An Articulatory and Acoustic Phonetic Study of Selected Consonants in Accents of Scottish English

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This thesis begins by reviewing the literature pertaining to Scottish English pronunciation which has been produced since the late-eighteenth century. The work of authors, such as Sylvester Douglas, Melville Bell, James Murray, James Wilson, William Grant, Anne McAllister, Jack Aitken and David Abercrombie, is reviewed and its contribution to our understanding of the nature of Scottish English pronunciation is assessed.

The methodology and findings of the present study are then presented. The data is gathered from speakers from Edinburgh, Glasgow and Aberdeen and it centres around their pronunciation of /r, l, w/ and /ʍ/ and their voice onset times for voiceless plosives. Certain discrepancies are noted between the description of these features in the existing literature and the realisations produced by the speakers informing the present study.

The articulatory nature and acoustic characteristics of all allophones of /r, l, w/ and /ʍ/ are described. Moreover, their incidence in all phonotactic contexts is set out. Hitherto unattested realisations (such as [ɾ̥] for /r/, and [ɰ] for /l/) are noted and discussed at length. The lexical incidence of /w/ and /ʍ/ is investigated and a sound change is observed. Voice onset times of /p, t/ and /k/ are measured in #CV and #CCV position. Statistical analysis finds no demographic difference in VOT values, but consistent significant differences emerge between the phonemic environments.

Finally, it is argued that the gulf that exists between the literature pertaining to Scottish English pronunciation and the results of the present study is indicative of the state of our knowledge of the phonetic characteristics of most English accents. Consequently, a case is made for the renaissance of phonetic investigation into all English accents.

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The errors within the text are entirely my responsibility.

This thesis is dedicated to my parents.

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Chapter 1 Introduction and aims of the thesis

1.0 Introduction.

In this chapter the aims of the thesis are set out, and certain concepts and ideas which are fundamental to it are discussed. The chapter begins by considering certain issues relating to Scottish English (henceforth ScE): how the term is used in the thesis; why this variety of English should be the subject of phonetic investigation; and why it is necessary to undertake a phonetic investigation of ScE accents. In developing the last part of this discussion, the reasons for the choice of certain consonants as the focus of the investigation will be presented.

The chapter continues by outlining the various aims of the thesis. In general, the main aim can be summarised as an attempt to contribute to the knowledge of the phonetic characteristics of present day ScE. Specifically, this entails an assessment of the existing literature concerning the phonetic characteristics of ScE, and an in-depth re-examination of those sections of it which pertain to the particular consonants which are the focus of the present study. Moreover, it includes the presentation of an in-depth articulatory and acoustic study of those same consonants.

Having considered the underlying rationale for the thesis, the chapter then presents an overview of its structure and a summary of the main findings.

1.1 Scottish English

The accents which are under consideration in this thesis are accents of ScE. An in-depth discussion of the range of that term as employed in this thesis is presented in Chapter Two, but it is useful to set out here a brief introductory statement of what constitutes ScE. It is possible to define ScE from a number of standpoints, geographical, historical and linguistic. Each approach to a definition results in the emergence of a slightly different understanding of what ScE is.

Taken at face value, the term might be used to denote all varieties of English spoken within the geographical confines of Scotland. The Linguistic Survey of

Scotland (Mather and Speitel 1975) took a even wider geographical base in its investigation (reflecting an interest in both English and Gaelic in Scotland) and surveyed the languages of Scotland, Northern Ireland, the Isle of Man, Northumbria, and Cumbria (Catford 1957: 105). For the present purposes, this approach to the definition of ScE is only partially successful for two reasons. Firstly, it would fail to separate the different varieties of English which are spoken in Scotland and which are linguistically distinct. For example, Scotland contains speakers who speak English with the accent known as Received Pronunciation (RP). Such an accent differs markedly from those accents found in Scotland which could be described as recognisably Scottish in that they exhibit certain typically Scottish characteristics, such as rhoticity, and they do not possess phonological distinctions, such as /a/ ≠ /ɑ/, /ɒ/ ≠ /ɔ/, and /ʊ/ ≠ /u/. Secondly, a purely geographical definition would exclude the accents of thousands of ex-patriot Scots, which, although spoken outwith Scotland, are recognisably Scottish. Thus, this definition of ScE is rejected.

When discussing accents of English within Scotland, it is more usual to restrict the application of the term ScE to the English spoken within certain areas of Scotland, in that a distinction is made between the English of the southern, central and eastern areas of the country and the English spoken in the north west. The reasons for this are partly historical and partly phonological.

Viewed historically, ScE is the term reserved for the variety of English spoken in the south, centre and east of Scotland, which emerged in the mid-eighteenth century. It is the anglicised descendant of the Scots language which, in turn, is a descendant of Northumbrian Old English, spoken by the Anglo Saxons, who settled the area which is now southern Scotland from the early seventh century. The history and development of this variety have been outlined elsewhere (e.g. Murray 1873; Murison 1977; Aitken 1979, 1984b; Romaine 1982) and will be discussed in chapter two (sections 2.1.2 ff.). The English spoken in the Highlands and Islands of Scotland, which has had a separate history and development, is referred to either collectively as Highland English (Shuken 1984), or sub-divided into Highland English and Island English respectively (Catford

1957: 111). The distinct origins and developments of ScE and Highland English have resulted in significant phonological and phonetic differences existing between them. For example, at the phonetic realisation level, /z, ʒ/ and /dʒ/ are realised as [s, ʃ] and [tʃ] in Highland English (Wells 1982: 413-414).

The reference to phonological characteristics of Scottish accents leads to the third approach to the definition of ScE, which is a linguistic one. Such an approach defines ScE as that variety of English characterised by the presence of certain lexical features, certain grammatical features, and certain phonological and phonetic features (such as those discussed and referred to in Abercrombie 1979, Aitken 1984a, and Wells 1982: 399-412). This enables all varieties which fulfil these criteria, wherever they are spoken, and at whichever point in time, to be classified as ScE.[1]

For the purposes of this thesis, the term ScE will be used with the third definition and be used to refer to those varieties of English which fulfil the linguistic criteria indicated above.

1.1.1 Why should ScE be studied?

It is not difficult to justify the study of ScE. Firstly, there is its historical position, referred to above (section 1.1) as one of the oldest varieties of English.

Secondly, there is its linguistic uniqueness. Scotland has been called a "dialect island" due its distinctive phonology (Aitken 1984a: 111), which results in "the largest and most important bunch of isoglosses in Britain [occurring] around the Scots-English border" (Aitken 1981: 77). Linked with this linguistic separateness is the strong national identity of the Scottish people, embodied in a legal system, in an education system, and in a established national church which are all separate to those of England and Wales. In addition, certain ScE accents, especially those linked with

[1] None of this is to suggest that ScE is a homogenous entity. Regional and sociolinguistic variation has been recorded by numerous authors over many years (e.g. Douglas 1775, Murray 1873, Ellis 1889, Colville 1909, Grant and Dixon 1921, Flom 1934, Reid 1976, Macaulay 1978, Johnson 1983, Milliken 1989, and McMahon 1989. See the discussion of the literature in Chapter 2).

such as the law, the church, and medicine, have a social prestige attached to them, both within and outwith Scotland, which is not enjoyed by other regional English accents. As a result, ScE has been described as being the variety of English "nearest to the self-confident independence of British English and American English" (Quirk and Greenbaum 1973:5).[2]

Moreover, there is a long and established tradition of describing and analysing aspects of ScE which sets a precedent and provides a historical context for its continued study. (See footnote 1 and Chapter 2.)

Consequently, it is appropriate to view ScE as an important and major variety of World English, which is a legitimate subject for academic study (McArthur 1979: 50).

1.1.2 Why a phonetic study?

Despite many studies of ScE accents, it is still fair to say that, from a phonetic point of view, they are among the most under-researched accents of English in that they have not been subject to the degree of scrutiny that other English accents, especially RP and General American, have received. This is reflected in the fact that, for example, Wells, in his outline of all accents of English, devotes less space to the pronunciation of ScE (1982: 393-416) than he does to Caribbean English (op. cit.: 560-591).

It is argued throughout the thesis that the existing literature provides a general indication of the phonetic characteristics of ScE, but that it lacks detail, and it lacks reference to instrumental phonetic investigation. The present thesis attempts to contribute to rectifying this situation by focusing on four aspects of ScE pronunciation and describing their articulatory and acoustic characteristics in detail. The consonants select for study are: /r/, /l/, /ʍ/, /w/, and the voice onset times (VOTs) of /p, t/ and /k/,

[2] Although Quirk and Greenbaum call this variety "Scots", in the opinion of the present writer they are referring to the variety of English defined as ScE in this thesis.

chosen because descriptions of them in the literature do not reflect the complexity of the reality of their phonetic realisations.

1.1.3 The choice of consonants

Each topic of the present study represents an aspect of ScE pronunciation about which exists an impression of the phonetic reality, an impression which is generally accepted as accurate and as adequate. For example, /r/ is said to have four main allophones: [r], which is becoming less common; [ɾ], which occurs intervocalically or in intervocalic consonant clusters; and [ɹ ~ɻ] which occurs word finally, or in word final consonant clusters (Wells 1982: 411). In fact, this is a gross over-simplification of the situation. The present thesis has identified thirteen allophones of /r/, and has examined their distribution in all possible phonotactic positions (see Chapter 4). The reality of situation is far more complex than Wells's account would suggest. Moreover, there is no acoustic information to be found in the literature which specifically describes the characteristics of ScE /r/ realisations.

/l/ is included in the thesis as it is subject to similar generalisations concerning its phonetic realisation and because it, too, has never been subjected to acoustic analysis. It is said to have three main allophones. The most usual is [lˠ], which is used in all positions, although [l] can also be heard, as can [lʲ] in certain geographical locations. In addition, a pharyngealised variety has been noted among Glasgow speakers (Wells 1982: 411-412). Once again, careful phonetic analysis reveals that this is not the entire picture, in that there is another allophone, whose distribution is restricted to syllable- or word-final position, and whose occurrence is largely predictable from its phonetic context. (See Chapter 5)

/ʍ/ has been chosen as a subject of study for three reasons. Firstly, descriptions of its phonetic realisation, although generally indicating a voiceless labial-velar fricative, have hinted at alternative allophones, which this study aims to identify. Secondly, the acoustic characteristics of the allophones have not been documented. Lastly, the lexical distribution of /ʍ/, traditionally described in terms of orthography (e.g. Wells 1982: 408-409), appears to be changing among some speakers. The thesis attempts to discover the extent to which this is happening, and whether part of the reason could lie in the phonetic characteristics of /ʍ/ realisations. (See Chapter 6 and Appendix 4.)

The last aspect of ScE pronunciation which the thesis focuses on is the VOTs of voiceless plosives. Once again, it is shown that the descriptions hitherto of this feature have been impressionistic in character. Although such statements are valid as far as they go, there exist at present no published instrumental data which would enable figures for ScE VOTs to be contrasted with VOT measurements in other varieties of English. This thesis examines the reality of VOTs in ScE and reveals the relationship between VOTs and the phonemic environment of the voiceless plosive. (See Chapter 7.)

The thesis does not seek to question the validity of existing accounts of ScE accents which provide a broad overview rather than a more detailed description. As long as they are not mistaken for detailed studies, they are useful summaries of ScE pronunciation. Moreover, they can indicate which aspects of ScE accents may be fruitful areas of further study.

1.1.4 The choice of Glasgow, Aberdeen and Edinburgh

The data from which this thesis draws its findings is taken from speakers whose regional origin and identity is either Glasgow, Aberdeen or Edinburgh. The underlying reason for this is that the present writer wanted to obtain data which would reflect the existing pronunciation of ScE in the three main conurbations of Scotland (which all happen to lie within the ScE linguistic area). In that way it might be possible to identify any similarities or differences between them, in terms of their pronunciation of the selected consonant phonemes.

In fact, the speakers do not show major differences. For example, there is no statistically significant difference between the VOTs of any of the regional groups (e.g. see section 7.3.2.5.1.1.2). At times, however, Aberdeen speakers appear to be slightly more conservative than the other two groups, inasmuch as they do not tend to utilise as large a range of allophones for each individual phoneme as the other groups. In addition, the allophones that they use are those attested in earlier literature, rather than the new allophones. Contrasting with this is the Glasgow group, the members of which use the greatest range of allophones and tend to use the more innovative realisations with greater frequency than the other groups. The Edinburgh group occupies the middle ground.

However, these observations must be interpreted in the light of the fact that the Glasgow speakers constitute the largest numerical group in this study, whereas the Aberdeen speakers are the smallest group. It is arguable that the fact that there is a larger group of Glaswegians makes it statistically more likely that they will produce the greatest range of realisations, and the fact that there is a much smaller group of Aberdeen speakers implies that they will produce a smaller range of realisations. Therefore, in generalising from the thesis findings, the writer is cautious about the representativeness of the results from the Aberdeen speakers

1.2 The aims of the thesis

The central aim of the thesis can be summarised as an attempt to collate articulatory and acoustic information about the realisation of certain consonants in three ScE accents, and to set that information in the context of the existing literature in the subject.

The subsidiary aims are many. The first is to establish the nature of the literature which deals with accents of ScE since the emergence of that variety in the eighteenth century; to identify its major interests and concerns; to identify how they have reflected the contemporary linguistic preoccupations of the time; to outline the various approaches to the subject matter; to identify their relative strengths and weaknesses; and to summarise the data which is retrievable from them.

The second aim is to clearly outline the methodology used in the present study so that its findings may be placed in their proper context.[3] A separate aim is to justify the choice of an articulatory and acoustic approach to the data and to discuss why other instrumental techniques were not used. Fourthly the thesis aims to establish the allophonic variation of the selected consonants, to establish the distribution of those allophones and to outline their acoustic characteristics. The final aim is to investigate any aspects of general phonetic theory which the ScE data calls into question.

The last point is regarded as one of the most important aspects of the thesis. It is necessary that phonetic theory should be continually tested against new data in order to ensure that it is universally applicable to the linguistic articulatory possibilities of humans. It is only by examining the phonetic characteristics of many accents in detail that such an objective becomes possible. In the present thesis, for example, one realisation of /r/ did not fit happily into any manner of articulation category provided by the 1989 IPA chart. Discussion of the nature of this allophone and the nature of, in this case, tap and approximant categories was necessary to resolve the situation. (See Chapter 4.)

As a result the thesis presents a systematic and in-depth description of the phonetic characteristics of certain features of ScE which is set in the context of the work of previous scholars. It is based upon both auditory and acoustic analysis, and it includes the discussion of relevant aspects of phonetic theory.

1.3 An overview of the structure of the thesis

The first chapter discusses certain fundamental issues which underpin the thesis. It also outlines the aims of the thesis, and provides an overview of its structure.

Chapter Two presents the review of the literature pertaining to the phonetic description of ScE accents. It discusses how the terms "Scots" and "ScE", among others, have been used by writers and are used by the present writer. With reference to

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[3] For example, see the previous comments in section 1.1.4 concerning the representativeness of the Aberdeen data.

the literature on Scots and ScE accents, it will be shown that, from the eighteenth century until the present day, many writers have attempted to indicate, to a greater or lesser extent, the quality of sound associated with ScE accents. Their work is seen as reflecting the concerns of their historical period. For example, whereas the eighteenth-century writings are motivated in the main by the Augustan notion of propriety in all things, including speech, nineteenth-century literature is motivated both by the rise in interest in comparative philology, in regional linguistic variation, and by an interest in the area of phonetics in general. Such concerns continue until around the middle of the twentieth century, when the increasing interest in various phonological theories overshadows interest in the phonetic aspects of accents, and sociolinguistic concerns begin to have an influence on the methodology of surveys.

The geographical and sociolinguistic coverage of Scottish accents is seen to be significant, and, although the accounts vary in the quality of their method and in the quantity of the retrievable information, in general the resulting literature can be regarded as a valuable resource from which it is possible to gain insight into the pronunciation of ScE over the past three centuries.

It is with this as a backdrop that the present author presents in the next five chapters an account of her own research. Chapter Three outlines the methodological issues related to the fieldwork, to the analysis of the data, and to the interpretation of the results. It discusses the concepts of the sampling, of the reliability and of the representativeness of data. It describes speaker selection, the recording procedure, the instrumentation, the methods of analysis, and their appropriateness to the particular data.

Chapter Four presents the results of the articulatory and acoustic investigation of /r/. The literature pertaining to /r/ realisations is examined in detail. This is followed by the presentation of the range of /r/ allophones identified in the present study. The articulatory and acoustic characteristics of each is described. In the process, one /r/ realisation, a cross between an alveolar tap and approximant, is discussed, and the category of "lowered tap" is introduced as a taxonomic phonetic category. The distribution of all /r/ allophones in various word positions and in all possible phonotactic positions is then outlined separately for each regional group of speakers. The chapter concludes by noting that the existing literature on /r/ realisations is a generalised account which does not reflect the actual range and variation of /r/ allophones in ScE.

In Chapter 5 a similar approach is taken to the analysis of /l/ realisations. Once more the existing literature is reviewed, and once more the results of the present study of /l/ realisations are presented. The study reveals the existence of a hitherto unrecorded ScE median approximant realisation: [ɰ̞]. It is discussed with reference to certain instrumental studies of similar /l/ realisations in English English accents, and the phonetic conditions for its selection are outlined.

Chapter 6 presents a phonetic and phonological investigation of /w/ and /ʍ/. A discussion of the relationship between an articulatory stricture and its corresponding auditory and acoustic output is pursued with direct reference to the realisations of both phonemes. The lexical incidence of the phonemes is also discussed and it is shown that the replacement of /ʍ/ by /w/, first noted by Macafee (1983), is geographically more widespread than she indicated.

Chapter 7 investigates the VOTs of voiceless plosives. As the variation in VOTs is of a quantitative rather than a qualitative nature, the VOT measurements are approached from a statistical standpoint. The individual and aggregate mean VOT measurements for each demographic group of speakers, for individual plosives, and for the phonetic environments #CV and #CCV (where the plosive is the first element in each environment) are calculated, and standard deviations and frequency distributions are computed. In that way the underlying similarities and differences which exist between the VOT values for each demographic group and for each plosive in each environment are revealed. It is shown that there is no significant difference between male and female VOTs, or between the VOTs of the regional groups. However, significant differences exist between /p/, /t/ and /k/ in both #CV and #CCV environments. Moreover, plosives in #CCV environments are shown to have and significantly longer VOTs than those in #CV environments. Furthermore, in this chapter the underlying statistical significance of the findings of the thesis as a whole is discussed.

Chapter 8 summarises the main findings and conclusions of the thesis and considers the successes and the failings of the present research. A positive aspect of the thesis is that more detailed data is available concerning the phonetic realisation of certain aspects of ScE. In addition, the presentation of the acoustic data provides a context for further acoustic investigation. On the negative side, the thesis has been found to possess some methodological weaknesses, such as the small sample base of the Aberdeen section of the data which resulted in some findings being of questionable statistical significance and representativeness.

Finally, this last chapter will argue that the research is fully justified by the opportunity which it has provided for the consideration of various aspects of phonetic theory, for the description of previously unreported allophones, for the presentation of acoustic data, and for the observation of a sound change in progress. Moreover it argues for the pursuit of similar phonetic studies of other aspects of ScE pronunciation.

Chapter Two A review of phonetic descriptions of Scottish accents[1]

2.0 Introduction

This chapter considers the literature on Scottish accents which has been published over the last three centuries. It aims to identify why writers were interested in writing about these accents, how they gathered their information, the type of information they were interested in, and how they analysed and presented their findings. Moreover, it will establish which areas of the country, and what sort of people, have been the focus of such investigations.

The chapter begins by considering the nomenclature employed by writers to designate the linguistic varieties which are referred to in this thesis as Scots and ScE. It discusses whether it is correct to consider the phonetics of both Scots and ScE accents when attempting to identify the range of realisations available to the ScE speaker. The discussion then moves to consider the literature on Scottish accents. The writings are approached chronologically, but patterns and trends do not coincide with century divisions. For example, one may observe Augustan concerns of "fitness" and "propriety" in the pronunciation dictionaries and school text-books of the eighteenth century; the influence of dialectology in studies from the end of the nineteenth century to the mid-twentieth century; the influence of the publication of works on general phonetics, by nineteenth-century writers such as Sievers, Bell and Sweet; the effect of the increasing importance of phonological theories in linguistics in the second half of the twentieth century; and, throughout, the goal of phoneticians to record information concerning the realisational details of different varieties of Scottish accents.

The chapter concludes by acknowledging the significance of the literature on the phonetics of Scottish accents.

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1 Part of this chapter was presented, in an amended form, at the Fourth International Conference on the Languages of Scotland and Ulster in August 1994.

2.1 Questions of terminology and linguistic variety

In the following discussion of the literature dealing with Scottish accents, pronunciations will be considered which the authors variously describe as Scotch (e.g. Mutschmann 1909, Sweet 1890, Wilson 1915), Scots (e.g. Grant and Dixon 1921, Winston 1971), ScE (e.g. Romaine 1987, Speitel 1969), and Scottish (e.g. Williams 1909). Before proceeding to consider the data which is presented by these authors, it is necessary to address two questions. Firstly, what is meant by these labels and, secondly, should any significance be attached to an author's choice of one or other of them? For example, is it correct to conflate all of these descriptions in order to attempt to gain an overall impression of Scottish pronunciation, or ought distinctions to be made between, for example, Scots accents and ScE accents? In the process of addressing these questions, the terms employed in this thesis will be presented and defined.

2.1.1 The diversity of nomenclature

From the introduction of a Germanic tongue into Scotland by the Anglo-Saxons in the 6th century, the terms *Inglis, Scottis, Scots, Scotch, Scottish* and *Scottish English* have been used at one time or another to identify it and to distinguish it from other language varieties. As Aitken (1981: 73-74) relates, *Inglis* (i.e. English) was the term originally used to refer to the Old English of both England and Scotland until 1494, when the name *Scottis*, which originally designated the Celtic tongue of Scotland, was used instead to identify the Inglis of Scotland.[2] During the seventeenth century, Scottis developed into three modern forms: *Scots, Scotch* and *Scottish,* all of which were used to denote the language (Oxford English Dictionary, entry under *Scotch, a. and n.*[3]). The most recent name which has acquired general acceptance would appear to be *Scottish English,* which can be found from the second half of the twentieth century (e.g. Speitel 1972, Verhoeven 1986).

Examining the use of these terms in the literature reveals some general patterns. For example, Scotch was a common term in the nineteenth century, being

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2 Aitken notes that *Scottis* did not replace *Inglis*, but that the two co-existed (loc. cit.).

used by Bell, Ellis, and Sweet, among others. However, during that century it became less acceptable to apply the term to the language, among other things, and, perhaps as a result of this, its last use in the title of a dialect monograph was Wilson's 1915 Lowland Scotch as Spoken in the Lower Strathern District of Perthshire.

The term *Scots* has maintained its popularity and acceptability, and continues to appear as the designation of the language, or of one of its dialects, throughout the present century. For example, Colville's 1909 Studies in Lowland Scots, Grant and Dixon's 1921 Manual of Modern Scots, Aitken's 1962 "Vowel length in modern Scots", and Lass's 1974 "Linguistic orthogenesis? Scots vowel quality and the English length conspiracy".

A glance at the titles of books and articles written in this century reveals that *Scottish* is no longer used to designate the language in the way in which, for example, Williams (1909) utilised it. It would appear to be restricted now to adjectival usage and, in this role, it forms many frequent collocations, e.g. Scottish vowels, Scottish English, Scottish intonation, Scottish accents and dialects, etc.

Although writers continue to make use of these terms, it would be an error to think that there was necessarily any consensus among them as to the exact meaning of any of them. For example, if one examines the speakers who are said to speak Scots, it becomes apparent that their speech patterns cut across many of the sociolinguistic categories which might be expected to result in linguistic diversity, such as age and class. Thus writers have often felt the need to identify more clearly the language variety they are describing, either by identifying it geographically (e.g. Taylor 1974, southern Scots), or by indicating some sort of sociolinguistic feature (e.g. Winston 1971, "educated" Scots), or linguistic factor (e.g. McClure 1979, "thin" and "dense" Scots). A similar phenomenon exists with the use of the term "Scottish English", which some writers occasionally feel is too all-encompassing; hence the appearance of terms such as "Scottish standard English" (e.g. McArthur 1979) or "educated Scottish standard English" (e.g. Aitken 1984b), in order to indicate more precisely the variety under discussion.

Since the end of the 1950s there has been a conscious attempt to clarify the linguistic factors surrounding the type of Germanic tongue spoken in Scotland, and to establish an agreed taxonomy for the main linguistic varieties (e.g. Abercrombie

1979; Aitken 1979, 1981, 1984a and b; Catford 1959; McArthur 1979; McClure 1979). In the discussion of this matter, writers have utilised arguments grounded in the historical development of the various varieties (e.g. Murison 1977), in their linguistic characteristics (e.g. Aitken 1984a and b), in geographical factors (e.g. Catford 1959), in considerations of national feeling, and cultural identity and heritage (e.g. McIntosh 1979, McClure 1979). Although no one particular idea or set of terms has gained universal acceptance, a general consensus has emerged so that the term "Scots" is now generally used to identify that variety of the language in Scotland which has most in common, linguistically, with the standard language of Scotland during the sixteenth and seventeenth centuries, and which is normally associated today with rural or working class speakers. Terms such as "Scottish English", or "Scottish Standard English" are used to refer to the variety used in Scotland which, for reasons outlined below, is more closely linked linguistically to the English of England and which is regarded as the standard variety of English in Scotland. Among the academic community, at least, the names "Scotch" and "Scottish" do not enjoy much popularity.

2.1.2 Scots and Scottish English

In this thesis, the writer follows the above noted convention of using the terms Scots and ScE to refer to two language varieties which differ in a number of ways. In the following sections, the linguistic, socioliolinguistic and historical characteristics which differentiate Scots and ScE will be set out in more detail.

2.1.2.1 Scots

Historically, Scots is a Germanic language, descended from the Northumbrian form of Old English which was brought into the south of Scotland by the Anglo-Saxons from the sixth century onwards. Its subsequent development from OE is generally regarded as encompassing three main periods: Older Scots, Middle Scots, and Modern Scots.[3] Although there are distinct differences between Scots and English in terms of phonology, morphology, syntax and lexicon (see, for

3 A brief history of Scots is set forth in, for example, Murison 1979. A fuller history is anticipated in Jones, forthcoming.

example, Catford 1959: 109-111), its general linguistic similarity to southern forms of Old English and later to Middle English is testified by, for example, the fact that Scots speakers saw no conflict in referring both to their own language and to English as "Inglis" (although, as mentioned above, the term "Scottis" was also in use from 1494 to denote Scots).

In time, the language spoken by the Celtic peoples of Scotland was gradually pushed by Scots to the western highlands and islands of the country. In the meantime, Scots became the language of the powerful and prestigious in Scotland, the language of the King, the court, the nobility and the wealthy. At its zenith it was the language of an independent kingdom: one which was capable of fulfilling, and which did fulfil, all of the functions of a standard language.

2.1.2.1.1 The decline of Scots

The gradual decline of the Scots language from this prestige position is generally attributed to several causes, both external and internal. The former category includes the Union of the Crowns (1603), the Union of the Parliaments (1707), the Reformation, and the "flowering" of the English language in England. Each of these events removed some language function or some aspect of prestige which Scots had fulfilled or possessed. For example, throughout Europe, the use of vernacular translations of the Bible was commonplace in countries where the Reformation had been successful. Although a Scots version of the Bible had been produced, it was the Authorised Version of 1611, an English translation, which replaced the Vulgate and which was used in churches where the congregation was Scots-speaking. Even though sermons and Kirk session minutes continued to be read or written in Scots, English, not Scots, was the language which revealed the word of God.

Ultimately, as a result of these factors, Scots lost its role as the standard language of Scotland. Its decline has been such that, for many linguists, it can no longer be regarded as a language, but has been relegated to a position where it is classed as a regional variety of English. (See further, for example, Aitken 1981: 72.)

