetition task involving only L1 should only produce errors consistent with the native language, and that a task involving L2 should result only in errors which lie on a continuum between the L2 features and the L1 features, or should be otherwise explicable in terms of particular difficulties with L2. Some of these spontaneous foreignisms may be due to the perceived foreign origin of the word affecting output, for example [ʃn] in *Snåsa* [ˋsnɔˑ.sɑ] → [ˈʃna͡ʊ.sa̠], with perceived Norwegian origin. However, an example such as *Sturry* [ˈstʌ.ɹi] → [ˈstʌ.ʀi̞], with perceived British origin but a non-native [ʀ], is more difficult to explain.

In an integrated lexical network model, such errors are more easily explicable than in a component model using separate modules for different languages. In the former type of model it is more likely that incorrect associations would be made, particularly if the experimental structure, which used input and output in various languages, resulted in heightened associations or recency effects for particular non-native features. This suggestion, though, would need more investigation.

Contrary to expectations, syllable structure changes did not result in more CV syllables (cf. discussion on Chapter 3, p. 50). Also contrary to expectations, output did not always 'improve' the structure or pronounceability of words. There were some examples of spoken output which are more difficult to pronounce than the input, for example *Acri* [ˈa.kɾi] → [aˈkŋ̍] (listening-speaking), and examples of written output which do not conform to the graphemic structure of English, and are not easily pronounceable, for example <Glinde> → <Ginlde> (reading-writing). Note that these do not conform to the patterns of the foreign languages either. Although the bigram frequency of erroneous answers in reading-writing was marginally higher than that of the input, and so structure was improved, or nativised, overall, it is evident that a constraint-type model is too strong. Of course, the errors may lie in the perception of the prompts rather than the production, or they may be surface slips rather than intentionally produced, but it does seem perfectly possible for subjects to produce output which lies outside the expected range of patterns.

b) Cross-media tasks - mapping an output

Two of the experiments in this study (listening-writing and reading-speaking) required subjects to produce an output in a different medium from the input, and the way in which they achieve this output is of particular interest. While traditional accounts focus on grapheme-to-phoneme rules, recent work is more lexicon-based (see discussion in Chapter 3, p. 54 ff.) This is not to say that the two strategies are mutually exclusive, nor indeed that they are independent; a rule may simply be an abstraction from a number of words in the lexicon.

There is of course an inherent problem in discussing the use of analogy in a study such as this which does not use explicit primes, since there is no control group to determine whether analogy has any effect. However, the use of primes is a rather artificial situation; they are perfectly adequate for showing that subjects are able to use analogy, but not for showing whether they use analogy as a basic strategy, and if so, which lexemes are most likely to be used as the basis for output. For some prompts, e.g., *Rede* (listening-writing) this seems to be affected by word-category, but unfortunately there are counter-examples such as *Ayr*.

There is a suggestion in the results of a relationship between frequencies of grapheme-phoneme relationships in the lexicon, and their use in subjects' output. Perceived word-origin has some effect on the chosen output, whether through the use of non-native rules or analogy with non-native lexical items, for instance the high use of <Sch> for [ʃ] in *Schwenke* (listening-writing), but in other cases word-origin seemed to be irrelevant.

The stress analysis in reading-speaking suggest that if analogy is used for stress assignment, it is in a general way (perhaps analogy with words with a similar syllabic structure) rather than analogy with individual lexemes with similar orthography. On the other hand, if rules are used, these too must apply only as a general pattern, since there are examples not only of the same graphemic string with different stress patterns, but the same phonemic string too, e.g. <Osimo> → [ˈɔ.zɪ.mo], [ɔˈzɪ.mo]). Neither rules nor analogy can explain, on the basis of the current data, why some written words were more prone to stress variations in the output than others. It was expected that perceived origin would have an effect, for instance leading to final stress on 'French' words (see, for example, Janda et al. (1994), discussed in Chapter 3, p. 84), but while this was true for some prompts it did not hold for others.

The next sections will compare rule-based and lexical look-up models to examine their explanatory power.

◊ *Rule-based grapheme-phoneme models*

The following is not an exhaustive account of rule-based models, but an examination of how a rule-based model maps the processes from input to output.

In a rule-based model, planning of cross-media output is achieved through grapheme-to-phoneme or phoneme-to-grapheme rules. Some of these rules may be conscious, and some sub-conscious; they may contain varying degrees of context (phonemic, word-category and so on), and they may be to some extent personal. In terms of Table 66, interpersonal variation in this type of task for unknown words would be due primarily to differing rules or rule orders under "Cognition".

We have, at a minimum, the levels of description shown in Figure 76. This description assumes ordering progresses from lower levels to higher levels, though with the possibility of feedback from higher levels; the outline does not cover all the possible levels of description that might be proposed. The example illustrates one of the responses in the reading-speaking experiment.

Output:	ɛk^{h}	ˈh^{j}i	.nɔs
Stress assignment:	ɛk	ˈhin	ɔs
Grapheme-to-phoneme rules:	ɛk	hin	ɔs
Grapheme grouping:	(e k)	(h i n)	(o s)
Input grapheme string:	e k	h i n	o s

Figure 76: Rule-based model for assignment of pronunciation to <Ekhinos> (reading-speaking)

Grouping of graphemes into vowel or consonant groups, and then larger units (roughly equivalent to syllables) must precede other processes, as it will affect both the phonemes assigned to the string and the stress location. If subjects use a different grouping of the graphemes, they will produce a different output, for example

Grapheme grouping:	(e (k h))	(i n)	(o s)

with <kh> analysed as a graphemic consonant group rather than a sequence of two consonants. This would then lead to a different phoneme assignation and, as suggested by the data in Chapter 3 (see p. 67 ff.), encourage stressing of the first syllable rather than the second due to the greater number of syllable-final graphemes, for instance (another reading-speaking response):

Stress assignment:	ˈɛx	in	ɔs
Phoneme assignation:	ɛx	in	ɔs

Language of origin or word-category might affect the choice of rules at any level, for instance a plural might have the grapheme grouping (<o + s>) rather than <o s>, while a foreign origin might encourage the grapheme-to-phoneme rule <i> → /i/ rather than, say, <i> → /ɪ/.

For a listening-writing response we can propose a similar process:

Output:	E		ch	ea		n	o	s
Phoneme-to-grapheme rules:	e		ch	ea		n	o	s
Assignment to phonemes:	ɛ	ˈ	x	i	.	n	ɔ	s
Input phone string:	ɛ	ˈ	ç	i	.	n	ɔ	s̠

Figure 77: Rule-based model for assignment of spelling to Ekhinos (listening-writing)

Perception in terms of features rather than segments would suggest a slightly different path, but for unfamiliar words as opposed to real lexical items it is difficult to suggest a plausible direct connection from features to a mental word-representation, with phonemes only derived at a later stage.

◊ ***Analogical lexical-look-up models***

We now turn to lexical models. There is ample evidence that speakers use analogy when dealing with unfamiliar words (see Chapter 3), although we are still uncertain of the mechanisms used to do this. Rules may have a place in such a system, but they are supplementary to lexical storage, and may well be derived from the lexicon. In a lexicon-based model, some redundancy might be reduced by use of rules, and there is some evidence that this takes place, at least for less frequent words. However, the processing power of the human brain is such that redundancy is a not required feature. As an aside, it is interesting to note that as computer memory and processing power increases, speech technology pronunciation lexicons are moving away from reliance on rules for unfamiliar words and towards storage of individual pronunciations, as a means of achieving higher accuracy. Advances in connectionist modelling (for instance Seidenberg and McClelland 1989, and Plaut et al. 1996) show how a precise, quantitative version of an analogical model may be instantiated.

Potential grapheme groupings:	(e k) (h i n) (o s) (e (k h)) (i n) (o s)
Activation (longer strings)	#ek (-); ekh (-); khi (-); hin (hind, thin...); hino (rhino...); hinos (-); ...
Activation (immediate context):	#e (easy...); ek (eke, derek...); kh (khan, blockhead...); ...
Activation (single graphemes):	e (easy, pet ...); k (key, oak, ...); h (hot, each...); ...
Input grapheme string:	e k h i n o s

Figure 78: Use of analogy in the processing of <Ekhinos> (reading-speaking) - hierarchical lexical access

In a hierarchical model (Figure 78 above), derivation is still bottom-up, with lower levels analysed into higher ones. Lexical look-up could occur at each stage; levels of description would be similar to those in Figure 76 for rule-based models, but the derivation would be based on words and word-fragments (or possibly word-sets) rather than rules. We could build subsequent levels in similar ways to the grapheme → grapheme grouping derivation, and with each level activated information may be inherited by the next level. The outcome would then be a synthesis of the most strongly activated words.

The model is now much more complex, but this complexity gives us a far greater explanatory potential. In particular, not all speakers will have the same vocabulary, and they may vary in the access order of associated words; research suggests that more frequent words are accessed first, but there are also recency effects. We can assume that native speakers are all familiar with common words, but for rarer words and uncommon names, they may have differing vocabularies, and names are especially likely to have different frequencies for different speakers, which may affect the order of activation. So, <ek> may activate *Derek* for some speakers, but not for others. Referring back to Table 66, interpersonal variation in this type of task under a lexical model would be due both to cognition (processes, lexical networks and preferred strategies) and language knowledge (vocabulary).

This model would also allow certain parts of a word to dominate the outcome, as we have seen happening in the experiments. For example, in the case of <Schwenke>, <sch> does occur word-initially in a number of items (<school>, <scheme> etc.), but <#schw> only occurs in <schwa>. So, subjects attempting to activate longer substrings would need to access proper names and/or German words. Features stored with these words would then be inherited by the next level of processing. An example such as [ˈʃtɛ.la͡ʊ] → <Schtellau> causes some difficulties; we would have to say that the [ʃt] sequence was recognised as German, which triggered German words, but that words with [ʃ] ↔ <sch> rather than [ʃt] ↔ <st> were activated.[80]

Another example is <ö>, as in <Bolkesjö>. This segment might dominate the process both from an attentional point of view (unfamiliar segments and strings stand out and so may form the starting point for analysis[81]) and functional (it will activate only Germanic words). A hypothesis could then be formed (for example, "this word is German"), which would be tested on other

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[80]<Schwenke> could, alternatively, be output in a rule-based model by recognition of <#schw> as a German string; <Schtellau> might be output by overgeneralisation of the rule.
[81]It will be remembered that written words are not necessarily processed from left to right.

segments and at higher levels.

Returning to <Ekhinos>, there are many possibilities at each stage, so we cannot predict the output in a given case. There are only two repeated pronunciations: [ɛˈxi.nɔs] (2 subjects) and [ˈɛ.k^{h}i.nɔs] (3 subjects), so there is evidently no favoured outcome. There is no strong feature which dominates the outcome; although the graphemic combination <kh> is unusual, and so is potentially a strong feature, it does not dominate the pronunciations as it has a number of possible solutions, which are equally valid in this case. If it were word-initial, or word-final, the words it activates might have rather more in common with each other and so suggest particular paths to follow - for example, word-initial <Kh> would probably suggest an Arabic word and the pronunciation [k^{h}]; this might in turn influence other features of the output.

As an alternative to the bottom-up hierarchy in Figure 79, we might suggest that longest matches are used for reading-speaking. This seems more likely in terms of how we process real words, but the results in the current study are not strongly supportive of this model. In Chapter 7, longest matches in reading-speaking were examined as a likely basis for analogy, but unfortunately the results were inconclusive, with some words appearing to exhibit the use of such analogy and some not. Rosson (1985), it will be recalled, proposing a combined rules/analogy model, suggested that if there were "strong rules" available, i.e. common grapheme-to-phoneme correspondences, these might well be used, while if such rules were not available lexical analogy was more likely; if this is the case, we might well expect to see variation in the use of analogy.

To account for the results of the current experiments, we have to include word category and word origin, which did not dictate the outcome, but did seem to influence certain prompts. Perceived origin, for example, might explain the lack of *stir* analogies for <Stira> (generally [ˈsti.ɾə]) or the lack of analogies for based on *Helen* for <Velen> (generally [ˈve.l$^{\gamma}$ən]), though this is merely speculation. We do not really know how words are selected as the basis for analogies.

For spoken words, lexical access is generally agreed to progress from left-to-right. It also seems that listeners do not wait until they can produce a longest match before forming hypotheses, but begin as soon as the first element is heard. This also means that the second element should not generate hypotheses independently from the first, i.e. for the spoken string [#ɛç], [ç] will not activate words that have not already been activated by [#ɛ].

↑ Lexical activation: #ɛ[82] (Eddie, echo...); #ɛˈç (*match fails, try* #ɛˈk); #ɛˈk (*match fails, try* #ɛˈs); (espresso, ...); ...

Input phone string: ɛ ˈ ç i . n ɔ s̱

Figure 79: Use of analogy in the processing of Ekhinos (listening-writing) - lexical match

It can be seen that we soon run into problems for unfamiliar words if we assume that the match must be at all close for lexical items to be activated.

However, there is evidence in the data that analogy is used for word-endings as well as word-beginnings, as mentioned above for <shire> as an element in *Bolkesjö* (listening-writing); this of course causes problems for the above model. The difficulty only occurs if we assume that analogy is performed through lexical access, but it is difficult to see how it could be otherwise. There might instead be an abstraction of <shire> from all the *shire* words in the lexicon, forming a kind of rule, but we would then need to say that all potential analogies which did not match the word beginnings were actually rules.

◊ ***Summary of issues***

So, in summary, it seems there are three basic types of model for generating cross-media output:

i. Rules only are used. This is improbable given the results of the experiments.
ii. Analogy only is used. This is possible, but it is difficult or impossible to prove the use of analogy for short strings, particularly without the use of primes.
iii. A combination of rules and analogy is used. This is perhaps the most likely, but it could be argued that the apparent use of 'rules' combined with analogy may actually be consistent with an analogy-only model, with rules derived as needed from lexical items rather than stored as rules.

Given that analogy appears to be an available strategy in the cross-media production of unknown and non-native words, there are a number of questions specific to the processes used. Some have been addressed in the literature, but none have been fully answered:

i. If it transpires that two different strategies, rules and analogy, are available, under what circumstances is analogy initiated?

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82 Whether this segment is perceived as a phoneme, or is simply a collection of features, is not relevant to the overall illustration.

ii. How are stored lexical items selected for analogy with unknown written or spoken words?
iii. If analogies use lexical access, how can we account for listening-writing analogies which are not based on word-beginnings, in a model consistent with findings in psycholinguistics?
iv. If analogies do not use lexical access, how are they performed?

These fall under the topic of "Cognition" in Table 66, which is perhaps the most problematic area to study as it is difficult to explore cognitive processes and storage in the brain except through indirect means, but more progress is needed on these questions if we are to form a comprehensive model of the reproduction of unfamiliar words.

8.4. Summary of conclusions

Variability in the output was greater than expected, making it difficult to generalise from the data to form a predictive model. We are still a long way from a holistic model of the processes which take place in the mental processing of unknown foreign words. However, we can say that:

- As expected, subjects were able to guess the language of origin of the prompts, whether written or spoken, although the exact features by which they do this proved elusive. They were able to perform this task even for relatively unfamiliar languages. The confusability between languages did not match exactly with language families, but did prove to be similar for written and spoken prompts.
- It had been expected that the judgements of origin would influence the spoken or written output of the names, that 'French' names would exhibit French or English features, 'German' names would exhibit German or English features, and that unfamiliar languages would exhibit mainly English features. However, the output was far more variable than this, with unexpected features appearing even in the same-media experiments. Even towns perceived to be British were not immune to this, though this may have been partly due to the nature of the experiment. It is therefore unrealistic to propose different mental components for storing or processing words from different languages.
- Current knowledge of perceptual processing and lexical access is insufficient to account for all the elements of the perceptual data. Errors

in reading-writing support the notion of automatic phonological activation, but it is not clear how this activation is achieved. Some of the results suggest that perception involves activation of lexical networks, via different types of information, for instance pronunciation or word-category.

- Many of the results relating to same-media production can be accounted for by the expected sub-lexical nativisation processes, whether due to rules or analogy, but there were also a number of examples of both accurate non-native output and hyperforeignism.
- For cross-media production, it appears that lexical networks and analogy may be used as a basis for forming an output, though for some words the results contradicted this suggestion. Longest matches are not used in all cases for finding matches for written words, while left-to-right processing does not predict output in all cases for spoken words. More work is needed on how and why analogy is used.

8.5. Further research

There are still many unanswered questions in the (re)production of unfamiliar words, particularly for foreign words and cross-media tasks. Partly this is because our knowledge of how we store, perceive and produce even native words is still fragmentary, but it also likely that, given the dynamic nature of lexical networks and the interpersonal variation in linguistic knowledge, skills and strategies, the best we can hope for will be a probabilistic model.

There are many issues which emerge from this study as potential areas of further research, ranging from small details of linguistic analysis to broad questions of linguistic and cognitive theory. The following are just a few of these:

- Precisely which features do listeners or readers use to judge the origin of an unfamiliar word?
- Which features of foreign languages are most salient for perception, production and cross-media output, and why?
- What is the effect of contradictory features, such as <*Psakhna*> [p͡saˈxna], which has a conflict for English speakers between the stress pattern and the syllable weight?
- Under what circumstances do speakers use hyperforeignism for words

they believe to be native? Is this simply a consequence of the experimental design, or does it happen in other situations?

- How are lexemes stored mentally? Which features are specified and which are derived, and which may be used for lexical access?
- Does analogy depend on lexical access?
- If analogy is used in an experiment such as this, without primes, why is it used for some prompts and not others? Or, are the outputs which appear not to use analogy actually a complex synthesis of analogies taken from different words?
- How do speakers decide which word or words to use for analogies?

This study has provided a starting point for further work on these and other issues, and it is hoped that future research will result in more comprehensive models for the reproduction of unfamiliar and/or foreign words.

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Appendix A. Sample Answer Sheets

Towns and Countries

Version NewRSa

Introduction:

In this experiment you will be given a list of towns, and you will be asked to decide which country they belong to. If you have any questions you may ask either before you start the experiment or after the Practice Test.

You will be asked to complete a practice test, the main experiment and a questionnaire about yourself. Please check that you have been given all three sections.

Please wait for instructions before beginning each question.

Section 1: Practice Test:

The 'Practice Test' contains three questions. Questions 1 and 2 require written answers, while for Question 3 you will be asked to read your answers aloud onto tape. When you have finished the test sample, we will check that you have all understood the questions and completed all parts.

Section 2: Main Experiment:

The 'Main Experiment' repeats the above procedure for all the questions. The instructions from the Practice Test are repeated for each question in a condensed form. Please complete all sheets.

Section 3: Questionnaire:

Please fill in the questionnaire.

Section 1: Practice Test
Please answer all questions. If you do not know an answer, please guess.

Subject: «num»

NewRSa Page 1/2

• Question 1: Could these towns be in Britain?