2.1.2.1.2 The anglicisation of Scots

As the Scots language lost its prestige, so those speakers of Scots who were sensitive to such social pressures sought to remodel their language on the more "acceptable" English of England. This was not a task which was beyond their capabilities, for, as has already been noted, there existed a great deal of common linguistic ground between Scots and English. For example, Scots and English had a great deal of vocabulary in common, reflecting their shared Germanic heritage and their mutual experience of, for example, the linguistic influence of Scandinavian invaders. Likewise, their grammars were more similar than different. Thus when Scots speakers wished to anglicise their Scots, it was particularly easy for them to make changes to the vocabulary and grammar, which had much in common with English; it was also easy for them to monitor them from, for example, written examples of English.[4]

The linguistic element of Scots which was most divergent from the east Midlands dialect of English, the variety which would be selected and codified to form the standard variety of English, was, and would continue to be, pronunciation. Scots had descended from a separate northern dialect of Old English, one which was already divergent from other dialects in terms of pronunciation, and, as time went by, Scots phonology was not subject to all of the same sound changes which the English of southern England would undergo. To cite two examples, the Great Vowel Shift was not carried out to the same extent in Scots (e.g. /u/ did not diphthongise to /au/), and, secondly, non-rhoticity has not as yet made in-roads into the phonological structure of Scots.[5]

The activities of individuals such as Sheridan (e.g. 1780), indicate that many Scots were aware of the differences between their pronunciation and that of the native English speaker, and were determined to overcome them. Yet, it is arguable that it did not prove quite so easy for Scots to anglicise their pronunciation as it was for them to adapt their grammar and vocabulary. For one

4 And indeed lists of "Scotticisms" were compiled so that the Scot who wished to anglicise would be aware of what words and phrases should be avoided.

5 For a detailed account of the development of the Scots vowel system see, for example, Kniezsa (1976). On the matter of rhoticity it should be noted that Romaine (1978) found evidence of non-rhoticity among certain Edinburgh school children.

thing, unless a Scot had access to an English speaker as a model for pronunciation, it was hard for such aspects of language to be exemplified, and the degree of direct face-to-face communication necessary to enable this was, one assumes, relatively limited. Moreover, it must be remembered that it is normally inherently difficult for a speaker of one dialect to adopt the pronunciation habits of a second dialect without special attention being given to the process. It is suggested that, on account of both of these factors, the variety which would emerge, namely Scottish English, would ultimately resemble English in all but pronunciation, which is indeed the situation which we find today.[6]

2.1.2.2 Scottish English

The origin of ScE has its roots in the same constitutional, social, cultural and religious factors which led to the demise of Scots. Due to historical events, notably the Union of the Crowns and the Union of the Parliaments, the Scottish nobility were encountering English society at close quarters. The wealth and prosperity of England contrasted sharply with the poverty and appalling social conditions which existed in Scotland during the seventeenth century, and sections of Scottish society could see the benefits of emulating the ways of their southern neighbour. For example, Scottish landowners, impressed by the prosperity of English farms, encouraged changes in Scottish agricultural practices, to bring them more in line with English methods (Nichols 1979: 109-110). At a less practical level, much of the Scottish aristocracy and middle classes, inspired consciously or subconsciously by the Augustan movement of the eighteenth century, began to anglicise their language. The writings of James VI and I are often used as examples of how the Scots language was gradually made more like English by individual writers. All a writer had to do was to effect English spelling systems,

6 There are, of course, several lexical, morphological and grammatical differences between ScE and English English, outlined in, for example, Aitken 1984a: 103-109. However, the overwhelming difference lies in pronunciation, which includes not just segmental but also suprasegmental aspects. That there are significant differences, for example, between ScE and English English intonation, syllabification, tempo, and voice quality is noted in Brown, Currie and Kenworthy (1980), Abercrombie (1969), Sweet (1877), Sprague (1880) and Esling (1984), among others.

dispose of a few obvious "Scotticisms" of grammar and vocabulary, and the result looked English, rather than Scots.

As far as the spoken language was concerned, the changes were not quite as straightforward. "Scotticisms" of vocabulary and grammar had to be avoided (less easy to achieve in the spontaneity of spoken discourse), and pronunciation had to be radically altered. It is not easy for us to be sure of the target pronunciation, as English pronunciation of the seventeenth and eighteenth century is as difficult to reconstruct accurately as that of Scots. However, if present ScE phonology is used as a yardstick, it becomes clear that the phonology in terms of phonotactics, if not system, did undergo some change. (See, for example, Catford 1959: 109-110.) What is not clear is the extent to which Scots speakers were able to anglicise the phonetic aspects of their language.

Yet, this anglicisation of Scots was not comprehensive. It was a "top down" movement, inasmuch as those who desired social betterment, usually the upper and middle classes, strove to master English and, of that group, those who had the greatest degree of contact with English speakers were enabled to achieve the greatest assimilation. Those who lacked the desire or the means to anglicise their language, retained a language variety closer to Scots. Thus the Scots of the lower classes tended not to be affected by this anglicisation process. As the Scots language declined in prestige, so the speaker of Scots (who, as discussed, tended in any case to be of lower social status) was associated with this low-prestige position and was typically stereotyped as uneducated and of a lower socio-economic position than the individual who anglicised his or her speech. At worst, the Scots language was regarded as sub-standard, and efforts were made through education to eradicate it. At best, there were a limited number of functions where its use was felt to be appropriate, such as poetry.

During the last one hundred and fifty years, Scots has regained some of its former functions and some of its former prestige. Nevertheless, it is arguable that the majority of Scots speakers, even those speakers who possess a relatively small proportion of Scots features in their dialect, are doubtful about the social acceptability of their language and often reveal a certain "linguistic insecurity" about Scots.

2.1.2.3 Scots and Scottish English - how different are they?

It is tempting in the light of the preceding discussion to visualise Scots and ScE as two separate entities. However, the reality of the situation is not quite so simple. Although it is easy to state the linguistic differences between the Scots of the seventeenth century and the ScE of today, Scots, like any living language, is not static, and has altered diachronically. In addition, there have always been synchronic differences to consider. As a result, it is not a simple matter to attempt to separate Scots from ScE. Individuals whose grammatical and lexical features are to all intents and purposes ScE may quite easily have certain phonological and phonetic features which are Scots. Likewise, it is possible to hear speech which is ScE in grammar and phonology, but is interspersed with Scots vocabulary. (See Aitken's discussion of this situation, 1984b: 521-522.) Moreover, some linguists would argue that Scots does not exist as a separate language, in that it is not possible to use it as a medium for the expression of all concepts and ideas without incorporating aspects of English. As a consequence, nowadays Scottish speakers cannot always be divided easily into Scots or ScE speakers.

In an attempt to represent this situation, Aitken (1981) has talked of the "bi-polar continuum" along which most Scots operate.[7] Theoretically, each speaker has access to features of both linguistic systems and possesses the ability to range from one end to the other as occasion demands. It would appear that speakers make judgements about the appropriateness of a particular variety based on stylistic and contextual factors. In addition to the stylistic use of Scots and ScE, one must also be aware of the fact that certain sociolinguistic factors would seem to correlate with the use of ScE or Scots, in that features of Scots are far more likely to be found in the linguistic systems of older, rural speakers, especially those who have not been exposed to the normalising tendencies of the education system for longer than necessary.

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7 He writes: "the situation is a continuum, so there are intermediate varieties, much room for idiosyncratic variation and much obvious inconsistency in performance. Both dialect-switching and what I call style-drifting occur. All varieties share a very large common core." (Aitken 1981: 74.)

2.1.2.4 Different language varieties?

As has been discussed above, it is not always easy to distinguish successfully between Scots and ScE. For one thing, as has been established, writers have used a variety of labels for the linguistic varieties they are describing, and one cannot assume that two writers will be referring to exactly the same variety by the use of one term or another. Thus it is clear that an attempt at contrasting Scots and ScE phoneme realisations is no simple matter. It would seem reasonable, nevertheless, to attempt to make decisions based upon the information writers supply about the linguistic and sociolinguistic characteristics of their informants. Thus we might expect that an individual described as a "dialect speaker" is speaking Scots rather than ScE. Moreover, information concerning a speaker's phoneme selection (e.g. using /sten/ rather than /ston/ as the pronunciation of "stone"), or the presence of segment deletion (e.g. /fu/ as opposed to /ful/) might indicate a Scots rather than a ScE speaker. Indications that the informant was an older person from a rural area and without much schooling might also lead us to conclude that we are dealing with a Scots speaker. Theoretically, that would leave us in a position to make comparisons concerning their realisation of phonemes. Yet even this attention to linguistic information may not be as helpful as one might hope.

For example, Scots grammar has lost much of its distinctiveness, so the grammatical choices of a speaker may not be revealing. There are certainly still many Scots lexical items which a speaker may choose to use, but for most speakers these will be mixed with specifically English words. If we turn to phonology, we can appeal to some historical differences in phonological structure, such as initial /vr-/ or /wr-/ clusters; the phonological system may also possess certain features not found in ScE, such as /ø/. However, for the most part, these are historical features, not found among speakers today. There do remain differences of lexical incidence, such as /ɪ/ in <boot>, <school>, /e/ in <home> and <stone>, and these go some way to clarify the nature of the distinction between the two varieties. However, as discussed above, the distinction is not always clear-cut and divisions are not easy to establish.

2.1.3 Distinguishing between Scots and Scottish English accents

In order to attempt to ascertain whether the phonetic realisation of consonants by Scots speakers varies greatly from that of ScE speakers, it is a necessary preliminary to divide the existing descriptions of Scottish accents into two: those pertaining to Scots and those pertaining to ScE. Comparisons can then be made of allophones of similar phonemes.

For the purposes of this brief study it was decided to focus on a limited sample of literature which contained descriptions of /r/ realisations.[8] /r/ was selected because, as far as ScE is concerned, it is the consonant which has among the largest range of allophones, as will be seen in chapter 4. Therefore there is a greater possibility that, if distinctions between Scots and ScE exist at the phonetic level, then they will be identifiable in the realisations of /r/.

Works dealing with Scots that have been considered are: Bell 1896, Dieth 1932, Ellis 1889, Murrray 1873, Mutschmann 1909, Speitel 1969[9], Wettstein 1942, Wilson 1915 and 1926, Wölck 1965 and Zai 1942. Works which were judged to contain information pertaining to ScE are: Abercrombie 1957a, Grant 1913, Mather 1973, McAllister 1938, Romaine 1978, Speitel 1969 and Williams 1909.

With reference to /r/ realisations, it appears that there is a slight difference between Scots and ScE realisations of /r/ inasmuch as the Scots forms are [r, ɾ, ɹ], with devoiced [r̥] in certain positions, as well as certain idiosyncratic velar and uvular forms, such as [ʁ, ʀ] and [χ]. ScE possesses more or less the same range of realisations. The only omission is the uvular realisations, although idiosyncratic voiced velar realisations are noted (McAllister 1938: 96). The addition is the voiced retroflex approximant [ɻ]. A finer distinction is achieved if one examines which realisation speakers are reported to favour. Here a pattern emerges which reveals that Scots speakers have a tendency to prefer [r] and [ɾ], whereas ScE speakers prefer [ɹ].

8 The range and diversity of /r/ realisations in Scottish accents is examined in full detail in chapter 4.

9 Speitel actually includes information on both Scots and ScE accents. His comments on each will be considered under the appropriate heading in each case.

In general then it would appear that the ScE speakers have available to them all of the major realisations which Scots speakers are reported to use. In addition to these, though, the ScE speakers also have a realisation which would appear to be relatively new and innovative (i.e. [ɹ]). One other point to note is the fact that this relative lack of distinction between the range of ScE and Scots allophones of /r/ would seem to add more weight to the argument outlined above that the distinction between Scots and ScE speakers is not as decisive as the existence of the two terms would suggest.

At the level of phonetic realisation of consonants, then, it would appear that Scots speakers and ScE speakers share a "common core" of allophones, with ScE speakers potentially possessing some additional recent innovations.[10] It is argued that this finding mitigates against the notion that a strict division must be observed between the descriptions of the phonetics of ScE and Scots speakers in the discussion which follows in the remainder of this chapter, even if it were possible to do such a thing systematically and consistently.

2.1.4 Summary and conclusion

In this section, I have attempted to outline the diversity of nomenclature employed by individual writers over many years to indicate those language varieties referred to in this thesis as "Scots " and "Scottish English". I have shown how the various terms are used differently by different authors and how there has been a move over the last forty years or so to use the terms Scots or ScE in a consistent fashion. In addition, I have set out the way in which the present writer uses the latter terms. I have discussed the complexity involved in attempting to establish clear differences between these two varieties, and I have considered whether, at the level of phonetic realisation, it is a worthwhile enterprise. With reference to /r/ realisations in particular and, perhaps, other consonants in general, it would appear that one difference between Scots and ScE accents lies not so much in the range of allophones available to the speakers of each, but in their tendency to use certain allophones rather than others.

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10 As will be seen from the results contained in chapters four to seven, this is indeed the case with the ScE speakers who contributed to the present study.

Therefore, in conclusion, it is argued that it is not naïve to refer to earlier accounts of the phonetics of both Scots and ScE accents when attempting to identify the range of realisations available to ScE speakers. The analysis of /r/ realisations suggests that ScE speakers have not only the Scots realisations in their repertoire, but potentially possess more recent, innovative realisations which Scots speakers do not.

2.2 The eighteenth century

The aim of those who wrote on eighteenth-century Scottish accents was generally to "improve" the pronunciation of English by the Scottish people.[11] As outlined above, the motivation behind this lies in the political and social upheaval which occurred in Scotland in that century, and in the tremendous urge for improvement to Scottish life and society which gripped the upper and professional classes of the time. The majority of the sources for Scottish pronunciation at this time are pronouncing dictionaries (e.g. Burn 1796, Sheridan 1780) and school text-books for children (e.g. Dun 1766, Anon 1776, Barrie 1794). Some of them used the accent of London as a model (e.g. Kendrick 1784), while others proposed the accent of polite Edinburgh society as the standard to be met (e.g. Adams 1797). Douglas (c1775) discusses the accent of Aberdeenshire.

The writers use a number of methods to represent pronunciation. For example, Scot (1779) manipulates the orthography, whereas Barrie (1794) uses a technique which both Sheridan and Walker (1791) used before him. He provides lists of monosyllables arranged by the orthographic vowel. He then indicates those words which have the same vowel sound by placing a specific number above the vowel letter. Lists of words are then arranged alphabetically, grouped under the same letter and number. An example is given in Table 2.1.

11 See, for example, Sheridan's comments concerning the standard of pronunciation (1780: xxx).

Many of the text-books outline what may be regarded as their own phonetic theory. For example, definitions of vowels, diphthongs, consonants, and word accent are provided by Barrie (1794: 273-274), whereas syllables are discussed by Dun (1766: x).

Table 2.1 An example of Barrie's transcription technique.

4
dark
dart
darn

Descriptions of ScE at this time tend not to provide details of the articulatory basis of pronunciation. There is some discussion of that nature, but it is not always helpful or without ambiguity. For example, Ellis (1869: 212) includes Wilkins's comments on the Scots pronounciation of "gh thorow (sic) the throat", which is not particularly informative. Similarly, Dobson (1968: 80-81) reviews discussion of John Hart's description of the pronunciation of i and u by Scots, highlighting several difficulties of interpretation. Generally, though, the descriptions of pronunciation tend to be impressionistic ones, based upon the auditory qualities of a pronunciation, and not upon how a sound is articulated. Douglas is an example of this where vowels are concerned (Douglas c1775: 13, Köhler 1966: 37-38).

2.3 The nineteenth century

In the mid- to late-nineteenth century there was a move away from impressionistic accounts of Scottish accents towards a far more systematic and objective approach. Underpinning this was the publication of works on phonetics, such as those by Sievers, Ellis, Sweet and Bell, which put the analysis of pronunciation onto a far more scientific footing.

Whereas one may regard the twentieth century as the period of phonological analysis of ScE, nineteenth-century accounts of Scottish accents are, on the whole, very much concerned with realisational detail.[12] In some cases, the minutiae and quantity of this realisational information is almost overwhelming.

A number of famous nineteenth-century phoneticians, in addition to less well-known individuals, analysed Scottish accents to a greater or lesser extent. The motivations behind the work of these men fall, in the main, into two categories: philological and phonetic. The former motivation is that of Ellis and Murray, whose respective works were, among other things, an attempt to clarify the development of ScE from Old English.[13] Bell and Sweet were interested in ScE realisations, it will be seen, mainly for their ability to illustrate articulatory phonetic features. A third motivation was the desire to note the pronunciation characteristics of a specific locality. An article by a writer named Sprague (1880), which outlines features of Edinburgh pronunciation in the late-nineteenth century, is discussed here as an example of such studies.

What follows is an account and evaluation of the work of these nineteenth-century scholars.

2.3.1 Alexander Melville Bell: 1819-1905

It is in the many books and monographs in which Bell explains his phonetic theory and describes Visible Speech (VS), a non-roman phonetic notation of which

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12 It should be remembered that although Henry Sweet and Baudouin de Courtenay had independently recognised the principle of the phoneme, and despite the fact that there was a general awareness of it in the late-nineteenth century, it was not considered to be an important concept until the early-twentieth century (Jones 1957: 3-7).

13 In fact Murray, Bell and Ellis all express the view that "Scotch", as they called ScE, was an earlier or older form of English English.

he was the inventor, as well as in his more general works on phonetics (e.g. Bell 1867; 1887; 1894a; 1894b; 1896), that we find many detailed phonetic descriptions of some features of Scottish pronunciation in the mid- to late- nineteenth century.

One drawback to this information is that Bell seldom specifies whose pronunciation he is discussing. He was himself born in Edinburgh[14] and, on occasion, he notes that it is his own "Lowland Scotch" pronunciation which he is transcribing (e.g. the transcription of part of Burns's Cotter's Saturday Night (Bell 1894a: 85-86)). There are other occasional geographical specifications: he cites the use of [ʔ] as an allophone of the /t/ phoneme in intervocalic position (although, of course, not in those terms) as being a characteristic of Glasgow pronunciation (Bell 1887: 45; Bell 1889: 21).[15] For the most part, however, he is content with very general indications, such as "Scotch". Thus, Bell's descriptions are, it will be shown, phonetically detailed, but are rarely accompanied by any useful sociolinguistic information about their distribution. For our purposes then, the information Bell provides is, to a certain extent, incomplete.

2.3.1.1 The data

Bell supplies a great deal of detailed realisational information on vowels (e.g. Bell 1849: 25, 26, 62; Bell 1889: 43, 46; Bell 1894a: 40). As far as consonants are concerned, much of his descriptive accounts would not seem out of place in a modern phonetics textbook. There is the previously mentioned note on the glottal plosive, as well as a phonetic description of the realisation of the /r/ phoneme. Bell describes the latter in terms of "vibration of the whole forepart of

14 Biographical details of Bell's life can be found in Hopkins 1977.

15 It is interesting to note that although both Bell and Sweet (1877; 1901; 1908) make reference to [ʔ] as a /t/ allophone in Glasgow and Renfrewshire, Murray (1873), in his description of the accent of the southern counties of Scotland, does not. This would imply that in the late-nineteenth century this allophone had a greater restriction on its geographical distribution than it does today (cf. Wells 1982: 409; Aitken 1984a: 102). Of course, there is always the possibility that Murray was just not aware of it.

the tongue", identifiable as IPA [r] and/or [ɾ] (Bell 1896: 8). His account of the realisation of the /l/ phoneme clearly indicates that it was dark, that is velarised (or perhaps even pharyngealised) as he notes "the superaddition of a vowel sound, nearly that of u (9). The l being thus to sound almost like ul in ultimate" (Bell 1849: 144). The manner of description indicates a sound which would equate with IPA [lˠ], and in descriptive terms differs little from some modern writers' accounts of clear and dark /l/ realisations (e.g. Ladefoged 1975: 55; Gimson 1962 (1980): 200). The place of articulation of /x/ is described as "at the middle of the soft palate" (Bell 1882: 22), and Bell also describes the articulation of [x] in a manner which, again, is understandable to the modern reader: "while sounding C or Є allow the lips to approximate, and the effect will be heard of the "back-mixed" consonant" (Bell 1894a: 23).

Scottish intonation patterns are mentioned only in passing and are described in a sweeping and generalised fashion. He draws attention to two main patterns: one, a repetition of a falling pattern, he associates with the west of Scotland; the other, predominantly rising, he associates with the north of the country.[16]

Although we can criticise Bell for such a limited account, it should be noted that it is possible to encounter similar treatments of Scottish intonation in late twentieth-century literature (e.g. Abercrombie 1979: 68; Wells 1982: 414), and that at the present time there is still a paucity of information concerning all suprasegmental features of Scottish accents.[17]

There are what we would regard as structural comments concerning /wr-/, to the effect that it can be a phonotactic possibility in initial position: "in the Scotch

16 Interestingly, this account does not to square with later twentieth-century writers such as McClure 1980. See further, p 55.

17 Information on aspects of suprasegmentals in ScE in the twentieth century is reviewed later in this chapter, p 54 ff.

dialect, both letters are still often heard in such words as wretch, wright, &c" (Bell 1849: 143).[18]

Thus, one can see that Bell's descriptions of certain features of Scottish pronunciation are comparable in terms of phonetic accuracy with descriptions of pronunciation by twentieth-century writers. In addition, much of what he wrote can be found in the work of other nineteenth-century writers such as Sweet, Murray and Ellis, a fact that attests, firstly, the influence of Bell on those who were his pupils and, secondly, the extent which they collaborated both with him and with each other.

2.3.2 Henry Sweet: 1845-1912

Like Bell, Sweet includes references to particular features of Scottish pronunciation in a number of his works on general phonetics (e.g. Sweet 1877; 1902). Again, like Bell, he very seldom specifies the origin of these pronunciations in any more detail other than "Scotch", although occasionally we are informed that the pronunciation is that of Glasgow or Edinburgh (e.g. 1877: 7, 15). Much of the data which he cites can be found in Bell's works: /r/ realisations; the presence of /x/; and general remarks on Scottish intonation patterns. Original material includes notes on articulatory settings of the lips and the pharynx.

Sweet never wrote about a sound which he himself had not heard (1877: xi; 1890: iii). Thus we may ask ourselves upon what sources he might have based his comments concerning Scottish accents. A few suggest themselves. Sweet's mother was Scottish and she may have used the articulations to which he refers. Sweet states that as a result of his parentage he himself possessed "a few Scotticisms" (Sweet 1890: v-xi). Secondly, Sweet was taught phonetics by Bell, who, as has

18 Barrie wrote that "w is silent before r" (1794: iv). Whether he is being descriptive or prescriptive is debatable.

I am informed that the speech of a resident of Denholm, taped in the 1950s, would suggest that there are still a very few older speakers in this area of Scotland who still possess this feature. (Personal communication from M K C MacMahon.)

already been noted, was himself a Scot. Moreover, the similar examples noted by both men would seem to suggest that Sweet might have been describing Scottish sounds which Bell had originally brought to his attention as characteristic of Scottish accents. Indeed, Sweet occasionally notes that Bell had done this (e.g. Sweet 1880-81: 339; 1877: 7). One must also bear in mind that for both Bell and Sweet the purpose of citing sounds from a particular language or accent generally was to exemplify a detail of phonetic theory, whether a description of a place or of a manner of articulation. Thus the similarity between their respective choices may well be explained by the fact that most of the examples which they have in common are characteristic, well-known, Scottish sounds, which their readers would have little difficulty in bringing to mind, thus facilitating their understanding of the material that was being presented.[19]

2.3.2.1 The data

Realisational data is most common, including such facts as /t/ realised as [ʔ] (Sweet 1877: 7, 1880-81: 339); the presence of preaspiration (Sweet 1877: 76)[20]; /hj/ as [ç] (Henderson 1971: 111); /r/ as [r] and/or [ɾ] (Sweet 1888: 4); /l/ realised with "back modification", i.e. as dark /l/ (Sweet 1877: 45; 1890: 85); and detailed phonetic comments on the quantity and quality of some Scottish vowels (e.g. Sweet 1877: 19, 26, 71; 1890: 76-81). There is also information on phonological structure, such as the absence of h-dropping (1890: 83).

Sweet also includes notes on certain suprasegmentals. His comments on articulatory setting draw attention to a narrowing of the upper glottis by Scottish speakers, which "gives an effect of strangulation" and "which is of a peculiarly

19 See Bell's remarks concerning "Lowland Scotch" (1882: 85).

20 Sweet regards this feature as "Scotch". If we allow Sweet's use of the word "Scotch" to encompass the speech of the Highlands and Islands, then his observation does not necessarily conflict with twentieth-century studies, which restrict preaspiration to Highlands and Islands English (e.g. Shuken 1984: 157-158). On the other hand, we cannot be exactly sure whose speech Sweet was describing at this point.

harsh character" (1877: 98).[21] Elsewhere Sweet refers to this effect as the "pig's whistle" (1890: 73). He remarks on a tendency to lip protrusion when articulating rounded sounds (Sweet 1877: 14). His comments on intonation are brief and reminiscent of Bell's, indicating a "rising tone...employed monotonously, not only in questions, but also in answers and statements of facts" (1877: 95). Glasgow speakers, he notes, are singular in possessing predominately a falling tone (loc. cit.).[22]

2.3.3 James A H Murray: 1837-1915

Murray's Dialect of the Southern Counties of Scotland (DSS) stands as one of the landmarks in Scottish linguistic description.[23] As an account of an accent (i.e. pronunciation), the work is set apart from those which precede it (such as Gregor 1866: 3-5) by Murray's application of systematic phonetic theory and notation to the description of pronunciation, rather than superficial indications. It is the first description of a Scottish accent (and dialect) which makes any attempt at thoroughness and accuracy.[24]

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21 The upper glottis is most probably the top of the larynx. It is interesting to note that the only study of ScE voice quality published since Sweet's day mentions "harshness" as a common feature of the speech of Edinburgh males (Esling 1978: 20). Could this be the same feature which Sweet was describing?

22 As with Bell's opinions on Scottish intonation, Sweet's too are rather at odds with Kenworthy's (1975) data on Edinburgh speakers, since she notes the presence of all types of intonation contours used with questions. In addition, the remarks on Glasgow conflict with McClure's (1980) account of twentieth-century west of Scotland intonation as well as with the present writer's native-speaker intuition.

23 It should be noted that Murray uses the term dialect to include pronunciation, lexis and syntax. In this thesis a distinction is made between dialect, which is lexis and syntax, and accent, which is pronunciation. Unless quoting directly from Murray, the terms accent and dialect should be understood to have the latter definitions.

24 Murray himself drew attention to the originality of DSS, at least with reference to the grammatical section, stating that his "own *Grammar of the Southern Scotch*... was actually the *first* attempt at recording minutely and lovingly the accidence and syntax of an English dialect" (Murray K M E 1977: 83).

Murray's interest in phonetics and in the description of Lowland pronunciation can be traced from a course in phonetics which he attended in 1857 (his teacher being, incidentally, Melville Bell). In 1859 he criticised a collection of poems and songs in the Border dialect on the grounds that they were "an attempted restoration, and not the Scotch of any particular time or district" (Murray K M E 1977:51). Murray was more interested in synchronic descriptions of accent and dialect. For private study he began to produce phonetic transcriptions of Border pronunciation of the Gospel of Matthew, of half of the Acts, of the Books of Jonah and Ruth, and an uncompleted phonetic key to Jamieson's (1825) Etymological Dictionary.[25] DSS was in this tradition.

2.3.3.1 Sources

Murray wrote of "Lowland Scotch", the subject of DSS: "it is my native dialect...as to which I am a competent witness" (Murray 1873: 89). Consequently, it is reasonable to assume that the accent described in DSS is, to a great extent, Murray's own accent, supplemented by many years of unsystematic observation of his Lowland Scots neighbours' pronunciation.

In terms of formal education, Murray's youth was typical of that of a rural boy of working class origins.[26] It is likely that in his early years his accent would have been fairly typical of a Hawick younger male working-class speaker (except that he possessed a stammer (Murray K M E 1977: 38)). At the age of seventeen, he was said to have had a "habit of sometimes hesitating over a word" and his resulting speech was described as being "a rather unusual and self-conscious enunciation" (loc. cit.).

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25 Murray K M E 1977: 51. This key was never used in any edition of the Dictionary and Murray considered the lack of indication of pronunciation to be a serious flaw, undermining the value of the work (Murray 1873: 91).

26 Murray's life has been documented in Murray K M E 1977.

On moving to London in 1867, his accent would have been subject to new, outside influences. In 1870, three years before the publication of DSS, he remarked on the anglicisation of his accent and the comparative "Scottishness" of his fellow countrymen.[27] Yet Sweet and Ellis, whose acquaintance he had made in London, were of the opinion, as were many other observers, that Murray's accent remained Scottish (MacMahon 1985: 109-110).

Thus we gain the impression that at the time of writing DSS, Murray's accent had undergone some changes since his youth, but that he had, to a large extent, retained certain detectable Scottish characteristics. Murray has been described as possessing the ability to "adjust his accent from Scottish to RP(?) reasonably effortlessly, as the occasion demanded" (MacMahon op. cit.: 110). If in DSS Murray did use his own speech as a source, it is probable that he would have had little difficulty in utilising the Scottish end of his range.

In addition to drawing on his personal knowledge of his own accent, Murray included in DSS the comments and observations of five individuals: one from Jedburgh who "knows the Border dialect well"; the editor of the Kelso Chronicle; a resident of Selkirk of 25 year's standing; Bell, who had taught Murray phonetics years earlier; and Ellis.

The first three comment in a general fashion, either about geographical variation or about how the accent had changed in their lifetime. Being native-speakers themselves, or having lived in the area long enough to have made observations on it over a number of years, it is likely that they are trustworthy commentators and that their observations, as far as they go, are reliable.

That Ellis and Bell's opinions on Scottish are found in DSS attests once again the close contact which existed between this group of linguists. Murray

27 "How thoroughly Scotch even literary men speak here. I could hardly believe it. I never noticed it as much before. I find per contra that I am taken for out-and-out English by everyone. How funny since all Londoners could tell me to be Scotch at once...and yet here no-one suspects me to be anything but English who does not know" (Murray K M E 1977: 92).

evidently respected their opinions. He not only made use of their phonetic theory and alphabets, but also referred to their analyses on a number of occasions. For example, he cites their analyses of particular Scottish vowel qualities (e.g. Murray 1873: 104). One can only speculate on the degree of influence that they had on Murray's analysis, but it is likely that it was substantial.

2.3.3.2 The accent

Despite the fact that one can establish possible sources which Murray may have used, it is not possible to extract from DSS conclusive information as to exactly whose accent is being described. Although it is apparent from a number of comments that Murray was aware that the accent of the southern counties was not one homogeneous mass, he, like his contemporaries, considered regional variation to be the sole factor which needed to be taken account of in a systematic way. Thus there is no attention to other sociolinguistic factors, such as variation by age, sex, class or style. Consequently, from a present-day standpoint, the data has to be regarded as somewhat incomplete.[28]

2.3.3.3 The data

Murray structures his description of the vowels and consonants by proceeding through the alphabet and noting the sounds associated with each letter. He utilises the phonetic theory of Bell's VS, and includes a short description of it in DSS. It is Ellis's palaeotype which he uses for notating pronunciation, in addition

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28 Murray's approach to linguistic description can be seen as being typical of dialectologists of the late-nineteenth century. Evolving as it did from comparative philology, traditional dialectology was concerned with investigating and recording the regional distribution of linguistic features in order to trace historical sound change in languages (cf. Petyt 1980: 37-38). Murray's prevailing concern with regional variation is apparent in the division of the country into geographically defined dialect areas and in the constant references to regional linguistic variation (e.g. Murray 1873: 80). His awareness of age variation can be seen in the comments regarding the differences in pronunciation of older and younger generations (Murray 1873: 84, 122, 130). Awareness of class, sex and style variation is not so easily identifiable.

to an occasional use of his own spelling system. By means of a table, the palaeotype can be related to the VS symbol in order that the "organic formulation" is clear (Murray 1873: 98-103). The result is a reasonably accurate phonetic description (although see the comments below concerning consonants), from which it is possible to reconstruct the accent and to present it in an IPA format.

Despite his enthusiasm concerning the ability of VS and palaeotype to "show the exact values of the sounds used in the Scottish dialect" (Murray 1873: 98), Murray did not utilise their potential to the full. He felt consonants to be less important than the vowels in the description of an accent (Murray 1873: 93-94, 118), and, probably as a consequence of this, he omits any description or label for the letters B, T, D, K, SH, NG and V, and he deals with the remaining consonants in varying degrees of detail. The realisational information concerning vowels is, on the other hand, very detailed, with comments on both quantity and quality of stressed and unstressed vowels.

As for suprasegmental features, Murray comments briefly on the tempo of Scottish accents, remarking on the "greater natural or ordinary length of vowels (which) is no doubt a chief cause of that more leisurely enunciation which is known as the Scotch Drawl" (Murray 1873: 98).[29] Murray does not attempt an analysis of intonation patterns, but merely draws the reader's attention to Bell's treatment of the subject (Murray 1873: 94-95).

2.3.4 Alexander J Ellis: 1814-1890

Ellis's Early English Pronunciation, Part V (1889) (EEP) contains some of the most in-depth, as well as geographically wide-ranging, phonetic transcriptions

29 Sweet does not make any comment on the tempo of Scottish accents, but his view of vowel length in most Scottish accents contrasts with Murray's observation. Sweet holds that "in many Scotch dialects there are no full long vowels at all, all long vowels being shortened to half-longs" (Sweet 1877: 59). Yet, bearing in mind the fact that both would have based their statements on subjective impressions of different speakers, this possible conflict of opinions may be of no great importance.

of Scottish accents of English ever undertaken.[30] The work has received much criticism concerning, for example, his use of palaeotype and the errors to which such a complex transcription system is prone (e.g. Petyt 1980: 73,76). As far as the Lowland section is concerned, we can identify gaps in the geographical coverage and in the subject areas examined.[31] Moreover, there are sections which should be treated with a degree of caution, as some of the transcriptions have as their source texts written by informants using what Ellis refers to as 'informant orthography' (henceforth io), the accuracy and consistency of which is open to debate (e.g. Ellis op. cit.: 683, notes 5 and 8). Moreover, Ellis states that not all transcriptions were completed under ideal conditions and, consequently, may not be as accurate as he would have wished (Ellis op. cit.: 683, notes 4 and 7; op. cit.: 748).

Ellis did not transcribe all of the material himself, but had the assistance of a number of colleagues in the collection of data. His main accomplices in the Lowland division were Bell and Murray, who not only gave Ellis permission to use their published work (see below) and information which they communicated verbally, but also interviewed informants and palaeotyped their pronunciation on Ellis's behalf. In addition, as previously mentioned, Ellis utilised the material provided by numerous informants, who, using io, supplied examples of their own pronunciation or of an accent with which they were very familiar (the latter method

30 Ellis's technique of presenting detailed transcriptions of the speech of individuals, in addition to generalised summaries of the pronunciation features of regional areas, has not been attempted by later writers on ScE. Although detailed phonetic analysis may be the starting point of many twentieth–century studies, the main concern tends to lie with phonological analysis. Thus, the raw data of pronunciation does not reach the printed page, except in the most generalised fashion (e.g. Mather and Speitel 1975).

31 Geographically, Ellis followed Murray's lead of dividing Scotland into four dialect areas: South Lowland, Mid Lowland, North Lowland, and Insular Lowland. Excluded are the Highlands and Western Islands of Scotland (i.e. those areas beyond the Celtic Border (Ellis op. cit.: 1)). Within the four dialect areas there are locations which he did not investigate in great depth, e.g. Northern Mid Lowland (Ellis op. cit.: 751).

With reference to the neglect of some phonetic features, one might note that Ellis's description of supra-segmental features is extremely superficial (Ellis op. cit.: 681).

in particular being of questionable value). There were also various intermediaries who assisted in the palaeotyping of the io.[32] Such methodology provides much scope for human error.

The material which was collected especially for EEP can be divided into four text types: comparative specimens (cs), dialect test (dt), classified word list (cwl), and transcriptions of the Book of Ruth (br).[33] Yet one is left with the overall impression that, for the Lowland division, Ellis tended to rely more heavily on previously collected material, some of which was already in print elsewhere, e.g. lines from Bell's Visible Speech (1867); a palaeographic transcription of Tam O'Shanter; and, most extensively, information from Murray's DSS (on which see above, pp 19-23). Moreover, Ellis refers to the importance of material which he obtained via conversations with Murray, Melville Bell and Graham Bell.

2.3.4.1 The data

There is a wealth of segmental phonetic data contained in EEP which, due to the use of palaeotype, is initially rather daunting and inaccessible to the phonetician of the late twentieth century, schooled in the traditions of the IPA.

The transcriptions are not accompanied by comments on realisations; rather, the palaeotype symbols can be related to a general preface section, where their articulation is described and commented on in varying degrees of detail.

At the beginning of each description of a dialect area, Ellis presents a summary of a few points which, to him, characterise the area and set it apart from the others. Of course, this is not done in terms of phonological features (cf fn 12), but in terms of realisational features. The remainder is a collection of palaeotype

32 Full details of informants, palaeotypers and other sources of information are contained within the text of EEP (Ellis op. cit.: 681-820). The information is summarised in the Alphabetical County List and in the Alphabetical Informants List (Ellis op. cit.: 64*-76*).

33 For a list of the geographical origin of Ellis's cs and accent illustrations for the Lowland division, as well as maps illustrating the same information, see Appendix 1.

transcriptions - the raw information of individuals' pronunciation. Ellis does not attempt to process it by extracting phonetic data from the specimens and presenting it in an ordered or structured fashion.

Yet, by sifting through the palaeotype transcriptions, one can extract the information. For example, from the cs one can discover that in Hawick /l/ could be syllabic - muckle is palaeotyped as (mɜk'l); in Hawick and Edinburgh there was probably lateral release of plosives - kettle is palaeotyped as (kæ̀tᶜl) and (két'l) respectively; in Edinburgh and Arbroath there was a syllabic nasal - lesson and certain are (les'n) and (sᴇrt'n) respectively; in Arbroath (f) is recorded for /ʍ/ in initial position; in Keith /vr/ is a phonotactic possibility in initial position - wrong is palaeotyped as (vraq); in Wick a palaeotyping of the word first suggests a retroflex fricative realisation of the /r/ phoneme - (fersht); and in Dunrossness a palatalised lateral is noted in initial position in a word such as laugh - (ljakh) (Ellis op. cit.: 684-693).

There is no information on any suprasegmental features.

2.3.5 T B Sprague

In 1880 T B Sprague recorded aspects of the English of Edinburgh, using Ellis's system of Glossic Spelling to include a few notes on pronunciation. Although Sprague's name may not be as familiar to present-day phoneticians as those of Sweet, Bell, Murray and Ellis, his article is of interest and importance due to the fact that it is an account of the speech of a nineteenth-century Scottish city. It will be remembered that, due to the interest in philological matters, the majority of accent descriptions at this time concentrated on the speech of rural communities. Sprague's description is, then, quite unusual.

Sprague tells us that he was not himself a native of Edinburgh, but that his remarks on pronunciation were the result of observations made over a period of six years' residence in the city. He does not appear to have restricted his description to any particular social group (again, there is a contrast with his contemporaries, who were interested in the "non-mobile, older, rural male"[34]): he notes the pronunciation of newspaper boys alongside that of the "educated residents in Edinburgh" (Sprague 1880: 113).[35] Moreover, among the latter group he notes "a greater difference in pronunciation...than there is between Englishmen of a similar class" (Sprague loc. cit.).[36]

Sprague's is a comparative study, with the "speech of...London" being used as the yardstick (Sprague op. cit.: 106). He concentrates on the areas of language where, in his opinion, Edinburgh accents differ most markedly from London accents. What follows is a summary of those comments which pertain to pronunciation.

2.3.5.1 Segmental features

In the main, Sprague's comments deal with systemic and selectional differences between the two varieties. There is very little information on realisation.

2.3.5.1.1 Systemic differences

Sprague notes the presence of three segments which are not present in London English. These are "the German ch and u" (Sprague op. cit.: 113) and a pronunciation of <wh> which he describes as being "distinctly aspirated" (Sprague

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34 This term has been used to characterise the type of individual who was sought by the nineteenth-century dialectologists as their informants. It is often abbreviated to "norm". It has been argued that whatever the nineteenth-century dialectologists' theoretical methods of speaker selection were, in practice hardly any survey kept strictly to them (Johnston 1984).

35 It should be noted that quotations are transliterated from Glossic Spelling in which Sprague wrote the article.

36 This would appear to be at odds with the opinion which Sweet and Ellis hold, namely that the speech of Edinburgh or Lothian is a "received Scotch", comparable in terms of social status, familiarity and uniformity with RP in nineteenth-century England.

op. cit.: 116). It is likely that he was referring to /x/; to a centralised front close-mid rounded vowel in the region of CV 10 [ø]; and to /ʍ/, respectively.

2.3.5.1.2 Selectional differences

Sprague notes [ʌ] as the first vowel in compromise, comparable and conserve (Sprague op. cit.: 115); [ʃ] in assume (Sprague loc. cit.); [ʒ] (or possibly [zj]) in presume (Sprague op. cit.: 116). In proper nouns, [z] as the pronunciation of a termination spelt <-is> (i.e. <Foulis>), and [is] as the pronunciation of those ending in <-es> (i.e. <Menzies>).

2.3.5.1.3 Realisational differences

As noted above, there is a paucity of realisational information. The previously mentioned description of <wh> as "distinctly aspirated" argues for a voiceless fricative, but the place of articulation and lip position are open to speculation. Sprague comments on one realisation of /r/ which he describes as being "often emphatically trilled, but" he says, "this is not so common as wh aspirate" (Sprague op. cit.: 116). There is an indication here of at least two, perhaps three, /r/ realisations: [r], [ɾ], and possibly [ɹ].[37]

2.3.5.1.4 Suprasegmental features

Sprague briefly extends his account of the accent of Edinburgh English to make some subjective comments on the tempo of Scottish pronunciation in general. "Scotchmen, as a rule," he states, "speak more slowly than Englishmen" (Sprague op. cit.: 116). He argues that this is as a result of the "aspirated" wh and the "often emphatically trilled" r which take more "time & effort" to articulate than

37 Perhaps Sprague's failure to be more specific about /r/ realisations is due to the difficulties which he had with Glossic Spelling, which, he tells us, centred around "principally...the use of the letter r" (Sprague op. cit.: 116).

the corresponding London realisations. Similar comments can be found in Murray (1873: 98). (See above, section 2.3.3.3.)

Sprague lists a number of words which exhibit differences in word accent position in Edinburgh and London pronunciation. He places a stress mark in the following fashion to contrast London and Edinburgh pronunciation: magazine', mag'azine; commi'ttee, committee'; manu're, ma'nure. Presumably this indicates maga'zine and 'magazine, co'mmittee and commi'ttee, and ma'nure and 'manure in London and Edinburgh respectively.

At the present time it is not possible to conjecture as to the accuracy of these descriptions. There are no comments on word accent in ScE by his contemporaries, and as will be shown later, writers in the twentieth century have not published any work concerning this area (see below, section 2.4.2, and Aitken 1984a: 102). The opinion of the present writer is that although 'magazine is a very common pronunciation today, commi'ttee and 'manure seem less likely.

Sprague draws attention to differences in syllabification of words in London and Edinburgh speech. One example quoted is that of the pronunciation by Edinburgh newspaper boys of the word review with three syllables: re-vi-ew. One might argue, though, that the cries of newspaper sellers are unrepresentative of usual pronunciation. The other examples, with Sprague's transcription in Glossic Spelling given in brackets, are: two (tu-u); broad (bro-ad); buoy (boo-oy).[38] Of these last three, the syllabification of broad and buoy seem very plausible for speakers from the east coast. The division of two into two syllables seems less likely.

38 Abercrombie notes differences in syllabification between Scottish and English English, suggesting a preference among Scottish speakers for open syllables (Abercrombie 1979: 82).

2.3.6 Evaluation

How then should the work of these writers on Scottish accents be evaluated? Firstly, one can consider the quality of their phonetic description. As has been stated, this body of work is the first application of systematic phonetic theory to the description of Scottish accents. Some of their terminology may have passed out of use (e.g. "breathed" meaning voiceless, and "open" as a manner of articulation); certain aspects of the theory employed may have been outmoded (e.g. Bell's vowel theory); and their transcription systems may have been generally replaced by, for example, the IPA alphabet; but, nonetheless, it is possible to overcome this and to understand their descriptions. One notices a degree of variation in the detail and calibre of their descriptions: whereas sections of Bell's discussions would not be out of place in a modern phonetic text-book, some of Sprague's comments are superficial and occasionally obscure.

It is also worth noting that Bell, Sweet, Sprague and Murray do not confine themselves to segmental features but comment on suprasegmental features such as tempo, intonation, word accent and voice quality. Although there is less attention given to these areas it is evident that the writers are aware that suprasegmental features are characteristic of an accent as segmental features are. Ellis alone side-steps the area of suprasegmental features.

There is no use made of instrumental techniques by any of these writers. Palatography and kymography are techniques which would have been available to them by the 1870s.[39] One could see the value of such investigatory techniques to each of them, but their failure to utilise instrumentation was probably a result of the

39 Abercrombie (1957) describes how J Oakely Coles read his paper "A plan for ascertaining more accurately the physiology of speech" to the Odontological Society of Great Britain on 5 February 1872. In it he outlined his method of direct palatography. Norman W Kingsley developed indirect palatography and first made the technique public in 1879.

opinion in British phonetics at that time that such techniques were not quite acceptable.[40]

The range and depth of the geographical coverage varies too. The comments made by Sweet and Bell concerning Edinburgh accents are not very detailed. In addition, we cannot tell whose speech is being described. Murray's coverage of the southern counties is, likewise, lacking in detail about informants. Yet it seems reasonable to assume that Murray himself was a reliable source and that the features which he notes were those which he regarded as typical of the area in general. Ellis's coverage of Scottish accents is geographically wide-ranging and, in addition, he gives us information concerning his sources. Yet, Ellis did not include any specimens from the west of Scotland and, although this does not invalidate the work for his purposes, it results in a significant omission from our viewpoint: the accent of Glasgow. Presumably the speech of Glasgow was too "mixed" for Ellis's purposes, as its population had been increased by the influx of people from other parts of Britain. In addition, there are flaws in his method of work which must be borne in mind.

Lastly we should note the high level of agreement among them, which may reflect in part the degree of communication and co-operation between them. The only major differences of opinion concern dialectal area boundaries.

2.3.7 Conclusion

The interest in ScE pronunciation which lies behind these works can be regarded as a result of the contemporary interest which educated individuals in the nineteenth century had in language and languages in general. Although it is possible to find flaws in methodology or to question specific details, the aim of these writers - to record and document ScE - cannot be faulted. The writings of Murray and Ellis especially were highly influential among those interested in ScE

40 In fact, the first instrumental data to be published by a British phonetician is contained in Daniel Jones' Introduction to the Pronunciation of English (1918).

pronunciation, and, as a result, much published work was forthcoming on the accent and dialect of specific areas of Scotland.

If one of the writers considered here is to be singled out it is, without question, James Murray. Not only did DSS show ScE to be as valid and valuable a subject of study as any other language variety, but it also set a standard which many subsequent writers would attempt to meet.

2.4 The twentieth century

Due to the increase in the volume of published studies of ScE accents in the twentieth century, this review will not focus on individual writers, but will consider the canon as a whole. It will deal firstly with the study of segmental features and then turn to the literature concerning suprasegmental features.

The differing nature of these various publications will be reviewed: their methodology; the motivation which lies behind them; in addition to other issues, such as the methods used in the presentation of the data. It will be seen that the studies are very diverse in nature, so that there is no consensus which emerges concerning how to approach a description of the accent.

It would be wrong to attempt to measure all of the following publications with the same yardstick. Some are as the result of much investment of money, time and labour, and are to be regarded, quite rightly, as ground-breaking. Others merely set out to present a general indication of the major points of various accents and are, therefore, less detailed.

2.4.1 Segmental features

The literature reviewed here is not necessarily exclusively concerned with the phonetic aspects of ScE. Some publications may be concerned ultimately with various other linguistic features, such as phonology or sociolinguistics (e.g. Romaine 1978). However, such publications will be included here because they have sections, large or small, containing information on realisational aspects of ScE. It is these sections which are of relevance to the present review.

2.4.1.1 Methods of data collection

In a number of cases the information about methods of data collection is not supplied (e.g. Abercrombie 1954; Aitken 1986, 1984a, 1984b; Grant and Robson 1932; McAllister 1938; Wilson 1912; Wright 1927), although it is often possible to glean some impression of where the data has come from.[41]

There are a number of writers who base their conclusions upon the analysis of data which they have elicited by means of formal surveys[42] (e.g. Agutter 1988a, 1988b; Dieth 1932; Hughes and Trudgill 1979; McClure 1970, 1977; Mutschmann 1909; Romaine 1978; Watson 1923 (for lexis but not pronunciation); Wilson 1926; Winston 1971). Other studies have been carried out using a less rigid approach. For example different word lists or reading passages have been used with different informants (e.g. Wilson 1915, 1923).

Writers such as Wettstein (1942) and Zai (1942) give no indication of having used either of the above approaches. Wettstein (1942) reports that he gathered all of his data and Zai (1942) some of his data via conversations with their informants, which, although informal, were managed and guided by the investigator.

Zai (1942) also refers to a more casual, yet ultimately more accurate approach: that of depending on a gradual accumulation of material via informal observation of speakers over a length of time. Abercrombie (1979) refers to the

41 For example, one would assume that individuals such as Abercrombie and McAllister would have gathered most of their information on ScE by means of observations, formal or informal, of the generations of Scottish students whom they taught.

42 The term "formal survey" is used here to indicate the use of word lists or reading passages prepared in advance by the author to elicit specific data. This material is presented in exactly the same format under similar conditions to each informant and the resulting material is then transcribed or recorded directly.

fact that his knowledge of ScE pronunciation is as a result of listening to students he has taught, aided by the observations which they have made to him concerning their own accents.

Various other writers, essentially but not exclusively those writing in the first half of the century, do not refer to any method of gathering data and one assumes that they used informal observations of individuals (perhaps even of themselves where appropriate) as the basis of their descriptions (i.e. Aitken 1984a, 1984b; Colville 1909; Dieth 1932; Grant 1913; Grant and Dixon 1921; McAllister 1938; Williams 1909; Wilson 1915, 1923).

Those writers who are attempting to summarise the state of knowledge concerning ScE accents will often confine themselves to a review of the existing literature available, rather than arguing everything from first principles. Wells (1982) and Macafee (1983) are good examples of this approach, where the information is collated in a clear and lucid fashion and the end result is a reliable account.

There is one other source used by writers on ScE: personal communication. Macafee (1983) includes one item of information which she has been given by a fellow scholar, but others have not been so particular as to source or quality. Colville's (1909) writings are filled with pieces of information passed to him orally which are little more than a succession of anecdotes, and therefore their reliability may be suspect.

Less than a third of the publications reviewed have made use of the formal survey. Those which have used this approach we can view as being complete in the type of information which they gathered: there will be so many citations of this or that word. As will be discussed in Chapter 3 of this thesis (p 48 ff.), a formal situation may not always be conducive to eliciting totally natural speech. Nevertheless, it does not preclude the collection of reliable data.

The use of "managed conversation" may result in a more relaxed performance by the informant, but it may still be a "performance" on the part of the speaker and, therefore, possibly unnatural at times. Casual observation of many individuals' speech over a period of months or years will produce the most natural pronunciation (cf. Abercrombie 1979; Aitken 1984a and 1984b; Dieth 1932; McAllister 1938). Moreover, some of the writers who use this approach tell us whose speech they were listening to and, as a result, we can set the details of pronunciation in a socio-economic context.

This last point leads on to another question: who exactly are the people whose speech has been set down for posterity?

2.4.1.2 Types of informants

The type of informants who are the focus of study is influenced by a number of factors. Firstly there is the question of whether the study has a sociolinguistic basis (e.g. Romaine 1978). In this case the survey will probably include a range of speakers who will be contrasted either by age, sex, social class, and so on. Alternatively, if the survey focuses on a particular geographical location, speakers will be selected exclusively from that area. (The geographical range of studies is examined in section 2.4.1.3 below.)

In the majority of cases there is no information given as to the identity of the individuals whose speech is under scrutiny (e.g. Abercrombie 1967; Aitken 1984a, 1984b, 1986; Colville 1909; Grant & Dixon 1921; Grant & Robson 1932; Macafee 1983; McAllister 1938; Wells 1982; Wilson 1912; Wright 1927). In some cases this seems reasonable: Macafee (1983) and Wells (1982) are reviewing other writers' work, so one may presume that the speech described is that of those writers' informants. On other occasions it seems to be less understandable. For example, one might argue that Grant and Dixon (1932) cannot justify their objective of describing "Modern Scots" if they do not inform us whose speech, in their opinion, it constitutes.[43] Likewise, Aitken (1984a, 1984b,1986) attempts

43 Although Grant and Dixon list the geographical spread of their data, we have no information concerning what sort of people or how many they used as informants.

general overviews of Scots and ScE in Scotland, but we are not informed whose accent he is using as the general guide.

Occasionally the reader is given socio-economic information in order to identify the speech community under examination. Thus we know that Abercrombie (1954) and Winston (1971) are concerned with the speech of educated and "polite" citizens. Presumably "polite" indicates that the speakers were of a certain social status and standing. Grant (1913), Trudgill & Hannah (1982) and Williams (1909) all interest themselves in the speech of "educated middle-class urban Scots". Agutter (1988a) and Hughes & Trudgill (1979) take their material from the speech of educated, young, middle class males and females, whereas it is working class children who provided data for both Romaine (1978) and Wilson (1915). Students appear to have been a popular source of information; Abercrombie (1979), Mutschmann (1909) and Williams (1909) have all used them as subjects of investigation. Occasionally, we are able to identify the exact individual involved. For example, Mutschmann (1909) made use of the pronunciation of William Grant, while McClure (1977) and Watson (1923) were happy to use themselves as informants.

Those writers whose aims are similar to Murray and Ellis, in that they wish to focus on the "genuine" or "pure" dialect, still target the (non-mobile) older rural male ((N)ORM) and, probably, his wife as the subject of their investigation. This group is made up from writers of the first half of the twentieth century, such as Dieth (1932) Wettstein (1942), Wilson (1915, 1923, 1926) and Zai (1942), who have all engaged in conversation with retired fishermen, shepherds, baillies, cattlemen, blacksmiths, weavers, servants and ploughmen.

In conclusion we can note the large group of publications which do not specify the types of informant used. We can also point out that the NORMs are sought out only by those writing in the first half of the century. The introduction of sociolinguistic concerns is most probably the reason why surveys after this time have a change of emphasis and target other groups (cf McIntosh 1952).

2.4.1.3 The geographical spread[44]

In the twentieth century a bias towards a regional approach to the description of accents and dialects has persisted, and one can understand why: it is an obvious and easy way to delineate a field of study. (For a regional listing of studies of ScE and Scots accents/dialects produced in this century and a map illustrating the regional coverage, see Appendix 2)

Proceeding through the regions one notices that some locations have been more popular than others.[45] For example, there has been no study which focuses on the accents of either Orkney or Shetland, although they have been included in general accounts of ScE accents (e.g. Grant & Dixon 1921), and their unique vocabulary items have been recorded. There has been no account of any accent within Fife or Central region. On the other hand, Strathclyde has received greater attention, with studies of aspects of the accents of Glasgow undertaken by Macafee (1983); of Lanarkshire, undertaken by Scherev (1933); and of Ayrshire, undertaken by McClure (1977), McNaught (1901), Wilson (1923), and Wright (1929).

Turning to Dumfries and Galloway, Riach (1978) published an account of the Galloway accents while, concerning the Borders, Watson (1923) wrote about Roxburghshire, as did Zai (1942), who produced an analysis of the accent of Morebattle. Wettstein (1942) took the area of Berwickshire as his geographical focus.

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44 Due to the linguistic situation in Scotland, this review does not include the accents of English found in the Highlands and Islands. (See chapter 1, section 1.1, pp1-3). For an account of the English spoken in these parts, see Shuken 1984.

45 It is worth remembering that the publications mentioned here are not all of the same type. Some are very detailed studies of one particular aspect of an accent (e.g. McClure 1977), whereas others are more wide-ranging in subject matter, although just as detailed (e.g. Dieth 1932; Speitel 1969).

Moving north, we note three accounts of Lothian accents: one of Midlothian, written by Speitel (1969); and three concerning the pronunciation of the people of Edinburgh, produced by Hartig (1928), Mather (1980) and Romaine (1978).

Tayside has received little attention, with only one study of the Perthshire accent, undertaken by Wilson (1915).

The Highlands and Grampian have been rather popular. The accent of Morayshire has been looked at by Cairns (1910/11) and again by Murison (1976). A large number of locations in Grampian were studied by Mutschmann (1909) (Banff Parish; Waulkmill Farm, Elgin; Gateside, Forres; Burghead; Kemnay, south Aberdeenshire; Maud, Aberdeenshire, and Peterhead), while Wilson (1912) and Nehls (1937) looked solely at Aberdeenshire. The Buchan accent and dialect has received attention from Forrest (no publication date), Dieth (1932) and Wölck (1965). Dieth places the location of the Buchan accent as "between Deveron and Ythan and the coast" (op. cit.: xvi).

Other writers take a larger geographical basis for their work. For example, one study of McClure's ranges "over a large area of west and south Scotland (the counties of Dumbarton, Stirling, Renfrew, Ayr, Lanark, Peebles, Selkirk, Wigton, Kirkcudbright and Dumfries)" (1970: 3). Grant and Dixon (1921) use informants from a huge area of the country: Berwick, Peebles, Haddington, Edinburgh, Linlithgow, Fife, Clackmannan, Kinross, Stirling, Dumbarton, Renfrew, Bute, Ayr, Lanark, Wigton, Kirkcudbright, West Dumfries, as well as including a few details of the accents of Orkney, Shetland and the north east.