*This question is not meant to test your geography, but your guesswork. Remember that you will not have heard of all the towns in the list, so **if you think a town could be British**, put a tick in the box next to it; if you are not sure whether it could or not, put a question mark; if you think it couldn't be British put a cross. For example, 'Atwick' looks British while 'Bouala' doesn't. Answer all of Question 1 before proceeding to Question 2.*

Please give a tick (✓), a cross (✗) or a question mark (?) to every town. The first one is filled in for you.

P'yŏngyang	✗		Essen	
Platt			Auxerre	

• Question 2: Could these towns be in the countries listed?

*Below is a table with another list of towns, and five countries. For this question **please decide, for each town, whether it could be in each of the countries in the table**. Please remember that while some towns exist in only one country, for instance 'Voltri', which only occurs in Italy, other names, for example 'Marne', occur in more than one country (in this case in France and Germany). Some of the towns in the list below are not in any of the five countries. Even if you have never heard of some of the towns, you may be able to guess where they could be and where they couldn't be, for example you might think 'Trondheim' looks German or Norwegian. 'Wutongqiao', on the other hand, is unlikely to be found in any of the five countries (it is in fact in China).*

*For **each box in the table, put a ✓, a ✗ or a ?**, as you did in Question 1. Remember that a town name may occur in a number of different countries, or it may not be in any of these five, so it is possible you might have up to five ticks or five crosses. Answer all of Question 2 before beginning Question 3. The first row is filled in for you.*

	France	Germany	Greece	Italy	Norway
Trondheim	✗	✓	✗	✗	✓
Korinthos					
P'yŏngyang					
Platt					

PTO

Section 1: Practice Test
Please answer all questions. If you do not know an answer, please guess.

Subject: «num»
NewRSa Page 2/2

- **Question 3: On balance, which of these six countries do you think the town is in?**

Please answer Question 3 by reading the sentences in the table below ***aloud onto tape****, filling in the blank as you read with one of the countries listed below, for example if you are given the sentence* 'Auxerre is in _____'*, you might read:* 'Auxerre is in France.'

Please remember that for this question you must choose ***one and only one*** *of the six countries listed, and you must answer in* ***full sentences****. (Even if you think the town could be in more than one of the countries, or is unlikely to be in any, please select one country for every town.) Do not refer back to your answers to Questions 1 and 2 before deciding on the country - there is no need to cross-check your answers and if you do so you may find Question 3 takes a long time to complete.*

Now ***read the full sentences, with your answers****, onto tape. Be sure to read them all. You do not need to write your answers down, but you might want to put a mark in the blank space as you answer, to make sure you do not miss any of the sentences out. Please speak up and speak clearly.*

Countries you may choose from:

Britain France Germany Greece Italy Norway

Auxerre is in ________.		Platt is in ________.
Korinthos is in ________.		Trondheim is in ________.

Section 2: Main Experiment
Please answer all questions. If you do not know an answer, please guess.

Subject: «num»

NewRSa Page 1/3

• Question 1: Could these towns be in Britain?

*For each town, **if you think it could be British**, put a tick in the box next to it; if you are not sure put a question mark, and if you think it couldn't be British put a cross. Answer all of Question 1 before proceeding to Question 2.*

Please give a tick (✓), a cross (✗) or a question mark (?) to every town.

Manosque		Lyngen		Keld	
Glinde		Bolkesjö		Cornus	
Schwenke		Velen		Pfinztal	
Sollom		Kvernes		Rede	
Novoli		Stira		Sparbu	
Toucy		Ålesund		Okhotsk	
Slattocks		Katerini		Rötz	
Meyssac		Volos		Acri	
Karousadhes		Firenze		Evje	
Watton		Dokka		Tallard	
Aire		Elatia		Greve	
Stellau		Maule		Megara	
Nahe		Bobbio		Guadalajara	
Ekhinos		Loano		Savigne	
Jaren		Lechlade		Tsamandas	
Snåsa		Schapen		Pelynt	
Valençay		Bredgar		Sturry	
Fermo		Larisa		Copparo	
Dreve		Psakhna		Livorno	
Laragne		Wolnzach		Hellesylt	
Osimo		Guist			

PTO

Section 2: Main Experiment
Please answer all questions. If you do not know an answer, please guess.

Subject: «num»

NewRSa Page 2/3

• Question 2: Could these towns be in the countries listed?

Please guess, for each town, where it could be and where it couldn't be.

Remember that a town name may occur in a number of different countries, or it may not be possible in any of these five, so you might have up to five ticks or five crosses. Answer all of Question 2 before beginning Question 3.

For each box in the table, put a ✓, a ✗ or a ?

	France	Germany	Greece	Italy	Norway		France	Germany	Greece	Italy	Norway
Pfinztal						Savigne					
Evje						Tallard					
Guadalajara						Watton					
Slattocks						Ålesund					
Dokka						Okhotsk					
Katerini						Bredgar					
Novoli						Sparbu					
Aire						Pelynt					
Psakhna						Firenze					
Dreve						Schapen					
Jaren						Fermo					
Karousadhes						Valençay					
Keld						Acri					
Glinde						Cornus					
Ekhinos						Elatia					
Greve						Velen					
Schwenke						Lyngen					
Tsamandas						Volos					
Rede						Wolnzach					
Bolkesjö						Kvernes					
Sturry						Laragne					
Stira						Rötz					
Loano						Megara					
Meyssac						Sollom					
Copparo						Maule					
Lechlade						Guist					
Bobbio						Larisa					
Osimo						Livorno					
Hellesylt						Nahe					
Snåsa						Toucy					
Stellau						Manosque					

PTO

Section 2: Main Experiment
Please answer all questions. If you do not know an answer, please guess.

Subject: «num»

NewRSa Page 3/3

- **Question 3: On balance, which of these six countries do you think the town is in?**

Please answer Question 3 by reading the sentences in the table below aloud onto tape, filling in the blank as you read with one of the countries listed below, for example if you are given the sentence 'Auxerre is in _____', *you might read:* 'Auxerre is in France.' *You do not need to write your answers down.*

*Please remember that for this question you must choose **one and only one** of the six countries listed, and you must answer in **full sentences**. Do not refer back to your answers to Questions 1 and 2.*

*Please **read the full sentences, with your answers, onto tape**. Be sure to read them all (you might want to put a mark in the blank space as you answer, to make sure you do not miss any of the sentences out). Please speak up and speak clearly.*

Countries you may choose from:

Britain France Germany Greece Italy Norway

Pelynt is in ______.	Rötz is in ______.	Stellau is in ______.	Valençay is in ______.
Tallard is in ______.	Sparbu is in ______.	Psakhna is in ______.	Sollom is in ______.
Megara is in ______.	Stira is in ______.	Aire is in ______.	Apice is in ______.
Novoli is in ______.	Larisa is in ______.	Hellesylt is in ______.	Pfinztal is in ______.
Snåsa is in ______.	Rede is in ______.	Osimo is in ______.	Guist is in ______.
Loano is in ______.	Acri is in ______.	Bolkesjö is in ______.	Evje is in ______.
Schwenke is in ______.	Manosque is in ______.	Livorno is in ______.	Savigne is in ______.
Cornus is in ______.	Kvernes is in ______.	Schapen is in ______.	Glinde is in ______.
Lechlade is in ______.	Dreve is in ______.	Toucy is in ______.	Katerini is in ______.
Volos is in ______.	Karousadhes is in ______.	Laragne is in ______.	Malham is in ______.
Bobbio is in ______.	Elatia is in ______.	Watton is in ______.	Ålesund is in ______.
Ekhinos is in ______.	Nahe is in ______.	Sturry is in ______.	Bredgar is in ______.
Jaren is in ______.	Greve is in ______.	Wolnzach is in ______.	Keld is in ______.
Firenze is in ______.	Copparo is in ______.	Fermo is in ______.	Velen is in ______.
Lyngen is in ______.	Dokka is in ______.	Tsamandas is in ______.	
Meyssac is in ______.	Maule is in ______.	Slattocks is in ______.	

Section 3: Questionnaire
Please answer all questions.

Subject: «num»
NewRSa Page 1/1

1. Sex:	M	F	**2. Age:**	

3. Education	**a) Name of your school:**					
	b) Your current school year:	S4	S5	S6	Other:_______	

4. Place of birth (town and country):	
5. Which highers are you taking/ do you intend to take?:	
6. Place(s) in which you have lived for most of your life (towns and countries):	

7. Your knowledge of different languages. Please answer a, b, c, and optionally d, e, f:

a) Your first language:*	English	Other:____________________

		(Please tick one box per row)				
		None or almost none	A little (simple sentences)	Moderate (simple conversations or texts)	Good	Very good (almost like a native speaker)
b) French	listening					
	speaking					
	reading					
	writing					
c) German	listening					
	speaking					
	reading					
	writing					
Others (please						
d)	listening					
	speaking					
	reading					
	writing					
e)	listening					
	speaking					
	reading					
	writing					

* If this is not English, please describe your knowledge of English in 6 d).

Appendix B. Segmental Responses to Listening Experiments

Notes:

The first row of each data set (listening-speaking, n = 26 or listening-writing, n = 27) represents the most common segments; the second row shows the second most common; frequencies are listed in the tables. All differences in the responses, whether major or minor, are taken to be different segments. As the data shows each segment individually, information about segment combinations is not included.

- = represents no response
- ^ represents a missing segment
- ? represents, or is attached to a queried segment (unclear speech or handwriting)
- ~ is attached to a segment obviously transposed from elsewhere in the word
- \- is attached to a 'missing' segment actually included in an adjacent segment, e.g. an <x> response for [ks], which has two slots in the table structure, would be recorded as x-

Although syllable boundaries and stress are generally not shown in the responses, they are included where they coincide with a single segment in the prompt. Segments are aligned with the prompt segments, but in some cases the syllable boundaries were not as implied by this layout.

As far as possible the most appropriate alignment has been chosen for each response, but in more complex cases, such as omissions or metathesis, the alignment shown may not always be what subject intended. There are also words where the alignment is not obvious due to the phonetic qualities of the prompt (for example, 'Jaren'). Capitals are not distinguished in the listing of the data here, but nearly all the responses had initial capitals.

Slattocks	ˈs	lʏ	a	ˌtʰ	ə	k	s
listening-speaking	s 24	lʏ 20	a 24	tʰ 25	ɪ 20	k 25	s 24
	= 1	ɫ 3	= 1	= 1	ə 5	= 1	^ 1
	s˞ 1		ă 1				= 1
listening-writing	s 25	l 27	a 27	t 22	i 26	c 13	s 21
	sch 1			tt 5	e 1	x 6	- 5
	st 1						

Pelynt	pʰ	ə	ˈlʏ	ɪ	n	tʰ
listening-speaking	pʰ 22	ə 16	lʏ 19	ɪ 23	n 24	tʰ 23
	p 2	ə̆ 3	ɫ 4	= 2	= 2	= 2
	= 2					
listening-writing	p 27	a 13	l 22	i 24	n 21	t 25
		o 5	ll 4	e 3	^ 6	te 2

Lechlade	ˈlʏ	ɛ	t͡ʃ	ˌlʏ	e	d
listening-speaking	lʏ 16	ɛ 25	t͡ʃ 23	lʏ 17	e 26	d 21
	ɫ 7	? 1	ʔ͡ʃ 2	ɫ 7		d̥ 5
listening-writing	l 27	e 26	tch 12	l 27	a 11	d 13
						de 13
		ei 1	ch 10		ai 10	

Rede	ɹ	i	d
listening-speaking	ɹ 21	i 26	d 18
	ɾ 2		d̥ 5
listening-writing	r 27	eɪ 17	d 27
		ee 6	

Watton	ˈw	ɔ	ˌtʰ	ə	n
listening-speaking	w 25	ɔ 25	tʰ 24	ə 25	n 26
	ʍ 1	ɔ˞ 1	θ 1	ə̈ 1	
			t̻ʰ 1		
listening-writing	w 26	a 25	t 16	o 16	n 27
	wh 1	ä 1	tt 11	e 5	
		ar 1			

Sturry	ˈs	t	ʌ	ˌɹ	i
listening-speaking	s 26	t 26	ʌ 22	ɾ 15	i 23
			ʌ̈ 2	ɹ 10	i̞ 1
					e 1
					ɪ 1
listening-writing	s 27	t 27	u 26	rr 25	ey 18
			o 1	r 2	y 7

Guist	g	ʌ͡i	s	t
listening-speaking	g 20	ʌ͡i 24	s 24	t 25
	d 4	ʌ͡ʉ 1	sʼ 1	= 1
		= 1	= 1	
listening-writing	g 19	ei 8	s 26	t 22
	k 4	i 5	sz 1	te 3
		ie 5		

Sollom	ˈs	ɔ	.lˠ	ə	m
listening-speaking	s 25	ɔ 24	lˠ 12	ə 17	m 25
	= 1	o 1	ɫ 11	ɔ 5	= 1
		= 1			
listening-writing	s 27	o 27	l 21	e 12	m 14
			ll 6	o 9	mn 10

Bredgar	ˈb	ɹ	ɛ	d	.g	a	ɹ
listening-speaking	b 25	ɹ 19	ɛ 22	d 25	g 24	a̠ 16	ɹ 21
	= 1	ɾ 4	ɛ̞ 2	= 1	k 1	ɑ 5	^ 2
					= 1		
listening-writing	b 27	r 26	e 18	d 24	g 26	a 26	r 21
		^ 1	ea 8	^ 2	-g 1	aa 1	re 5

Keld	kʰ	ɛ	lˠ	d
listening-speaking	kʰ 26	ɛ 21	lˠ 14	d 20
		ɛ̞ 3	ɫ 7	d̥ 5
listening-writing	k 25	e 26	l 27	d 24
	g 1	ue 1		t 2
	qu 1			

Tallard	t	a	.l	aː	ʀ
listening-speaking	d 13	ə 11	lˠ 16	a 8	ɹ 10
				a̠ 8	
	t 5	a 7	l 8		ʀ 3
	tʰ 5				
listening-writing	d 17	a 26	l 17	a 24	r 16
	t 10	air 1	ll 10	e 2	re 3

Cornus	k	ɔ	ʀ	.n	y	s
listening-speaking	kʰ 19	ɔ 23	ɹ 10	n 19	ʉ 7	s 24
	k 3	ɔ̰ 1	ɹ̆ 4	nʲ 3	jʉ 6	ʃ 1
		a? 1				z? 1
		o 1				
listening-writing	c 24	o 26	r 23	n 26	eu 9	se 13
	k 2	i?o? 1	l 2	gn 1	oo 6	s 5

Valençay	v		a		. l		ã		. s		ɛ	
listening-speaking	f	12	a	18	lˠ	22	ã	7	s	21	e	22
	v	11	ɛ	4	l	3	ɔ̃	5	t͡s	2	ɛ	3
							ɔn	5				
listening-writing	f	17	a	21	l	20	on	13	s	17	e	4
											é	4
	v	10	e	3	ll	3	an	5	c	5		

Maule	m		o		l	
listening-speaking	m	25	o	11	l	12
	=	1	ɔ	5	ɫ	7
listening-writing	m	27	o	16	le	15
			u	4	ll	7

Meyssac	m		ɛ		. s		a		kʰ	
listening-speaking	m	25	ɛ	17	s	23	a	25	kʰ	14
	=	1	e	4	z	1	=	1	ʔ	3
					ʂ	1				
					=	1				
listening-writing	m	26	é	22	s	17	a	27	c	11
	n	1	i	4	ss	10			ck	6
									k	6

Toucy	t		u		. s		i	
listening-speaking	tʰ	13	ʉ	20	s	26	i	23
	d	9	ʊ	4			e	2
listening-writing	t	20	ou	10	s	18	ee	8
	d	7	u	8	ss	6	i	5

Aire	ɛː		ʀ	
listening-speaking	ɛː	8	ɹ	10
	ɛ	7	ʀ	5
listening-writing	e	10	r	13
	ai	8	re	9

Savigne	s		a		. v		i		ɲ	
listening-speaking	s	25	a	23	v	25	i	22	n	14
	z	1	ə	2	b	1	ji	1	ɲ	4
							iː	1		
							ĩˑ	1		
							ə	1		
listening-writing	s	26	a	27	v	17	i	24	ne	7
	st	1			b	5	ee	2	n	5

Laragne	l	a	. ʀ	a	ɲ
listening-speaking	lʏ 17	ə 13	ɹ 8	a 21	n 7
	l 6	a 7	ɾ 7	aː 2	ŋ 3
listening-writing	l 23	a 21	r 24	a 21	gne 6
	r 1 ll 1 l' 1 'n 1	a 3	rr 2	ai 2 ei 2	n 4 nge 4

Manosque	m	a	. n	ɔ	s	k
listening-speaking	m 26	a 18	n 26	ɔ 24	s 25	k 23
		ə 3 ä 3		o 1 ɔ˞ 1	s̲ 1	^ 2
listening-writing	m 26	a 24	n 26	o 23	s 27	k 15
	v 1	e 2	nn 1	or 3		que 6

Schwenke	ˈ ʃ	v	ɛ	ŋ	. kʰ	ə
listening-speaking	ʃ 21	v 10	ɛ 18	ŋ 25	kʰ 21	ə 19
	ʃɪ 2	w 7	ɪ 3	= 1	g 2 k 2	ʌ 3
listening-writing	sch 16	l 7 w 7	e 21	n 27	k 23	a 13
	s 6		a 4		c 3	e 9

Rötz	ʁ	œ	t͡s
listening-speaking	ʁ 9	ʉ 5	t͡s 20
	ɹ 8	ɜ 3 œ 3	ʔ͡s 4
listening-writing	r 22	u 10	tz 13
	l 5	eu 7	ts 10

Dreve	ˈ d	ʁ	eː	. v	ə
listening-speaking	d 12	ʁ 10	e 16	v 24	ə 15
	t 9	ɹ 5	eː 9	b 2	œ 4
listening-writing	d 14	r 26	e 13	v 23	e 8
	t 12	i~ 1	a 5	b 3	a 5

Nahe	ˈ n	a̲ː	. ə
listening-speaking	n 26	a 10	^ 4
		aː 6	ə 3 lʏ 3
listening-writing	n 25	a 10	e 8
	'n 1 n? 1	ah 4 i 4	l 6

Schapen	ˈʃ	a̠ː	.pʰ	ə	n
listening-speaking	ʃ 20	a 14	pʰ 20	ə 23	n 25
	s̠ 2	aˑ 3	p 4	ɛ 1 ə̟ˑ 1 = 1	= 1
listening-writing	sh 24	ar 19	p 25	e 22	n 25
	sch 2	a 7	pp 2	i 3	u? 1 ^ 1

Wolnzach	ˈv	ɔ	l	n	.t͡s	a̠	x
listening-speaking	v 24	ɔ 19	ɫ 13	^ 15	s 14	a 21	x 11 ^ 11
	f 1 w 1	ɔ̃ 3	^ 4	n 8	t͡s 8	a̠ 4	
listening-writing	v 23	o 27	l 17	^ 13	s 11	a 27	ch 11
	w 3		^ 6	n 12	ts 7		^ 6

Pfinztal	ˈp͡f	ɪ	n	t͡s	.tʰ	a̠ː	l
listening-speaking	f 13	ɪ 24	n 25	s 13	tʰ 16	a 17	lˠ 17
	v 7	i 2	ŋ 1	t͡s 10	t 10	aː 3	l 6
listening-writing	f 17	i 25	n 15	s 12	t 26	a 26	l 19
	v 8	u 2	^ 12	tz 10	s 1	aa 1	ll 5

Glinde	ˈg	l	ɪ	n	.d	ə
listening-speaking	g 21	ɫ 9	ɪ 26	n 24	d 26	ə 16
	gə 4	lˠ 8		^ 1 n̆ 1		ʌ̈ 3
listening-writing	g 11	l 27	i 26	n 21	d 19	a 14
	ge 6		ih 1	t 3	t 7	e 8

Velen	ˈf	eː	.l	ə	n
listening-speaking	f 23	e 22	lˠ 18	ə 18	n 24
	θ 1 v 1 v? 1	eː 4	ɫ 7	ɛ 4	m 2
listening-writing	f 24	e 9	l 21	e 15	n 25
	v 2	a 6 ai 6	ll 6	i 10	ne 1 r 1

Stellau	ˈ ʃ		t		ɛ		. l		a̠͡ʊ	
listening-speaking	ʃ	16	t	24	ɛ	20	lˠ	15	ʌ͡ʊ	11
	s	5	=	2	ɛ̝	4	l	9	a͡ʊ	5
listening-writing	s	17	t	26	e	26	ll	22	a	16
	sch	7	e~	1	t~	1	l	4	ow	2
									au	2
									o	2

Volos	ˈ v		ɔ		. l		ɔ		s̠	
listening-speaking	v	24	ɔ	21	lˠ	17	ɔ	14	s	24
	b	1	o	3	l	6	o	11	s̠	2
	vʷ	1								
listening-writing	v	23	o	26	l	23	o	18	s	15
	f	3	a?	1	ll	3	ou	8	se	7

Katerini	k		a		. t̪		ɛ		ˈ ɾ		i		. n		i	
listening-speaking	kʰ	18	a	22	tʰ	20	ə	19	lˠ	12	i	25	n	25	i	24
	k	5	æ	2	pʰ	4	a	4	l	7	ĭ	1	n?	1	ĭ	1
															i?	1
listening-writing	c	19	a	25	t	16	a	13	l	15	i	24	n	26	i	15
	k	6	ar	2	p	5	e	11	r	7	e	1	l	1	e	5
											^	1				

Megara	ˈ m		ɛ		. ɣ		a		. ɾ		a	
listening-speaking	m	25	e	14	h	15	ɛ	9	ɾ	17	a	20
	=	1	ɛ	10	ɾ	2	a	8	ʁ	3	ä	1
									ɹ	3	a̠	1
											a͡ɔ	1
											a.hã	1
											a'	1
											=	1
listening-writing	m	27	e	26	n	13	a	23	r	24	a	15
			eh	1	h	4	e	4	rr	2	ah	6

Tsamandas	t͡s		a		. m		a		n		ˈ d		a		s̠	
listening-speaking	s	22	a	25	m	24	ə	12	n	24	d	25	a	24	s	23
	t͡s	2	=	1	n	1	a	8	n̆	1	=	1	ä	1	s̠̆	1
					=	1			=	1			=	1	^	1
															=	1
listening-writing	s	20	a	26	m	26	a	27	n	25	d	27	a	27	s	20
	ts	3	^	1	mm	1			^	1					z	2
									t	1					ss	2
															ß	2

Stira	ˈ s̠	t̪	i	. ɾ	a
listening-speaking	s 21	t 15	i 22	ɾ 14	a 14
	θ 1 s̠ 1 s̤ 1 s' 1 = 1	t̠ 7	iə̆ 3	ɹ 5	ə 5
listening-writing	s 27	t 27	ee 9	r 24	a 21
			e 6	rr 3	e 4

Ekhinos	ɛ	ˈ ç	i	. n	ɔ	s̠
listening-speaking	ɛ 25	x 16	i 23	n 24	ɔ 20	s 21
	? 1	h 3	ĩ 2	? 1 ^? 1	ɔ̃ 3	z 1 st 1 θ 1 s̺ 1 ? 1
listening-writing	é 24	ch 12	i 16	n 26	o 20	s 18
	a 2	h 9	e 7	nn 1	ou 4	se 4

Larisa	ˈ l	a	. ɾ	i	. s̠	a
listening-speaking	lˠ 14	a 23	ɾ 17	i 22	s 21	a 18
	l 9	ä 1 i~ 1 = 1	ɹ 2	ɪ 2	θ 2	ä 2
listening-writing	l 27	a 18	r 14	i 13	s 16	a 25
		i 5	^ 7	e 5	ss 3	ia 1 ia 1

Karousa-dhes	k	a	. ɾ	u	ˈ s̠	a	. ð	ɛ	s̠
listening-speaking	kʰ 19	a 19	ɾ 12	o 8	s 23	a 14	ð 6 lˠ 6	ɛ 11	s 20
	tʰ 2	ɛ 3	ɹ 8	ə 6	z 1 lˠ? 1 = 1	a̠ 7		ʉ 6	z 2
listening-writing	c 23	a 27	r 18	o 17	s 27	a 25	l 13	e 15	s 20
	k 3		n 4	a 5		ai 1 ar 1	v 7	i 7	z 2 ss 2 se 2

Elatia	ɛ	ˈl	a	.t̪	i	.a
listening-speaking	ɛ 6	lʸ 13	a 21	tʰ 17	i 23	a 11
	ɪ 4	l 8	æ 2	t̪ 3	j 1 ^? 1 = 1	ə 6
listening-writing	e 22	l 25	a 27	t 23	i 24	a 26
	he 2	ll 2		nt 2 tt 2	i? 1 ee 1 e 1	ah 1

Psakhna	p͡s	a	ˈx	n	a
listening-speaking	s 18	a 24	x 16	n 24	a 23
	p͡s 4	ɑ 1 = 1	k 6	ɲ 1 = 1	a̠ː 1 a̠ 1 = 1
listening-writing	s 19	a 27	ch 17	n 27	a 21
	ps 4		c 4		ah 5

Novoli	ˈn	ɔ	.v	o	.l	i
listening-speaking	n 26	ɔ 26	v 25	ə 14	lʸ 17	i 24
			vː 1	o 7	l 6	ĭ 1 i̝ 1
listening-writing	n 27	o 24	v 26	o 15	l 26	i 9
		ou 1 or 1 au 1	u~ 1	ou 3 u 3	ll 1	ie 4

Loano	l	o	ˈa	.n	o
listening-speaking	l 5 n 5	o 21	a 19	n 24	o 23
		əʹw 2	ă 2	nʼ 2	ɔ 2
listening-writing	d 20	ow 6 w 6	a 23	n 22	o 23
	t 3		ar 2	nn 3	oe 2

Bobbio	ˈb	ɔ	.bː	j	o
listening-speaking	b 26	ɔ 23	b 14	i 13	o 24
		ɔɪ̆ 1 ɔʹ 1 ɑ 1	bː 7	j 8	ɔ 1 oː 1
listening-writing	b 14	o 26	b 10	i 16	o 19
	p 12	a 1	p 9	u 5	e 2

Acri	ˈ a		. k		ɾ		i	
listening-speaking	a	22	k	20	ɾ	9	i	23
					ɹ	9		
	ha	2	g	2			=	2
	=	2	=	2				
listening-writing	a	22	k	9	r	21	i	9
	ha	3	c	6	^	3	ee	6
			ch	6				

Firenze	f		i		ˈ ɾ		ɛ		n		. t͡s		e	
listening-speaking	f	24	ɪ	11	ɾ	14	ɛ	22	n	22	t͡s	9	e	21
	=	1	i	10	ɹ	6	ɛˤ	1	nd	1	s	9	ikʰ	1
	?	1					?	1	nʔ	1			ɛ	1
							e	1	?	1			i	1
							=	1	=	1			?	1
													=	1
listening-writing	f	21	e	10	r	19	e	24	n	19	ts	8	e	5
			i	10									y	5
													i	5
	v	5			l	6	i	1	^	7	tz	5		
							ei	1			c	5		
							a	1			s	5		

Greve	ˈ g		ɾ		ɛ		. v		e	
listening-speaking	g	24	ɾ	17	ɛ	17	v	21	e	23
	k	1	ɹ	5	e	8	w	3	i	1
	=	1							e̞	1
									=	1
listening-writing	g	25	r	27	e	24	v	10	y	12
	c	1			a	3	n	6	ia	2
	d	1							e	2
									i	2
									ai	2

Fermo	ˈ f		e		ɾ		. m		o	
listening-speaking	f	20	ɛ	13	ɹ	11	m	24	o	23
	v	2	e	4	ɹ̆	3	mː	1	õ	1
					-	3	=	1	ɘ	1
					ɾ	3			=	1
listening-writing	f	26	e	11	r	22	m	24	o	19
	v	1	ai	10	^?	2	m?	2	oh	2

Osimo	ˈɔ	.z	i	.m	o
listening-speaking	ɔ 19	z 22	i 16	m 24	o 22
	o 3	dz 1	ɪ 5	m? 1	õ 1
		ð 1		= 1	ɔ̃ 1
		z? 1			oʔ 1
		= 1			= 1
listening-writing	o 21	s 13	i 19	m 23	o 22
	au 4	ss 7	e 3	n 3	oe 2

Copparo	k	o	ˈpː	a	.ɾ	o
listening-speaking	kʰ 18	o 12	pʰ 13	a 24	ɾ 17	o 24
	k 7	ɔ 9	p 5	ɘ 1	ɹ 7	ɹ̩ 1
				= 1		= 1
listening-writing	c 25	o 26	p 17	a 26	r 20	o 21
	k 1	= 1	mp 6	= 1	rr 5	oh 2
	= 1					

Livorno	l	i	ˈv	o	ɾ	.n	o
listening-speaking	lˠ 18	i 17	v 17	o 20	ɹ 13	n 21	o 26
	l 5	ɪ 9	b 7	o˞ 1	^ 5	nː 3	
				oˈ 1			
				ɔ̃ 1			
				œ 1			
				ɜ 1			
				ɜ? 1			
listening-writing	l 26	e 13	v 24	o 20	r 24	n 27	o 22
	n 1	i 11	b 2	ou 4	^ 2		uo 1
							os 1
							u 1
							io 1
							et 1

Snåsa	s	n	ɔˈ	.s	ɑ
listening--speaking	s 25	n 26	ɔ 9	s 24	ɑ 10
			o 9		
	ʃ 1			z 2	a 5
listening-writing	s 25	n 27	o 18	s 23	aw 7
	's 1		ow 5	z 1	a 5
	z 1			ts 1	
				ß 1	
				ss 1	

Hellesylt	h	e	lː	ə	s	y	l	tʰ
listening-speaking	h 23	ɛ 15	lʸ 17	ə 12	s 22	ʉ 9	^ 16	tʰ 19
	^ 3	e 9	l 4	ɪ 6	z 3	y 5	lʸ 2 ɫ 2 l 2	^ 3
listening-writing	h 26	e 25	l 14	^ 18	s 19	u 10	^ 22	t 21
	= 1	= 1 ey 1	ll 10	e 4	z 5	ui 8	l 3	te 4

Lyngen	l	y	ŋː	ə	n
listening-speaking	lʸ 12	ɪ 9	ŋ 21	ə 19	n 23
	ɫ 8	e 7	n 2	ɪ 5	ŋ 2
listening-writing	l 26	e 8	g 20	e 15	n 25
	pl 1	a 6	ng 5	a 5	m 1 ne 1

Jaren	j	ɑˑ	ə	ɳ
listening-speaking	j 23	a̠ 15	^ 21	ɹn 20
	= 2	ɑˑ 3	= 2	n 2 = 2
listening-writing	y 23	a 25	^ 27	rn 27
	j 3	aa 1 ah 1		

Sparbu	s	p	ɑː	ɾ	b	ʉ
listening-speaking	s 22	p 24	a 8 a̠ 8	ɹ 12	b 23	ʉ 8
	= 2	= 2		ɾ 5 ^ 5	= 2	ə 5
listening-writing	s 27	p 27	â 24	r 25	b 26	u 6
			u 2	rn 1 rt 1	d 1	oo 4

Bolkesjö	b	ɔ	l	k	ə	ʃ	ø
listening-speaking	b 20	ɔ 24	ɫ 18	kʰ 18	ə 23	ʃ 25	ø 8
	v 3	ʌ 2	lʸ 6	k 7	ə̆ 2	ʒ 1	ɜ 4
listening-writing	b 26	a 14	l 19	k 10	^ 8	sh 21	ire 6
	= 1	o 6	r 3	ch 4 c 4	i 7	sch 3	a 3 u 3

Dokka	d		ɔ		kː		a	
listening-speaking	d	23	ɔ	23	k^h	10	a	12
	=	3	=	3	=	3	=	3
listening-writing	d	27	o	26	nc	8	a	19
			a	1	c	7	ar	3

Kvernes	k		v		æˑ		ɳ		eˑ		s	
listening-speaking	^ g	6 6	v	11	a	12	ɹn	10	ʉ	9	s	21
			w	4	a̠	7	n	5	ɛ ɪ	5 5	θs ʃ θ ? =	1 1 1 1 1
listening-writing	co	5	b	16	a	20	n	13	e	14	s	15
	good go ge g	3 3 3 3	v	4	ye y i ei aya ag a?	1 1 1 1 1 1 1	rn	6	i	10	sk	4

Evje	e		v		j		ə	
listening-speaking	e	16	b	15	i	14	ə	13
	he	4	v	9	j	6	a	6
listening-writing	e	11	b	16	i	18	a	9
	a	5	v	3	e y	4 4	er	4

Ålesund	ɔˑ		l		ə		s		ʉ		n	
listening-speaking	ɔ	11	l^{γ}	17	ə	13	s	26	ə	14	n	19
	hɔ	5	l	7	ɪ	9			^	6	n̩	6
listening-writing	o	14	l	23	^	16	s	23	e	13	n	23
	ho	8	ll	3	i	6	st	2	o	10	nt nne ne mo	1 1 1 1

Appendix C. All Segmental Responses to Listening Experiments

Notes:

The data shows each segment individually, so information about segment combinations is not included.

- = represents no response
- ^ represents a missing segment
- ? represents a queried segment (unclear speech or handwriting)
- ~ is attached to a segment obviously transposed from elsewhere in the word
- \- is attached to a 'missing' segment actually included in an adjacent segment, e.g. an <x> response for [ks], which has two slots in the table structure, would be recorded as x-; + is used when the 'missing' segment is included in a non-adjacent one

As far as possible the most appropriate alignment has been chosen for each response, but in more complex cases, such as omissions or metathesis, the alignment shown may not always be what subject intended. Syllables and stress are not marked, except at the end where they are listed separately, but in some cases there is a difference recorded between sequences such as [t͡s] and [ts]; this may be due to an intervening syllable boundary, timing or other factors. There are also words where the alignment is not obvious due to the phonetic qualities of the prompt (for example, 'Jaren'). Capitals are not distinguished in the listing of the data here, but nearly all the responses had initial capitals.

Consonants

Plosives

p^h			
write		**speak**	
p	52	p^h	42
pp	2	p	6
		=	3
		t^h	1

p			
write		**speak**	
p	27	p	24
		=	2

pː			
write		**speak**	
p	17	p^h	13
mp	6	p	5
=	1	mp	2
np	1	=	1
pp	1	b	1
rp	1	mp^h	1
		mb	1
		p'	1
		$p^{h'}$	1

t̪			
write		**speak**	
t	66	tʰ	37
p	5	t	16
tt	5	t̪	9
nt	2	pʰ	6
?	1	=	2
pp	1	b	2
pr	1	d̪	1
		t̤	1
		t̪ʰ	1
		t̠	1
		t̟ʰ	1
		^	1

tʰ			
write		**speak**	
t	41	tʰ	107
tt	11	t	12
te	2	=	3
		^	3
		t̪ʰ	2
		θ	1
		tˑʰ	1
		ʔ	1

t			
write		**speak**	
t	105	t	83
d	24	d	22
të	4	tʰ	19
dt	1	=	4
e~	1	d̥	1
		n	1

kʰ			
write		**speak**	
k	54	kʰ	61
c	14	k	4
ck	6	ɡ	3
ch	2	ʔ	3
qu	2	=	2
cke	1	k͡ʔ	2
g	1	kːʰ	1
h	1	kˑʰ	1
		ʔˠ	1

k			
write		**speak**	
c	117	k	94
k	49	kʰ	92
ch	11	ɡ	10
ck	6	^	9
que	6	=	6
x	6	ɡə	3
co	5	tʰ	3
g	4	?	3
ge	3	pʰ	2
go	3	d	1
good	3	ɡɪ	1
kh	3	k̤	1
qu	3	kʰə	1
^	3	kʰɑɹ	1
=	2	kʰɪ	1
cc	2	q	1
ga	2	t	1
q	2	x	1
t	2	xˑ	1
?	1	ɤ	1
ca	1	k̆	1
gh	1		
goh	1		
gu	1		
ke	1		
kö	1		
nc	1		
p	1		
r~	1		
sk	1		

kː			
write		**speak**	
nc	8	kʰ	10
c	7	=	3
ck	5	kˑ	2
nk	5	kˑʰ	2
ch	1	ɡtʰ	1
kk	1	ɡð	1
		k	1
		kh	1
		kː	1
		kʰt	1
		?	1
		ŋkʰ	1
		x	1

b			
write		**speak**	
b	93	b	94
p	12	=	3
=	1	v	3
d	1	bˑ	1
?	1	f	1
		m	1
		^	1

bː			
write		**speak**	
b	10	b	14
p	9	bː	7
lp	3	bˑ	4
mp	3	?	1
bp	1		
rp	1		

d			
write		**speak**	
d	175	d	170
t	21	d̥	15
de+	13	t	9
^	3	=	5
b	1	?	2
de	1	b	1
k	1	d̪	1
tt	1	ɡ	1
		p	1
		t̪	1
		^	1
		ď	1

ɡ			
write		**speak**	
g	81	ɡ	89
ge	6	d	4
ga	4	ɡə	4
gi	4	=	3
k	4	k	2
gh	3	?	2
c	2		
'c	1		
d	1		
gho	1		
-g	1		

Taps

ɾ			
write		**speak**	
r	245	ɾ	132
l	23	ɹ	83
rr	16	ʁ	17
^	14	lˠ	14
n	8	=	12
d	2	^	10
h	2	l	9
ll	2	ɹʷ	7
rl	3	ɹ̆	7
?	3	?	5
=	1	-	4
c~	1	r	3
rk	1	lˠɛ	1
rn	1	ɾ'	1
rt	1	ɾi	1
re+	1	ŋ	1
		n	1
		s~	1
		χ	1
		ɹ̥	1
		ə̆ɹ̆	1