2.4.1.4 The type of data collected

A number of authors have set themselves the task of gathering information to produce brief guides to ScE or to a variety of ScE. Such works will contain information of greater or lesser depth on the phonemic system, phonemic structure, phoneme incidence and phoneme realisation of the accent under scrutiny

(Abercrombie 1979; Aitken 1984a & 1984b; Dieth 1932; Grant 1913; Grant and Dixon 1932; Hughes and Trudgill 1979; Macafee 1983; McAllister 1938; Mutschmann 1909; Watson 1923; Wells 1982; Wright 1927). Others concern themselves with examining a few aspects of a variety in greater detail (e.g. Agutter 1988a).[46]

Concentrating on vowels first, we see that a number of writers supply information on the realisation of vowels in a particular accent: Dieth (1932), Mutschmann (1909) and Zai (1942) are a selection of the writers who provide reliable information which is relatively easy to understand as they use either IPA or one of Sweet's systems. Wettstein (1942) does likewise, and also gives a good indication of the varying degrees of lip-rounding involved in the production of the rounded vowels. Wilson's (1923) phonetic spelling system results in his vowel realisations being impossible to decipher with any certainty. Unstressed "i" realisations are noted in a not too detailed fashion in an article by Grant and Robson (1932), and "i, ɛ and e vowels in Aberdeenshire" have their realisations described by Wilson (1912). In both cases, the descriptive method is hard to follow and the information virtually irretrievable. The information contained in McClure's (1970) investigation into vowels before /r/ is purely phonemic, as is Winston's (1971) analysis of certain vowels of "educated Scots".

Agutter (1988a, 1988b) and McClure (1977) both examine vowel length in different accents, concentrating on the phenomenon of the Scottish vowel length rule (SVLR), and arriving at opposite conclusions. Abercrombie (1957) writes a short piece on the /ɛ/ vowel, in which he describes its phonetic realisation and its lexical incidence; McClure (1970) investigates its lexical incidence further. Vowel harmony in Aberdeenshire Scots is noted by Dieth (1932) and analysed further by Flom (1934). Aitken (1962a) comments on its possible presence in this

46 There are other books, articles, theses and dissertations which deal with the phonological aspects of ScE phonemes (e.g. Kaminska 1995), but these lie outwith the scope of this review, since they focus on the phonological interpretation of the data, not on the analytical quality of the data.

and other Scots accents. No further mention of vowel harmony in Scots or ScE appears in the literature.

Turning now to consonants, we note once more the accurate and detailed articulatory description of the allophones of the consonant phonemes of specific accents by writers such as McAllister (1938), Mutschmann (1909), and Speitel (1969). The consonants which have received special attention include /r/: for example, there is a sociolinguistic study of the allophones by Romaine (1978); certain /r/ allophones are listed by Aitken (1984a); and /r/ distribution is described by Williams (1909)). Allophonic variation of /l/ is noted by Zai (1942).[47]

2.4.1.5 Methods of analysis

Three methods of analysis of data are used by twentieth-century writers: auditory, sociolinguistic and instrumental. The most popular by far is the first and all but a handful of writers have used this method exclusively. Of course not all of the investigators would have been trained to the same standard, and they do not all utilise the same phonetic theory.

Other authors have investigated the sociolinguistic aspects of ScE accents in a systematic fashion (e.g. McClure (1970), and Romaine (1978)). Others have simply given us their own social reactions to certain allophones or phonemes, such as Grant's judgements of pronunciations as "affected", or "less objectionable" (1913: 50, 52). McAllister frequently makes comments in a similar vein, describing the realisation of certain plosives as [ʔ] as a "degenerate tendency", and dark /l/ as a one of the "cruder local characters" (1938: 61, 105).

Published instrumental studies of ScE are rare.[48] Two early uses of instrumental investigation occur in the studies of Dieth (1932) and Wettstein

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47 A fuller review of the literature dealing with /r, l, p, t, k/, as well as /w/ and /ʍ/, is dealt with in Chapters 4, 5, 6 and 7 of this thesis.

48 McClure has recently published a survey of the formant values of ScE vowels, but the present writer has not as yet had access to it.

(1942). Both use the kymograph to measure vowel length.[49] Agutter (1988a, 1988b) uses a Digital Sona-Graph 7800 and Sona-Graph printer to investigate Scottish vowel-length and McClure (1977) utilises a four-channel kymograph.[50]

2.4.1.6 Purpose of survey or analysis

In the mid twentieth century, the development of phonological theories and their increasing importance in linguistics begins to be reflected in much of the work on Scottish accents. The recording of accurate phonetic data is no longer an end in itself: it is now merely an early stage in the process of phonological analysis of a particular variety (cf. Wells 1971). As a result there is a lessening of the occurrence of very detailed allophonic description of the type which Ellis assembled (1889) and an increase in phonological analysis of ScE (e.g. Aitken 1984, McClure 1970, Wells 1971 & 1982, Winston 1971). Moreover, the existence of a variety of instrumental techniques promises a wealth of new facts and figures - which never transpires.

2.4.1.7 Methods of presentation

A variety of transcription systems appear in twentieth-century publications. The earliest use of IPA consonant symbols and theory is by Williams in 1909. She utilises Sweet's phonetic theory and transcription system for the description and notation of vowels. Later writers, such as Wilson (1912) and Dieth (1932) do likewise. Certain writers use their own transcription systems, usually a phonetic spelling system (e.g. Colville 1909, Wright 1921). In later publications, Wilson (1915, 1923, 1926) uses a combination of four transcription systems in

49 Wettstein found that the average length of short, half-long and long vowels was 0.08 seconds, 0.14 seconds, and 0.20 seconds respectively. Diphthongs ranged between 0.12 to 0.28 seconds, while vowels in unstressed position averaged 0.05 seconds. Although Dieth tells us that he made use of the kymograph, he does not publish any figures.

50 Instrumental investigations of pathological speech are not reviewed here, as the scope of this thesis does not include such linguistic forms.

each book: IPA, New English Dictionary, the English Dialect Dictionary, and his own phonetic spelling system. The outcome is ultimately unsuccessful, as it results in a rather confusing mixture in which, for example, <k> and <c> are used to indicate the same sound. As the century reaches its middle, IPA symbols become universal.

As far as phonetic theory is concerned, writers do not tend to clarify their standpoint. Those who utilise IPA script, especially those writing in the second half of the century, are presumably using IPA theory.[51] Yet those writers of the first half of the century might use Bell's Visible Speech (e.g. Grant 1913) or one of Sweet's notations (e.g. Mutschmann 1909).

2.4.1.8 Conclusion

A number of general points can be made about the literature reviewed in this section. Firstly, it becomes evident that the coverage of Scottish accents has been geographically widespread, with only a few areas being neglected (see Appendix 1 and 2). Sociolinguistically, the coverage has included children (Romaine 1978, Wilson 1915), young adults (Abercrombie 1979, Mutschmann 1909, Williams 1909), and older people (e.g. Dieth 1932, Zai 1942); and both middle-class Scots (e.g. Grant and Dixon 1921) and working class Scots (Wettstein 1942 and Wilson 1923, 1926).

The studies have tended to concentrated on vowels, with less attention paid to consonants. In addition, there has been an under use of instrumental techniques as a means of investigation.

It becomes clear, then, that there has been no standard approach to the investigation of ScE accents.

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51 Yet one should not always make this assumption. McClure, writing in 1970, uses the realisations of certain vowel phonemes produced by individual informants as reference points to which he related other vowel realisations by the same individuals. In other words, he does not use Jones's Cardinal Vowels as reference points in his investigation.

2.4.2 Suprasegmental features

Published material on the phonetic study of suprasegmental features begins in 1938 with Frank's "Intonation and vowel quality in Berwickshire, Linlithgow, Stirlingshire and Fifeshire". The topic of intonation, along with voice quality, stress and rhythm, are the only suprasegmental features of Scottish accents to have received any attention from phoneticians. The remaining topics which we would normally include under the general heading of suprasegmentals, namely loudness, tempo, continuity, pitch range and accent, have all been neglected.

Since the main concern of this thesis is segmental aspects of ScE, the review of suprasegmental features will not attempt to be comprehensive. Instead it will only focus on intonation and voice quality.

It is possible to examine suprasegmental features both perceptually and instrumentally. The published work on ScE has been carried out using both methods (e.g. McClure 1980 used a pitch meter; Currie 1979b and Kenworthy 1975 used perceptual methods).

2.4.2.1 Intonation

In this review of the work carried out on ScE intonation it is necessary to note the difficulty of comparing different analyses of intonation due to the fact that individual researchers interpret the raw data of pitch variation using different theoretical approaches. This lack of any standard, agreed approach to the analysis of intonation is discussed briefly in Brown, Currie and Kenworthy (1980: 48-51). One reason for the lack of a standard method of analysis may be the fact that the parameters of analysis are not straightforward, as the use of intonation is tied to not just to linguistic functions but also to discourse functions (cf. Brazil 1985). These points having been raised, the present writer will attempt to summarise the main points which researchers have made concerning the similarities and differences between intonation patterns of a number of varieties of ScE.

Comparing the pitch pattern which Kenworthy (1975) observes on wh-questions, as spoken by Edinburgh speakers, with the pattern that McClure (1980) notes among speakers from the south west of Scotland, it would appear that both of the varieties have similar intonation patterns. Edinburgh speakers favour a pattern with two pitch peaks: one at the beginning of the utterance, the other at the end, with a fairly level pitch in between at a medium level. Speakers in the south west may use this pattern, but may also use a pattern consisting of a pitch peak towards the beginning of the utterance followed by a general downward drift. Alternatively, they may employ a pattern involving a fairly level mid pitch throughout the beginning and middle of the utterance with an abrupt and rapid rise on the last stressed syllable.

2.4.2.1.1 Twentieth-century analyses compared with nineteenth-century analyses

A by-product of this overview is the opportunity that it provides to make a comparison, albeit a limited one, of the findings of these twentieth-century writers with the vague outlines of Scottish intonation patterns given by the nineteenth-century phoneticians. Bell's (1894) comments on intonation refer only to the west and north of Scotland, so there is no common basis for comparison with Kenworthy's Edinburgh data.[52] Sweet indicates the presence generally in Scotland of a "rising tone...employed monotonously, not only in questions, but also in answers and statements of facts" (1877: 95). This would appear to be rather at odds with Kenworthy's data, since she notes the presence of all types of intonation contours in questions. On the other hand Sweet's remarks on Glasgow speakers do not conflict with McClure's findings concerning the intonation of Ayr, Paisley and West Kilbride, which are geographically close to Glasgow. McClure notes that in

52 Bell mentions Scottish intonation patterns only in passing. He draws attention to two main patterns: the first, a repetition of a falling pattern, he associates with the west of Scotland; the second, predominantly rising, he associates with the north of the country.

the ScE of these locations "true rising intonations are very rare" (McClure 1980: 208). Sweet's view is that Glasgow speakers possess predominantly a falling intonation pattern (Sweet 1877: 95).

We can conclude by noting that, seen beside the work of the twentieth-century writers, Bell and Sweet's comments are very superficial.

2.4.2.2 Voice quality

In her book Phonetics for Scottish Students (1909), Williams describes a total of three phonation types. These are voice, breath and whisper. She makes no comment on their use by speakers. Her omission of other phonation types, such as creak or breath, should not be regarded as an indication that these types were not being used by ScE speakers at the turn of the twentieth century. Rather it would seem more likely that Williams was being selective in the material she was covering, that she lacked the ability to analyse them, or that she did not notice them.[53]

One of the most recent and most thorough studies of voice quality among ScE speakers was carried out by Esling (1978a and 1978b). Esling analyses the voice quality of, in total, 179 Edinburgh male speakers, both men and boys. This is done both auditorily, using the framework of analysis set out in Laver (1975), and instrumentally, using the techniques of laryngography and, for one speaker, laryngoscopy.[54] An attempt to correlate instrumental and auditory findings is made. Moreover, Esling analyses his results sociolinguistically using a Labovian approach, in order to investigate whether voice quality characteristics and social class can be correlated.[55]

53 For a brief discussion of what phoneticians do not describe and the inferences that may be drawn, see Brown 1981: 74-76.

54 Although Esling interviewed 179 speakers, the main auditory analysis concentrates on 32 individuals. The laryngographic data is obtained from 4 speakers, and Esling himself is the subject of the laryngoscopic study.

55 Esling establishes three social groups: Group I contains the highest social group; Group II consists of the middle group; and Group III is made up of those speakers with the lowest social ranking.

His findings suggest that, as far as phonation types are concerned:

> "Creaky voice judgements predominate for speakers in Group I of the sample, with higher social indices. Towards Group III, the less statusful end of the social scale, judgements of creaky voice diminish; while judgements of harsh or whispery voice tend to increase. Judgements of tongue position indicate greater raising and fronting in Group III than in Group I. Judgements of raised larynx, and of faucal and pharyngeal constriction, are more common at the lower end of the status scale (Group III); while nasality is noted more commonly at the upper end of the scale (Group I).
>
> "...the conclusion is that these combinations of voice quality features constitute contrasting articulatory settings of different social orders in the community."
>
> (Esling 1978a: 308)

One can note that creaky voice and harsh voice are the most common features in the entire sample, whereas combination phonation types, such as harsh creaky voice and harsh whispery creaky voice are among the least common characteristics of the group. Sweet (1877: 98) refers to the "harsh" character of some ScE speakers' voice quality, in keeping with Esling's findings. We should bear in mind, however, that Sweet and Esling may not use the term to refer to the same auditory characteristics.

2.4.2.3 Conclusion

This overview of the published work on ScE suprasegmentals indicates that the topic is being approached more systematically and in more depth than it was in the nineteenth century. Some aspects, such as intonation, would appear to present special problems to investigators, due to the nature of the subject. Others, such as voice quality, can be studied with less difficulty. Overall, however, there is no doubt that much remains to be done concerning suprasegmental features.

2.5 Summary

This chapter aimed to assess the many studies of Scottish accents which have been published over the last three centuries, and focused especially on the phonetic studies or on the phonetic aspects of those studies. It began by considering the diverse nature of the nomenclature which has been used to refer to Scots or ScE, and by clarifying the use of the latter terms within this thesis. The discussion sought to justify the fact that the present writer does not attempt to distinguish between descriptions of Scots accents and of ScE accents, but uses all of the phonetic data as a context for the investigation of aspects of ScE accents, which follows.

The publications considered have been examined by a number of criteria: the purpose of the study; the method of data collection; the types of informants; the geographical spread of the studies; the types of data which have been gathered; the methods of analysis; the nature of the phonetic theory; and how the data is presented.

In general the eighteenth century is the period of the pronouncing dictionary, as writers attempt to instruct Scots how to pronounce their own language. The nineteenth century sees attention turning to the analysis of local accents and dialects for philological purposes. The publication of works on phonetics in the mid-nineteenth century enables subsequent writers to note details of pronunciation with greater accuracy and more systematically than those who preceded them.

The mid-nineteenth to the mid-twentieth century is the "golden age" of investigation into the phonetic characteristics of the segmental features of ScE. The subsequent development of various phonological theories and linguists' growing interest in them seem to have lessened the importance of phonetic investigation as a subject in its own right, to be pursued for its own sake. Nonetheless, the same period has witnessed a compensatory interest in the systematic investigation of certain suprasegmental features of ScE.

Most parts of Scotland and most ScE accents have been the focus of a study at one time or another. The purposes and aims of the studies have varied tremendously, as have the resources available to the investigators; the diverse nature of the publications reflects this. Nevertheless, the resulting body of literature is a significant source of information and amounts to a very respectable canon.

Chapter 3 Methodology

3.0 Introduction

In the previous chapters, the rationale behind embarking on a survey of certain features of ScE was outlined. This chapter presents the methodology which was applied both in the collection of the information and in its analysis. In any scientific investigation it is necessary to fully document the methods employed in order that experiments may be repeated so that results may be checked and verified, and so that the results may be interpreted in the light of the method.

In order to achieve the primary aim of this study a number of objectives were identified. Firstly, a substantial body of data has to be collected in an acceptable way from an appropriate group of informants. Secondly, the body of data ideally should be statistically relevant and representative, so that reliable conclusions can be reached and generalisations made about ScE speakers' pronunciation characteristics. Thirdly, the data must be stored in a form which fulfils three criteria: it has to be of a quality sufficient to facilitate both auditory and instrumental analysis; it must not deteriorate and, lastly, it has to be retrievable for future investigation. The data should be analysed using appropriate methods and, lastly, the results of the analysis should be interpreted in their proper context.

Each of these objectives will now be discussed in greater depth.

3.1 Sample sizes and statistical representation

In a survey such as this, there are two variable factors which will determine the size of the sample which is required. The first is variation within the speaker himself or herself, and the second is variation between the speakers.

3.1.1 Variation within the speaker

No individual functions in exactly the same fashion all the time. Physical factors, such as fatigue or physiological changes caused by illness, like the common cold, will affect the body's ability to carry out all sorts of tasks, including articulation. The individual's emotional state is important too. For example, excitement and anxiety may manifest themselves as changes to speech (Abercrombie 1967: 9). Environmental factors are also influential: the relative formality of a situation may cause an individual to alter her speech to that level which she feels is appropriate to the situation. Moreover, unfamiliarity of surroundings may induce a level of stress which may affect the speaker's fluency. The relative spontaneity of an utterance may influence the pronunciation so that, depending on whether the speaker is reading a word list, a sentence or a passage, taking part in a formal question-and-answer session, or speaking spontaneously, different results will be obtained.[1]

Thus, if one intends to obtain a sample of an individual's speech which truly represents the range available to that person, one would have to make many recordings of the speaker in various physical and emotional states, as well as in different social circumstances.

3.1.1.1 Speaker variation within this sample

In this survey it was decided not to include the range of speech variation within an individual, as outlined above. This was done for a number of reasons which will be discussed.

Recording speech produced by each speaker while the individual was experiencing different mood states would have necessitated many recording sessions involving the same speaker. This would have entailed a high degree of contact between the speaker and investigator which was felt to be impracticable, given the burden it would place upon individual speakers and the resources available to the investigator.

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[1] Notice that Labov (1972) and Trudgill (1984) found differences in speakers' speech which correlated with casual style, formal style, reading passage style, and wordlist style.

Sampling an individual's speech in different environments was also judged to be inappropriate in this case. Given the fact that the speakers' utterances were also required for the purposes of instrumental analysis, it was necessary to obtain the highest possible quality of recordings. As this could best be achieved under controlled conditions, each speaker read the word/sentence list and reading passage in the Phonetics Laboratory. This is a slightly unusual environment for most people, yet it should be borne in mind that each speaker was an educated individual who, it can be assumed, had no excessive fear of a microphone and tape recorder. Moreover, the investigator made a point of spending a few minutes chatting informally with the speakers and explaining the survey to them in order to put them at their ease (as is discussed below, sections 3.3 and 3.3.6, p 68 and 71).

Thus, it is apparent that we should not expect the manner of pronunciation recorded in the Phonetics Laboratory to be truly representative of an individual's entire range of articulation, but we can be confident that it is representative of one style of natural speech available to the speaker.

One point can be made in defence of the data gathered, and that is that this survey supplies a large amount of tokens of each feature provided by each speaker. For example, there are 15 examples of /r/ in word initial position and 15 examples of /r/ in initial consonant cluster position per speaker, and the voice onset times are calculated from over thirty measurements for each individual. As a result one can, with confidence, regard the resulting data as statistically representative of each individual speaker.

3.1.2 Variation within speakers

The second variable factor in this sample is the variation between speakers. There are two areas to be considered: those variations which characterise the individual (e.g. age and sex), and those which indicate the individual's membership of a group (e.g. socio-economic status, religious affiliation, gender, ethnic group, regional origin, participation in a social network) (Abercrombie 1967: 7-9).

3.1.2.1 Characteristics of the individual: age and sex

An individual's age is relevant to his or her speech. Older generations tend to possess certain linguistic forms which younger generations use less or not at all, and vice versa. Murray, for example, noted this to be the case in the southern counties of Scotland (1873: 122, 130). Labov showed that age does not operate independently as a variable, but that it is linked to social class (1972: 59).

That there are differences between male and female speech has been shown by many studies (e.g. Cheshire 1982, 163-164; Coates 1986; Romaine 1978; Smith 1979). For example, in some English-speaking communities women are seen to attempt a mode of pronunciation which is closer to the standard, i.e. the prestige variety, than that of men (cf. Macaulay 1977; Labov 1972). Differences in the communicative competence of both sexes have also been identified (cf. Graddoll and Swann 1989; Tannen 1991, 1994).[2]

3.1.2.2 Membership of groups

Differences in socio-economic status have been shown to correlate with differences in speech (cf. Esling 1979; Macaulay 1978; Trudgill 1974). Many different factors are relevant: education levels; income levels; type of employment, if any; and social class.

In Britain there is a very strong correlation between most individuals' regional origin and pronunciation. This type of variation was first investigated in the nineteenth century, for example by Ellis (1889) and Murray (1973), and its

[2] In recent years it has become more common to distinguish between sex, which is a biological characteristic of the individual, and gender, which indicates the role deemed appropriate for each sex by the society an individual is born into (e.g. Coates 1986: 7-12). This distinction has proved to be of some usefulness in, for example, the discussion of communicative competence and its acquisition (e.g. Tannen 1991, 1994).

influence is still relevant today. The situation in Scotland is outlined elsewhere (e.g. Aitken 1984a, 1984b).

The use of the concept of social networks (Blom and Gumperz 1972; Milroy 1980; Milroy and Milroy 1978) has revealed many correlations between linguistic behaviour and interpersonal relationships (Milroy 1982).

3.1.2.3 Taking account of speaker variation in Scotland

This very brief review of certain possible causes of linguistic variation among speakers leads one to the conclusion that the potential for linguistic variation among ScE speakers is extensive, and that the actual degree of variation in pronunciation is impossible to know without attempting an extensive survey.

If one were to attempt the ideal survey of Scottish pronunciation, the starting point would be to elicit information from as large and as representative a sample of the population as one could. This would entail interviewing a specific number of male and female individuals from each age group, from every socio-economic group, from every educational level, from different religious denominations, from different ethnic groups, and from every regional area. Only by applying such criteria to one's survey could one, firstly, discover the actual range of variation which exists among speakers of ScE and, secondly, approach the task of gathering a sample of the speech of that society which was both representative and statistically relevant. On that basis alone could generalisations be made with confidence.

3.1.2.4 Implications for this survey

It became apparent at a very early stage in the present research that limiting factors, such as time, and resources, would impose certain restrictions, and one of the major restrictions concerned the size of sample of speakers that could realistically and effectively be coped with. Resources were not available for the analysis of the pronunciation of a cross section of society as outlined above, so the appropriate response had seemed to be to restrict the research to a limited group of speakers and to accept the fact that, statistically and sociolinguistically, they are not necessarily entirely representative.

Ultimately, the aim of the present research is to gather phonetic facts about speech in three regional areas, so an equal number of speakers from the three cities under investigation was sought. It was felt important to include samples of the speech of both men and women, so an aim was to include an equal number of both sexes. Other variants were kept to a minimum. Age variation and educational variation would be restricted. As a result of this, as well as the fact that the Phonetics Laboratory was easily accessible to them physically, speakers were selected from the students and staff of Glasgow University.[3] In the selection of speakers, no account was taken of their respective socio-economic status.[4]

It is obvious then that certain restrictions and compromises in the representativeness of this sample have proved to be unavoidable. Nevertheless, this is not necessarily to be regarded as a shortcoming. The main aim of this study is to contribute to knowledge concerning pronunciation possibilities within ScE from a phonetic standpoint, not to attempt a sociolinguistic analysis of them. If the sociolinguist sees that there are gaps in the speaker-selection techniques, or the statistician has reservations about the significance of the data, given the size of the sample, they are justified in their observations. Yet, as long as one is aware of these points and takes the limitations of this survey into account, one can interpret the results accordingly. The phonetician will still find the resulting data valid and of use if the detail and quality of the phonetic description is of a sufficient standard.

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[3] The restriction of ethnic groups to whites of non-ethnic origin is purely coincidence and, presumably, a reflection on the ethnic characteristics of the English Language Ordinary class of 1993/94 in particular and of the University in general.

[4] For discussion of the socio-economic profile of the resulting group of speakers, see Appendix 3 .

3.2 Choice of speaker

The selection of individuals was done first and foremost on a regional basis. Individuals were randomly approached and asked about their place of origin. If it was either Glasgow, Aberdeen or Edinburgh, they were asked if they thought their speech was typical of their area. If they felt that they were typical they were then asked to take part in the survey.

As noted earlier, one aim was to have an equal amount of women and men in the survey. This was done primarily so that an equal amount of information from each sex would be gathered. The notion that sex-related differences might be identified was tempered with the realisation that the statistical basis of any such suggestion would be rather insecure, given the small number of speakers involved.

Finally, a goal of thirty speakers was set: five women and five men from each area. This total was felt to be a good compromise inasmuch as it was a manageable number and also a number which would elicit a respectable pool of data. In practice it proved impossible to gather thirty speakers. It is to be regretted that this is the case, for again it limits the information gathered and the interpretation of the results. Glasgow is represented by nine individuals: five women and four men, Edinburgh by five: four women and one man and Aberdeen by two: one of each sex. Despite the very small sample of Aberdonians it was decided to include the data as it is still of interest to phoneticians, even if one cannot necessarily make generalisations based upon it.

3.2.1 Speaker reference labels

The names of individual speakers were never recorded. Thus each speaker was given an identifying reference label consisting of three elements. The first element is a letter, either G, E, or A, indicating the speaker's regional origin as Glasgow, Edinburgh, or Aberdeen respectively. The second element is either M or F, indicating the speaker to be either male or female. The final element is a serial number which identifies the speaker within his or her regional and sex group. Thus

GM2 refers to the second Glasgow male speaker in the sample, whereas EF4 is the reference used to refer to the fourth female speaker from Edinburgh. The speakers in the sample are referred to consistently in the thesis using this method. The speakers contributing to the study are as follows:

GM1, GM2, GM3, GM4

GF1, GF2, GF3, GF4, GF5

EM1

EF1, EF2, EF3, EF4

AM1

AF1

3.3 Elicitation of the data

In the elicitation of data one has a number of choices to make. Firstly, one can record people with or without their consent. The latter was rejected for two reasons. First and foremost it is unethical. Secondly, it is impracticable given the fact that the recordings were to be made in the Phonetics Laboratory (see above, section 3.1.1.1, p 62)

A second choice concerns whether the speech to be recorded is spontaneous or not. As this survey is particularly concerned with the realisation of specific phonemes in particular contexts, it was felt that the recording of spontaneous speech would not be an efficient way to gather examples as there is no guarantee of relevant examples occurring. Therefore it was decided that the speakers should be asked to read from a prepared passage and word and sentence lists.[5]

All speakers were told that they were contributing to a study of the Scottish English of Glasgow, Aberdeen or Edinburgh. They were not told which features in

[5] This method is not without drawbacks itself. For one thing, it is less natural than spontaneous speech and may result in a slightly more formal style of pronunciation (cf Labov 1972 and Trudgill 1984), although it is arguable that certain features under investigation in this study are outwith the conscious control of an individual (e.g. voice onset time).

particular were being investigated in case it should influence their pronunciation. Although data was elicited by three methods, in the event it was the sentence list and the subsidiary word list that were used most extensively.

3.3.1 The reading passage

The reading passage was "The Story of Arthur the Rat".[6] The speakers were asked to read it first, as it was hoped that the content of the passage might distract the speakers from the nature of the task and set them at ease. In the event, the passage was used to check aspects of the speaker's pronunciation, for example, it enabled the investigator to establish the fact that the Aberdeen speakers had a /f/ ≠ /ʍ/ distinction, by supplying an example of the phonemes in comparative distribution..

3.3.2 The sentence list

In an earlier pilot study, five separate speakers were asked to read a word list of 210 items. It could be argued that such forms are not representative of natural speech. Indeed, this became a concern during the analysis of this data as many of the words contained features which may be typical only of words in isolation. For example, a high proportion of the words had glottal reinforcement of their initial segments (e.g. [ʔˈgɪɹl^{ɣ}, ʔʍil^{ɣ}]), affrication and aspiration of word final plosives (e.g. [hat^{sh}, l^{ɣ}ʉp^{ɸh}], and a slow tempo of speech.

For these reasons it was decided that the main study should be constructed around the carrier sentence "Say X again", where X is the word under study. There were 205 sentences in the study and it was hoped that their use might lead to a less artificial pronunciation. It is in fact arguable if this happened. A number of speakers paused before and after the target word, in order to emphasise it, with the result that it became, effectively, a citation form again: [se + + ˈ ʍil^{ɣ} + + ɪgɛn].

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[6] On the authorship and development of this passage see MacMahon 1991.