Fricatives

f			
write		**speak**	
f	70	f	67
v	8	v	3
f	1	?	3
ph	1	θ	2
th	1	=	2
		fː	1

v			
write		**speak**	
v	167	v	203
b	43	b	31
f	20	w	16
w	12	f	14
m	8	=	4
l	7	ʍ	3
n	6	?	3
^	5	m	2
nn	4	ʍː	1
g	3	n	1
p	3	bɹ	1
gg	2	d	1
nd	2	lˠ	1
th	2	t͡s	1
=	1	vʷ	1
bb	1	v̥	1
dg	1	vː	1
ggn	1	vj	1
gh	1		
h~	1		
ll	1		
mm	1		
u	1		
u~	1		
vh	1		
vv	1		
wv	1		

ð			
write		**speak**	
l	13	ð	6
v	7	lˠ	6
r	2	?	4
ln	1	v	3
ll	1	ɫ'	1
m	1	=	1
?	1	ɹ	1
th	1	ɹʷ	1
		ɹi	1
		d	1
		w	1

s			
write		**speak**	
s	368	s	407
ss	22	=	9
se	15	z	7
z	10	ʃ	4
st	8	?	3
c	6	s̠	2
-	5	t͡s	2
sk	4	s'	2
sse	4	s̪	1
sz	2	s̬	1
ß	2	θ	1
tz	2	θs	1
's	1	d͡s	1
=	1	^	1
ç	1		
ch	1		
n	1		
sc	2		
sch	1		
ts	2		
-t	1		

z			
write		**speak**	
s	13	z	22
ss	7	=	1
z	5	ð	1
zh	1	dz	1
zz	1	?	1

s̠			
write		**speak**	
s	143	s	153
se	13	=	5
ss	8	θ	4
z	6	z	4
sse	3	?	4
ch	2	s̠	3
sk	2	s'	1
st	2	s̤	1
ß	2	s̪	1
c	1	s̞	1
e~	1	s̯	1
i~	1	st	1
so	1	z̥	1
th	1	^	1
x	1	s̠̆	1
zt	1		
zz	1		

ʃ			
write		**speak**	
sh	50	ʃ	82
sch	28	s	5
s	24	=	4
=	1	s̰	2
ch	1	ʃˑ	2
shc	1	s̠	2
sn	1	ʃɪ	2
sw~	1	ç	1
^	1	s̰ˑ	1
		ʃː	1
		tʃ	1
		ʒ	1

ç			
write		**speak**	
ch	12	x	16
h	9	h	3
kh	3	kʰ	2
th	2	?	1
kih	1	ɡ	1
		hʲ	1
		x̟	1
		ç̃	1

x			
write		**speak**	
ch	28	x	27
^	6	^	12
r	6	k	6
c	4	ɡ	1
ck	2	=	1
k	2	ɹ	1
g	1	h	1
gh	1	kʰ	1
h	1	χ	1
q	1	xː	1
que	1		
x	1		

ɣ			
write		**speak**	
n	13	h	15
h	4	ɾ	2
rr	3	ɰ	1
r	2	=	1
l	1	ɹ	1
ll	1	ɹʷ	1
m	1	ð	1
nh	1	lˠ	1
nn	1	ɣ	1
		x	1
		^	1

ʁ			
write		**speak**	
r	48	ʁ	19
l	5	ɹ	13
i~	1	r	5
		ɾ	3
		lˠ	3
		ʀ	2
		?	2
		ʁ	1
		ɬ	1
		ɹʷ	1
		l	1
		w	1

h			
write		**speak**	
h	26	h	23
=	1	^	3

Nasals

m			
write		**speak**	
m	193	m	198
mn	10	=	7
n	4	?	1
?	4	mː	1
^	3	n	1
mm	1		
v	1		

n			
write		**speak**	
n	497	n	485
^	42	^	16
nn	5	nˑ	7
t	4	?	7
m	3	=	6
ne	3	n̩	6
?	3	nː	4
r	2	ŋ	3
'n	1	n̆	2
g+n	1	ɲ	2
l	1	m	2
mo	1	nd	2
nne	1	aŋg	1
nt	1	d	1
p	1	ŋ~	1
t~s~	1	nʔ	1

ɳ			
write		**speak**	
rn	33	ɹn	31
n	13	n	7
?	2	=	3
gn	1	nˑ	2
rnm	1	nː	2
nn	1	ɳ	1
ny	1	nð	1
r	1	ɹm	1
m	1	?	1
		nʲ	1
		ɹ̆n	1
		ɾn	1

ɲ			
write		**speak**	
ne	14	n	21
gne	9	ɲ	5
n	9	ŋ	5
nge	5	njə	6
ng	3	ɲə	2
gn	2	nj	2
ngh	2	njʌ̈	2
gna	1	njä	1
gnh	1	njĕ	1
gnyi	1	=	1
ngk	1	nja	1
ngt	2	ŋʲ	1
nia	2	ŋcʰ	1
nne	1	nd͡ʒ	1
nya	1	ŋg	1
		^	1

ŋ			
write		**speak**	
n	27	ŋ	25
		=	1

ŋː			
write		**speak**	
g	20	ŋ	21
ng	5	n	2
g~n~	2	ɡ	1
		ŋ˞	1
		?	1

Approximants

j			
write		**speak**	
i	34	j	37
y	30	i	27
e	6	ĭ	6
u	5	?	3
j	3	=	2
=	1	ðj	1
ey	1	ɲ	1
yy	1	nj	1

w			
write		**speak**	
w	26	w	25
wh	1	ʍ	1

ɹ			
write		**speak**	
r	76	ɹ	71
rr	26	ɾ	22
re	5	ʁ	2
^	1	=	2
		^	2
		ɹʷ	1
		hɹ	1
		ʀ	1
		r	1
		ɹ̆	1

Lateral approximants

l			
write		**speak**	
l	350	lʏ	242
ll	67	l	105
^	31	ɫ	78
d	20	^	21
le	16	?	9
r	10	=	8
n	3	n	7
t	3	l̪	4
=	2	ð	3
rr	2	d	3
th	2	θ	3
lë	1	ɫ̜	1
'n	1	ʁ	1
g	1	ʎʏ	1
l'	1	lʏɔ	1
lle	1	ɫ˞	1
lm	1	ɫ̩	1
pl	1	ʌ	1
		l̺˞	1
		lːʏ	1
		lʏĭ	1
		lʏj	1

lʏ			
write		**speak**	
l	151	lʏ	99
ll	10	ɫ	39
t	1	l	8
		=	4
		l̪	3
		?	1
		l̥ʏ	1
		lː	1

lː			
write		**speak**	
l	14	lʏ	17
ll	10	l	4
=	1	ɫ	3
r	1	?	1
^	1	lː	1

Trills

ʀ			
write		**speak**	
r	76	ɹ	38
re	12	ʀ	16
rr	4	ɾ	9
l	2	ʁ	5
rre	2	^	5
^	2	ɹ̆	5
cg	1	=	4
ch	1	?	4
g	1	χ	3
hch	1	ɹ˞	2
rd	1	lʏ	2
rgh	1	və	2
rri	1	ʁə	1
rs	1	ɾə	1
rye	1	a̠ɹ	1
ve	1	ɾəχ	1
		ɡ	1
		ʀ̤	1
		ʀ̥	1
		r̥	1
		ə̆ɹ̆	1

Affricates

p͡f			
write		**speak**	
f	17	f	13
v	8	v	7
w	2	p͡f	2
		θ	1
		v˞	1
		v̥	1
		ʔ͡v	1

p͡s			
write		**speak**	
s	19	s	18
ps	4	p͡s	4
s~p~	1	t͡s	2
s~p~t	1	=	1
s~t~	1	k̚s	1
sc	1		

t͡s			
write		**speak**	
s	46	s	60
ts	33	t͡s	49
tz	31	ʔ͡s	4
c	5	=	2
s~t~	5	d͡s	2
z	3	ts	2
ch	1	?	1
ks	1	d͡z	1
n~	1	ks	1
s~k~	1	s̬	1
sh	1	z	1
st	1	ʔs	5
t	1	dž	1
tes	1		
tse	1		
tst	1		
tze	1		
^	1		

t͡ʃ			
write		**speak**	
tch	12	t͡ʃ	23
ch	10	ʔ͡ʃ	2
tct	1	?	1
tsch	1		
tschs	1		
tscs	1		
x	1		

Vowels

Primary

i			
write		**speak**	
i	184	i	323
e	60	ɪ	28
ee	39	=	7
ei	28	ȋ	5
ey	19	?	5
ie	17	e	4
y	12	iə̆	3
ea	8	i̞	3
?	4	ĭ	2
+	4	ə	2
^	4	ɪ̆	1
is	3	a̱~	1
é	3	ɛ	1
ë	2	iː	1
ée	2	j	1
es	2	ji	1
o	2	ȋˑ	1
ia	2	^	1
ehe	1		
eigh	1		
er	1		
ët	1		
et	1		
eux	1		
eehe	1		
ic	1		
ire	1		
s~	1		

ɪ			
write		**speak**	
i	75	ɪ	73
e	3	=	2
u	2	i	2
ih	1	ə	1

e			
write		**speak**	
e	54	e	99
ai	22	ɛ	32
a	20	he	4
y	17	i	4
i	10	=	3
é	7	e̞	2
ei	5	ɛə	2
ea	3	ɪ	2
er	3	?	1
he	3	e̝	1
ia	3	ɛ̥	1
=	2	ɛ̈	1
ee	2	ɛː	1
ie	2	eː	1
ais	1	ikʰ	1
ay	1	eə̆	1
ë	1		
?	1		
eux	1		
ey	1		
ha	1		
hai	1		
iy	1		

eˑ			
write		**speak**	
e	14	ʉ	9
i	10	ɛ	5
ai	1	ɪ	5
ei	1	i	2
u	1	=	1
		?	1
		ɛ̝	1
		iɛ	1
		ʏ	1

eː			
write		**speak**	
e	22	e	38
a	11	eː	13
ai	7	ɛː	1
ei	4		
ae	2		
é	2		
es	2		
ä	1		
air	1		
ay	1		
r~	1		

ɛ			
write		speak	
e	287	ɛ	217
a	28	e	54
i	19	ə	21
ea	8	ɛ̝	13
é	6	=	11
ai	5	ɪ	9
y	3	?	7
ay	2	a	6
ei	2	ʉ	6
er	2	hɛ	3
he	2	ɛ̥	2
'e	1	ä	1
?	1	ɛˁ	1
ais	1	ei	1
ce	1	ɛ̝ˑ	1
ë	1	ɛ̈	1
ée	1	hə	1
eh	1	he	1
es	1	hɛ̝	1
ey	1	hɛ̈	1
hi	1	hë	1
ie	1	hɪ	1
s~	1	i	1
t~	1	ɪ̈	1
ue	1	ə̆	1
		ɛ̃	1

ɛː			
write		speak	
e	10	ɛː	8
ai	8	ɛ	7
ei	3	=	2
ay	2	hɛ	2
a	1	e	1
aei	1	ɛ̞	1
eh	1	e̞	1
hei	1	ɛ̞ː	1
		ɛ̝	1
		ɛ̥	1
		he	1

æˑ			
write		speak	
a	20	a	12
?	1	a̠	7
ag	1	=	1
aya	1	?	1
ei	1	ɑ	1
i	1	a̠	1
y	1	a̠ː	1
ye	1	aˑ	1
		æ	1
		æˑ	1

a			
write		speak	
a	670	a	498
e	19	ə	61
ah	17	a̠	29
ar	10	=	27
ai	5	ä	27
i	5	ɛ	19
a	3	ɑ	11
ei	3	a̟	5
ha	3	æ	5
o	2	ʌ	4
^	2	ʌ̈	4
'a	1	?	4
=	1	ă	3
à	1	ḁ	3
a'	1	aː	3
aa	1	e	3
aar	1	aˑ	2
ahk	1	ha	2
air	1	^	2
as	1	ʌ̟	1
er	2	aɾ	1
ia	2	a͡ɔ	1
et	1	a̠ː	1
ou	1	a̝	1
ow	1	ɑ̈	1
y	1	aʀ	1
		ɛə	1
		ɛ̈	1
		i~	1
		æ̈	1
		ælˠ	1
		ã	1
		ahã	1
		ă̟	1
		œ̠	1

aː			
write		speak	
a	24	a	8
e	2	a̠	8
aa	1	aː	6
		ɑ	2
		=	1
		aˑ	1

a̠			
write		speak	
a	27	a	21
		a̠	4
		aˑ	1

a̠ː			
write		speak	
a	43	a	41
ar	20	aː	10
aah	4	a̠ː	8
i	4	aˑ	4
aa	2	a̠	2
all	2	aɹ	2
?	1	ãː	1
ail	1	a̟ˑ	1
al	1	a̠ɹ	1
ay	1	ɑː	1
ih	1	æ̠ː	1
ir	1	a̟	1
		ɔ	1
		ʌ͡i	1
		=	1
		a͡e	1
		a͡ɪ	1

ɑ			
write		**speak**	
aw	7	ɑ	10
a	5	a	5
or	3	a̠	4
o	2	ɚ	1
?	2	əɹ	1
aar	1	aˑ	1
ah	1	ɑʔ	1
ar	1	a̠ˑ	1
arr	1	ɑ̞	1
e	1	ɑː	1
oe	1		
ort	1		
ur	1		

ɑˑ			
write		**speak**	
a	25	a̠	15
aa	1	ɑˑ	3
ah	1	=	2
		ɑ	2
		a	2
		ɑ̞	1
		ɑ̈	1

ɑː			
write		**speak**	
a	23	a	8
u	2	a̠	8
â	1	ɑː	4
e	1	ɑ	3
		=	2
		ɑ̞	1

ɔ			
write		**speak**	
o	270	ɔ	285
a	41	o	24
ou	15	ɔ̃	6
au	6	=	5
or	4	ɔˑ	3
u	4	?	3
?	4	ʌ	2
=	1	ʊ	2
ä	1	ɔ̞	2
ar	1	ʌ̈	1
aw	1	ɑ	1
eu	1	ɑˑ	1
oi	1	o̝	1
^	1	ɔɪ̆	1
		ɔ̰	1

ɔˑ			
write		**speak**	
o	32	ɔ	20
ho	8	o	12
ow	5	ɔˑ	7
a	2	hɔ	5
au	1	oˑ	2
ew	1	ɒ	1
hö	1	ʌ̆	1
?	1	a͡ʊ	1
oll	1	ɔ̞	1
ou	1	ø	1
vo	1	ʊ	1

o			
write		**speak**	
o	208	o	213
u	12	ɔ	18
ou	11	ə	16
e	7	=	5
oe	7	ʊ	4
ow	7	?	4
w	6	ə̆	2
oh	5	ɔ̃	2
a	3	õ	2
ew	3	ŏ	2
oo	3	əw	2
=	2	oˑ	2
os	3	ɔ̈	2
aw	1	ö	2
er	1	oː	1
et	1	ɹ̝	1
eut	1	ʌ	1
eux	1	a	1
io	1	ɜ	1
oeu	1	œ	1
ond	1	o̝	1
one	1	u	1
ont	1	wˑ	1
or	1	y	1
oue	1		
ount	1		
ów	1		
ü	1		
uo	1		
uw	1		
ux	1		
v~	1		
^	1		

u			
write		**speak**	
o	20	ʉ	22
ou	12	o	8
u	8	ə	6
oo	6	u	5
a	5	ʊ	4
i	2	ɔ	3
oi	1	=	1
		ɔ̈	1
		ü	1
		?	1

ə			
write		**speak**	
e	119	ə	238
^	72	ɪ	42
a	70	^	28
i	66	ə̆	10
o	32	=	8
u	14	œ	7
er	13	ʌ	6
l	6	ɔ	6
=	3	ɛ	5
ar	3	a	8
ea	3	ʌ̈	5
eu	3	ɪ̈	4
eux	3	əɹ	5
?	3	ɛ̈	3
ll	2	lʏ	3
ua	2	œ̠	2
eur	2	ə̜	2
ai	1	œ'	2
é	1	a̠	2
eau	1	e	2
ek	1	i	2
en	1	l	2
ha	1	ɔ̈	2
ia	1	?	2
ie	1	œ̠˞	1
il	1	ʌ	1
in	1	aɹ	1
oux	1	aː	1
û	1	ɹ	1
ue	1	ɹə	1
ur	1	ə̟'	1
w	1	əː	1
y	1	ɜ	1
		a̠m	1
		ɜ̜	1
		ɑ̈	1
		ä	1
		ia	1
		ɪt	1
		lː	1
		øɹ	1
		əɪ̆	1
		ɜə̆	1
		ũ	1

Secondary

y			
write		**speak**	
u	15	ʉ	16
eu	10	ɪ	13
ui	9	y	8
e	8	e	7
i	8	jʉ	6
oo	7	i	3
a	6	ʊ	3
ou	5	jy	2
?	3	^	2
ae	1	ə	1
ai	1	ʌ	1
=	1	ɜ	1
ei	2	e̞	1
ee	1	ʉ̈	1
eh	1	eː	1
er	1	ɪ'	1
oi	1	iʉ	1
y	1	ɪ̜	1
		ǰʉ	1
		jʊ	1
		ø	1
		ø̠	1
		ʏ	1
		?	1
		y̠	1
		y̜	1
		ɨ̆	1

ø			
write		**speak**	
ire	6	ø	8
a	3	ɜ	4
u	3	ɜ˞	2
un	2	?	2
on	2	œ	1
en	2	œ̠	1
an	1	əɹ	1
aw	1	ɜ̜	1
e	1	ɜ̜ɹ	1
i	1	o	1
o	1	ø˞	1
ae	1	øɪ̆	1
=	1	ø̠	1
ou	1	ø̈n	1
um	1		

œ			
write		**speak**	
u	10	ʉ	5
eu	7	œ	3
oo	4	ɜ	3
ou	2	œ̠	2
eou	1	ə̜	2
i	1	ɨ̇	2
ö	1	ɜ̜	2
ui	1	œ͡ʉ	1
		œ̜	1
		œ̈	1
		ə	1
		ʉ̈	1
		?	1
		ø͡ə	1

ʌ			
write		**speak**	
u	26	ʌ	22
o	1	ʌ̈	2
		ʌ̟	1
		ɜ	1

ʉ			
write		**speak**	
e	14	ə	19
o	11	ʉ	10
u	6	^	6
oo	4	u	3
eu	2	ə̆	2
i	2	ʉ̆	2
ou	2	=	2
eaux	1	ə̜ɹ̠	1
ie	1	œ	1
im	1	ɜɹ	1
?	1	ʉ̈	1
oue	1	jø	1
ouh	1	o	1
oum	1	øɹ	1
our	1	ʊ'	1
oux	1		
ue	1		
um	1		
un	1		
^	1		

Diphthongs

a̠͡ʊ			
write		**speak**	
a	16	ʌ͡ʊ	11
au	2	a͡ʊ	5
o	2	a	3
ow	2	a̠͡ʊ	3
?	2	=	2
an	1	ə	1
awo	1	o	1
ou	1		

ʌ͡i			
write		**speak**	
ei	8	ʌ͡i	24
i	5	=	1
ie	5	ʌ͡ʉ	1
ai	4		
eu	1		
igh	1		
ui	1		
y	1		
ÿhea	1		

Nasals

ɑ̃			
write		**speak**	
on	13	ɑ̃	7
an	5	ɔn	5
en	3	ɔ̃	5
a	2	n̩	2
^	2	o	1
oun	1	ɔŋ	1
o	1	ɔnd	1
		ən	1
		ɑ̃n̆	1
		ɔ̃n̆	1
		=	1

Stress, tone and boundaries

Stresses

ˈ			
write		**speak**	
N/A	972	ˈ	824
		^[83]	35
		=	23
		.	18
		?	16
		+	9
		ˌ	7
		/	3
		ˎ	1

Tone

ˋ			
write		**speak**	
N/A	81	ˈ	26
		ˊ	22
		ˍˊ	14
		=	3
		ˋ	3
		?	3
		/	2
		ˏ	1
		ˇ	1
		ˎ	1
		ˉ	1
		^	1

ˇ			
write		**speak**	
N/A	189	ˈ	83
		˝	23
		ˇ	22
		ˍˊ	20
		ˊ	19
		/	4
		^	4
		=	2
		ˌ	2
		ˆ	2
		˜	1

Syllable boundary

.			
write		**speak**	
N/A	1701	.	1366
		ˈ	145
		=	38
		^	37
		?	25
		ˌ	14
		+	6
		ˊ	3
		˝	2
		ˉ	2

Word-initial boundary[84]

/			
write		**speak**	
N/A	675	/	401
		ˈ	190
		?	24
		=	19
		ˌ	16

[83] Many of these will be word-initial boundaries.

[84] This has been included as a potential place-holder for stress; if there are no suprasegmental features, the symbol / is used.

Appendix D. Reading-Writing Errors

Errors made in the reading-writing experiment can be classified as follows. (Some responses have more than one type of error and so appear twice, but each error is only analysed in one way, even when there is more than one possible analysis.) Errors are underlined; unclear graphemes in the responses are shown in italics and are not included in the analysis of errors. "..." represents a trailing off or illegible scribble. Prompts are shown in the font which was used for presentation. The groupings used are:

- Substitution: changing the identity of one or more graphemes
- Omission: omitting one or more graphemes
- Insertion: inserting one or more graphemes
- Diacritic errors: errors in transcribing diacritics
- Transposition and relocation: swapping of grapheme positions, or moving one or more graphemes to other locations in the word
- Miscellaneous: remaining errors

Responses marked with an asterisk are those for which similar errors were made in the reading-speaking experiment (for example, the written error <Pelnt> and the spoken error [p^{h}ɛl^{ɣ}nt^{h}]), or for which such an error cannot be determined (for instance, there is no consistent difference in pronunciation between pairs such as <Copparo> and <Copparro>). It is difficult to distinguish accurately between the two types as there are many ambiguous cases: <Navoli>, for example, might correspond to [nəˈvo.l^{ɣ}i], an actual response, or [ˈna.vo.l^{ɣ}i], which did not occur. If there is more than one error in the response, the judgement applies to the word as a whole, not just to the underlined error. (These judgements assume plausible grapheme-to-phoneme correspondences.)

◊ ***Substitution***

Cases in which a word was changed by replacing one single grapheme with a different grapheme, or grapheme combination:

Stimulus	Response	
Bobbio	Bobbia	
Bolkesjö	Bolkosjö	
	Boleskiö	*
	Bolkysjö	*
	Bolkesyö	*
Bredgar	Bedger	
Cornus	Carnus	
Dokka	Dokha	*
Ekhinos	Echinos	*
	Exhinos	*
	Exhinos	*
	Exhinos	*
	Ekhines	
Fermo	Ferno	
Firenze	Fiaranze	
	Fiernza	
Greve	Grave	*
Hellesylt	Hellesyi	*
	Hellesyit	*
Jaren	Jenen	
Karousadhes	Karousaches	
	Karodsadnes	
Katerini	Katerine	*
	Katarini	*
Keld	Keid	
	Keid	
Kvernes	Kyernes	
Larisa	Lariso	*
Lechlade	Lechleke	
	Lechleke	*
Loano	Loana	*
	Loana	*
	Loana	*
Lyngen	Lynden	
	Lynze	
Livorno	Livirno	
	Liviroo	
	Livormo	
Manosque	Manasque	
	Monosque	*
	Monosque	*
	Monosque	*

Stimulus	Response	
Megara	Megard	
	Megard	
Meyssac	Mayssea	
Novoli	Noveil	
	Navoli	*
	Novili	
Pfinztal	Pfinzel	*
	Pfinztai	
	Plinzial	
	Pfinztaz	
Psakhna	Psakma	
	Psakmna	
	Psakana	*
Schapen	Schraper	
Schwenke	Schwake	
Slattocks	Stattocks	
Snåsa	Snaza	*
Sollom	Soliom	
	Soilem	
Sparbu	Sparbe	*
	Spurda	
Stellau	Stelleu	*
Tallard	Taliard	
	Tailard	
Tsamandas	Tsamandes	*
	Tsamardas	
	Tsamandos	*
	Tasmadus	
	Tasmandus	*
Valençay	Velency	*
	Valeycy	*
	Valançay	*
	Valençe n	
	Vevençey	
Velen	Val*eri*	
Volos	Vojos	
Wolnzach	Wohnzach	
	Walnzach	*
	Walnzach	*
	Wolnzarh	
	Woinzach	

Table 67: Substituted characters (reading-writing)

◊ ***Omission***

Cases in which one or more graphemes were omitted:

Stimulus	Response	
Ålesund	Ålesu_d	
Bolkesjö	Bolke_jo	
	Blocke_jö	
Bredgar	B_edger	
Copparo	Copp_o	
Firenze	Fire_ze	
Hellesylt	Hell_sy_t	
	Hellensy_t	*
	Hellest_y	
	Hellesy_t	*
	Hellesy_t	*
	Hellesy_t	*
	Hellesy_t	*
	Hellesy_te	*
	Hellesyi_	
Karousadhes	Karousa_hes	
	Karoushad_	
	Karo_sa_h_	
	Karo_sad_es	
	Karous_hdes	
	Karousad_es	*
	Karousad_es	*
	Karousad_es	*
	Karousad_es	*
	Karousad_es	*
	Karousad_es	*
Kvernes	Kve_nse	
Laragne	Lar_gne	*
	Lar_gne	*
	Lar_gne	*
Lechlade	Lechald_	
Loano	L_ano	*
Lyngen	Ly_gen	*
	Ly_gen	*
	Lynze_	

Stimulus	Response	
Manosque	Man_sque	
Meyssac	Meys_ac	*
Pelynt	Pely_t	
	Pel_nt	*
	Pel_nt	*
Psakhna	Psak_na	*
	Psakh_a	
	Psak_as	
	Psakm_a	
Pfinztal	Pfinz_el	*
	Pfinz_al	*
	Pfinz_al	*
	Pfinz_al	*
	Pfinz_ail	*
	P_inztal	
Rötz	Rö_za	*
Schwenke	Schwe_ke	*
	Schwe_ke	*
	Schwa_ke	
	Swh_enke	*
Slattocks	Slatto_ks	*
Sollom	Sol_om	*
Stellau	Stella_	
Tallard	Talla_d	
Tsamandas	Tsama_das	
	Ts_mandas	*
	Tsada_mas	
	Tsamd_asa	
	Tasma_dus	
Valençay	Valenc_y	*
	Valeyc_y	*
	Valenç_y	*
	Valenç_y	*
	Velenc_y	*
Watton	Wat_on	*

Table 68: Omitted characters (reading-writing)

◊ ***Insertion***

Cases in which one or more graphemes were inserted:

Stimulus	Response	
Copparo	Copparro	*
	Copparro	*
Ekhinos	Ekhinnos	*
Karousadhes	Karoussadhes	*
Katerini	Katter*inj*i	
Kvernes	Kverness	*
	Kverness	*
	Kverness	*

Stimulus	Response	
Psakhna	Pskhanna	*
	Pskahanna	*
Rötz	Röt tz	*
Valençay	Vallençay	*

Table 69: Insertion of graphemes (doubling of existing graphemes, reading-writing)

Stimulus	Response	
Ålesund	Aleshund	*
Bolkesjö	Bolkesejö	
	Blockejö	
Cornus	Cornius	
Dreve	Dreves	
Dokka	Dokkha	
Evje	Evjie	
Firenze	Fireneze	
	Fiaranze	
Hellesylt	Hellensyt	*
	Hellesyte	*
Laragne	Lavargne	
Lechlade	Laichanlde	
Lyngen	Lyndgen	*
	Lyndgen	*
Meyssac	Meyassac	
Pelynt	Pleyntn	
	Peleynt	*
	Pelynet	

Stimulus	Response	
Pfinztal	Pifinztal	*
	Pfinzail	*
Psakhna	Psakas	
	Psakhena	
	Pskahanna	
Rötz	Röz a	*
	Rötz e	*
Savigne	Savingne	*
Schapen	Schraper	
Schwenke	Schwenkes	*
Snåsa	Snaska	
Stellau	Stelliau	*
	Stellaue	*
	Stelleau	*
Tsamandas	Tsasmandas	

Table 70: Insertion of graphemes (non-doubling, reading-writing)

◊ ***Diacritic errors***

Some of these (for instance <Snas̊a> as a response to <Snåsa>) could have been classified as metathesis, but in the analysis here only completely transposed characters (such as <Bölkesjo> as a response to <Bolkesjö>) have been treated as such. Errors in writing diacritics:

Stimulus	Response	
Ålesund	Alesund	*
	Alesund	*
	Alesund	*
	Alesund	*
	Alesund	*
	Aleshund	*
	Alesund	*
	Alesund	*
	Alesund	*
	Alesund	*
	Álesund	*
	A*u*lesund	
	Äelsund	*
	Alësund	*
	Älesund	*
	Àlesund	*
	ălesund	*
Bolkesjö	Bolkejo	
	Bolkesjo	*
	Bolksejo	*
	Bolkesjo	*
	Bolkesjo	*
	Bolkesjo	*
	Bolkesjo	*
	Bolkesjō	*
	Bolkesjŏ	*

Stimulus	Response	
Rötz	Rotz	*
	Rotz	*
	Rotz	*
	Roẗz	*
	Rôtz	*
Snåsa	Snaza	*
	Snas̊a	*
	Snasa	*
	Snasa	*
	Snasa	*
	Snasa	*
	Snäsa	*
	Snäsa	*
	Snäsa	*
	Snâsa	*
	Snâsa	*
	Snaska	
	Snása	*
	Snāsa	*
Valençay	Valencay	*
	Valencay	*
	Valenca̧y	*
	Valency	*
	Velency	*
	Valeycy	*
	Velancäy	

Table 71: Diacritic errors (reading-writing)

◊ ***Transposition and relocation***

These are errors of position. In transposition errors two or more adjacent or non-adjacent characters are swapped. For relocation errors, single graphemes are moved elsewhere in the word, jumping over two or more graphemes to their new locations, but not affecting the ordering of other graphemes. Relocation over a short distance could, of course, be viewed as transposition of several graphemes.

Stimulus	Response	
Ålesund	Äelsund	*
	Ålusend	
Bolkesjö	Blockejö	
	Bölkesjo	*
	Bolksejo	
Dreve	Derve	*
Ekhinos	Ehkinos	*
Firenze	Fiernza	
	Firenez	
Hellesylt	Hellelyst	
	Helleslyt	*
	Hellesty	
Karousadhes	Karousahdes	*
	Karousdahes	
	Karoushdes	
Katerini	Katirine	*
Kvernes	Kvense	
Laragne	Larange	*
	Larange	*
	Lavargne	
Lechlade	Laichanlde	
	Lechald	

Stimulus	Response	
Novoli	Noveil	
	Novoil	
Psakhna	Paskhna	
	Psahkna	*
	Psakhan	
	Psakhan	
	Pskahna	
	Pskahanna	
Pelynt	Pelnyt	
	Pleyntn	
Pfinztal	Pfintzal	*
Savigne	Savigen	*
	Savinge	*
	Savinge	*
Sparbu	Spurda	
Stira	Stria	
Tsamandas	Tasmadus	
	Tasmandus	*
	Tsadamas	
Valençay	Velancäy	

Table 72: Errors of transposition (reading-writing)

Stimulus	Response	
Bolkesjö	Boleskiö	
Bredgar	Bregard	
Glinde	Ginlde	
Karousadhes	Karoushad	
	Karhousades	
	Karoushades	
	Karoushades	
	Karoushades	

Stimulus	Response	
Laragne	Laragen	
Psakhna	Psaknah	
	Pskhanna	
Schwenke	Schweken	
	Swcheeke	
Tsamandas	Tsamdasa	

Table 73: Errors of relocation (reading-writing)

◊ ***Miscellaneous***

The errors in these responses do not fit easily into the above groupings.

Stimulus	Response	
Acri	Aeira	
Bolkesjö	Boleysk	
Ekhinos	Exinhos	*
Evje	Evjic	
Hellesylt	Hellesyte	*
	Hellestke	
	Heleisyit	
	Hellesight	*
	Helysic	
	Hellestyn	
Karousadhes	Kansavat	
	Karogosadhes	
	Kr*oa*...	
	Karouschen	
	Karas	
Livorno	Liverono	
	Livonno	

Stimulus	Response	
Meyssac	Meysacc	*
	Meysacc	*
Psakhna	Psaklu	
	Pashahna	
	Pskanda	
	P*c*akshada	
Pfinztal	Pfintzia	
	Pfinztati	
Schwenke	Swen...	
Snåsa	Sloaki	
Slattocks	Stallocks	*
	Saltralks	
Tsamandas	Tsamashe	
	Tsandanas	

Table 74: Miscellaneous reading-writing errors (errors not underlined)

Appendix E. Responses to Minimal Graphemic Units (Reading-Speaking)

Notes:

The criteria used for dividing words into letter groups, and annotating prompts and responses, were as follows.

i. Single letters were used wherever possible.
ii. Consonant or vowel sequences were listed as multi-grapheme units if some subjects pronounced them as a valid unit. This valid unit may have been a single consonant or vowel, or an affricate or diphthong. Vowel + nasal consonant were listed together if some subjects pronounced them as a nasal vowel. This does produces some variation in the treatment of the names, as some sequences are listed as units for one word but sequences for another (e.g. <en> in *Valençay* but <e>, <n> in *Schapen*), depending on how subjects treated them, but this is consistent with the overall scheme of division into the smallest practical units.
iii. Mute <e> was marked as (e), and the preceding vowel as V(e), if the pronunciation of V was potentially altered by the <e>, or as {e} and V{e} if the pronunciation of V should not be altered by the <e>. In the response to V, the response to (e) is listed in brackets, e.g. [i(ə)]. (The <e> in <Savigne> and <Laragne> was treated as part of a <gne> group, while <que> in <Manosque> was also treated as a group.)
iv. Other letters which were occasionally dropped, or whose pronunciation was affected by context, were not explicitly annotated.
v. Obviously metathesised segments in the responses, such as [ˈplˠe.ɪnt] for <Pelynt>, were marked with tilde, i.e. [lˠ~] and [e~].
vi. Unclear responses are marked as ?, and blank responses as =, while missing segments are marked with ^.

Insertions in the response were assigned to the adjacent segment to which they bore the closest relationship, or failing that, they were arbitrarily listed under the first. The data tables show the written prompt, and the number of occurrences, along with responses in IPA.

Single consonants

b	**4**
b	93
?	1
ɡ	1
pʰ	1

c	**5**
kʰ	66
k	18
s	17
x	4
ǂ	2
ʃ	2
^	1
´k	1
ʔ	1
ɹ~	1
c	1
kʲʰ	1
kʰː	1
qʌ	1
sx	1
t͡ʃʼ	1
z	1

d	**9**
d	184
ḍ	7
t	6
?	3
^	2
tʰ	2
=	1
!	1
bd	1
ḍː	1
d̟	1
də̆	1
dː	1
dɛəː	1
ɡ	1
k	1
n~	1
s~	1

f	**2**
f	46
f̬	1
fː	1

g	**4**
ɡ	94
d͡ʒ	1
ɡʷ	1

h	**1**
h	24

j	**2**
d͡ʒ	18
j	13
ʒ	6
i	4
^	3
d	1
ʃ	1
?	1
t͡ʃ	1

k	**5**
kʰ	98
k	8
^	3
?	3
ɛ~	2
ə~	1
f	1
k̬	1
kʰh	1
s	1
sk	1

l	**20**
lˠ	429
ɫ	24
?	7
=	3
lˠʼ	3
^	2
e~	2
t~	2
ɫ̩	1
ɪ~	1
lˠə	1
lˠː	1
lˠis	1
l̩ˠː	1
t	1
tʰ~ʌ̈	1

m	**8**
m	177
mʼ	6
^	1
=	1
ʌ͡i~	1
i~	1
məɾ	1
mː	1
mɪn	1
n	1
?	1

n	**23**
n	478
ŋ	20
^	16
?	5
nː	3
=	2
a~	2
kʰ~	2
s~	2
z~	2
t~s~	1
ʔ̥	1
ən	1
an	1
đ	1
d~	1
j~a	1
lˠ	1
lˠɔ	1
nʼd	1
n̆	1
nʔ	1
nə	1
no	1
nɔ̃ː	1
nv	1
nz	1
s	1
v	1
zɛn	1

p	**3**
pʰ	42
p	26
pʼ	1
pʼʰ	1
?	1
pʰet̚pʰ	1

r	**23**
ɹ	295
ɾ	215
^	8
ʁ	8
ɛ~	3
˞	2
ɹ̆	2
r	2
?	2
ɹ~n	1
ɥ	1
ɹˠ	1
ɹʷ	1
ɹ̣	1
ɹ̝	1
ɹː	1
ɹo	1
ɜ~	1
g~	1
i~	1
kʰ~	1
lˠ	1
pʰ~	1
s~	1

s	**23**
s	430
z	58
^	12
sː	11
ʃ	7
s̬	6
s̠	5
?	5
sʼ	3
=	2
çː	1
ɾ~	1
d~z	1
ĕ~	1
n	1
o~	1
s~h	1
ʃː	1
sːt	1
slˠ	1
stn̩ə	1
ʒ	1
ʒɔ	1

t	**10**
t	107
tʰ	103
^	7
s~	6
ʔ	3
?	3
t̪	2
tʰe	2
=	1
ɛ~lˠ~	1
a~	1
e~	1
tə	1
tʰʼ	1
tʰː	1

v	**9**
v	205
f	3
ṿ	2
β	1
?	1
f̬	1
vː	1
vi	1
w	1

w	**3**
w	52
v	17
fw	1
?	2

z	**3**
z	22
s	7
t͡s	7
t~	5
dz	4
n~	4
^	3
d̆z	3
d͡z	3
s̬	2
ʒ	2
=	1
~sː	1
ʔ~	1
ʔ͡s	1
an~	1
ɛ~	1
t͡sː	1
ts	1
tz	1
?	1