Thus preglottalisation and final aspiration and affrication occurred occasionally: [se + + ˈʔɹolˠ+ + ɪgɛn], [se + + ˈ lˠʉpᶲʰ + + ɪgɛn].[7]

It can be seen that the carrier sentence did not overcome the problems encountered when using the citation forms. Indeed, it caused problems of its own. For example, it was not possible to investigate voice onset times of voiced plosives as they were now surrounded by voiced elements and were, more often than not, fully voiced.

In conclusion then, neither method can be regarded as superior to the other. Each has its benefits and its drawbacks.

3.3.3 The subsidiary word list

The pilot study had also revealed the impossibility of investigating certain features from a tape recording. Thus the main study had a third element included in it which was a word list of nine words, spoken by the speaker while facing the investigator. The list had two purposes: to elicit information on inherent and contextual lip rounding of /r/, and to elicit the presence of dental and possibly interdental laterals.

3.3.4 Selecting the contexts

The reasons which lie behind the choice of features to be investigated has already been outlined in the introductory chapter (section 1.1.4, pp 6-7). This section will discuss the phonemic contexts in which those features were collected.

It was hypothesised that the realisation of /l/, /r/ and /ʍ/, and certain aspects of the realisation of voiceless plosives, might be influenced by any surrounding elements[8]. Thus it seemed sensible to ensure an example of each of these features

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[7] The symbol + + indicates a pause in speaking.

[8] For example, it is thought more likely for [ɾ] to occur inter-vocalically than post-vocalically (e.g. Wells op. cit. : 411). However, although /l/ is said to be velarised in all positions in most accents of ScE (e.g. Wells 1982: 411-412), it is possible that

in every possible phonotactic position. A list was constructed of the phonotactic possibilities of Scottish English for these segments and, on the basis of that list, a suitable set of words was selected. (See chapters 4, 5, 6 and 7 for details of the phonotactics of the selected words.

3.3.5 Selecting the words

Words were deemed suitable if:

i) they were common words, not restricted to cant, slang or a specific variety of English, and were words which a speaker of English would encounter reasonably frequently; and

ii) they exemplified at least two features of relevance to the study. Thus the word <loiter> supplies an example of /l/ before /ɔe/, and /r/ in final position.

Exceptions to i) were such words as <Vlad>, <whoa>, and <skliff>. They were included in spite of this for the following reasons: <Vlad> gave an example of /l/ after /v/ in initial position, which is not a native English combination. <Whoa> was unfamiliar to most speakers in a written context, though most of them knew the word when it was defined as being the word said to horses to slow or to stop them. It was included as it was the only word which exemplified the use of the graphs <wh> in front of the /o/ phoneme which could be pronounced [ʍ]. <Skliff> was unfamiliar to two Edinburgh speakers, but not to those from Glasgow or Aberdeen. (Having said that, neither of them had difficulty in pronouncing the word.) It was included nevertheless as it provides the word initial consonant cluster /skl/ in stressed position. (<Sclerosis> was rejected as a test word as the primary stress is on the second syllable.)

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before a front close vowel it could be palatalised (see chapter 5 below). Thus it is sensible to cater for such a possibility by including examples of different phonotactic contexts in the test words.

3.3.6 The presentation of the sentence list, word list and reading passage

Each speaker was allowed to peruse the word list, sentence list, and reading passage before the recording and was asked to identify any words which he or she was unsure of. It was felt that it was possible for the investigator to assist speakers in this way without compromising the validity of the data elicited, as the features under examination are not those over which a speaker will usually exert conscious control (e.g. voicing/devoicing; aspiration,). The speaker was encouraged not to adopt a "proper" accent, and was reassured that if she "fluffed" a sentence or word it was perfectly possible to stop the tape and to re-record. This removed a lot of the pressure felt by some individuals to provide a word-perfect "performance".

3.4 Recording techniques

The recordings were all made in the Phonetics Laboratory at Glasgow University. The equipment used was a Uher "4000 Report-L", which has the following technical specifications:

tape speed: 7 1/2 ips.

frequency response: 40-20,000 Hz at 7 1/2 ips.

signal to noise ratio: less than or equal to 52 db at 7 1/2 ips.

Wow and flutter: ± 0.20 db at 7 1/2 ips.

3.5 The storage of the data

The material was transferred to cassette tape. Those parts of the recordings which were to be instrumentally analysed were digitised and stored on floppy disc.[9] The signal was digitised using a filter of 44.1 kHz.

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[9] Not every utterance was subjected to this process as it is extremely time consuming and involves the use of a great deal of disc space. On average, ten sentences (thirty words) could be stored on one high-density disk. Over three hundred high-density disks would have been needed to store all the speakers' utterances in this form. This underlines the superiority, in terms of time and storage space, of DAT tape recorders for data gathering and compact discs for data storage.

There was another form of storage used for the results of the analysis. This was Paradox, a commercially available database. The use of a database was felt necessary as the sheer amount of information obtained would have been very difficult to process on paper. Paradox proved particularly useful in manipulating the voice onset time measurements and in performing the calculations of that data quickly and accurately. (See chapter 7 below.)

3.6 The analysis of the data

The data was subject to two forms of analysis: auditory and instrumental. Neither approach is regarded by the present investigator as being more valid than the other. Instrumental analysis gives absolute values of quantities, but it cannot interpret the relative linguistic importance of the quantities. On the other hand, the ear cannot attempt analysis of such precision. Nonetheless, it can analyse the qualities which are important to perception.

3.6.1 The auditory approach

The auditory analysis of the data was carried out by the present writer and involved the transcription of the data, using IPA script, along with any diagrams, CV charts and written notes needed to clarify points that the transcription could not fully record.[10] The resulting transcriptions are included as Appendix 8.

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[10] It may be argued that auditory transcriptions will be influenced by the phonetic and phonological background of the phonetician and that identical material might be analysed differently by a separate phoneticians. For example, it is possible that the present investigator is better able to analyse west coast ScE than that of the north east because she has a greater familiarity with the former. Although there is some truth in this, on can cite, in defence of the auditory transcription, Ladefoged's experiment which showed a high degree of agreement among British-trained phoneticians in their analysis of vowel qualities (Ladefoged 1967).

3.6.1.1 The limitations of transcription

Despite the usefulness of IPA symbols in enabling one to describe in a shorthand form the distinctive features of a phonetic event, it must be borne in mind that the greater part of the phonetic information concerning the articulatory events involved is omitted (International Phonetic Association 1989: 67-68).

Thus the symbol [l], for example, indicates + voice, + alveolar, and + lateral approximant. It is also possible, by the use of diacritics, to indicate other features such as secondary articulations, e.g. velarisation or labialisation; certain phonation types, and general indications as to duration. Nonetheless, information as to, for example, the exact portion of the tongue in contact with the alveolar ridge, whether or not the articulation is unilateral or bilateral, the position of the rims of the tongue relative to the inner side of the upper gums and molars, and the degree of lowering of the mandible are all omitted.

Phoneticians would not dispute the fact that it is the entire vocal tract which is involved in the articulation of any sound. Nonetheless, phonetic theory, angled as it is to the needs of phonology rather than phonetics, can lead us to believe that this sort of information is dispensable, or, at best, secondary. (Note, for example, the fact that one parameter of the construction of the 1989 IPA chart is that a symbol is allotted to a sound only if that sound is phonemically distinctive in a language (International Phonetic Association 1989: 68)).

Likewise, the symbol [l] does not enlighten us concerning the whole range of phonetic information obtainable through instrumental research, such as the volume-velocity of air being expelled from the lungs, the difference in transglottal air pressure, the exact nature of vocal fold vibration or the electrical activity in the muscles of, for example, the tongue.

The conventional symbols, therefore, are limited and limiting in the amount of information the contain. They are a shorthand which can do no more than summarise a small amount of the total information available. They are not a definitive statement of articulatory events.

3.6.2 The instrumental approach

There is a wide range of instrumentation available to phoneticians to assist them in the analysis of data. However it is important that the researcher should have a clear idea not only of the extent to which a piece of machinery will be useful, but also of the reasons for using it in the first place. Thus, the merits of each technique must be assessed and the use of any instrumentation must be justified before it is employed.

The present writer had access to one instrumental technique: sound spectrography. Yet she is aware that other forms of instrumentation could have been used profitably to gather information which would have assisted the analysis of the selected features. That being the case, four instrumental techniques will now be discussed: palatography, x-ray, aerometry, and sound spectrography, and their contribution , potential or otherwise, to the present research will be critically assessed.

3.6.2.1. Direct palatography and electropalatography

The origin of palatography (PG), the instrumental study of articulation in the area of the palate, has been documented by a number of writers (e.g. Abercrombie (1957) and Strenger (1968)). Although the direct and indirect static techniques have remained largely unchanged, certain advancements have been made in the recording and display (permanent or otherwise) of the data. For example, direct PG has been simplified by the use of close-up instant cameras used in conjunction with palatal reflectors, so that permanent records of wipe-offs may be obtained immediately (Anthony 1954). A development of the indirect technique is electropalatography (EPG), outlined by Hardcastle (1972), among others.

3.6.2.1.1 Practical considerations

The practical shortcomings of traditional PG have been discussed elsewhere (Abercrombie 1957). Essentially they centre around the potential for interference to articulation caused by the introduction of an alien body into the mouth. Whether it is the charcoal powder used in direct PG; the artificial palate and the necessary fittings; or bundles of wires used in EPG which lead from the electrodes and exit from each side of the mouth, all forms of palatography are intrusive to some extent. It is necessary to take into consideration the resulting effects upon articulation that this will have and to decide whether this, in turn, will lead to inaccurate and, therefore, incorrect results.[11]

Other shortcomings concern the impossibility of constructing an artificial palate which is flexible enough to follow soft palate movement; the wide differences in palatal anatomy among individuals which necessitates the custom building of a separate artificial palate for each subject[12]; and the inability of speakers with false teeth to use an artificial palate satisfactorily.[13]

3.6.2.1.2 Application of (E)PG in this study

It would be feasible to investigate Catford's claim that place of articulation of ScE /l/ varies between dental and alveolar according to its position in the word

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11 Many investigators would hold that this is not the case, arguing that after a period of familiarisation the interference caused by the apparatus is minimal (e.g. Auttesserre and Teston 1977: 408-409; Sara 1979: 436). With reference to the question of adjustment to an artificial palate on the part of the speaker, it has been argued that the experience is comparable with the individual fitted with false teeth, who soon becomes accustomed to them, with only minor adjustment of articulation. The present writer would disagree that the two situations can be equated. A dental surgeon spends many years in training in order to fit dentures correctly whereas, generally, phoneticians do not.

12 Given the differences in vocal-tract anatomy, it is not an easy task to specify a normal vocal tract, save in the most general terms. Herein lies a main weakness of the data obtained via all of the instrumental techniques being discussed here (excepting sound spectrography): there is no straightforward way in which to compare the results. Thus, when one examines various "normal" vocal tracts, one is not comparing like with like.

13 On the face of it, this may not appear to be as serious a drawback as the others, but it would prove to be a limiting factor in the selection of suitable subjects both for indirect PG and for EPG.

(1977: 251-252). In this case, the difficulties of palate division would be overcome by the clear physical distinction between the teeth and the alveolar ridge. Furthermore, it would be possible to investigate the occurrence and frequency of /l/ realisations which involve both the dental region and the alveolar ridge as simultaneous passive articulators (see below, Chapter 5, section 5.2.1.1.5). Moreover, if linguograms were made simultaneously with static palatograms, one could investigate any tendency on the part of individual speakers to favour apical or laminal articulation. The use of EPG would facilitate the investigation of /l/ vocalisation. One could not only confirm the extent of /l/ vocalisation, but one could also study the sequence of contact patterns to investigate the precise coarticulation activities in, for example, /tl/ and /lt/ clusters.[14]

At first glance, PG may seem an appropriate experimental approach to the investigation of the extent of tongue/velum contact in /w/ and /ʍ/ allophones, by gathering information on the stricture differences of various allophones. On reflection, though, it is apparent that this would not be the case. PG reduces three-dimensional reality to a two-dimensional representation so, although we could examine the extent of tongue contact, we would have no information either on the shape of the roof of the mouth or concerning the presence and nature of any grooving of the tongue. Therefore we would have no information on the area of the channel through which the air is actually flowing. In order to get round this, one could assume a constant value for the soft palate and tongue shape of each speaker, thus enabling comparisons of, and possibly conclusions from, the palatograms of individual speakers.

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[14] EPG has been used by Hardcastle and Barry (1989) to study /l/ vocalisation in south-east English English accents. The technique allows the researcher to overcome one difficulty of analysis, i.e. the auditory and acoustic similarity of vocalised /l/ allophones and alveolar laterals. (See further, Chapter 5, section 5.2.1.1.4., below.)

Nonetheless, it could be difficult to compare the findings for each speaker in a valid and meaningful way and, therefore, to generalise from the results.[15] Furthermore, it would not be possible to examine any labial stricture and, since this is of vital importance in the articulation and to the auditory/acoustic output, this would be a drawback.

3.6.2.1.3 Conclusion

The present writer is of the opinion that, unless speakers can be given time to acclimatise themselves to (E)PG, then it should not be used, as the intrusive nature of the technique interferes too much with the natural articulation of individual speakers. For a study of this sort, where the accents of a group of speakers are being examined, the practical drawbacks to using (E)PG outweigh the advantages. For this reason, it is not used.

3.6.2.2 X-ray

The development of the use of x-ray in phonetic research, and the techniques employed are outlined in, for example, Ball (1984), MacMahon (1986), Painter (1979), and Strenger (1968)

3.6.2.2.1 X-ray techniques

X-ray methods currently utilised can be divided into two main types, namely direct and indirect techniques. The former, also called radiography, entails the direct recording of the x-rays onto photographic film or plate. In the latter, the x-rays fall onto a fluoroscopic screen where they are converted to light energy. It is

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[15] This information could, of course, be elicited if plaster casts were taken of the roof of each subject's mouth and the information on palatal contours related to the palatograms (Ladefoged 1957). This would incur a more expensive and time consuming study. An alternative method would be to use ultrasound in conjunction with (E)PG, as was done by Stone et al (forthcoming).

the image on this screen which is photographed, using either still, serial and cinefilm, or videotape.

Often, the subject's tongue surface is painted with a solution of barium in order to obtain a clear outline. To obtain a clear image of the tongue it may be coated with barium sulphate paste, or the subject may drink a glass of a barium solution (which also gives clarity to the image of other soft tissue in the mouth), or pellets may be attached to certain points of the tongue, the images of which may be tracked.

In the analysis of an x-ray image a number of measurements may be made. These will be compared with values obtained from an x-ray of the subject in rest or reference position (Strenger 1968: 334). Thus one might compare jaw angle, laryngeal displacement, and velic opening and closure during articulation with the rest position.

3.6.2.2.2 Application of x-ray techniques in the present research

3.6.2.2.2.1 /l/ realisations

X-ray has already been used to investigate /l/ realisations (e.g. Giles and Moll 1975, Sproat and Fujimura (forthcoming)). Their work has centred around the articulation and distribution of clear and dark allophones. In the present research, a similar approach would be a useful supplement to an acoustic/auditory study of /l/. One could examine the position of the root of the tongue and its proximity to the pharynx, as a pharyngeal quality to /l/ is occasionally noted in Scottish speakers. (One would have to be aware, however of the possibility of some speakers having pharygealisation as part of their voice quality. Such speakers would show a stricture of approximation between the root of the tongue and the pharynx on a semi-permanent basis.)

It might be possible to observe /l/ vocalisation, although the front of the tongue can be difficult to observe (Ball 1984: 128). It is likely that (E)PG would provide more useful data in this case.

3.6.2.2.2.2 /r/ realisations

As for the analysis of /r/, cine or video recording would very probably capture the "lowered tap" /r/ realisation (discussed in full in Chapter 4, section 4.2.1.9 below), although the investigation might be frustrated due to the probability that the image of the side and front teeth will mask the apical and laminal articulation the tongue. Nonetheless, it would be of interest to examine the body of the tongue during /r/ realisations. Such studies have been done of American English /r/ (e.g. Zawadski and Kuehn 1980), but the interplay between front of tongue articulation and the body and root of the tongue has not been investigated with reference to ScE /r/ realisations.

3.6.2.2.2.3 /w/ and /ʍ/ realisations

It would be possible to measure the dimensions of one vector/plane not only of the velar, but also of the labial stricture in /w/ and /ʍ/ realisations. However, it is possible to obtain the former piece of information via (E)PG, and the latter can be observed and measured by, say, videotaping the speaker and analysing the tape. There is no need to use x-ray as the lips are visible to the naked eye.

3.6.2.3 The interpretation of (E)PG and x-ray data

Phoneticians have traditionally described speech sounds in articulatory, that is surface physiological, terms. Ladefoged (1967) reports the high level of agreement among groups of phoneticians in the application of this technique in classifying fine auditory distinctions between small variations in vowel and consonant sounds. He contrasts this with another experiment in which the phoneticians were unable to agree on the physical extent of the alveolar ridge in the roof of the mouths of four subjects.

Thus Ladefoged highlights one of the problems of the analysis of EPG and PG data: how exactly do we relate wipe-off areas or patterns of light to our traditional articulatory categories? It may be fairly straightforward to identify a dental as opposed to an alveolar wipe-off, since there is an actual physical division, but other distinctions used in auditory analysis, such as palatal, pre-palatal and post-alveolar, are less easy to correlate with an anatomical zone. Division of the tongue would present similar problems in the interpretation of linguograms.

Without an agreed method of correlation, there are certain limitations to the articulatory information which can be extracted from (E)PG data. It can be used to confirm tongue contact with the roof of the mouth; it can be used to identify, in a generalised way, place of articulation; and EPG can be used to indicate the timing and sequencing of tongue contact with the palate. But, due to a lack of a common basis of comparison, it is not possible to use (E)PG data in comparative inter-speaker studies.

In common with (E)PG, x-ray shares the problems of interpretation of data incurred when one reduces three-dimensional reality to a two-dimensional representation. Moreover, one must contend with the fact that there are differences in palatal anatomy which make it difficult to compare speakers as like with like. Furthermore, since, at the present time, vocal-tract anatomy has not been typed, we cannot compare type with type.

3.6.2.3.1 The place of x-ray and (E)PG in phonetic research

(E)PG and x-ray provide data on the physiological events during the speech of individuals. It is necessary to consider how such data interacts with the results of other forms of phonetic analysis and to consider its value to phonetic research.

Let us consider two x-ray studies mentioned previously: Giles and Moll's (1975) cineradiographic study of three subjects and Sproat and Fujimura's (forthcoming) investigation of four subjects, using x-ray microbeam pellet tracking techniques. In both of these the articulation and distribution of /l/ allophones in American English are examined with specific reference to light (i.e. clear) and dark allophones.

Questions are raised by these authors as to the appropriateness of the traditional, subjective, introspective account of the articulatory characteristics of the dark allophone. It will be recalled that the usual account is that the dark allophone is velarised, that is to say that, in addition to the primary stricture, there is a secondary stricture of open approximation between the back of the tongue and the soft palate (see references in Sproat and Fujimura (op. cit.: 3)). This account is at odds with the x-ray data presented in the above studies, which show a posterior elongation of the tongue dorsum. In the light of this information, then, dark /l/ may not always, strictly speaking, involve velarisation.

Is it necessary, on the basis of such data, to consider auditory analysis as secondary to x-ray and (E)PG data, or even to abandon it on account of its potential inaccuracy? It will be argued that, for a number of reasons, this response would be quite inappropriate.[16]

Firstly, as has been mentioned previously in the discussion of the interpretation of (E)PG and x-ray data, it is very difficult to correlate articulatory categories and anatomical zones in a consistent and generally agreed manner. In addition, our ability to compensate for the auditory effect of the differences in vocal-tract anatomy is far greater than our ability to compensate for the physical reality of such differences in our analysis of x-rays and (electro)palatograms.

Furthermore, it is not possible for us to deduce from an x-ray or a(n electro)palatogram what the corresponding auditory output is. In the study of /w/ and /ʍ/, elsewhere in the present research, the point will be made that the relationship between articulatory stricture and acoustic/auditory output is not a straightforward one, in that a number of articulatory events may combine in different ways to produce auditorily similar and, in some cases, identical results. Nonetheless, it may be argued, that this cannot be regarded as a flaw in (E)PG and

[16] This is to ignore, for the present, the statistical significance of such studies which present data from so few subjects.

x-ray investigation, as their aim is not to provide information on auditory/acoustic output. This links in with the third point.

It is possible for us to divide speech into a number of phases (e.g. Catford 1987: 3-7) and, with the exception of neurolinguistic programming and identification, to study each phase in an appropriate way. The acoustic phase and the neuroreceptive phase designate that part of the communication process in which the sound waves are intercepted by the listener's ears, and the neural impulses proceed along the auditory nerve to the areas of the brain which decode the signal.

Perception, then, is dependent upon the interception and decoding of acoustic information, such as formant frequencies, harmonics, poles and zeroes, and fundamental frequency. Physiological information is unnecessary. Since this is the case, it is argued that those methods of analysis which deal with the acoustic and auditory aspects of speech must be considered to be as important, if not more important, than (E)PG and x-ray techniques. In the study of an accent, acoustic and auditory investigation is closer to the psychological reality of speech as we perceive it, than is an x-ray or (E)PG.

3.6.2.4 Aerometry

Anthony and Hewlett (1984) give an historical outline of aerometry. There are a number of techniques available to study the aerodynamic phase of speech, and a description and discussion of them are available in Warren (1976), Painter (1979) and Anthony and Hewlett (op. cit.), among others. Each technique has slightly differing aims but, in general, they share the object of measuring and recording the air pressure, volume or flow rate at some point in the vocal tract or just outside the oral and/or nasal cavities.

3.6.2.4.1 Application to this study

Most articulatory categories can be correlated with a characteristic flow pattern. For example, fricatives are reported to involve greater airflow rates than other segments (Anthony and Hewlett op. cit.: 92) and to display characteristic airflow patterns that distinguish them from other articulations (Anthony and Hewlett loc. cit.; Butcher 1977). From this information, we can deduce that aerometry may assist the research into /w/ and /ʍ/ realisations.[17]

Aerometry is one possible method of verifying complete oral closure and, as a result, it may be of use to investigate the exact nature of the stricture between the tongue and the alveolar ridge in the "lowered-tap" realisation of the /r/ phoneme (discussed in full in Chapter 4, section 4.2.1.9 below).

3.6.2.4.2 Difficulties in the use of aerometry

The limitations of the technique available to the writer at the present time would argue against the use of aerometry. In the first place, for the most part, the realisations of the /r/ and /ʍ/ phonemes are not always predictable. It would be desirable, if not necessary, for there to be a simultaneous auditory recording in order that the airflow readings could be correlated with a particular realisation. The effect of the face-mask in distorting the auditory output would make the simultaneous recording of limited value for later auditory and acoustic analysis. There are a number of techniques which attempt to overcome this by, for example, incorporating a mike on the inner surface of the face-mask (e.g. Anthony and Hewlett op. cit.: 83; Catford 1977: 241).

Another approach to this problem is to make a sound recording immediately prior to the aerometry. This has the obvious drawback of one not being able to be certain that the same allophone was be repeated in the airflow assessment.

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[17] If investigation of intra-oral and beyond-lip air-pressure could be combined with an x-ray study and/or a PG study of /ʍ/, it might be possible to gain insight into the relationship which exists between air-pressure and supra-glottal stricture, which must be precisely co-ordinated in the articulation of a fricative in order to produce air turbulence (Butcher 1977: 171). It would be necessary to have good quality simultaneous audio recording in order to be sure of the exact realisations of the /ʍ/ allophone.

Therefore it would become impossible to correlate aerometry readings with particular allophones, and the value of the study would be reduced.

3.6.2.5 Sound spectrography

Sound spectrography is the analysis of the acoustic characteristics of sound, including speech sounds. The sound wave is analysed in terms of frequency, amplitude, and time. There is a long-standing and generally accepted body of knowledge about the acoustic characteristics of speech sounds in general (e.g. Fant 1960, 1973; Lehiste 1964).

Spectrography has both positive and negative aspects. It has a huge advantage over the previous three instrumental techniques in that it is not an invasive method. In fact the subject does not have to be present when the analysis is being done. Moreover, it analyses those factors which are analysed by the human ear and, therefore, the results are relevant to our understanding of our own perception and decoding of speech.

Yet there are some complexities. The difficulties of segmentation of sound spectrograms, for example, have long been appreciated.[18] The conventions of transcription and traditional auditory phonetics can influence one to think that one element follows another in a sequential progression. In fact, this is shown to be fiction when one subjects speech to detailed acoustic phonetic analysis. It is not possible to isolate a portion of a sound spectrogram and assert that it corresponds exactly with a phonetic element. The start of one phonetic event, as represented on the spectrogram, will overlap with some part of the previous event. It may also contain some acoustic information pertinent to the following phonetic element. Indeed, the very nature of the acoustic features of a phonetic element may be context conditioned, in that they utterly depend on the acoustic characteristics of

[18] In chapters 4, 5, 6 and 7, the present writer outlines the criteria that have been employed in this study to segment the allophones of /r/, /l/, /w/, /ʍ/ and voiceless plosives from other realisations represented in each spectrogram.

the preceding or following phonetic event. Consider, for example, how different preceding and following plosives will alter the shape of the transitions of a medial vowel (Catford 1977: 61), or how the place of articulation of a surrounding phonetic element will influence the F2 frequency of the acoustic representation of a following nasal. As has been noted by many researchers, phonetic segments and acoustic events cannot be mapped onto each other in a one-to-one fashion, as the acoustic nature of one segment is affected and will influence that of another.

There is also the problem of where exactly to take the formant measurement from. If the formant has a steady state then one might choose that point, but if it is of varying value, or it is in transition, then one must make a decision as to what to measure.[19]

Despite these difficulties, it is necessary for investigators to attempt to relate acoustic events to phonetic or to linguistic events if acoustic information is to be incorporated into their phonetic theory.

For this study, a computer program called Soundscope 16 was used to perform the acoustic analysis. The analog sound wave is converted to a digital signal (the filter used was 44.1 kHz) and the program can perform a range of calculations on the digitised signal. For example, it can compute the Fo of the speaker, and can calculate the percentage of voiced and voiceless sound contained in an utterance. It can also perform the spectrographic analysis of the sound wave. Moreover, it is possible to use the cursor to calculate very accurately the time in milliseconds (ms) between any two points on the sound wave. This feature was of great use for the measurement of voice onset times of voiceless plosives.

For the purposes of the analysis, spectrograms were calculated using a 300 Hz bandwidth filter and a 45 Hz filter. The program was set to analyse all

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[19] In this study an average value has been estimated for those formants which vary. If a transition, forming part of segment, is either from or towards a neighbouring segment then it has been ignored in the calculation of the segment's value, but if it is characteristic of the segment then it has been included in the analysis (e.g. /w/ and /ae/).

frequencies in the range of 0 - 10 000 Hz. The illustrative spectrograms that are included in the thesis are printouts of some of the analyses that were carried out using the 300 Hz filter.

One feature of the resulting spectrograms which is different to the traditional spectrogram is that the duration of the entire analysis is not of a standard length. As a result, any length of utterance can be analysed by the program at one time. The operator can give the computer general instructions that the visual representation of the signal should be stretched out or compressed, but it is not possible to instruct the computer to isolate a specific duration of utterance and to represent it visually over an exact length, i.e. to set a standard duration to length ratio. This is unfortunate, as it makes it impossible to compare comparative durations of separate features from one spectrogram to another by visual means alone, as was possible with the traditional spectrogram produced, for example by a Kay Sonograph. Thus in considering the spectrograms illustrating voice onset times of voiceless plosives (see chapter 7) one should not compare the visual length of one VOT with the length of another as the ratios of time duration to length are not necessarily the same.

3.6.2.5.1 Applications to this study

As far as this study is concerned this form of analysis is of great use in investigating much of the data. The following is not intended as a full description of the acoustic approach, but merely as an indication of what sort of information is available for examination.

3.6.2.5.1.1 /l/ realisations

The nature of /l/ allophones will be revealed by spectrographic analysis in a number of ways. For example, it is generally held that dental and alveolar realisations are distinguishable by the duration of formant transitions, the latter being longer than the former. Moreover, palatalised and velarised laterals are distinctive in the value of their second formant, the former having formant values reminiscent of a front vowel, the latter of a back rounded vowel. Such information will both enhance and confirm auditory analysis.

3.6.2.5.1.2 /r/ realisations

Again formant values will assist in the distinction of, for example, alveolar and retroflex realisations. Also it will be possible to identify the nature of any friction associated with certain /r/ realisations.

3.6.2.5.1.3 /w/ and /ʍ/ realisations

The acoustic characteristics of these two phonemes are, in theory, distinct. /w/ will show fully voiced formants. Its F2 has a slow plus transition from c 1400 Hz to c 600 Hz and then a second transition to the F2 value of the following segment. F1 is of very low value c300 Hz and is of a relatively steady state. /ʍ/ is voiceless, and will exhibit bands of random intensity consistent with the presence of friction.