ç	**1**
s	18
t͡ʃ	2
kʰ	1
kʰː	1
skʲ	1
ts	1

Consonant groups

bb	**1**
b	23
bː	1

ch	**2**
kʰ	16
x	8
t͡ʃ	7
k	4
ʃ	4
ɧ	2
ʔ͡ʃ	2
kʼ	2
?	1
ʃɛ	1
xː	1

ck	**1**
k	23
kʼ	1

dg	**1**
dg	21
?	2
d͡ʒ	1

dh	**1**
d	18
^	1
ð	1
dʼ	1
?	1
dh	1
s~	1

kh	**2**
kʰ	13
x	10
k	4
kh	4
kʰa	3
^	2
?	2
a~	1
cʰw	1
k̆x	1
ka	1
kɛ	1
kːʰ	1
kːʰt̚	1
kʰhʲ	1
ŋ~	1
ŋk	1

kk	**1**
kʰ	21
kːʰ	1
kʰːj	1
x	1

kv	**1**
kv	9
kf	2
kʰɛv	2
v	2
k̆v	1
kʰav	1
kʰev	1
kʰɛvɹ	1
kʰɛvː	1
?	1
kʰib	1
knɥ	1
ṿ	1

ll	**4**
lˠ	86
ɫ	3
lˠˑ	2
lˠː	2
lˠi	1
lˠj	1
lˠn	1

pf	**1**
f	8
p͡f	7
ʔ͡f	2
=	1
?	1
pʰ	1
pʰəf	1
pʰəv	1
pʰɪʔf	1
pʰɪ~	1

pp	**1**
pʰ	21
ɹ~	1
p	1
pʰˑ	1

ps	**1**
s	7
p͡s	5
pʰa~	3
?	1
p͡ss	1
p͡st	1
pʰ	1
pʰəs	1
pʰas	1
plˠas	1
pʊs	1
sː	1

rr	**1**
ɾ	19
ɹ	5

sch	**2**
ʃ	32
s	3
sk	2
sˑk	1
ʃɹ	1
ʃə	1
sə	1
sc	1
ʃɪpːt͡ʃ	1
skr	1
sl&	1
?	1
ʃt͡ʃ	1
t͡ʃ	1

sj	**1**
sd͡ʒ	5
?	3
s̱j	2
sj	2
zd͡ʒ	2
^	1
k~o~d͡ʒ	1
ʃ	1
ʃˑ	1
ʂd͡ʒ	1
sʃ	1
sx	1
z	1
zj	1
zs̱	1

ss	**1**
s	19
z	4
sː	1

ts	**1**
s	7
t͡s	3
tʰa~	3
tʰ	2
tʰs	2
ʔs	1
tʰə~z	1
tʰəs	1
tʰəz	1
tʰa~z	1
tʰe~	1
ts	1

tt	**2**
tʰ	44
lˠ~	1
lˠ~t	1
t̪ʰ	1
tʰː	1

tz	**1**
t͡s	20
^	1
tʰ	1
tsə	1
tst	1

Single vowels

a	**33**
a	401
ə	88
ɑ	49
a̠	40
ä	34
ʌ̈	32
ʌ	25
ɔ	24
^	15
ɑ̈	11
e	10
ɛ	6
ä̠	5
æ	5
a̹	4
s~	4
=	3
?	3
aʔ	2
ɛ̈	2
ɪ	2
i	2
ɔ̃	2
z~	2
~	1
əs	1
ʌ̹	1
ɑˑ	1
ɑ̃	1
ä̠	1
aː	1
alˠ	1
anʌ	1
ɛɹ	1
e̞	1
ɛː	1
g~	1
k~	1
lˠ~	1
n~	1
ɔ~	1
ɔ͡ə	1
ɔ̈	1
ɔlˠ	1
ʃ~	1

å	**1**
a	19
e	4
n~	1

e	**13**
ɛ	167
ə	54
e	37
ɪ	9
ɛ̈	7
ɜ	6
i	5
?	5
ɛ̝	4
^	3
a	3
e̞	3
lʸ~	2
=	1
ɹ~	1
ɛ̆	1
ɛɹ	1
ɛ̱	1
ɛlʸ	1
e̝	1

i	**13**
i	168
ɪ	78
ə	15
^	10
a	6
ʌ͡i	5
ɛ	4
e	4
a͡e	3
=	2
m~	2
o	2
ɹ~	1
ə̟	1
ʌ̟	1
ʌ̈	1
ɜ	1
ã	1
ä̱	1
f~	1
ɪ̈	1
?	1
ï	1
iä̱	1
ɔ̃	1

o	**23**
ɔ	243
o	214
ə	33
ɔ̈	7
ɔ̝	5
ʊ	5
?	4
^	3
ʌ̈	3
ʉ	3
o̞	3
ö	3
ʊ̈	3
=	2
ɜ	2
a	2
ɛ	2
əʔə	1
ə̜	1
ä~	1
d͡zo	1
ɪ	1
ɪ̆	1
iɔ	1
n	1
nio	1
ɔ'	1
õ	1
ɔ̜	1
oɛ	1
s~	1
ʊ̆	1

ö	**2**
o	23
ɔ	19
ʉ	2
ø̱	1
u	1
?	1
ɔe	1

u	**4**
ʉ	33
ʌ	26
ə	12
ʊ	4
?	4
ʌ̈	2
ʉː	2
ɔ	2
o	2
u	2
=	1
ʉ̆	1
ʉ̈	1
ɔ̃	1
ɔ̟	1
ʊ̱	1
y̱	1

y	**3**
i	29
ɪ	16
e	15
ɛ	2
?	2
^	1
ʉ	1
e̝	1
i̞	1
ia	1
iɪ	1
n~	1
o	1

Vowel groups

au	**1**
ʌ͡ʊ	12
o	5
ʉ	4
ʌu	1
?	1
o͡ʊ	1

ay	**1**
e	23
ea̱	1

ey	1
e	14
ɛ	5
ɛː	1
eː	1
ɛhiə	1
ei	1
ɔe	1

oa	1
o	11
oa	5
wa	2
əɾa	1
a	1
oa̠	1
?	1
ona	1
ʊa	1

ou	2
ʉ	27
u	5
ɔ	4
ʌ͡ʊ	3
o	2
^	1
ə	1
ʌ͡u	1
au	1
?	1
ʉ̈	1
ʊ	1

ui	1
i	9
wi	7
ʉ	2
ə	1
ʌ͡i	1
ɛ̈lʸtɛ	1
lʸɔ	1
ʊ	1
wʲi	1

Vowel + mute (e)

a(e)	3
a(ə)	19
a(^)	13
a(e)	5
e(^)	5
a(ɛ)	4
ɛ(ɛ)	3
a̠(ɛ)	2
ɛ(^)	2
æ(ə)	2
?	2
^(ɛ)	1
^(o)	1
^(^)	1
^(ɔ)	1
ə(ɜ)	1
ə(a)	1
ɑ(^)	1
a(ɜ)	1
a(ä)	1
ɑ(e)	1
a(ɪ)	1
a(i)	1
a̟(ə)	1
e(ə)	1
ha(^)	1

e(e)	3
ɛ(^)	29
i(^)	17
e(ə)	7
ɛ(e)	3
e(e)	3
e(^)	2
ɹ~(^)	1
ɹ~(i)	1
ɛˑ(^)	1
e(ʌ̈)	1
ɛ(ɛ)	1
e(ɛʔ)	1
ɛ(e̞)	1
ɛ(i)	1
ɛ̃ː(^)	1
i(ə)	1
i̡(^)	1

å(e)	1
a(ɛ)	8
a(^)	4
a(ə)	2
a(e)	2
?	1
=(=)	1
a(ɛf)	1
a(ɪ)	1
a(i)	1
a̠(ɛ)	1
e(ɛ)	1
ʊ(^)	1

Mute (e)

(e)	7
^	80
ə	33
ɛ	22
e	14
i	4
ɜ	2
ɪ	2
?	2
=	1
ʌ̈	1
a	1
ä	1
ɛʔ	1
e̞	1
ɛf	1
ɔ	1
o	1

Vowel + mute {e}

ah{e}	1
a{^}	4
e{^}	4
ah{^}	2
e{ə}	2
?	2
a͡e{œ}	1
aˑʔ{^}	1
a{ə}	1
a{i}	1
a̠ː{^}	1
aː{^}	1
ah{a}	1
ah{ɛ}	1
ah{e}	1
eː{^}	1

ai{e}	1
ɛ{^}	9
e{^}	8
ɛ̞{^}	3
ɛ{ə}	2
?	1
ɛ{e}	1

au{e}	1
ɔ{^}	12
ʌ͡ʊ{^}	2
?	2
a{ʉ~}	1
a͡u{^}	1
ʌ͡ʊ{ə}	1
ʌ͡ʊ{o}	1
ʌʊ{e}	1
ɑ{^}	1
ɔ{ə}	1
ʊ{ə}	1

e{e}	**5**
ɛ{^}	23
ɛ{ə}	22
ɛ{ɛ}	16
ɛ{e}	15
ɛ{i}	5
i{^}	4
?	4
ɜ{^}	3
e{ə}	2
ɛ{ĕ}	2
i{ə}	2
^{z~}	1
a{s~}	1
ɛ{ɪ~}	1
ɛ{n~}	1
ə{ɛ}	1
ɜ{ɛ}	1
ɜ{e}	1
ɜ{ɛ̈}	1
a̱{eː}	1
ɛ{ən}	1
ɛ{ɪ}	1
e{i}	1
ɛ{iː}	1
ɛ{s}	1
ɛ̱{ɛ}	1
ɛː{ə}	1
i{e}	1
ɪ{ɔ}	1
i̩{e̩}	1
ilʏə{e}	1
ɔ̃{e}	1
ɔ{i}	1

i{e}	**1**
ɪ{^}	10
ɪ{ə}	7
i{^}	3
a͡e{^}	1
ʌ͡i{^}	1
ɪ{ʌ̈}	1
lʏː~{i}	1

o{e}	**1**
ɔ{ɛ}	11
ɔ{ɛ̩}	2
ɔ{i}	2
?	1
ɔ{ňj~e}	1
ɔ{s~}	1
ɔ{sː~}	1
^{ɛ}	1
ɔ{ə}	1
ɔ{e}	1
ɔ{ɛd}	1
ɔ{ɪ}	1

Mute {e}

{e}	**10**
^	98
ə	43
ɛ	32
e	23
i	11
?	4
ĕ	2
ʉ~	2
ɛ̩	2
ɪ	2
s~	2
œ	1
ɹ~	1
ən	1
ʌ̈	1
a	1
e̩	1
ɛ̈	1
ɛd	1
eː	1
ɪ~	1
ɪ̈	1
iː	1
ňj~e	1
n~	1
ɔ	1
o	1
s	1
sː~	1
z~	1

Consonant(s) + vowel(s)

que	**1**
k	11
kʰ	3
ke	2
kwə	2
ǂ	1
k̚	1
kə	1
ki	1
kjʉ̈	1
ko	1

gne	**2**
njə	10
n	5
^	3
gni	3
ʒ	3
?	3
ɲ	2
nə	2
ŋnjə	2
ɹ~ne	1
dd͡ʒə~n~	1
n~d͡ʒ~e	1
ɲe	1
a~n	1
ge~n~	1
geɛ~n~	1
gnə̆	1
gnʌ̈	1
gne	1
ŋ	1
nd͡ʒe	1
nd͡ʒë	1
ni	1
nje	1

ti	**1**
tʰi	10
ʃ	4
tʰ	4
ʃi	2
=	1
t͡ʃj	1
t̪ʰi	1
tʰj	1

Vowel + consonant(s)

en	**2**
ən	18
ɛn	17
ɔ̃	2
əŋ	1
ɑ̃	1
a̱n	1
ɛ	1
e	1
ë	1
en	1
ɛnt̚	1
ɪ̩n	1
jən	1
?	1

yl	**1**
ɪlʏ	9
^	6
t~	2
ɫ̩	1
ə	1
ʌ͡i	1
ʌ͡ilʏ	1
a	1
?	1
lʏ~ɪ~	1

yng	**1**
ɪnd͡ʒ	5
ɪŋg	4
ɪng	3
ɪŋ	2
ʌɪŋ	1
ãʒ	1
eʒ	1
ɪd͡ʒ	1
ɪg	1
iŋg	1
ɪnɪg'	1
ɪnʒ	1
iʒ	1
yʒ	1

Appendix F. Publications

This appendix contains copies of the following publications:

Schmidt, Mark, Fitt, Susan, Scott, Christina, and Jack, Mervin (1993). Phonetic transcription standards for European names (ONOMASTICA). *Proceedings: Eurospeech 93,* Vol. 1, pp. 279-82. Paris.

Fitt, Susan (1995). The pronunciation of unfamiliar native and non-native town names. *Proceedings: Eurospeech 95,* Vol. 3, pp. 2227-30. Madrid.

Fitt, Susan (forthcoming). Spelling unfamiliar names. *Proceedings: ICOS 96*. Aberdeen.

PHONETIC TRANSCRIPTION STANDARDS FOR EUROPEAN NAMES (ONOMASTICA)

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ABSTRACT

This paper details the standards identified for phonetic transcription of names as part of the ONOMASTICA project, a European-wide research initiative for the construction of a multi-language pronunciation lexicon of proper names. The main design criteria adopted by the consortium for the development of this multi-language pronunciation dictionary are discussed, including aspects such as phonetic transcription standards, definitions of quality, quality control mechanisms and language specific details concerning phonetic transcription and the annotation of the language of origin.

Keywords: Multi-language dictionary of proper names; phonetic transcription standards; quality control.

1. THE ONOMASTICA PROJECT

The ONOMASTICA project was established as part of the 'European Commission Framework Programme - Linguistic Research and Engineering'. It seeks to create a set of pronunciation lexicons of European names, including city and town names, street names, family names, company and product names in a machine assisted fashion where expert phoneticians carry out editorial preparation of the project lexicon using customized software.

A total of nine languages of the European Community are covered in the project which include: Danish, Dutch, English, French, German, Greek, Italian, Portuguese and Spanish. The project thus has nine partners preparing the lexica for their respective languages from names data files provided by their associated telephone company.

The goal over the 2-year project is to derive pronunciation dictionaries for up to 1,000,000 names per language in a semi-automatic way and to investigate the problems of exchanging national names amongst the partners to create a matrix of 'nativised' pronunciations for each (thereby) foreign name in each other language.

1.1 OBJECTIVES AND EXPECTED IMPACT

The non-availability of large pronunciation dictionaries of names continues to impede the development of many applications in speech technology. In particular, the acceptability of applications where speech output systems provide spoken feedback depends heavily on the capability of producing correct, or at least acceptable, pronunciations for names of various categories.

The objective of the project is to make available, for widescale exploitation, quality controlled pronunciation lexicons in machine readable form (CD-ROM) for use in automatic language systems and of primary interest to international European companies in the telecommunications sector and in the European dictionary publishing industry. In particular, the multi-lingual dictionaries produced on this project will benefit products in the following sectors:

- Telecommunications: automated directory enquiry systems, reverse directory enquiry systems, catalogue ordering systems, telephone banking, automated credit card authorization, enhanced talking newspapers and books for the blind etc.
- Consumer sector: Map information and guidance systems, talking dictionaries and courseware systems for pronunciation teaching.
- Publishing: hard-copy as well as electronic dictionaries containing pronunciation fields.

2. SCIENTIFIC APPROACH

The conversion from an orthographic to a phonetic representation of a name in an automatic system can be achieved either by **dictionary** or by **rule**. The project aims to compile electronic dictionaries for names using machine assistance in the form of rule-based generation of name pronunciations as raw materials for expert phoneticians to edit as entries to the dictionary.

Although the main objective of the project is to provide a lexicon of names, one of its major goals is to develop an optimal set of grapheme-to-phoneme rules which function as an accelerator to human editing. The emphasis that is placed on human editing and automatic conversion by rule is expected to vary in different languages in the project because of obvious differences in the reliability of grapheme-to phoneme correspondences for different languages.

Historically, the development of rules for run time application has been preferred ([3],[5]), due to the capability of rules of treating unseen names, but the widespread availability of optical disk technology has greatly increased the feasibility of storing large dictionaries which could guarantee the correct automatic pronunciation of the vast majority of names in a national telephone directory if every person's name together with its phonetic representation were listed.

Furthermore, adopting the rule-based approach as the only method has its limitations due to the complexity of specifying grapheme-to-phoneme rules for names which can be very different from those of the general language. It is a well established fact ([1],[6]) that grapheme-to-phoneme correspondences are different for names with different languages of origin, and it is also debatable whether the phonological systems of names are exactly equivalent to the phonological systems of those languages. The nature of the problem comes partly from the mobility of names, because names move with people and tend to surface in a language without passing through the slow linguistic process of borrowing and subsequent modification. Their anomalous pronunciations often fossilise and result in pronunciation difficulties for both man and machine.

3. CROSS-LANGUAGE PHONETIC CRITERIA

This section describes the standards agreed to by the consortium with respect to:

- Phonetic standards
- Quality specifications for lexicon entries

3.1 PHONETIC STANDARDS

3.1.1 Phonetic alphabets

The final version of the lexicon will contain transcriptions coded as unique IPA numerical reference numbers as described in [2].

3.1.2 The level of transcription

The central purpose of the lexica is the provision of simple, comprehensible transcriptions which allow native as well as non-native speakers to produce adequate and natural pronunciations of names. Furthermore, the transcriptions should be usable (either directly or indirectly) as input for speech synthesis systems and/or as lexica in speech recognition applications.

Therefore, the level of transcription that has been agreed to be the most profitable for these purposes is a **broad phonetic** level. At this level very fine phonetic detail such as degrees of voicing in oral stops, degrees of aspiration in voiceless stops or assimilated vowel nasalization etc. are not transcribed. Important allophonic contrasts however, such as word final devoicing in German or clear and velarized /l/ in English as well as the contextually conditioned realization of the voiceless velar fricative in Greek and German ([x] before back vowels and [ç] before front vowels) are transcribed. For native speakers fine phonetic as well as allophonic contrasts are superfluous in a transcription due to their knowledge of the language. For non-native speakers fine phonetic detail adds unnecessary complications, whereas important allophonic contrasts are necessary in order to make adequate pronunciations.

3.1.3 Annotation of stress and syllabification

Lexical stress is marked on names which contain more than one syllable and phrasal stress is marked on compound names. Monosyllabic names are unmarked. Two levels of stress, primary and secondary, are marked by diacritic before the stressed syllable. Possible stress shift (in English) is also marked.