3.6.2.5.1.4 Voice onset times

It is possible to use Soundscope 16 to measure extremely accurately the duration of any portion of the sound wave. This lends itself to the calculation of voice onset times, as a measurement may easily be taken from the noise burst of the plosive to the onset of voicing.

3.6.2.6 Conclusion

In this section, four instrumental techniques have been described and discussed, and their potential application to the present research has been considered. Of the four, it is sound spectrography which will provide the most useful results for this particular study, in the opinion of the present writer.

Nonetheless, it is hoped that this section has indicated how (E)PG, aerometry, x-ray and could be used to advance our knowledge of ScE.

3.7 Interpretation of the analysis

Having gathered the data and analysed it, it is necessary to consider how exactly the results should be viewed, that is to say, what sort of claims can be made on the basis of this data about ScE pronunciation in general. In order to do this it is necessary to attempt to assess the statistical significance of the data. This will be done in depth in Chapter 7, where the VOT measurements are subjected to various statistical tests. The significance of similarities and differences which arise from that section of the data is calculated, and the reliability of the data is measured.

Although the remaining data is not subjected to the same thorough testing, it is possible to speculate on the significance of the remainder of the data based on the analysis of part of it. For each individual, hundreds of items of data were gathered, therefore one can confidently state that the data for each individual is representative of that individual's accent. Moreover, there exists enough data from Glasgow, and perhaps from Edinburgh, to assume that it is representative of the parent populations. Given the small size of the sample it would be foolhardy to conclude that it was representative of Scottish English speakers as a whole, but it does indicate to us what we may expect to find in that population.

3.8 Conclusion

This chapter has described the methodology which was used in the present study. It has described the method of speaker selection; the techniques used to elicit the data; the forms of phonetic analysis that the data was subjected to; and it has mentioned briefly the tests that were carried out on parts of the data to establish the significance of the findings. The results of the study are presented in the following four chapters.

Chapter 4 /r/ realisations in ScE

4.0 Introduction

Many writers on ScE pronunciation (e.g. Murray 1873: 118; Wilson 1915: 7; Dieth 1932: 85; Zai 1942: 20) have stated that the pronunciation of consonants is, in the main, similar to that of English English. One usual exception to this view is the realisation of /r/, which has been regarded, and is regarded to this day, as one of the most characteristically "Scottish" features of a Scottish accent.

This chapter aims to do three things: to outline the present state of our knowledge of /r/ realisations; to present, in response, an auditory analysis of /r/ in ScE; to describe the acoustic characteristics of those /r/ realisations.

4.1 /r/ in Scottish English

There exist in the literature numerous descriptions of /r/ realisations and it is the purpose of the first section of this chapter to review them in detail in order to summarise our present state of knowledge. Although diverse in many respects, all the accounts presented are similar in one respect: they are all auditory descriptions. There are at present no published descriptions of the acoustic characteristics of ScE /r/ realisations.

4.1.1 General descriptions of /r/ in the nineteenth century

4.1.1.1 Ellis

Ellis gives a short description of /r/ realisation in nineteenth-century Britain: "In English at the present day, (r) has at least two sounds, the first, when preceding a vowel, is a scarcely perceptible trill with the tip of the tongue (r) which in Scotland...and with some English speakers becomes a clear and strong trill (.r)." The second sound to which he refers occurs in final position and is [ə] or no sound at all. It is present in all of Britain except Scotland (Ellis 1869: 196).

Elsewhere, Ellis enlarges upon his description of Scottish /r/ realisation, noting that it is "a strongly trilled tip-tongue r even when not preceding a vowel" (Ellis 1889: 681).

The palaeotype symbols which Ellis employs to represent Scottish /r/ are (r) and (.r). The former is what Ellis calls the "true trill" and it is defined thus: "a sharp beat produced by allowing emitted voice to flap the tip of the tongue...the strength and length of the beat vary much" (op. cit.: 84*). It is possible to equate this description with an apico- or lamino-alveolar tap (IPA [ɾ]). The palaeotype (.r) is described as "a strongly flapped L(owland)-Scotch (r)" (op. cit.: 85*). From this one may conclude that the realisation is an apico- or lamino-alveolar trill or tap (IPA [r] or [ɾ]).

The palaeotype symbol for the voiceless (or "flated", to use Ellis' term) equivalent of these articulations is (rh), but Ellis states that the articulation does not occur in English. It is possible, however, that Ellis is making a phonemic rather than a phonetic statement (although, of course, being unconcerned about the distinction), in which case one cannot rule out the possibility of the occurrence of both [r̥] and [ɾ̥] in certain positions.

4.1.1.2 Sweet

In many of his works on phonetics, Sweet uses the realisation of Scottish /r/ to illustrate trill articulations. For example he writes:

> "*Trills*...result from the vibration of the flexible parts of the mouth, either against one another...or against some firm surface, as when the point of the tongue trills against the gums in forming the strong Scotch r...Their common character is due to the rapid periodic interruption of the breath by the contact of the trilling body with that against which it is trilled, its elasticity...causing it to resume its

> former non-contact, to be again driven or to fall back...Trilling is indicated by the 'trill modifier' ʕ, thus ωʕ= Scotch *r*."
>
> (Sweet 1890: 35)

From the above description it seems reasonable to conclude that the articulation being described corresponds to IPA [r].

4.1.1.3 Bell

Like Sweet, Bell's remarks on Scottish realisations of /r/ are to be found among his general phonetic work. He analyses Scottish /r/ as "trilling or rattling vibration" (Bell 1896: 9). He further defines this as "vibration of the whole forepart of the tongue" (op. cit.: 8). This description does not conflict with any contemporary accounts, and it seems reasonable to conclude that the realisation described here is [r].

4.1.2 Geographically specific descriptions of /r/ in the nineteenth century

4.1.2.1 Murray: the southern counties

In his description of the accent of the working class rural community of the southern counties of Scotland, Murray describes the /r/ realisation as "in all positions trilled sharply with the point of the tongue" (Murray 1873: 120). This description implies an apico- or lamino-alveolar trill (IPA [r]).

4.1.2.2 Sprague: Edinburgh

Sprague notes some features of Edinburgh pronunciation, following a residence there of some six years. He states that /r/ is "often emphatically trilled, but not universally" (Sprague 1880: 116).[1] The phrase "emphatically trilled"

[1] The quotation is transliterated from Glossic spelling, which Sprague employed.

implies [r], a trill articulation. The other articulation, without the emphatic trill, may indicate the presence of a tap realisation (IPA [ɾ]).

4.1.2.3 Le Mâitre Phonétique

The nineteenth-century editions of Le Mâitre Phonétique contain a number of specimens of Scottish pronunciation. The accents represented are Aberdeenshire (Brebner 1898: 109), Braemar (Staples 1896: 164) and two pronunciations which are defined sociolinguistically, one described as "refined", the other as "vulgar" (Smith 1896: 81). In each case, the same example passage is used. It contains examples of /r/ finally and medially.

In each transcription, the symbol (r) is used to represent the /r/ realisation. According to the contemporary principles of the IPA, transcriptional practice indicates that (r) is used to denote "linguales roulées". This might lead one to conclude that the articulation is a voiced alveolar trill (IPA [r]). However, since no information is supplied as to the broadness or narrowness of the transcriptions under discussion, it is impossible to be certain of the exact articulation.

4 1.3 The twentieth century

In the twentieth century, ScE accents are generally described in more detail. The geographical coverage of the descriptions extends from the Scottish-English border in the south to as far north as the Buchan area. It is bounded in the east by the coast and in the west, more or less, by Loch Lochy and Loch Ness. In addition, writers are, on the whole, more specific as to the socio-economic status of their informants.

4.1.3.1 General descriptions of /r/

4.1.3.1.1 Le Mâitre Phonétique: General Scottish

Specimens of Scottish accents are recorded in twentieth century editions of Le Mâitre Phonétique (e.g. Jones 1906: 103; Robson 1911: 84; Robson & Riach

1911: 183; Grant 1911: 60; Graham 1933: 34-35). None of the specimens are defined geographically or sociolinguistically; they are all referred to as "Scotch".

The symbol used to indicate the /r/ realisation in each transcription is [r]. Despite the use of square brackets here, there is no indication of whether the transcriptions are either phonemic or phonetic, broad or narrow.[2] Thus it is not possible to decide whether the realisations involved are voiced alveolar trills or some other realisation.

4.1.3.1.2 McAllister (1938, 9th ed 1963)

McAllister notes six possible realisations of the /r/ phoneme in Scottish accents of English. The main ones are the point trill and the point fricative. The remaining four she regards as "inaccuracies" on the part of individual speakers.

4.1.3.1.2.1 The "point trill"

McAllister defines the trill as an articulation in which "a flexible organ of the mouth is held loosely directly in the breath stream and vibrated by the force of the breath against a more resistant organ" (McAllister 1963: 63). The exact place of articulation is described as "the point of the tongue articulating with the apex of the teeth ridge" (op. cit. 94). This realisation is then an apico-alveolar trill (IPA [r]). McAllister notes that the voiceless version of this trill occurs as a realisation of /θr/, so that <three> would be pronounced [r̥i] (op. cit.: 57).

4.1.3.1.2.2 "Fricatives"

Before discussing the "point fricative" it is necessary to investigate McAllister's use of the term "fricative". She defines it as follows: "The two parts of the mouth articulating together ... form a very narrow passage through which the

[2] The convention of using slash brackets for phonemes and square brackets for phonetic symbols dates from the 1930s (personal communication from Dr M K C MacMahon).

breath has to force its way in escaping from the mouth. As it does so, the breath rubs vigorously against the two organs, setting up the noise of friction characteristic of these consonants. This is the most frequent type of articulation for English consonants: f v, θ ð, s z, ɹ, ʃ ʒ, ç, j, x, ʍ, w" (op. cit.: 62).

Despite the phrase "the breath rubs vigorously", which implies air turbulence, we can see from her discussion of the realisations of j and w (IPA [j, w]) that the term fricative includes manners of articulation which the IPA would now classify separately as fricative and approximant. In her discussion of the realisations of j and w she links their articulation with that of the vowels i and u (IPA [i, u]), therefore implying that they are without friction (op. cit.: 124, 127). Her description of f, v, θ, ð, s, z, ʃ, ʒ, ç, x, ɹ and ʍ, on the other hand, stresses their sibilant nature (IPA [f, v, θ, ð, s, z, ʃ, ʒ, ç, x, ɹ, ʍ]). One can therefore divide McAllister's "fricative" /r/ realisations into the separate present day IPA categories of fricative and approximant.

4.1.3.1.2.2.1 "Point fricative"

According to McAllister, the major type of fricative articulation present in Scottish accents of English is the point fricative, which may be equated with an apico-post-alveolar approximant (IPA [ɹ]). It involves "the point of the tongue articulating with the teeth ridge" (op. cit.: 94) and "curling the tip of the tongue upwards until it touches the apex of the teeth ridge" (op. cit.: 95). McAllister supplies a diagram of the articulation which shows the blade and part of the front of the tongue assuming a concave shape. There is, however, no retroflection. Both the voiced and voiceless version of this articulation occur, the voiceless version as a result of devoicing after voiceless segments (op. cit.: 57). It is likely that one effect of devoicing on this segment would be the introduction of friction.

4.1.3.1.2.3 "Inaccurate" realisations

The remaining four articulations McAllister lists as being unacceptable /r/ realisations (cf. op. cit.: 95-96, notes (iii) a & b).

4.1.3.1.2.3.1 Voiced labio-dental fricative

The first of these is the voiced labio-dental fricative v (op. cit.: 95). In this realisation "the outer edge of the lower lip articulates with the edge of the upper teeth" (op. cit.: 60). It is reasonable to equate this with a voiced labio-dental fricative (IPA [v]) or, given the definition of "fricative", with the labio-dental approximant [ʋ].

4.1.3.1.2.3.2 The "burr"

Another unacceptable /r/ realisation is what McAllister calls "the burr" (op. cit.: 57). She describes the articulation as "the voiced form of ch in loch" (op. cit.: 96) or of x (op. cit.: 44). As x is described elsewhere as an articulation involving the back of the tongue and the soft palate (op. cit.: 60, 62), it seems reasonable to conclude that the articulation is a voiced velar fricative (IPA [ɣ]). It is also possible to interpret the "burr" as a uvular realisation, perhaps [χ, ʁ] or [ʀ].

4.1.3.1.2.3.3 "Semi vowels"

The "semi vowels" j and w are cited as the remaining inaccuracies. They are described as involving the approximation of the "front of the tongue and the hard palate" and "the tongue position for the vowel u with lip articulation" respectively (op. cit.: 59 - 60). They may be equated with IPA voiced palatal approximant [j] and voiced labial velar approximant [w].

4.1.3.1.2.4 Distribution of [r] and [ɹ] in the word

4.1.3.1.2.4.1 Initial position #/r/V and #C/r/V

McAllister notes the generally held attitude that a standard feature of Scottish accents is the presence of trills in word-initial position. However, her own survey shows that among students originating from Caithness to Dunbartonshire no more than three in ten use [r] word initially or in initial consonant clusters (op. cit.: 105). The remainder use [ɹ].

4.1.3.1.2.4.2 Intervocalic position

McAllister notes that [r] is the universal /r/ realisation in this position (op. cit.: 105).

4.1.3.1.2.4.3 Word final position V/r/# and V/r/C#

In word final position V/r/#, McAllister states that [ɹ] is the more general realisation, although [r] is possible. In a final consonant cluster, a trill is the more usual realisation.

4.1.3.1.3 Aitken

Aitken notes seven realisations throughout Scottish accents: [r, ɾ, ɹ, ɹ̇, ɻ, r̥] and uvular realisations. He also observes the fact that there is the occasional Scottish speaker who is either consistently or randomly non-rhotic (1979: 111-112)

4.1.4 Descriptions of accents specified by geography

4.1.4.1 The north east

4.1.4.1.1 Mutschmann 1909

The work of Mutschmann on north-east Scottish accent and dialect is spread over Aberdeen, south Aberdeenshire, Deeside, Portsoy and "other parts of the North-Eastern area" (Mutschmann 1909: 1). That Mutschmann's aim is to record the accent of less well-educated working-class people is clear from his choice of informant and the reasons he gives for selecting them. They are young children who "still adhere to the pronunciation learned at home and in the street" (op. cit.: 13) and students, "being persons who spoke the dialects of their native districts from childhood" (op. cit.: 2).

He records two possible /r/ realisations in these groups of speakers: a "strongly trilled voice consonant" and a "back or guttural *r*" (op. cit.: 17). Presumably, the former is a voiced apico- or lamino-alveolar trill or tap (IPA [r], [ɾ]). It is only possible to speculate that the latter is a voiced velar or uvular articulation. There is no information as to the manner of the articulation.

Velar and uvular realisations are frequently mentioned in the literature as potential /r/ realisations in Scotland. Nonetheless they are usually regarded as idiosyncratic forms, characteristic neither of geographical area nor of sociolinguistic group. McAllister (cf. p8 above) held this view and Mutschmann for his part believes that the trill alone is the "correct" realisation (op. cit.: 17).

4.1.4.1.2 Dieth 1932

Dieth devotes part of his study to a description of the "current pronunciation throughout Buchan" (Dieth 1932: xvi). For the most part, the informants are a cattleman and his wife from Yonderton, so the accent recorded may be regarded as being representative of rural, working-class speakers. This fact corresponds to Dieth's stated view that the best authority on the local dialect and accent is the "intelligent but not over-educated man in the country" (op. cit.: vi).

Dieth records two /r/ realisations, one of which he describes as a "vivid, sharp tongue-point trill" (op. cit.: 99), the other as a realisation which is "less vigorously trilled" (op. cit.: 100). It seems reasonable to conclude that Dieth is describing realisations which vary between a trill and a tap (IPA [r] and [ɾ]).

4.1.4.1.3 Wölck 1965

Like Dieth before him, Wölck's study covers the Buchan area of north-east Scotland. He records four /r/ realisations. The first of these is described as "(alveolar) gerollt" (Wölck 1965: 27), the second is a "flap" (op. cit.: 27), and the third a "frictionless continuant" (op. cit.: 29). Although there is no in-depth description of the articulations involved, it seems reasonable to conclude that the realisations which Wölck notes equate with a voiced alveolar trill, tap and approximant respectively (IPA [r], [ɾ] and [ɹ]). The final realisation is what Wölck calls "uvular [ʀ]", which may be interpreted as a voiced uvular trill or fricative (IPA [ʀ, ʁ]). He notes that some people make exclusive use of this realisation rather than any alveolar one. Unlike Mutschmann, however, Wölck makes no judgement as to its acceptability.

Wölck notes the distribution pattern of the trill, tap and approximant realisations. The trill occurs at the beginning of a stressed syllable. Intervocalically, the trill and the tap are in free variation. The approximant, the tap and the trill all occur word finally and in word final consonant clusters (loc. cit.).

4.1.4.2 The south-east

4.1.4.2.1 Speitel 1969

Speitel's work in Midlothian contains information about the /r/ realisations of seven informants. He distinguishes between a Midlothian Scots accent and a standard Scottish English accent. The Midlothian Scots /r/ realisation is "usually a voiced roll...with partial devoicing in final position" (op. cit.: 53). It seems reasonable to conclude that this equates with IPA [r] and [r̥].

In intervocalic position, the realisation is referred to as a "flap". Taking into account the fact that the terms "tap" and "flap" have often been used interchangeably, as well as the fact that today's realisation is a tap, it seems likely that the articulation is what is here understood as a tap (IPA [ɾ]), not a flap.

In the Standard Scottish accent of the area, the situation is different. Speitel notes that although the "roll" (IPA [r]) is common, the more usual realisation is a voiced frictionless continuant (IPA [ɹ]). The voiceless equivalent also occurs as a realisation of initial /θr-/. Therefore it is not, strictly speaking, an /r/ realisation. (McAllister notes this realisation too; see above section 4.1.3.1.2.1, p 94.)

Speitel records the occurrence of another /r/ realisation in Scottish English accents: a "retroflex frictionless continuant". Despite the a lack of any further articulatory description, one may conclude that this articulation is a retroflex approximant (IPA [ɻ]). Speitel notes that this realisation has a restricted usage, being present only in the speech of teenagers, especially teenage girls.

4.1.4.2.2 Mather 1973

Mather also notes the presence of "retroflexed r consonants" in Edinburgh. He proposes that retroflex /r/ is a social marker, being a feature of the speech of teenage girls who attend certain Edinburgh girls' schools (Mather 1973: 63).[3]

4.1.4.2.3 Romaine 1978

Romaine's study of /r/ in Edinburgh differs from those discussed above in that the data is gathered exclusively from the speech of children aged 6, 8 and 10. Three /r/ realisations are noted: [ɾ, ɽ] and [ɹ]. There is an absence of any other articulatory information

4.1.4.3 The south

4.1.4.3.1 Wilson 1915

Wilson's 1915 study is localised to the valley of the Earn in south west Perthshire, between the Grampians and the Ochils. The speakers whose accent he

[3] Mather also notes that "retroflexed r consonants" are present in Caithness, Sutherland and Nairn.

details are the oldest members of the rural community. Due to this fact, it seems reasonable to suppose that the accent recorded may have more in common with Scottish accents of the nineteenth century. The speech style on which he bases his findings is casual spoken style (op. cit.: 9-10).

Wilson notes only one realisation of the /r/ phoneme. Using his own descriptive framework, he analyses it as a voiced trilled point consonant, which he describes as involving the tip of the tongue and the teeth ridge (op. cit.: 14-15). He equates this with the contemporary IPA classification of "Rolled Point and Blade" (op. cit.: 17). From this, it seems reasonable to conclude that the articulation being described is an alveolar trill or tap (IPA [r] or [ɾ]), depending on the number of rolls.

4.1.4.3.2 Wilson 1926

In this study, Wilson concentrates on a geographic area covering Perth, Fife, Haddington, Midlothian, Linlithgow, Ayr, the Firth of Tay and the Grampians, Lammermuir, Moorfoot and Leadhills. The speakers whose accent he detailed were the oldest members of the rural community (Wilson 1926: 9-10).

Wilson notes one /r/ realisation which he describes as a "trill". Although no in depth description is supplied, it is reasonable to conclude that the articulation is similar to that outlined in his 1915 study (section 4.1.4.3.1 above), in which case the articulation is a voiced alveolar trill or tap (IPA [r] or [ɾ]), depending on the number of rolls involved.

4.1.4.3.3 Grant & Dixon 1921

Grant and Dixon describe a type of Scottish pronunciation which they call "modern Scots" or "Standard Scots". It is based on "Lothian dialect", a term which they use to describe the accent and dialect of the area covering Berwick, Peebles, Haddington, Edinburgh, Linlithgow, Fife, Clackmannan, Kinross, Stirling, Dumbarton, Renfrew, Bute, Ayr, Lanark, Wigtown, Kirkcudbright and West

Dumfries. They regard it as a standard accent because although it may be heard in all the above mentioned locations it is characteristic of none in particular (op. cit.: xxi).

One /r/ realisation is noted: a voiced point trill. It is described as a "sound formed by the trilling of the point of the tongue against the upper gum." From this description it may be concluded that the realisation is an apico-alveolar trill (IPA [r]). This realisation occurs in all positions.

Grant and Dixon also describe a voiceless version of the voiced trill as a realisation of initial /θr-/ clusters, as McAllister (1938) and Speitel (1969) do.

4.1.4.3.4 Zai 1942

Zai's study concentrates on the Morebattle district in Roxburghshire, part of the area studied by Murray. He notes one major /r/ realisation which is "articulated with a single tap of the tip of the tongue against the teeth ridge" (op. cit.: 20). Zai states that occasionally there are two or three taps together, but that /r/ is never "rolled". This indicates an [ɾ] and an [r] realisation.

4.1.4.3.5 Wettstein 1942

Wettstein studied the pronunciation in Berwickshire. Among older, working-class rural labourers he notes two /r/ realisations: "a flapped or trilled alveolar" (op. cit.: 5), which are most likely to be [ɾ] and [r]. The former is the more usual.

4.1.4.4 The west

4.1.4.4.1 Williams 1909

Williams (1909) defines "Polite Scottish" both geographically and sociolinguistically as the accent "heard from educated speakers in the South West of Scotland" who speak "English adapted to the speaker's natural speech tendencies" (op. cit.: 9). She identifies three realisations of the /r/ phoneme: a trill, an "open consonant" and a "back *r* sound".

4.1.4.4.1.1 The trill

From Williams' description this realisation is an apico- or lamino-alveolar trill (IPA [r]): "the tip is raised against the ridge, but it is instantly pushed down by a strong current of air from the lungs: it instantly reinstates itself by means of muscular force, only to be again thrust down. In a strong trill this happens often" (op. cit.: 27). Williams goes on to note that strong trills are more common in excited or emphatic speech styles.

4.1.4.4.1.2 The "open consonant"

Williams describes this realisation in the following manner: "the tip of the tongue is raised to the teeth ridge and held there, a small passage is left between the centre part of the ridge, and through this the breath passes out in a steady stream" (op. cit.: 27). Williams notes that this realisation occurs frequently.

The description could be interpreted either as an apico-alveolar fricative or as an apico-alveolar approximant (IPA [ɹ̝, ɹ]).

4.1.4.4.1.3 The "back *r*-sound"

Williams groups two realisations under this heading. The first she describes as the voiced equivalent of /x/, a "voiced back open consonant" (op. cit.: 29) in which "a small passage is left between the back of the tongue and the soft palate, and by this means the breath passes out uninterrupted" (op. cit.: 28). Despite Williams' statement that the breath is "uninterrupted", it is clear from her definition of terms that the articulation is in fact a fricative (op. cit.: 22). The description of the place of articulation seems to infer velar, but it may also be interpreted as uvular (IPA equivalent: [ɣ] or [ʁ]).

The second possible "back r-sound" which she describes involves the addition of a uvular trill to the [ɣ] or [ʁ] described above. The resulting articulation, then, is a voiced fricative, either velar or uvular, combined with a voiced uvular trill (IPA [ɣ͡ʀ] or [ʁ͡ʀ]).

Like Mutschmann (1909) and McAllister (1938), Williams regards any uvular or velar /r/ realisation as a deviant pronunciation (op. cit.: 28-29).

4.1.4.4.2 Macafee 1983

In her account of the accent of Glasgow, Macafee notes four /r/ realisations. She confirms a growing trend away from the trill realisation in favour of the tap or approximant, noting that the trill is confined to emphatic speech. The tap is used intervocalically.

Macafee states that Glaswegian adult speakers occasionally exhibit non-rhoticity in a manner similar to that noted by Romaine among Edinburgh school children (cf. section 4.1.4.2.3). She puts forward the hypothesis that the phoneme may not in fact be deleted but that it may be realised as a "pharyngeal vocal segment" (op. cit. :32). No description is supplied of the articulatory characteristics of this realisation and it is therefore only possible to suppose that the articulation may be a pharyngeal approximant or fricative (e.g. IPA [ɑˤ, ħ] or [ʕ]).[4]

4.1.5 Areas of Gaelic substratum

4.1.5.1 Grant 1913

Grant notes two realisations of /r/ in areas with a Gaelic substratum: a retroflex fricative and a "peculiar modification of the preceding vowel". No further

[4] Of these the approximant would seem the more likely, based on casual observation of Glasgow speakers (personal communication from Dr M K C MacMahon).

information is offered, but it is reasonable to conclude that the modification is some sort of r-colouring.

4.2.5.2 Grant and Dixon 1921

Grant and Dixon note one /r/ realisation in accents of English in districts with a Gaelic substratum. They describe it as a "voiced point fricative retroflex".

Grant and Dixon define the term fricative as "a consonant breathed or voiced where the breath passage is narrowed so that the breath has to force its way out with audible friction" (op. cit.: 20). Despite this definition, they, like McAllister (op. cit.) include in this category j and w (IPA [j, w]) as well as s and z (IPA [s, z]). This indicates that the manners of articulation differentiated by the IPA as approximant and fricative are subsumed by this single term. As Grant and Dixon do not specify exactly what degree of friction is present in the voiced point fricative retroflex it is, therefore, difficult to estimate the exact manner of articulation. However, in the light of Grant's description of this segment elsewhere (Grant 1913, cf. section 4.1.6.1.3, below), it is suggested that this segment is a fricative in the IPA sense of the term. That is to say that it involves a stricture of close approximation which results in friction. The location of the stricture is between the sub-apex of the tongue and the alveolar ridge.

4.1.6 Sociolinguistically specified descriptions[5]

4.1.6.1 Grant 1913

Grant's model is the "more conservative pronunciation of educated Scotland" which he further defines as "the speech of the educated middle classes in Scotland" (op. cit.: 4). He notes a number of /r/ realisations: trill, tap, voiced point fricative and a back or guttural r. He regards the trill as "still the most

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[5] See also the accounts by Mutschmann (1909), section 4.1.4.1.1; Dieth (1932), section 4.1.4.1.2; Romaine (1978), section 4.1.4.2.3; Williams (1909), section 4.1.4.4.1.

characteristic Scottish sound corresponding to the letter r" (op. cit.: 35). However he notes that the tap and alveolar fricative are replacing it in certain positions.

4.1.6.1.1 "Voiced point trilled"

The articulation is classed as "voiced point trilled (rolled)" and described as "a succession of taps of the tip of the tongue against the teeth ridge" (op. cit.: 35). Grant goes on to note that there is a growing tendency to "attenuate the force of the trill" especially word-finally and in pre-consonantal position.

4.1.6.1.2 Tap

Combined with the lessened force of the trill word-finally and pre-consonantally is the growing use of a tap in these positions. Grant regards this change as the result of a southern influence.

4.1.6.1.3 Voiced point fricative

Like McAllister (1934), Grant and Dixon (1921) and Williams (1909), Grant uses the term "fricative" to include articulations which the IPA would divide into fricative and approximant. For Grant, the term indicates any articulation involving open or close approximation of the articulators. He writes that a fricative is "formed by a narrowing of the air passage at some point so that the air escapes making a kind of hissing sound" (Grant 1913: 15). Included in his category of fricative is the voiced point fricative. In deciding whether it should be regarded as a fricative in the IPA sense of the term or as an approximant, it is helpful to take into account Grant's discussion of j and w (op. cit.: 45). In this he states that these two articulations differ from the other fricatives in that they have little friction and that they resemble the vowels i and u respectively. It seems reasonable to conclude from this that j and w are the only articulations in this "fricative" category which are actually approximants in the IPA sense of the term.

The remaining articulations, including the "voice point fricative", all involve a stricture of close approximation which results in air turbulence or friction.

The "voice point fricative" involves the apex of the tongue and the alveolar ridge. The front of the tongue is described as assuming a concave shape. However, the concavity is not of such a degree that the underside of the tongue is involved in the articulation (op. cit.: 43).