Syllabification and word boundaries are marked, following the principle of maximal syllable onset unless morphological considerations override this principle (see Section 4 for examples from English).

3.2 QUALITY SPECIFICATIONS

Each transcription in the ONOMASTICA database is assigned one of three quality bands, with Band I being the highest, enabling the user of the lexicon to determine the reliability of the pronunciation (See section 3.2.1 below for pronunciation verification for English Band I.)

An initial goal of the project is to create a hand-transcribed set of 50,000 quality Band I names to be used as a basis for rules development and testing. To allow for maximum coverage this 'golden set' of high quality transcriptions will contain the most frequently occurring names. Transcriptions for the remaining names will subsequently be produced by rule, placing them in quality Band III. Quality Band III names will be checked and edited where necessary by hand and promoted to Bands I and II.

3.2.1 Verification of pronunciations (English)

It is an aim of the project to produce pronunciations which are not only acceptable to a native listener but also as far as possible to the owner of a name. For example, for English all pronunciations given a quality Band I are defined as being acceptable to the owners of the names. Many names in the set of English names provided by BT Laboratories will be familiar to the phonetician or can easily be checked in existing dictionaries, and pronunciations can immediately be verified or edited and assigned quality Band I. However, there is a significant number of names for which the pronunciation will not be known or for which there is an element of doubt or a possibility of alternative pronunciations. In order to provide acceptable pronunciations and so increase the number of quality Band I names in the database, various quality control procedures are being adopted.

One procedure is to contact the owners of names by telephone to confirm pronunciations. Contact telephone numbers are obtained from the BT 'Phone Disk' which operates on a PC. This enables the researcher to search for names with no need to specify an address or even a region. This is particularly useful for finding the owners of very unusual names which may occur only once and could be anywhere in the country.

Secondly, British schools and ethnic community groups are being invited to collaborate in the project. Teachers and community leaders are requested to provide information about unusual or commonly mispronounced names. Participants provide written annotations of such names by use of rhyming or reference to common words or parts of words to describe the pronunciation. Through this device large quantities of data containing unusual names, particularly foreign names, including information about their language of origin could become available.

Finally, through the placement of advertisements and articles about ONOMASTICA in national newspapers, members of the public are being invited to submit details of their own unusual names.

4. WORKING PRACTICES

Working practices have been agreed for use of the project and are described here with specific reference to English.

4.1 Multiple word entries

Multiple-word entries are included in the database and are transcribed in full, with the exception of recurring, predictable elements such as street name types (see section 4.2.2 below). This approach enables more accurate transcriptions to be given for certain names, such as 'Rowley', which is pronounced [ˈrou.li] in all cases except for the town 'Rowley Regis', which is [ˌrau.li ˈriː.dʒɪs].

4.2 Stress

4.2.1 Phrasal stress

A single polysyllabic name can have both primary and secondary stress markers. However, in the case of multiple-word names a maximum of one stress per word is assigned, with only one primary stress which functions as a phrasal stress marker, for example 'Elim Pentecostal Church', which is transcribed as [ˌiː.lɪm pɛn.tɪˌkɒ.stɫ ˈtʃɜːtʃ].

4.2.2 Stress shift

For English, both primary and secondary stress are marked. Additionally, stress shift is marked on certain words, which enables more accurate prediction of stress in phrases. An example is 'Aberdeen', which in isolation is pronounced [ˌæ.bəˈdiːn], but is subject to stress shift when it precedes words taking primary phrasal stress, such as 'road'. In these contexts the main word stress shifts from the last to the first syllable, giving [ˌæ.bə.diːn ˈroud] rather than [æ.bəˌdiːn ˈroud]. 'Carlisle', on the other hand, is not subject to stress shift and would give [kɑːˌlaɪɫ ˌroud]. Since 'road', 'crescent' and so on are common elements in street names it is obviously more efficient to have a separate dictionary for these, to mark stress shift on individual lexical entries and to produce the combinations by rule, rather than having multiple-word entries.

4.3 SYLLABIFICATION

Many different methods of syllabification are possible and no one system is wholly satisfactory on all criteria - phonological, morphological, acoustic, and articulatory. For syllabification of English transcriptions in this work, the principle of maximal onset is being used for simplicity, so that consonant clusters are treated as syllable initial if they are permissible clusters at word beginnings. 'Mostyn' is therefore transcribed as ['mɒ.stɪn] rather than ['mɒs.tɪn] or ['mɒst.ɪn]. However, this may be overridden by morphological considerations to give more intuitive syllabification, so that 'Foxcroft' is transcribed as ['fɒks,krɒft] rather than ['fɒk,skrɒft].

4.4 Multiple pronunciations

Approximately 10% of the names transcribed so far have multiple pronunciations. All known possible pronunciations are entered within the criteria outlined above (for example differences due to surface phonetic realisations are not transcribed). The customized software used in the production of transcriptions enables the specification of information relating to category, language of origin and miscellaneous annotations. The following comments can be linked to specific pronunciations.

4.4.1 Category markers

In some cases two pronunciations differ in category, and so marking the category will aid the eventual user of the lexicon. For example, 'Clavering' as a surname is ['klæ.və.riŋ], whereas the town of the same name is ['kleɪ.və.riŋ].

4.4.2 Miscellaneous annotations

Sometimes pronunciations are annotated with respect to particular referents, for example the town 'Blean' in Kent is pronounced [blin], whereas 'Blean' in North Yorkshire is pronounced [bleɪn]. Another example is the surname 'Lamont', which has two different pronunciations, ['læ.mənt], which is the usual Scottish pronunciation, and [lə'mɒnt], which is used in Northern Ireland and is also used by the British politician Norman Lamont; this information is included as cross-indexed annotations in the lexicon.

4.4.3 Local variants

Pronunciations in accents of English other than RP are not transcribed, as this is outside the scope and aims of the project. However, where a local variant is markedly different in an unsystematic and unpredictable way, this is transcribed, for example [hʌn'stæn.tən], but there is also a local variant ['hʌn.stən] which is included in the lexicon and annotated as a local pronunciation.

5. CONCLUSIONS

The pursuit of onomastic research on a European scale permits novel cross language research concerning the pronunciation of names as well as the identification of languages of origin. The project is currently assembling a database of city and town names from non-border regions in each country, in order to train an n-gram based language identification system. This system allows the application of language dependent rule-sets for grapheme-to-phoneme conversion. The identification of non European languages is also part of this study, due to the large amount of non European names found in the telephone directories.

The project, in its later stages, will also see the exchange of the most common names in each language amongst all the partners, in order to construct a matrix of names pronunciations. This will be particularly interesting for the study of processes of nativization particularly with respect to the adaptation of 'foreign' graphemic or phonemic sequences to the language in question. This will be approached from two angles, firstly from the point of view of the native speaker of a language, and secondly, from the point of view of the adaptations that carriers of foreign names (or their descendants) make in order to assimilate the pronunciations of their names to a particular language.

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THE PRONUNCIATION OF UNFAMILIAR NATIVE AND NON-NATIVE TOWN NAMES

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ABSTRACT

This paper will discuss pronunciations of unfamiliar names, both British and foreign, by native speakers of English. Most studies which look at peoples' pronunciations of unfamiliar or pseudowords are based on English word-patterns, rather than a cross-language selection, while algorithms for determining the pronunciation of names from a variety of languages do not necessarily tell us how real people behave in such a situation. This paper shows that subjects may use different systems or sub-systems of rules to pronounce unknown names which they perceive to be non-native. If we wish to model human behaviour in novel word pronunciation, we need to take into account the fact that, while native speakers are not experts in all foreign languages, neither are they linguistically naive.

8.5.1. INTRODUCTION

As part of a study of the nativisation of names, an experiment was carried out which required subjects to pronounce unfamiliar European town names, presented either aurally or visually.

It had been found in pilot tests that native speakers of English varied their pronunciations according to the perceived language of origin of the name. For example, the invented written surname <Batin> was generally read aloud as [ˈba.tɪn] when presented as an English name, but [ba.tɛ̃] when presented as French, though some names appeared to more amenable to manipulation than others. For the current experiment subjects were therefore asked to record which country they thought the town belonged to.

8.5.2. METHOD

Seventy town names were chosen from Britain, France, Germany, Greece, Italy and Norway, with 52 names to be studied and 18 fillers (some of these were familiar to the subjects). Where data from the filler names is of interest, this will be noted in the discussion. Morphologically transparent names were avoided, particularly among the more familiar languages, as their origins would have been too obvious, and they might have led to a larger than usual degree of pronunciation by analogy [3].

For written presentation, spellings from [6] were used; this determined, amongst other things, the transliteration of Greek [x] as <kh> rather than <ch>. For aural presentation, taped prompts were then made of the names. This was carried out by a single speaker, to reduce variation in pronunciation due to speaker characteristics rather than the characteristics of the names. Additionally, using different speakers would have made the language of origin of each name too obvious. As the subjects were to be Scottish, a phonetician from the East Coast of Scotland produced the prompts, so for the British towns the subjects would be expected to reproduce a local accent. (Where 'English' and 'non-English' are used to describe features of the prompts or the subjects' speech, it is important to remember that this refers to an accent of English with certain important differences from RP, such as the use of post-vocalic /r/ and the phoneme /x/). For the other town names in the experiment, the prompts were checked for acceptability in the native languages.

Ten native speakers of English (all from the Edinburgh area) read the names onto tape: five subjects repeated the names from the taped prompts, and five read them aloud from text. Subjects were not given any instructions as to the way they should pronounce the names, as the intention was to record their natural pronunciations. The answers were given in the sentence frame "Town is in Country", so as to record the subjects' linguistic judgements about the origin of the names, the English language context encouraging the subjects to nativise the names. Answers were chosen from a closed set of the six countries in the experiment.

8.5.3. RESULTS

Phonetic transcriptions were made of the results, and these were compared to the original prompts.

3.1. Phones and phonemes

There was some conflict between attempts to use foreign segments or foreign grapheme-to-phoneme correspondences, and nativisation processes.

3.1.1. Written prompts

Very few non-English segments were produced by the subjects in response to written prompts. The only clear examples were [ʁ] and [œ] in two instances of <Rötz> (Germany, [ʁots] and [ɹœts] respectively). The only other examples which could potentially be

Oral stops		
p	Dieppe	2
t	Tallard	1
t	Toucy	4
	Toulouse	

Fricatives		
ʀ	Rötz	1
ʀ	Auxerre	1
ʀ	Laragne	1

Primary vowels		
u	Norddal	4
u	Karousadhes	4

Secondary vowels		
œ	Rötz	1

Nasal vowels		
ɔ̃	Valençay	1

Figure 1. Foreign phones reproduced by subjects from aural prompts, with numbers of occurrences.

classified as non-English segments are of doubtful segmental status, such as [ts] in 'Rötz' or 'Tsamandas' (Greece). Even if they were classified as affricates in their native languages, which is by no means uncontentious, it would be difficult to ascertain whether an individual response was intended by the speaker to be an affricate. If both parts of a potential affricate exist in English, they should not present any problems in combination unless that particular sequence either does not occur at all, or only occurs in certain environments.

There was evidence of awareness of different grapheme-to-phoneme correspondences in foreign languages, such as <W>→[v] for <Wolznach> (Germany) and <J>→[j] for <Jaren> (Norway). It should be noted, however, that all five subjects placed 'Jaren' in Germany, so it cannot be determined whether or not they are aware that the same correspondence holds for Norwegian. This example illustrates the importance of recording the perceived language of origin of the names. Interestingly, the pronunciation [j] was only used once for <j> in <Bolkesjö>, (which all the subjects correctly assigned to Norway) and twice for [j] in <Evje> (assigned to various countries). (In the other responses it was pronunced as [dʒ], [ʒ], or omitted). More data would be needed to determine whether it was the language of origin or the word-position which determined the subjects' pronunciations.

There was also some overgeneralisation of features of familiar foreign languages to unfamiliar ones, as in two instances of [tʰ] rather than [θ] for <Th> in <Thessaloniki>; one subject thought the town was Norwegian and another Greek, suggesting that they were not consciously applying German or French pronunciation rules. Both these subjects spoke German but no other foreign languages. (This town was in fact a filler, but turned out to be unfamiliar to most subjects.)

3.1.2. Spoken prompts

The prompts (including the filler towns) contained 61

	Non-native		Non-native		Country
#dj/	dj̣ɛp	✓	**Di**eppe	✗	France
#kv	ˋ**kv**æ'.ɳe's	✓	**Kv**ernes	✓	Norway
#pf	'p͡finʦ.tʰa̠ːl	✓	**Pf**inztal	✓	Germany
#ps	p͡sa'xna	✓	**Ps**akhna	✓	Greece
#ʃt	'ʃtɛ.la̠ʊ	✓	**St**ellau	✗	Germany
#ʃv	'ʃvɛŋ.kʰə	✓	**Schw**enke	✓	Germany
#ts	ʦa.man'das̠	✓	**Ts**amandas	✓	Greece
bj/_	'bɔ**b.bj**o	✓	Bob**bi**o	✗	Italy
bb	'bɔ**b.b**jo	✓	Bo**bb**io	✗	Italy
pp	kop'pa.ɾo	✓	Co**pp**aro	✗	Italy
ʃʃ	'peʃ.ʃa	✓	Pe**sci**a	✗	Italy

Figure 2. Non-native sequences in the prompts (# represents a word-boundary).

foreign sounds, giving 205 potential foreign sounds for 5 subjects. In fact, subjects repeated just 14 of these, shown in Figure 1.

Some of the sound changes made are of interest as they do not follow the usual principle of change to the nearest native sound (though, it should be noted, "neither the speaker himself nor the linguist who studies his behavior is always certain as to just what sound in his native tongue is most nearly related to the model." [4], p. 215). For some of the more familiar filler names, some subjects appeared to be using English versions of the names rather than nativised versions of the prompts - all subjects produced ['ɔz.ɫo] for [ˇus.lu] ('Oslo'), and one, after some hesitation, gave [mɪ'lan] for [mi'la.no] ('Milan').

A few errors could be attributed to perceptual confusion, such as two instances of [f] for [θ] in 'Thessaloniki' and [ð] for [l] in 'Loano'. This analysis is supported by a parallel experiment in which subjects were asked to write the names on the tape, rather than repeat them aloud; here, 4 out of 5 subjects wrote <F> rather than <Th> in 'Thessaloniki' and 3 gave <D> rather than <L> in 'Loano'. These particular prompts may not have been as clear as others, leading to a high number of errors; also, being word-initial there were fewer perceptual cues than in word-medial cases.

3.2. Phonotactics

There are a number of possible analyses according to whether certain features are classed as segmental or sequential. For example, [ʁ] in 'Bremen' (['bʁe.mən]) might be analysed as a non-native segment, part of a non-native sequence, or both. For this discussion, only sequences which contain native sounds in non-native combinations are examined. As in the analysis above, sounds which could be analysed either as segments or sequences, such as the Italian long consonants, are taken to be sequences. Non-native graphemic sequences are not included in the analysis here unless they represent non-native phonetic sequences. There are 11 relevant sequences, given in Figure 2.

Categorisation of written sequences as native or non-native is not always straightforward; as some graphemic sequences may occur in English but only rarely, or in loanwords; in Figure 2, sequences have been marked as non-native if they occur only in loanwords, for example word-initial <Ps>.

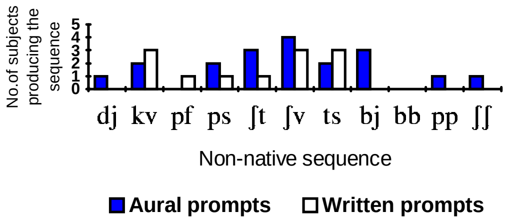

Figure 3. Non-native sequences produced by subjects.

Results for both experiments are shown in Figure 3. For both written and spoken prompts, more of the initial non-native sequences were produced than the Italian long consonants. More data would be needed to see whether this were due to the subjects' lack of knowledge of Italian, the low salience of these sequences, the structure of English, or another reason.

3.2.1. Written prompts

It had been expected that non-English phonotactics would not be used except where the sequence was familiar, as in the case of word-initial [ʃt] for subjects who knew some German. However, for all the names with non-English consonant clusters some subjects did produce the clusters correctly. Additionally, some subjects produced non-English clusters where they were not required, presumably by analogy with foreign languages they were familiar with, as in the pronunciation [#ʃn] rather than [#sn] for <Snåsa> in Norway. (The subject in this instance gave "Norway" for the country, which suggests he was not consciously attempting a German pronunciation.)

There were two instances of incorrect non-native sequences for <Schwenke>: [#sv] and [#ʃw]. As there are four consonants in a row, for which the only likely native pronunciations would be [sw] (which does not take into account the <ch>) or [#skw], from <#sch>/_V→[#sk], (which only applies before a vowel), it is not surprising that all subjects produced a non-native sequence. Additionally, this is a relatively well-known German sequence. <Kvernes> also elicited an incorrect non-native sequence, of [#gv], possibly due to voicing assimilation.

Unsurprisingly, graphemic sequences present in English, from languages unknown to the subjects (French and Italian) did not elicit non-native phonetic sequences. This is a further reason for the lack of Italian long consonants in the responses.

3.2.2. Spoken prompts

Overall more non-native sequences were produced from spoken prompts than written prompts, though there is not enough data here to be conclusive. It is interesting to note, though, that errors were still made even where it might be expected that reproduction of the sequence would be simple. For example, [ʃv] and [ʃt] are common word-initial sequences in German, are well-known through loanwords, and are easy for an English speaker to pronounce. Yet, despite the fact that all of the 5 subjects in this experiment rated their knowledge of German as average, one produced [ʃw] (also a non-native cluster) for [ʃv], and two gave [st] for [ʃt].

3.2.3 Types of process

Although some non-native sequences were produced, typical nativisation processes were also in evidence in both experiments:

- omission of one segment, e.g. initial [t] in [səˈman.das]
- vowel epenthesis, e.g. [ə] in [kəˈvaɹ.nɛs]
- substitution of one segment to give a native sequence, e.g. [j] → [i] in [diˈɛpʰ]
- substitution of the sequence by a native segment, e.g. [dj] → [ʤ] in [ʤɛpʰ]

3.3 Stress

In general subjects in this experiment stressed the names as they would be stressed in their native languages (see Figure 4).

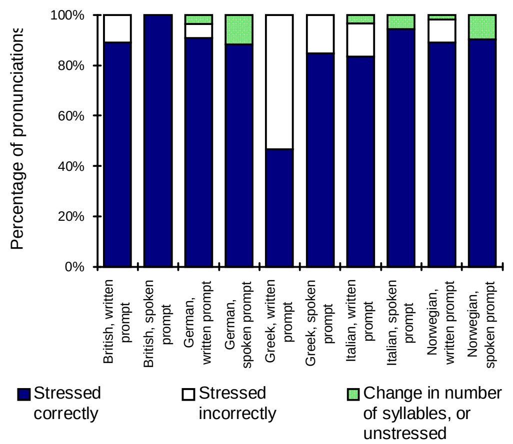

Figure 4. Multisyllabic towns stressed as in the language of origin - responses to written and spoken prompts (all towns included, but French omitted as it does not have lexical stress).