4.1.6.1.4 "Back or uvular r"

This realisation is elsewhere referred to as a "voiced back trill or uvular trill" (Grant 1913: xvi). It is possible to equate the voiced uvular trill with IPA voiced uvular trill ([ʀ]), as Grant describes such an articulation as involving "a rapid succession of taps of some elastic organ" (op. cit.: 15). In this case the elastic organ is the uvula.

The "voiced back trill" is less easily dealt with. Grant defines "back" as "articulated between the back of the tongue and the soft palate" (op. cit.: 14). This place of articulation rules out a trill manner of articulation, as it is a physiological impossibility for either the velum or the back of the tongue to act as an active articulator in such an articulation. It is, perhaps, best to interpret this description as either a velar fricative or uvular trill, or as implying the combination of a uvular trill and a velar fricative (IPA [ɣ, x, ʀ] or [x͡ʀ, ɣ͡ʀ]).

4.1.6.2 Grant and Robson 1925

This study is for the most part a rewriting of Grant (1913, cf. section 4.1.6.1 ff. above). Once again, the model described is that belonging to well-educated, middle-class Scots (Grant and Robson op. cit.: xiv).

4.1.6.2.1 Realisations

The realisations noted are similar to those described in Grant 1913: the voice point trill, tap, and voice point fricative and "uvular ʀ".

4.1.6.3 Abercrombie 1957a

Abercrombie (1957a) supplies /r/ realisation information for an "educated Scottish pronunciation in a fairly formal style". He notes that /r/ may be a "lingual roll, a flap or a fricative".[6]

4.1.6.4 Aitken 1979

Aitken's view of educated /r/ realisations is that, generally, they will be one of the "weaker realisations", such as alveolar and retroflex approximants since, he suggests, the tap and the trill are confined to the working class. He notes also the effect that /r/ may have upon a preceding monophthong, especially /e/ and /o/, in that it will cause them to "diphthongise" (Aitken op. cit.: 114).

4.1.7 Summary

It becomes clear that /r/ realisations are extremely varied both diachronically and synchronically. The trill, so common in the nineteenth century, has become a less frequent allophone by the late twentieth century, its occurrence restricted by some speakers to initial stressed position, stylistically restricted to emphatic use. On the other hand the tap remains more widespread, although it too may be on the decrease (Aitken op. cit.: 114). Many realisations which are not noted by nineteenth-century commentators, such as the alveolar approximant, the retroflex approximant and the alveolar fricative, are now common. Moreover, it would appear that /r/ realisations are sociolinguistic markers for ScE speakers.

It is possible to list the range of /r/ allophones as described to date: [r, ɹ, ɾ, ɾ̥, ɻ, ɹ̝] (as well as the "inaccuracies": [ʀ, ʁ, ɣ, j] and [ʍ]). It remains to be investigated whether these are the only possible realisations being used by ScE speakers today.

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[6] Transcribed from the original phonetic script.

Table 4.1 The distribution of /r/ allophones by word position.

Initial			Medial	Final
#/r/V	#C/r/V	/θr/[7]	V/r/V#	V/r/#, V/r/C#
[r, ɹ]	[r]	[ɹ̥]	[r, ɾ]	[ɹ, r]

Although we have some idea of the range of realisations that are possible we have only a restricted idea of their distribution. The Table 4.1 summarises what is known. In the opinion of the present investigator, there remains much to be discovered. For example, there is no indication where retroflex approximants or voiceless post-alveolar fricatives are likely to occur. Nor is it possible to tell whether certain consonants in, for example, an initial consonant cluster tend to be followed by particular /r/ allophones. Moreover, there is no reference to the presence of any secondary articulations which might co-ordinate with /r/. Despite the volume of literature on /r/ realisations in ScE, it would appear that there still remains a great deal to be investigated.

4.1.8 Conclusion

In this section, the literature on /r/ realisations has been reviewed and assessed. Despite the volume of writing on the /r/ realisations, much remains to be discovered about other possible allophones, the occurrence of the allophones in specific phonemic contexts, the nature of any accompanying secondary articulations, and the acoustic characteristics of the realisations. It is the aim of the next section to do this.

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[7] Strictly speaking, the realisation noted here is the realisation of /θr/, not /r/. See section 4.2.1.2.1, above.

4.2 An auditory and acoustic study of /r/ realisations in present day ScE

The data was gathered from recordings of words containing /r/ in all possible phonotactic positions.[8] The words were then divided into those containing /r/ in initial, medial and final position so that any possible effect of word position could be investigated. Moreover, words were selected so that attention could be given to the possible effect of phonemic context upon the realisation.

In word initial position, tokens for /r/ were elicited in words with the following initial pattern: #/r/, #C/r/ and #CC/r/. In #/r/ position the words were: <reader, raider, redder, rather, rags, rotten, roll, ruder, ribbon, rigged, rudder, rider, rise, rowdy> and <royal>. Thus there was one example of /r/ before /i, e, ɛ, ɔ, o, u, ʌ, ʌi, ae, ʌu, ɔe/, with two for /rɪ/ and /ra/ respectively.[9]

In #C/r/ position, the words were: <prestige, brave, Brechin, trial, dragged, dreary, drool, crawl, grab, threaten, phrase, shrill>, exhibiting /r/ after /p, b, t, d, k, g, θ, f/ and /ʃ/.

Three phonotactic possibilities exist for /r/ in #CC/r/ position, namely /spr, skr/ and /str/. These are illicited by <sprinkle, scramble> and <strangle>.

In medial position, /r/ was examined within the framework of V/r/V, which keeps as a constant a succeeding unstressed vowel (/e/ in the case of these speakers), but varies the preceding vowel. Thus the words used were: <dreary, hairy, very, Harry, sorry, story, jury, bury, hurry, diary, flowery>, illustrating /r/ after /i, e, ɛ, a, ɔ, o, u, ɪ ʌ, ʌ, ʌi, ae, ʌu, ɔe/.

Medial consonant clusters involving /r/ were examined by including words which illustrate /r/ infront of all possible consonants, ie, /t, d, k, g, m, n, θ, f, v, s, ʃ,

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8 For a fuller discussion of the overall methodology of the study see chapter 3.

9 The word list was designed initially with one example of /r/ before each vowel phoneme. However, since another two words, <rather> and <rigged>, originally included for other purposes, also illustrated #/r/V, they were included when the data was analysed. Similar duplications can be found in the rest of the sample, for example, the #C/r/V data contains three examples of initial /dr/ and two of initial /br/.

l, tʃ, dʒ/. The words are: <artist, burden, murky, bargain, farmer, warning, Arthur, surface, service, horses, marshes, curler, urchin, urgent>.

In final position, /r/ can occur after the vowels /i, e, ɛ, a, ɔ, o, u, ʌ, ʌɪ, ae, ʌu/ and so the words <here, nowhere, err, jar, nor, pour, pure, fur, rider, tyre> and <sour> are included. Moreover, /r/ can occur in a final /r/C cluster before /p, b, t, d, k, m, n, θ, f, v, s, z, ʃ, tʃ/ and / dʒ/. Thus the following words are included in the study: <harp, kerb, hurt, absurd, leopard, park, warm, warn, earth, surf, serve, curse, cares, marsh, church, urge>.

4.2.1 The range of realisations

As suspected, the range of /r/ realisations was greater than that observed by previous writers. There were a total of thirteen separate types of /r/ realisation identified:

[ɹ] voiced postalveolar approximant
[ɹ̥] devoiced postalveolar approximant
[ɹ̝] voiced postalvaolar fricative
[ɹ̝̊] devoiced postalveolar fricative
[ɾ] voiced alveolar tap
[ɾ̥] devoiced alveolar tap
[ɾ̝] voiced alveolar fricative tap
[ɾ̝̊] devoiced alveolar fricative tap
[ɾ̞] voiced lowered alveolar tap
[ɻ] voiced retroflex approximant
[ɝ ɚ ʌ˞] r-coloured vowels
[ʋ] voiced labiodental approximant
[ɣ] voiced velar fricative

The following sections will expand on the preceding list by providing a description of each realisation individually. The first part of the description will provide a summary of the articulatory movements that may be supposed to correlate with the auditory impression of that realisation, based on general phonetic theory. The description is not intended to suggest that there was any more in-depth articualtory analysis, as there was not. It is speculation, albeit informed speculation.

Secondly, the general acoustic characteristics of each realisation will be presented. The acoustic information was obtained using Soundscope 16 (see Chapter 3, sections 3.5.2.4 ff). The program was set to analyse all frequencies in the range of 1-10 000 Hz, and each realisation was analysed using both 300Hz bandwidth filter and a 45 Hz filter. A record was then made of the resulting information concerning, where appropriate, formant frequencies, the presence or absence of voicing, and the characteristics of any friction that may be present. Print-outs were not made of every realisation examined but illustrative spectrograms, obtained using the 300 Hz filter, which seem to portray the most usual features of a particular realisation were produced as hard copy and are included in order to exemplify most of the features under discussion. Thus, on occasion, they do not display every item of acoustic information which is commented upon.

The /r/ sections of the spectrograms were identified in a number of different ways and so, the method used to segment the /r/ realisations differed. Voiced approximants are characterised by the presence of voiced formants. Approximants were judged to begin where the F2 and F3 of the preceding vowel underwent a minus transition to the lower values for /r/. The end of the /r/ was judged as occurring where the F2and F3 of the /r/ undergo a plus transition towards the higher frequencies of the following vowel.

Devoiced approximants, such as those included here on pages 118 and 119, were seen to be only partially devoiced towards the end of the segment. Thus the cue of initial F2 and F3 transition was used to separate the /r/ from the preceding vowel. The devoiced approximant was separated from the following voiced vowel by the onset of voicing.

Retroflex realisations were judged to begin where by the formants of the previous vowel began to undertake transitions. The [ɻ] was separated from the succeeding vowel when its formants had completed a transition pattern towards the steady state formants of the following vowel.

Fricative realisations were identified using the presence of random noise over the frequency bands and, where appropriate, the absence of voicing (GF3/21, GM3/21).

Tap realisations were judged to have begun where there was an absence of high frequency trace on the spectrogram. (There may be a low frequency band indicating laryngeal activity in voiced allophones.) The subsequent onset of voiced formants, following a noiseburst, was judged to indicate the onset of the following vowel.

The identification of fricative taps relied on the identification of fricative noise, although this was not unproblematic (see section 4.2.1.7.1 below for a fuller discussion of specific spectrograms.)

As is discussed in section 4.2.1.9.1 below, the lowered tap was distinguished by the cessation of F2 and F3.

One point that is usefully remembered is that auditory and acoustic analysis are significantly different ways of investigating data. The former, involving human input, will be more subjective: the ear is atuned to focussing on some aspects of the sound signal while ignoring others (see, for example, Repp 1981b). For example, extraneous, non-linguistic noise will be ignored. Moreover, the listener will come to the task with certain expectations about the sounds that are present, such as perceiving them in terms of phoneme segments. The sonograph has no such preconceptions. Firstly, it will exercise no discretion about which sounds to focus on, so non-human or non-linguistic sounds, such as coughs, banging doors, etc, will have their acoustic properties analysed alongside the linguistic ones. Furthermore, the sonograph will be sensitive to frequencies that the ear cannot detect, and will capture acoustic events that are of too little duration to register with the human ear.

Thus, it should not be anticipated that the perception of the phonetician will necessarily mirror the acoustic profile of each sound.

4.2.1.1 [ɹ] voiced postalveolar approximant

The auditory effect of this sound would suggest an articulation in line with the following description. The stricture is between the blade of the tongue and the post-alveolar ridge. The blade of the tongue is raised towards the back of the alveolar ridge so that there is a stricture of approximation between either the blade or the apex of the tongue and the alveolar ridge. The front of the tongue slopes away in a concave shape. The sides of the tongue lie along the inner side of the upper teeth from the molars to the canines or first premolar, depending on the individual concerned. The phonation type is voice or includes voicing.[10]

4.2.1.1.1 [ɹ] acoustic profile

The four spectrograms (p114-117) reveal the presence throughout the /r/ of the vertical striations associated with the opening and closing of the vocal folds that gives rise to voice. Further consideration of the appropriate section of the two spectrograms of AF1/2 and AM1/2 <bargain> reveals a marked minus transition of F2 and F3 from the higher frequencies of the preceding vowel, and a less dramatic minus transition of F1. Consideration of the spectrograms of GF1/1 and GM1/1 <reader> illustrates two /r/ realisations in each case. Considering the first /r/, we see the pattern for intervocalic [ɹ], albeit not word-medial /r/. Once again, one notices the minus transition of F2 and F3 from the vowel or <say> into the first /r/ of <reader>. The spectrogram of GM1/1 <reader> illustrates clearly how close F2 and F3 values are, relatively speaking, at that stage. Next we see the transitions of

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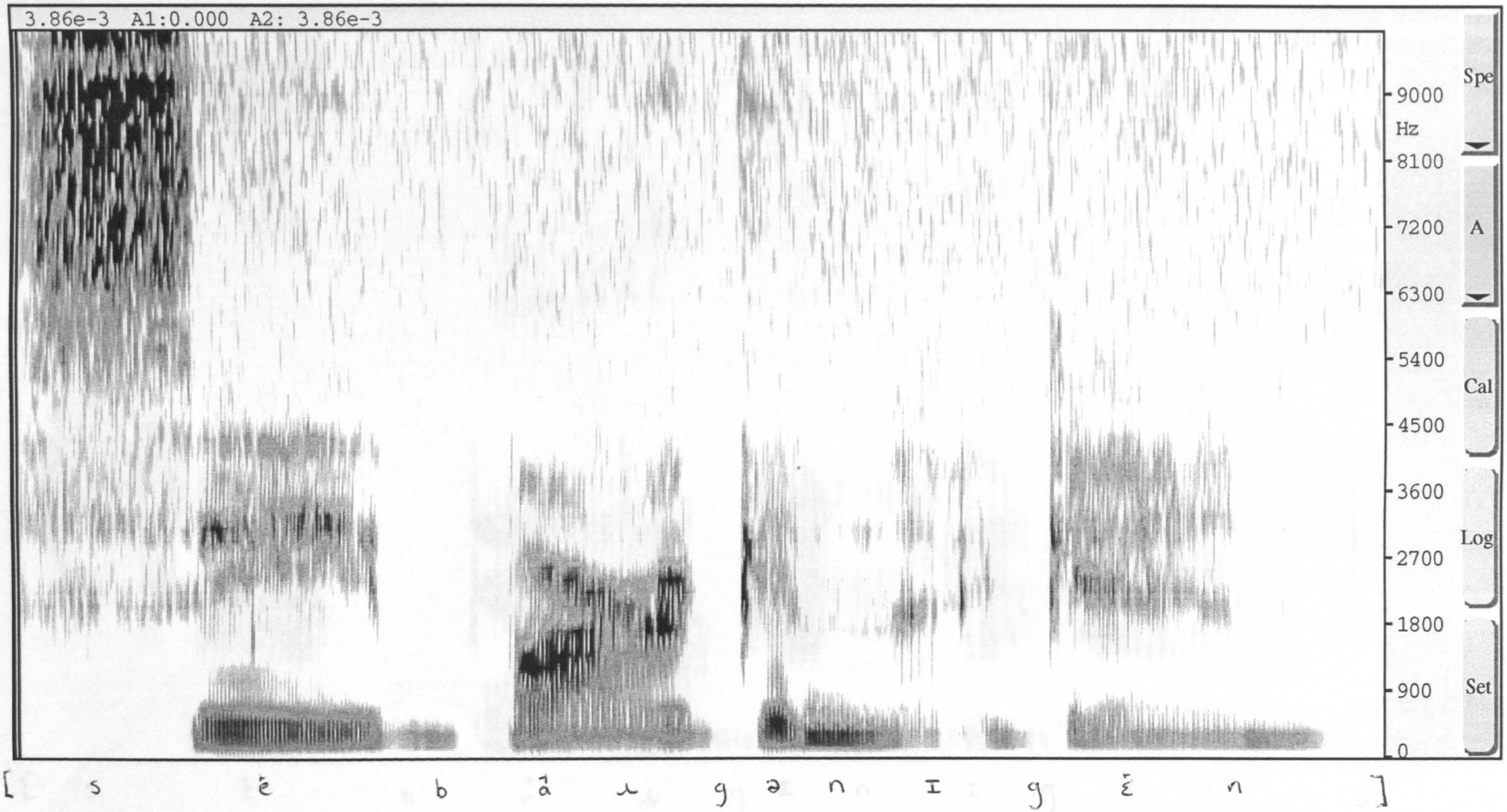
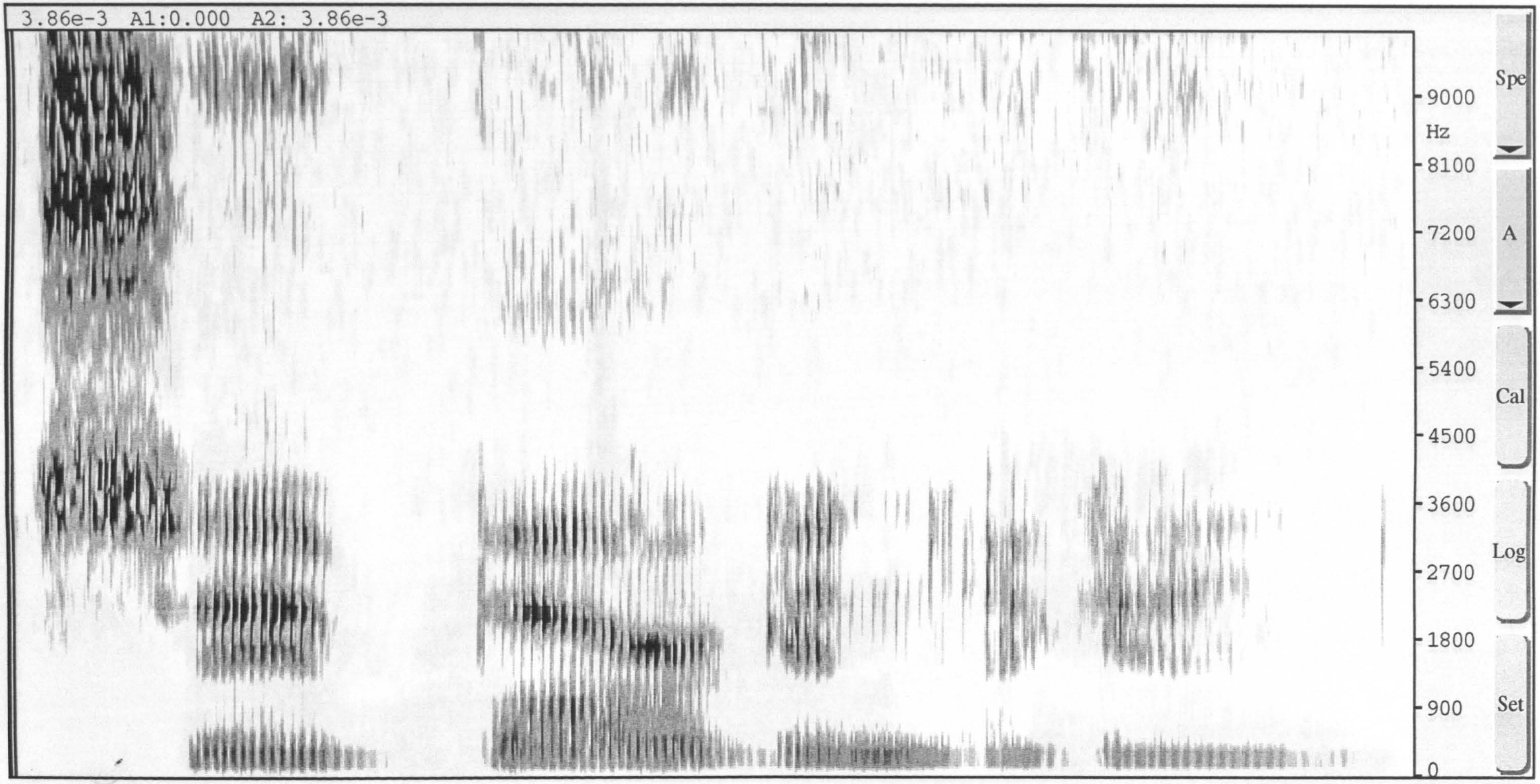
[10] The terms "phonation" and "voice" are used in the sense described by Laver 1994: 184, 191-194.

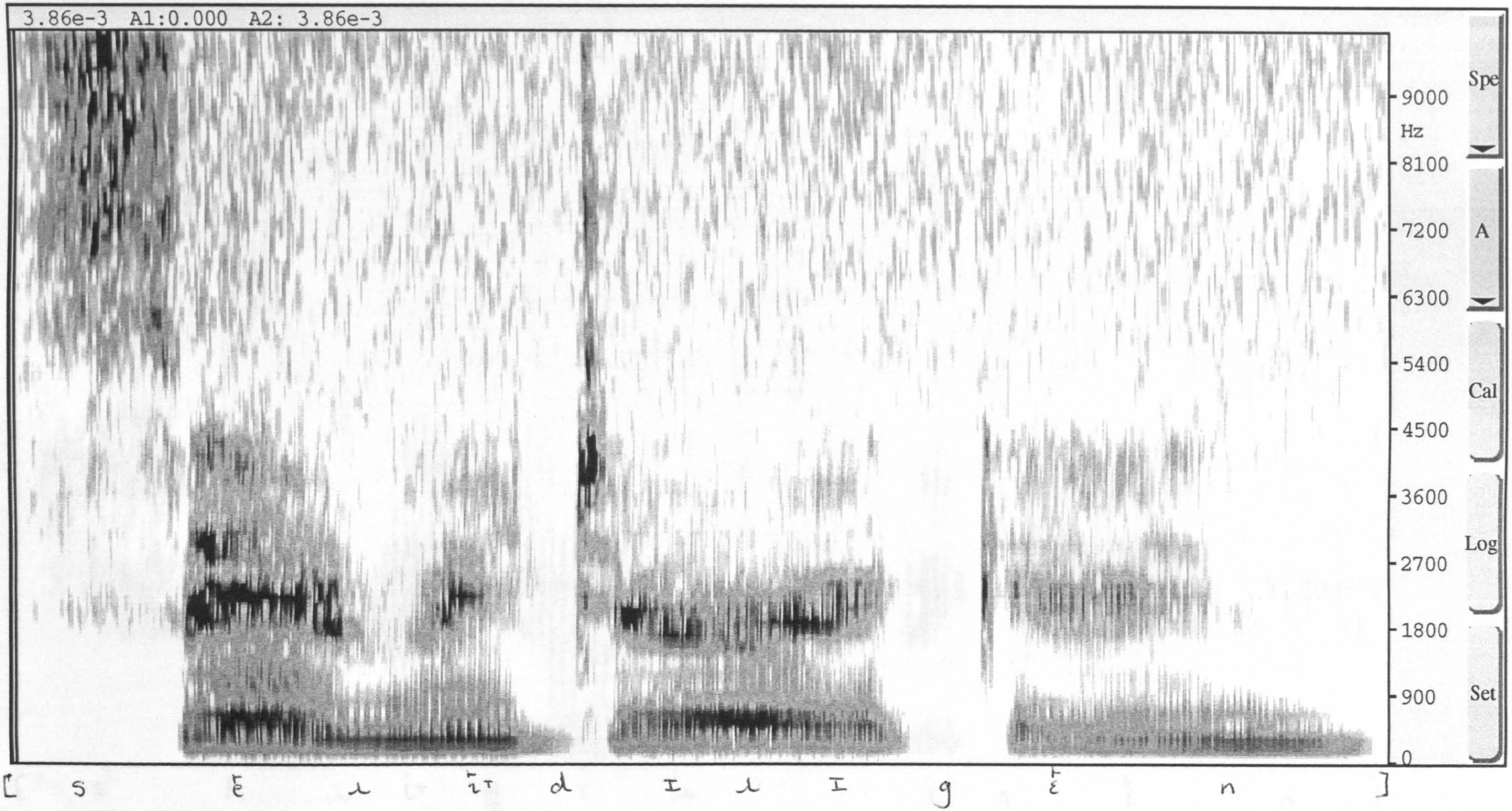


AF1/2 Say "bargain" again

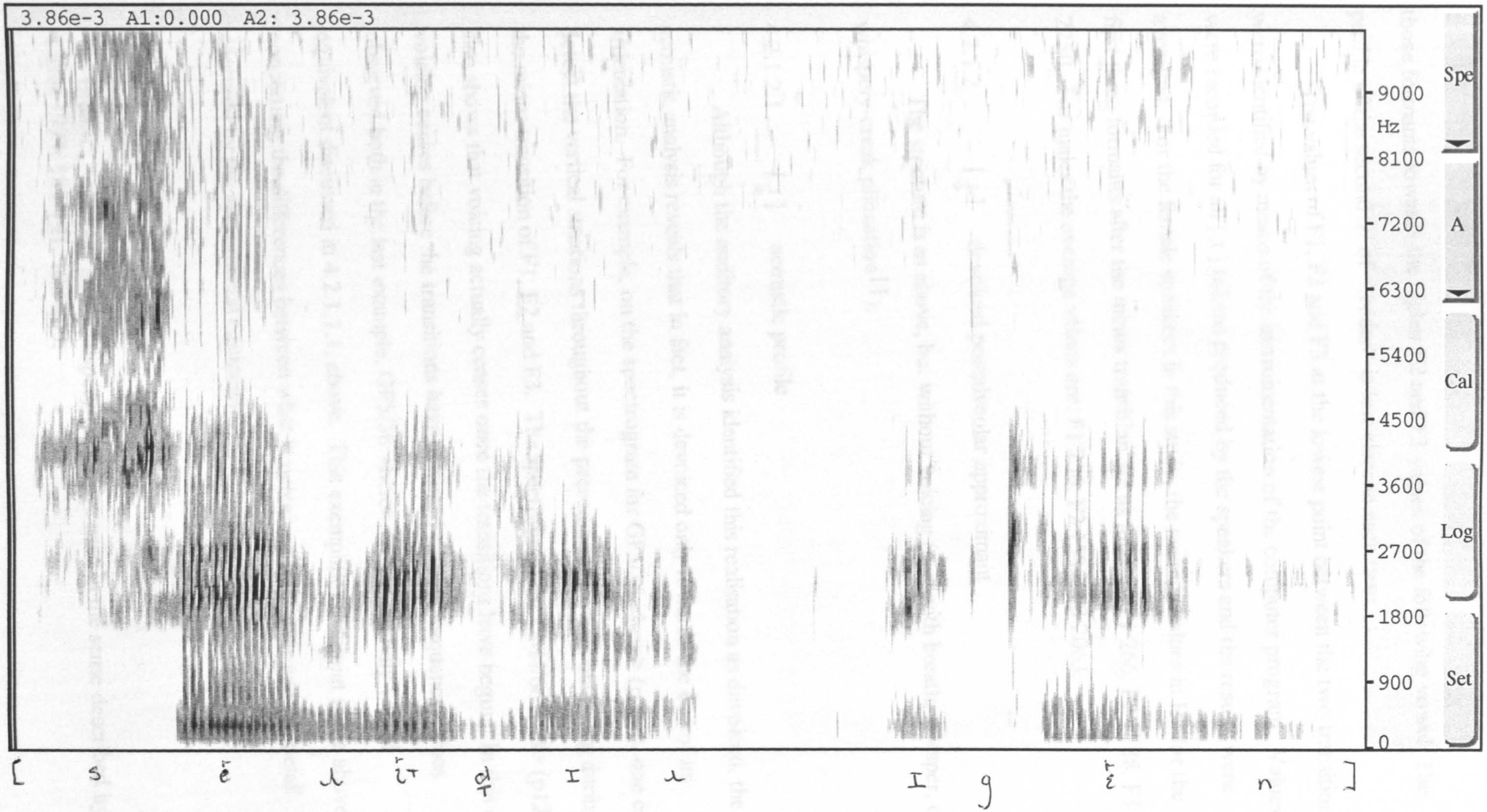


[s ẽ b ɑ ɹ g ɪ n ɪ g ɛ̃ n]

AM1/2 Say "bargain" again



GF1/1 Say "reader" again



GM1/1 Say "reader" again

those formants towards the higher F2 and F3 values of the following vowel. The profile of the second /r/ of <reader> is less clear in each case.

The values of F1, F2 and F3 at the lowest point between the two transitions were identified by means of the instrumentation of the computer program. Values were recorded for all [ɹ] tokens produced by the speakers and the results were averaged. For the female speakers in this study, the average values in Hz for the first three formants after the minus transition are as follows: F1 266, F2 1788, F3 2250. For males the average values are: F1 256, F2 1585, F3 2063.

4.2.1.2 [ɹ̥] devoiced postalveolar approximant

The stricture is as above, but without voicing (e.g. with breath, whisper, or whispery-creak phonation[11]).