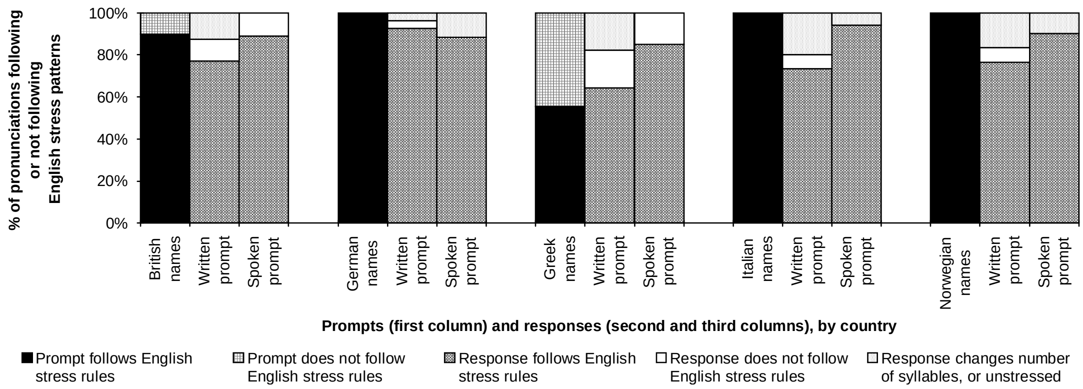

Figure 5. Percentage of names following English stress patterns (see [2]) in prompts and responses (all towns included).

3.3.1. Written prompts

Baker and Smith [1] found that subjects used a combination of rules and analogy with other English words to determine stress patterns in nonsense words, but in cases where the words are thought not to be English, and are all names, it cannot be assumed that such a strategy would apply. Figure 5 shows that the majority of prompts, despite coming from a variety of languages, in fact follow similar stress patterns to English nouns, and subjects seem to be using these rules in their stress assignment. There were some notable exceptions, such as <Sollom> (Britain), which 4 subjects incorrectly stressed on the second syllable. Interestingly, the only subject who stressed the first syllable was also the only one who classed it as British. Greek had the highest percentage of names which in the original were not stressed according to English stress rules (see [2]), and also incurred the most errors in responses to both written and spoken prompts (see Figure 4). The written prompt <Tsamandas> [tsa.manˈdas], for example, was stressed by all subjects on the heavy second syllable. (It should be noted, though, that Greek had the highest average syllable length, 3.22 compared to an overall average of 2.44, allowing for more error; it also appears to be more difficult to determine syllable weight from written prompts for longer names; this is a point for further research.) On the whole, towns which incurred the most disagreement across subjects did not have an obvious heavy/light syllable pattern in the written prompts, such as <Novoli> [ˈnɔ.vo.li] (Italy).

3.3.2. Spoken prompts

In the repetitions of spoken prompts, there were naturally fewer errors; there were 14 instances of changed syllable structure (for example, [ˈbɔb.bjo] → [ˈbɔ.bi.o]) but only 5 actual stress movements, both on Greek names. Three of these occurred on 'Korinthos', ([ˈkɔ.ɾin.θɔs̠] → [kʰɔˈrɪn.θɔs]) which was a potentially familiar filler name, though the English version 'Corinth' is also stressed on the first syllable, and two on 'Psakhna', [psaˈxna] → [ˈpsax.na]. Both of these were changed to conform to the English stress rule, but more data is needed to see how common this change is, and whether it is caused by difficulty of perception or production.

3.4. Tone

No attempt was made to produce Norwegian tones. For the written prompts, this feature may not be well-known enough to be produced spontaneously. Although obvious in the spoken prompts, it may be considered part of the language, like intonation, rather than belonging to the word itself, and therefore inappropriate in an English sentence.

8.5.4. CONCLUSIONS

The subjects were correct about language of origin 44% of the time (not including fillers). This is substantially better than random guessing, though nowhere near Vitale's 96% accuracy in automatic language identification of surnames, which is higher than humans can hope for due to the input of sophisticated specialist knowledge. (It should also be noted that Vitale's name-set were randomly selected, and so included names with common morphemes, which were omitted from this experiment.) More names need to be studied to isolate the particular orthographic features which led the subjects to their judgements. Although the subjects were not wholly accurate in their pronunciations, it has been shown that they did not always pronounce the names using English rules, even for languages they were unfamiliar with. They produced some non-English segments and consonant clusters, and used non-English grapheme-to-phoneme correspondences; these were used in some cases appropriately, but in others they were overgeneralised to languages in which they do not apply, suggesting that the native language is not always the default for pronouncing unknown words.

I would like to acknowledge the help of the staff and students of Queensferry High School.

8.5.5. REFERENCES

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SPELLING UNFAMILIAR NAMES

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Introduction

This paper will examine the written transcription of unfamiliar spoken names. It is well documented that the writing of personal and place names by people who are unfamiliar with the spelling of the name contributes to the evolution of names. The current paper describes a study which examines the processes involved, using experiments in which Scottish subjects are asked to write down unfamiliar spoken British and European town names.

Writing down unfamiliar spoken names, whether native or foreign, causes a number of problems. If, for example, making a map of an uncharted area, the written form may be based on the spoken form alone (though see Nicolaisen (1961) for a more in-depth approach to transcribing previously unrecorded place-names[1]). This problem can also occur when writing down people's names or addresses. Of course, the writer can often ask for the spelling, but if transcribing from, say, a recorded message this is not possible.

English has a notoriously variable relationship between pronunciation and spelling, so an unknown spoken name may be transcribed with a number of different spellings. Furthermore, there are a large number of names and name-elements which have more than one accepted orthography, so even familiar names can cause problems - we may know that a person's name is [ɹid], but not whether it is <Read>, <Reid> or some other variation.[3] If the name is foreign, it may contain sounds which have no obvious orthographic equivalent in English. Additionally, folk-etymology can play a part, adapting the unfamiliar to the familiar.

Mishearing is another difficulty, and with foreign-language names there is the further problem of non-native sounds, leading to either accurate perception followed by an attempt at spelling using either native or non-native graphemes, or perceptual categorisation in terms of native sounds, followed by a native-type spelling. We will see below that people do sometimes use non-native graphemes, and they may also use non-native sound-to-spelling correspondences.

Experiments

In order to see how people perform this task, experiments were designed, creating a controlled situation which reduced the number of variables that occur in the natural process. Sixty town names from six different countries were recorded onto tape by a Scottish phonetician, who produced the names as closely as possible to the pronunciations in each language of origin, with the British towns having Scottish pronunciations. Well-known towns were avoided, as were well-known name elements, such as *-land* or *-berg*. Twenty-seven subjects from Edinburgh, aged 14-16, were asked to write down each town name after hearing it twice, and also to choose the country of origin from a closed set of six (Britain, France, Germany, Greece, Italy and Norway).

Responses matching original orthography

In this study it is perhaps irrelevant to talk of 'correct' responses, since for a given spoken name there may be several perfectly legitimate spellings, but only one which is 'correct'.[2] In some cases there may even be more than one existing spelling, for instance Greek <kh> is often transliterated as <ch>. However, it is interesting to see the pattern of matching responses (see Figure 1). British towns have the greatest number of matching responses, but this is not especially high. Although most subjects knew either French or German, while none knew any of the other languages in the study, there were fewer 'correct' responses for France and Germany than for Greece and Italy. We could speculate that the relatively good performance on Greek and

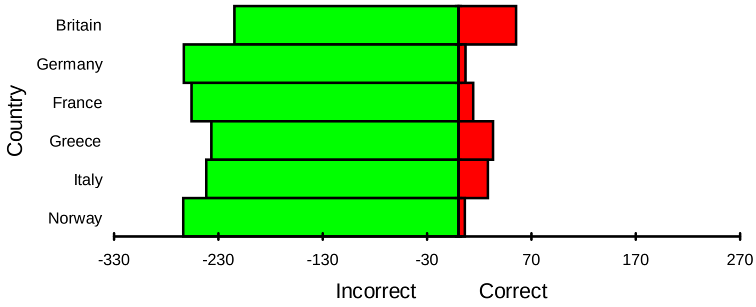

Figure 1: Summary of responses matching original orthography

Italian towns is due to a simpler vowel system, or to sound-to-spelling correspondences which match more closely the most common ones for English ([a] → <a> and so on), but further data would be necessary to investigate this. It should also be remembered that the towns were not selected randomly; with a random selection of unknown names, the score for British towns in particular would doubtless have been much higher as familiar morphemes such as *-field* would have appeared in the name set.

Legitimate spelling variation

In English, any orthographic vowel may represent schwa, though some do so more commonly than others. Sixteen schwas were present in the prompts, giving 432 responses. Thirteen represented original orthographic <e>, while 3 names had <o> in the original spelling. <e> was in fact the most common response (199) followed by <a> (69) and <i> (66). It is difficult to say whether the responses reflect a general correspondence of [ə] → <e>, in preference to [ə] → <a> and so on, as data of this kind is difficult to obtain. Schwa is particularly problematic, since many words with schwa have variants with either full vowels (such as *obey*) or syllabic consonants (such as *chasm*), so to determine the statistical likelihood of schwa representing <e> would require extensive speech data, rather than dictionary citations.

For other vowel sounds too there are numerous different orthographic representations (see Venezky 1970).[4] Spelling often varies according to position in the word, for example *Psakhna* ([psaxˈna], Greece). Both the vowels in the prompt were the same, yet whereas the first was unanimously transcribed <a>, while the second had 21 <a>'s but also 5 <ah>'s and 1 <as>. This was possibly an attempt to represent [a] in an open syllable, which does not occur in English, though the rest of the data does not show a clear pattern. (Final orthographic <a> is not especially uncommon in English words, though a large proportion of these are names such as *Clara*, suffixes such as *-phobia* or borrowed words such as *ikebana*. It might be worth examining whether people are aware of such differences between names and other words.)

Consonants may also have legitimate spelling variations. For instance, *Pfinztal*, *Velen* and so on were given single <l> by some subjects and double <l> by others. Explanations for some responses are more complex, such as *Meyssac* ([mɛ.sak], France), which was given 17 <s>'s and 10 <ss>'s. French does not have lexical stress, but if subjects heard the first syllable as stressed they should have written the [s] as <ss> (as in *lesser*), since intervocalic single <s> following a stressed short vowel is generally pronounced as [z], as in *closet*; however, if they thought the second syllable was stressed (a common interpretation of French words) the single <s> would be a valid spelling for [s], as in *aside*.

Folk-etymology

There are a number of examples of known morphemes being used to transcribe the names. For example, *Bredgar* (['bɹɛd.gaɹ], Britain) was given the spelling <Bred-> by 14 subjects, but <Bread-> by 8 subjects. Of course, it is difficult to say whether the subjects were spelling this word by direct analogy with the word *bread*, or by the use of spelling rules gleaned from a wide variety of words, which would allow [ɛ] → <e> (commonly), or [ɛ] → <ea> (less commonly).[5] However, for 14 [ɛ] prompts, giving 378 responses, there were 292 <e>'s while the only <ea>'s were the 8 responses for *Bredgar*, suggesting analogy with *bread*. It should be noted, though, that <ea> is used for [ɛ] disproportionately often in the environment preceding [d]. (Bredgar had the only [ɛd] sequence in the data.)

A number of instances of <-shire> appeared in the responses. *Bolkesjö* ([ˇbɔl.kə.ʃø], Norway) was given 6 <shire>'s despite containing a non-English vowel and no final [ɹ], as would appear in a Scots pronunciation of *-shire*. *Sollom* (['sɔ.lᵞəm], Britain) was, unsurprisingly, spelt <Solemn> by 6 subjects. Strangely, other subjects appear to have taken elements of *solemn*, with 4 using <-umn>, though final <mn> is relatively rare in English.

It can also be the case that people try to apply their knowledge of foreign languages in processing unknown foreign names. For example *Livorno* ([li'vor.no], Italy), was written by one subject as <Les Vorno> and by another as <Les Vernos>, and placed in France; the subjects were evidently using their knowledge of French to interpret the name.

Categorisation of foreign sounds

> "The phonological system of a language is like a sieve through which everything that is said passes...when [a person] hears another language spoken he intuitively uses the familiar "phonological sieve" of his mother tongue to analyse what has been said."[6]

A good example of the problem of categorising spoken foreign sounds is *Tallard* ([ta.laːʀ], France). The French /t/ is part-way between English [t] and [d]; 10 subjects wrote <t>, while 17 wrote <d>. Sometimes there is an obvious native counterpart to a non-native sound, such as [ç] in *Ekhinos* ([ɛ'çi.nɔs̠], Greece), which was mostly given similar spellings to Scots [x]:

Spelling	Occurrences
ch	12
kh	3
h	9
th	2
kih	1

Table 1: Spelling of [ç] in Ekhinos

Of course, it is not possible to tell whether the subjects perceived the sound as [x] (or in some cases [h]), or whether they perceived it correctly as [ç] and used the most appropriate spelling they could.

Mishearings vs misperceptions

Mishearing involves a major error in hearing a sound, while misperception describes the erroneous categorisation of a sound in terms of the native system, and is a possible explanation for *Ekhinos*, as described above. If a sound is misperceived, some of the original features are preserved: for instance, the French vowel [y] contains the features [+front] and [+rounded]. It is typically nativised by English speakers by changing one of these features, resulting the high back rounded vowel [u], or sometimes split into [ju], thus preserving all the features but distributing them across two phones.

It therefore seems likely that the [ɣ] of *Megara* [ˈmɛ.ɣa.ɾa] was generally misheard, rather than misperceived, as the most common spelling given was <n>, whose phonetic equivalents bear no resemblance to [ɣ]. Some sounds are more liable to be misheard than others, due to their acoustic qualities.[7] Also, some prompts were misheard more often than others, because of the quality of recording, unclear pronunciation and so on.

In some instances it is clear that sounds were simply not heard, as a large number of subjects omitted to transcribe any letter at all for a particular sound; sometimes graphemes were inserted where there was no corresponding sound, either through mishearing or an error in writing. An interesting problem arises from the use of post-vocalic <r>. Given that the subjects were Scots, with rhotic accents, that the prompts were spoken by a Scottish speaker, and that the foreign languages in the study mostly use graphemic <r> to represent an [r] sound of some description, we would not expect subjects to use the spelling <r> unless they actually hear an [r].[8] However, there are a number of instances in which subjects did in fact write <r> where there is none in the prompt, for example *Snåsa* ([ˋsnɔ˞.sɑ], Norway), which had 10 <r>'s written after the final vowel. It is possible that the subjects are influenced by RP sound-to-spelling correspondences; they may draw on RP because in a formal environment such as an experiment they use their knowledge of standard English pronunciation, or because they are treating RP as a 'foreign language'.

Use of non-native graphemic features

Some non-native graphemes and grapheme sequences were used, as well as non-native sound-to-spelling correspondences. For example, two subjects used <ß> for the final sound of *Tsamandas* ([t͡sa.manˈdas̠], Greece), one placing it in Germany and one in Norway. Additionally, accented characters such as <é> were used. Although the majority of these appeared in names which the subjects thought were French, there were a few in towns which subjects placed in other countries, which contradicts the usual view of nativisation that involves only the source and borrowing languages.

An example of a non-native sound-to-spelling correspondence is <Sch-> in *Schapen* ([ˈʃa̠ː.pʰən], Germany), and *Schwenke* ([ˈʃvɛŋ.kʰə], also Germany). Sixteen subjects did in fact use <Sch-> *Schwenke*, and 2 for *Schapen*. The discrepancy between the two is perhaps due to the perception of the name; 20 subjects placed *Schwenke* in Germany, possibly due to the stereotypical German [ʃv], while only 5 did so for *Schapen*.

Representation of length and rhythm

A number of words had long vowels or long consonants in the prompts. Geminate consonants are not typically found in the middle of monomorphemic English words (though they may be found in polymorphemic words, such as *bookcase*). In some cases it is not possible to tell whether the subjects perceived the long consonants, since a word-medial double-consonant spelling such as <kk> can represent a single spoken consonant in English. However, some double consonant spellings must represent two sounds, for example word-medial <pn>. Looking at the data, we find five names with phonologically long consonants (see Table 2).

	[bː] in *Bobbio* (Italy)		[pː] in *Copparo* (Italy)		[kː] in *Dokka* (Norway)		[lː] in *Hellesylt* (Norway)		[ŋː] in *Lyngen* (Norway)	
	Data	No.	Data	No.	Data	No.	Data	No.	Data	No.
Probably long	mp bp lp rp	3 1 3 1	mp np rp	6 1 1	nk nc	5 8			gn	2
Ambiguous			pp	1	kk	1	ll	10		
Probably short	p b	9 10	p	17	c ch ck	7 1 5	l r	14 1	g ng	20 5
Other			blank	1			blank	2		

Table 2: Representation of long consonants

Some spellings suggest that subjects have heard extra length; as the table shows, this often manifests itself as a continuant preceding the consonant. Unfortunately there is little data on short consonants in similar environments for comparison.

Conclusions

This experiment produced complex data, some of which gives clear indications of the way subjects processed the names, and some of which can be interpreted in a number of ways. We can see that the subjects are not linguistically naive; although they sometimes interpret unknown names, both foreign and native, using their native language framework, they also employ their knowledge of foreign languages, sometimes overgeneralising this knowledge to languages they do not know. Further work is now needed in order to build up a model of the interaction of the many processes involved.

Notes

1 Wilhelm F.H. Nicolaisen, 'The Collection and Transcription of Scottish Place-Names', *Septieme Congresso Internazionale de Scienze Onomastiche,* (Firenze, 1961, Vol. 4), 105-14.

2 Angle brackets are used throughout this paper to represent orthographic forms; pronunciations are given in a close IPA transcription, in order to differentiate between the different languages involved.

3 Original spellings listed here were taken from the *The Times Atlas of the World, Concise Edition*, (London, Times Books, 1992, 6th edn.).

4 Richard L. Venezky, *The Structure of English Orthography,* (Paris, Mouton, 1970).

5 The role of analogy in pronouncing words is discussed in Robert J. Glushko, 'Principles for Pronouncing Print: the Psychology of Phonology', In Alan M. Lesgold and Charles A. Perfetti (eds), *Interactive Processes in Reading,* (Hillsdale, Erlbaum, 1981), 61-84.

6 Nikolai S. Trubetzkoy, *Principles of Phonology,* (Berkeley, University of California Press, 1939 [translation 1969]), 51-2.

7 George A. Miller and Patricia E. Nicely, 'An Analysis of Perceptual Confusions among some English Consonants', *Journal of the Acoustical Society of America,* (Vol. 27, 1955), 338-52.

8 French *-er* verbs, of course, are a counter-example.