4.2.1.2.1 [ɹ̥] acoustic profile

Although the auditory analysis identified this realisation as devoiced, the acoustic analysis reveals that in fact, it is devoiced only towards the end of its articulation. For example, on the spectrogram for GF5/36 <here> (p120), one can detect the vertical striations throughout the preceding /i/ vowel continuing during the minus transition of F1, F2 and F3. The spectrogram for GM4/66 <fur> (p121) also shows that voicing actually ceases once the transitions have begun. In this case voicing ceases before the transitions have achieved the low frequency values observed both in the last example, GF5/36 <here>, and in the fully voiced equivalent discussed in 4.2.1.1.1, above. This exemplifies the point made above concerning the differences between what is perceived by the ear and the detail captured by the instrumental equipment.

11 "Breath", "whisper" and "whispery-creak" are used in the sense described by Laver 1994: 189-191, 198-200.

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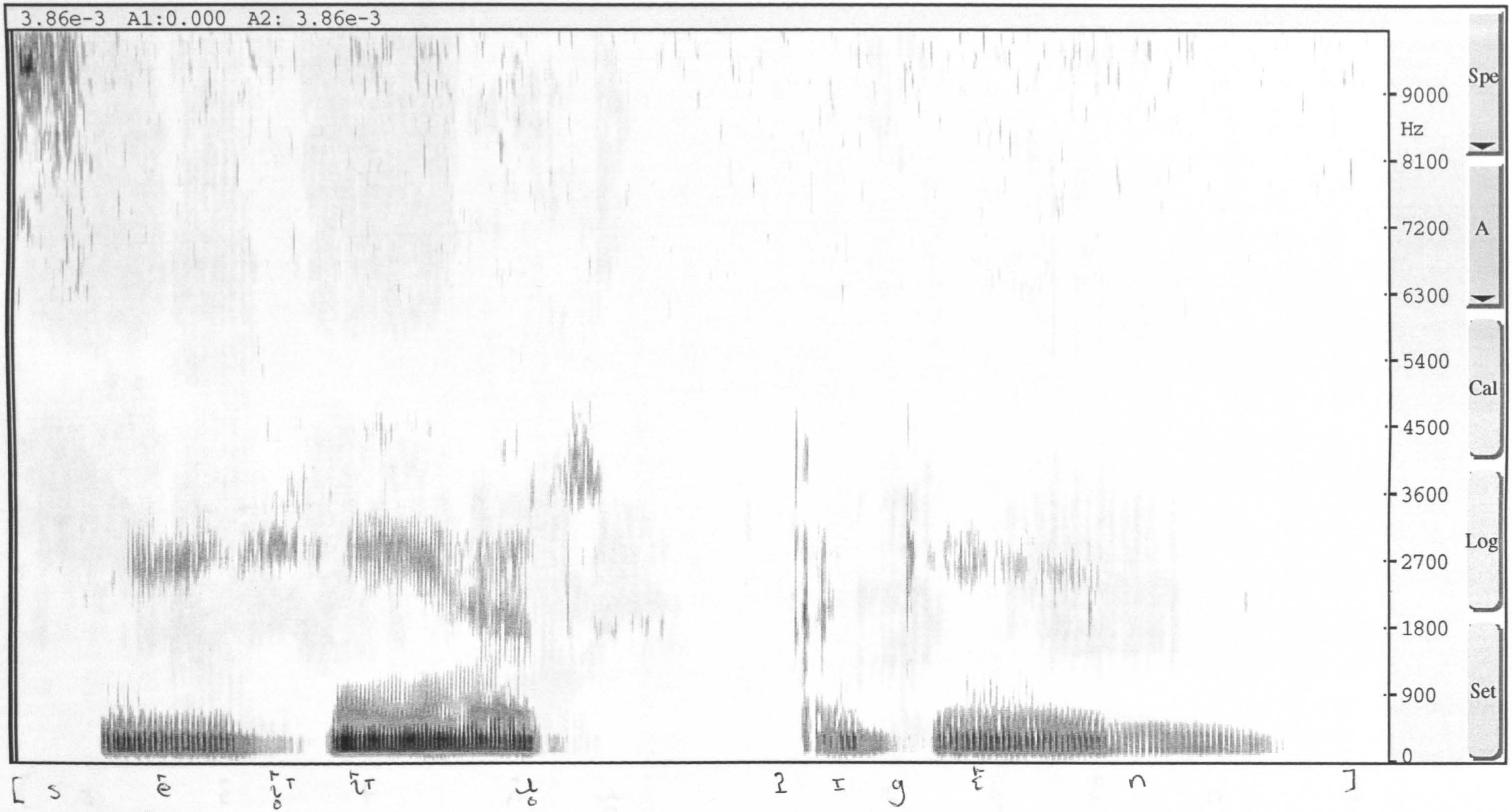
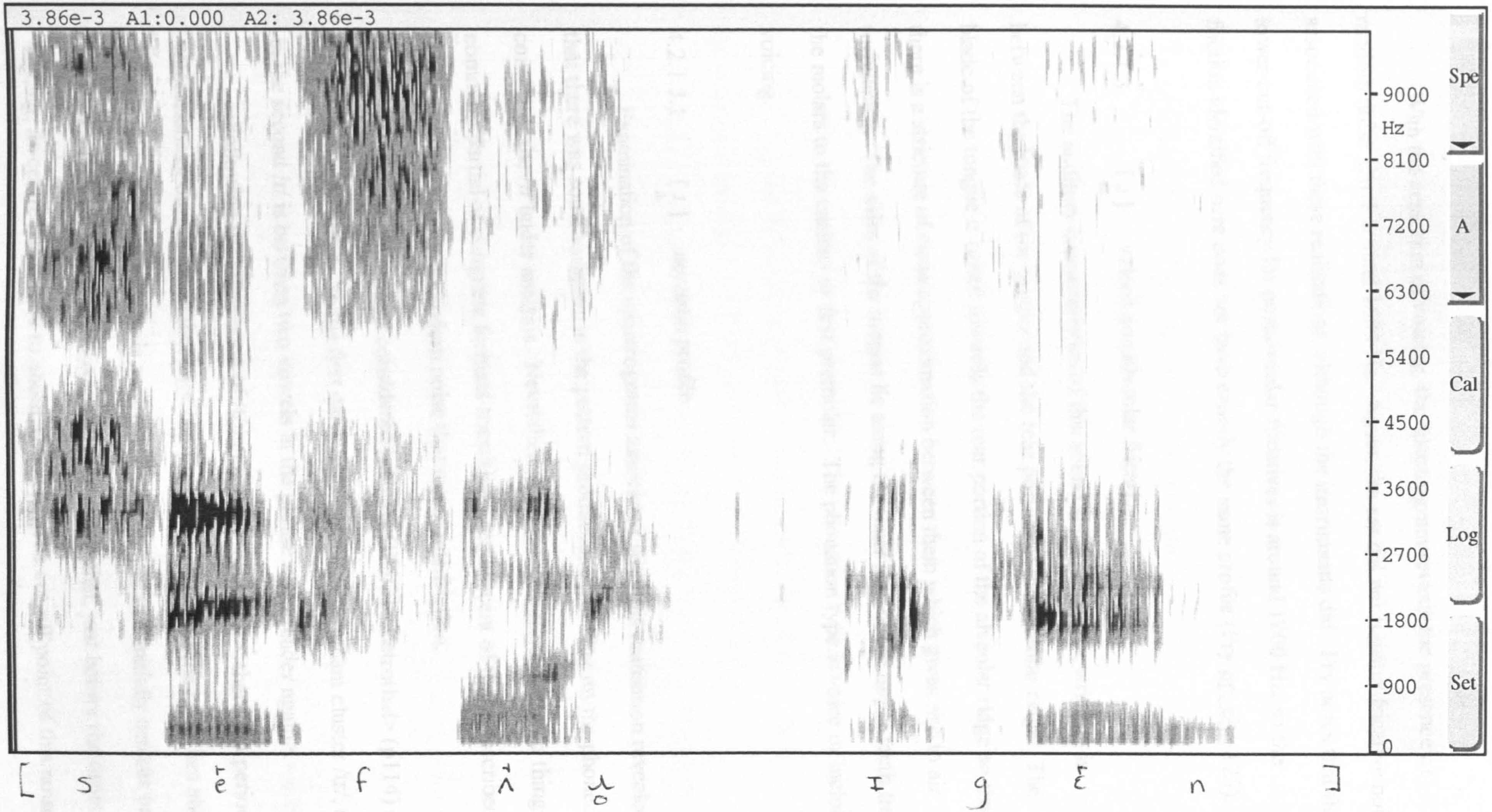


GF5/36 Say "here" again



GM4/66 Say "fur" again

With the cessation of voicing, the spectrogram reveals the presence of random noise above around 1600 Hz. Again, the ear did not register fricative noise associated with these realisations, although the instruments did. Fry notes that the lower cut-off frequency for postalveolar fricatives is around 1200 Hz, so the friction identified here does not have exactly the same profile (Fry op. cit.: 125).

4.2.1.3 [ɹ̝] voiced postalvaolar fricative

The auditory characteristics of this sound suggest that the stricture is between the blade of the tongue and the rear portion of the alveolar ridge. The blade of the tongue is raised towards the rear portion of the alveolar ridge so that there is a stricture of close approximation between them which gives rise to air turbulence. The sides of the tongue lie along the inner side of the upper teeth from the molars to the canines or first premolar. The phonation type is voice or includes voicing.

4.2.1.3.1 [ɹ̝] acoustic profile

Examination of the spectrograms associated with this realisation revealed that there was some variation in the pattern produced, depending on the phonetic context of the /r/ under analysis. Nevertheless, the spectrograms had two things in common: partial or complete formant transitions, reminiscent of those described above for [ɹ], and some random noise that represents friction.

The two spectrograms considered here are GF5/21 <betrothal> (p114) and EF3/1 <reader> (p115). In the first case, /r/ is part of a consonant cluster /tr/, and in the second /r/ is between two vowels in the phrase <Say reader again>.

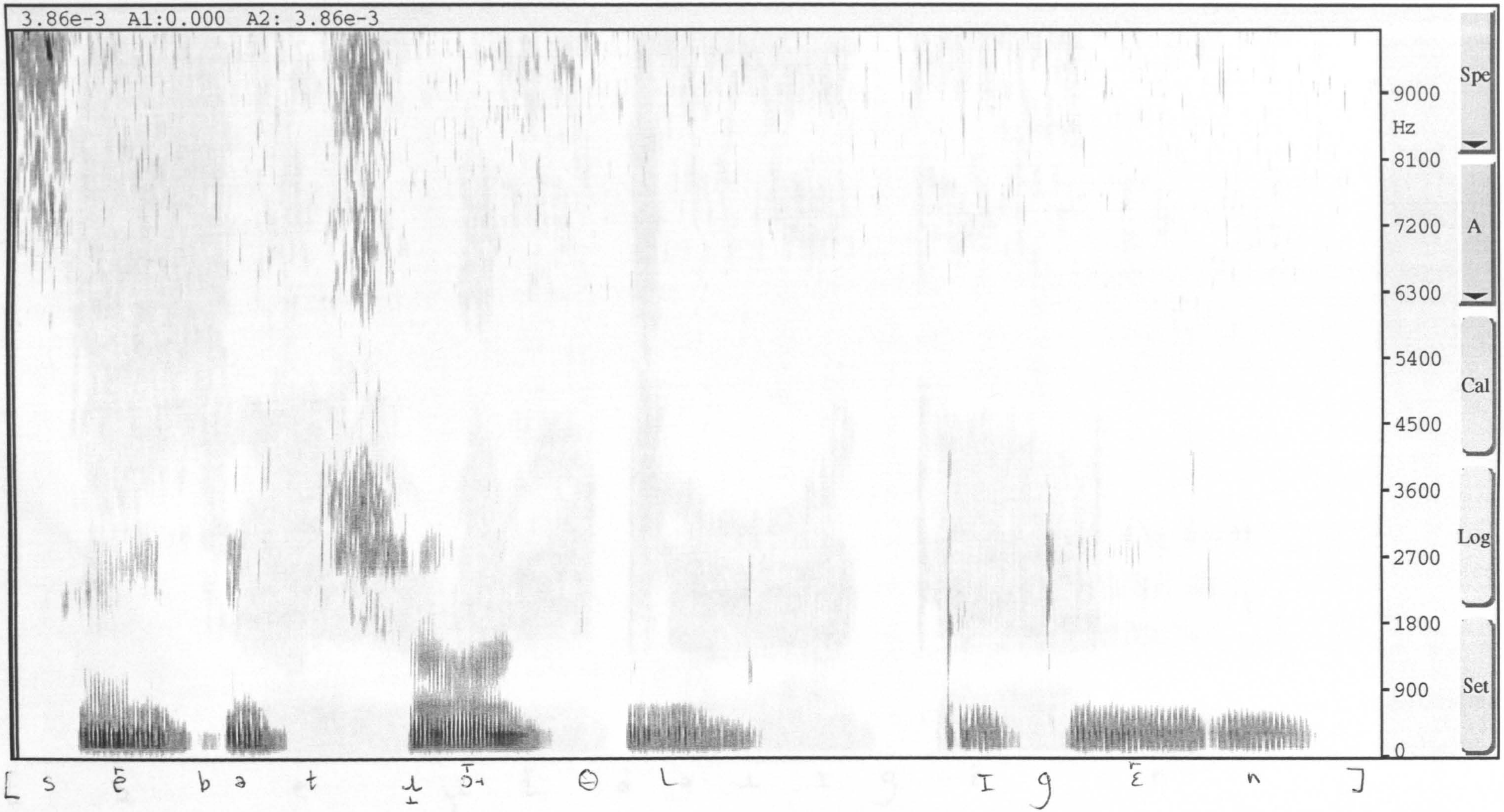
Following the noise burst of /t/ in GF5/21 <betrothal>, there is a period of voicelessness, during which there are bands of noise. Most of the noise lies above 2300 Hz, but below that there is a narrow band of noise that initially centres on 2000 Hz. That band of noise lowers in frequency so that, just before the onset of voicing, its centre has shifted to about 1800 Hz. The cut-off point of this noise at its lowest point is around 1600 Hz, still well above the value given by Fry of 1200 Hz (Fry1979: loc. cit.). With the onset of voicing, this noise band becomes a voiced formant, which continues its minus transition to around 1200 Hz. After a short duration this formant begins a transition towards around 1500 Hz, at which point it ceases.

With the onset of voicing after /t/ other formants appear, at around 400 and 600 Hz. These do not appear to undergo noticeable transitions.

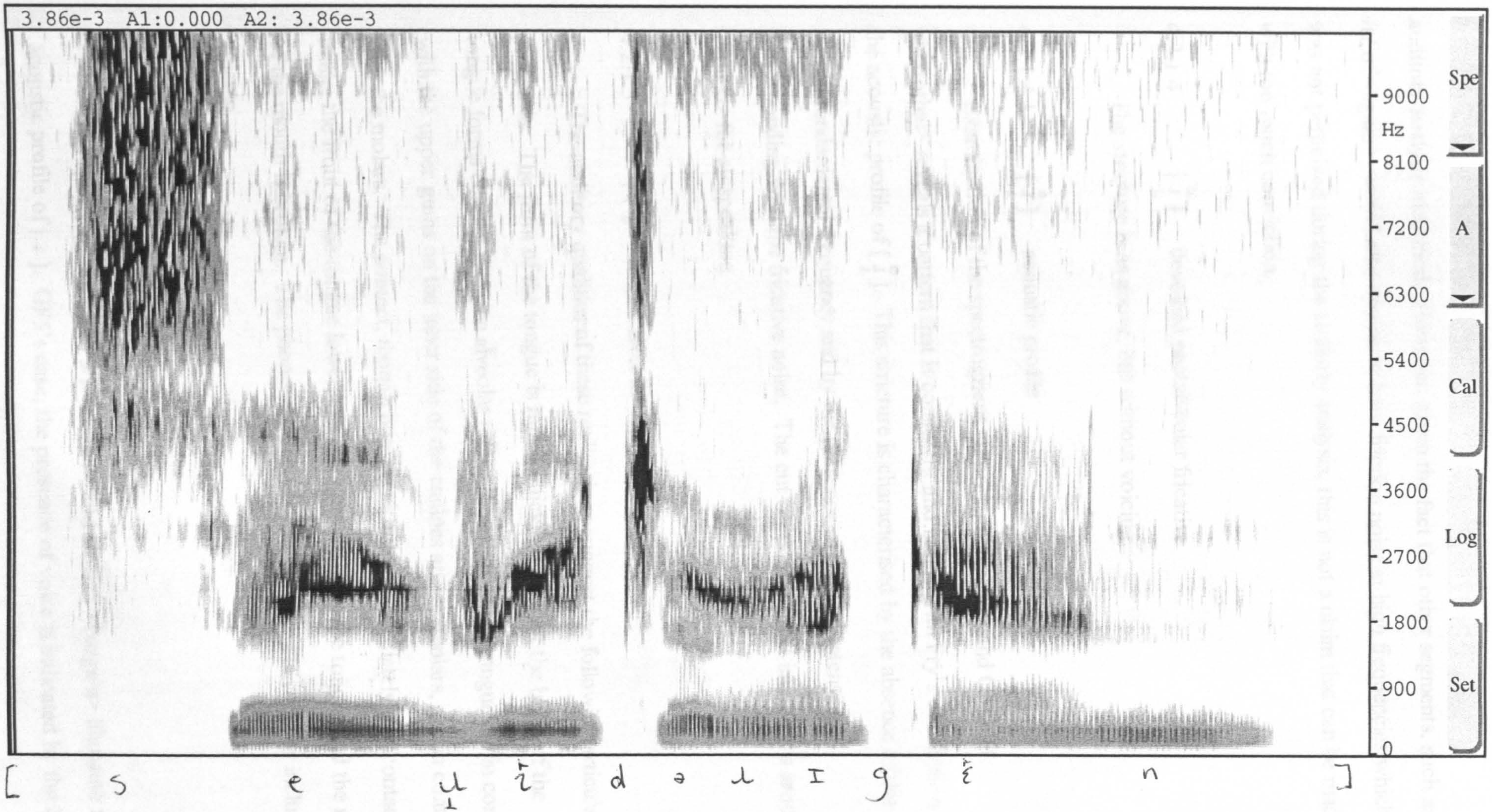
It is suggested that the perception of /r/ in the GF5/21 example may begin and be linked with the voiceless band of noise that occurs after the release of the /t/. This might link with the perception of friction. With voicing we have an F1 of around 400 Hz, an F2 of around 800 Hz and an F3 that completes its minus transition at about 1200 Hz. It is possible that the voicing, the minus transition of F3 and the relative closeness of F2 and F3 relate to the perception of [ɹ̝]. That F1 and F2 do not undergo any subsequent transition can be explained by the nature of the vowel that follows, i.e. /ɔ/, whose F1 and F2 have very similar values.

The second spectrogram considered here, EF3/1, shows a different pattern, but it is suggested that this is due to the fact that the /r/ in this case is between vowels. Firstly, surrounded by voiced vowels, the /r/ is voiced throughout. Secondly one can identify the formant transitions similar to those noted for [ɹ] above (4.2.1.1.1). The /e/ in <say> has F1 at around 387 Hz, F2 at 2239 Hz and F3 at around 2700 Hz. There is then a noticeable minus transition resulting in formant values of F1 258, F2 1722, and F3 2239 Hz. The formants then move again in the direction of higher values for the /i/ of <reader>.

This spectrogram has random noise throughout it at high frequency bands, which is more intense in some places than in others. For example, The noise associated with the /s/ of <say> and the noise burst of the /d/ in <reader> are the most intense and are characteristic of the friction that was present during those segments. It is possible to notice a band of random noise of lesser intensity that coincides with the dip in F1, 2, and 3. It may be that this is the friction that the



GF5/21 Say "betrothal" again



EF3/1 Say "reader" again

auditory analysis identified. However, given the fact that other segments, such as /ɛ/ of <again>, would also appear to have friction noise at high frequencies which was not perceived during the auditory analysis, this is not a claim that can be made with too much conviction.

4.2.1.4 [ɹ̝̊] devoiced postalveolar fricative

The stricture is as above, but without voicing.

4.2.1.4.1 [ɹ̝̊] acoustic profile

Examination of the spectrograms GF3/21 <betrothal> and GM3/21 <betrothal> reveals a pattern that is consistent and in line with Fry's description of the acoustic profile of [ɹ̝̊]. This stricture is characterised by the absence of the voiced fundamental frequency and by the presence of random intensity, corresponding with the fricative noise. The cut off point of that intensity is around 1200 Hz for all speakers.

4.2.1.5 [ɾ] voiced alveolar tap

The auditory qualities of these realisations suggest the following articulatory processes. The front of the tongue is raised quickly, such that the blade of the tongue forms contact with the alveolar ridge. The rims of the tongue are in contact with the upper gums on the inner side of the canines and premolars, and in contact with the molars. The contact, though brief, is airtight. Immediately that contact is made, the front of the tongue lowers, and contact between the tongue and the roof of the mouth is broken. The phonation type in these examples is voice or includes voicing.

4.2.1.5.1 [ɾ] acoustic profile

The spectrograms of GF5/1 <reader> and GM4/2 <bargain> illustrate the acoustic profile of [ɾ]. GF5's case, the presence of voice is indicated by the low

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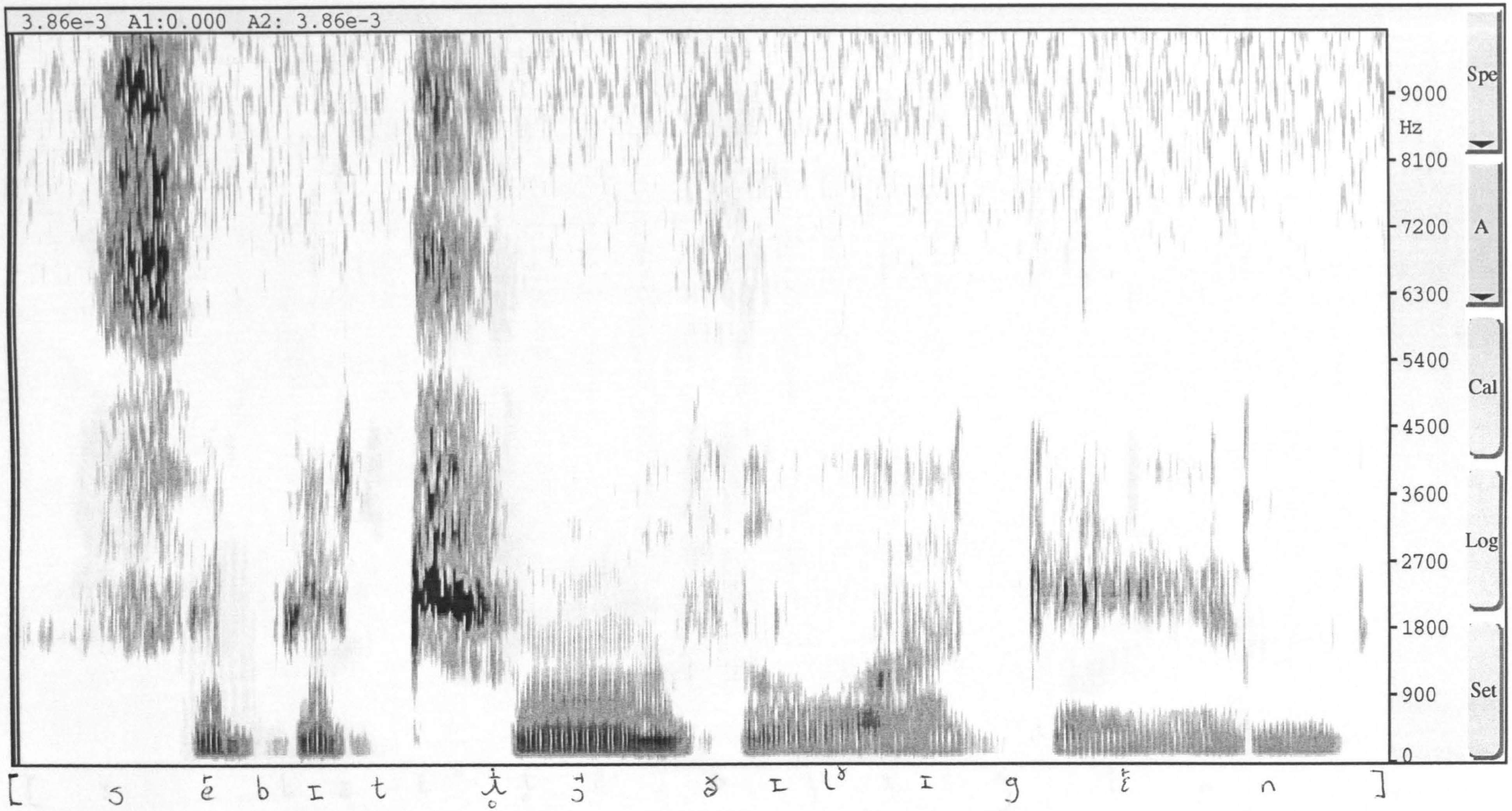
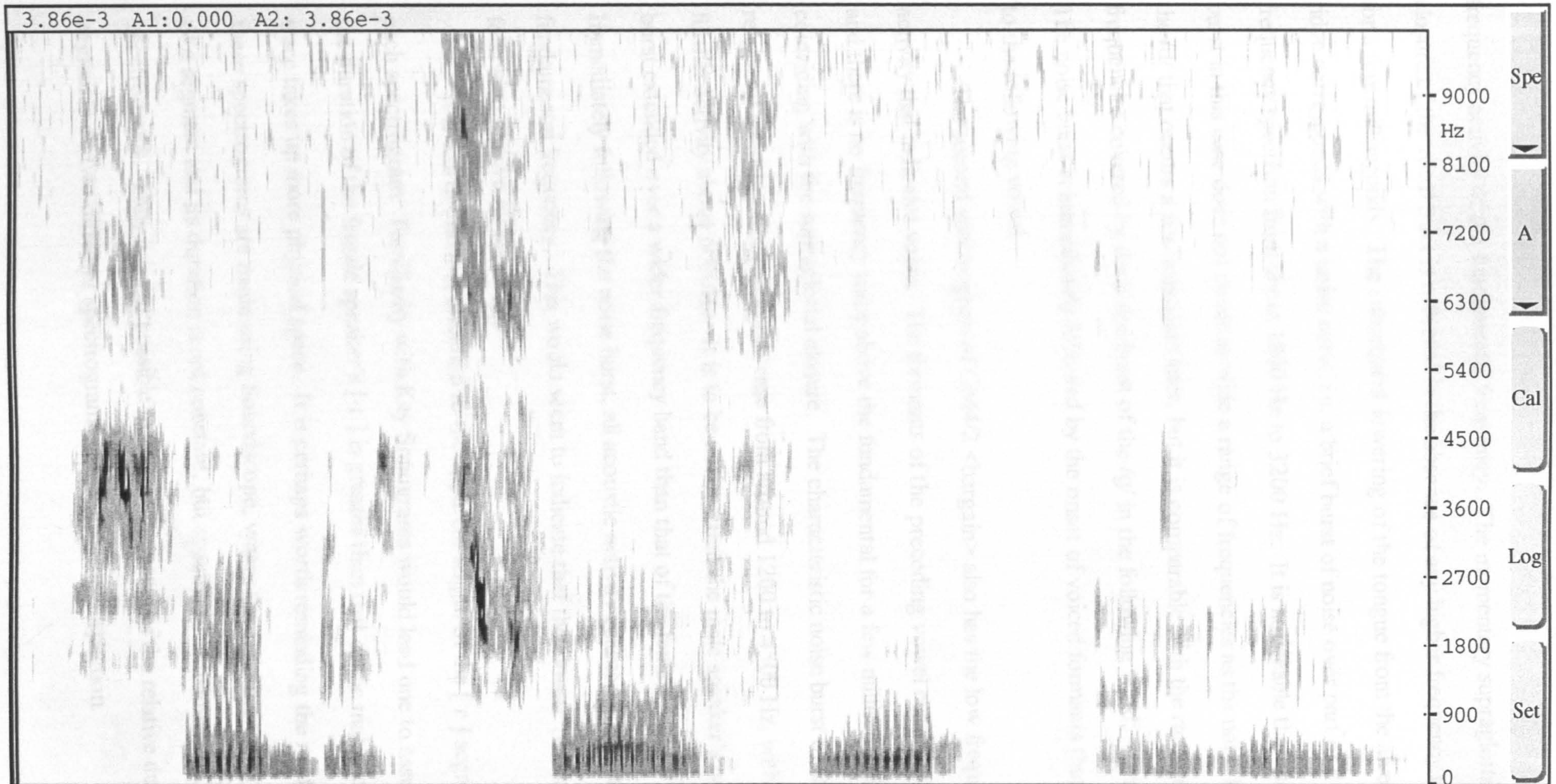


GF3/21 Say "betrothal" again



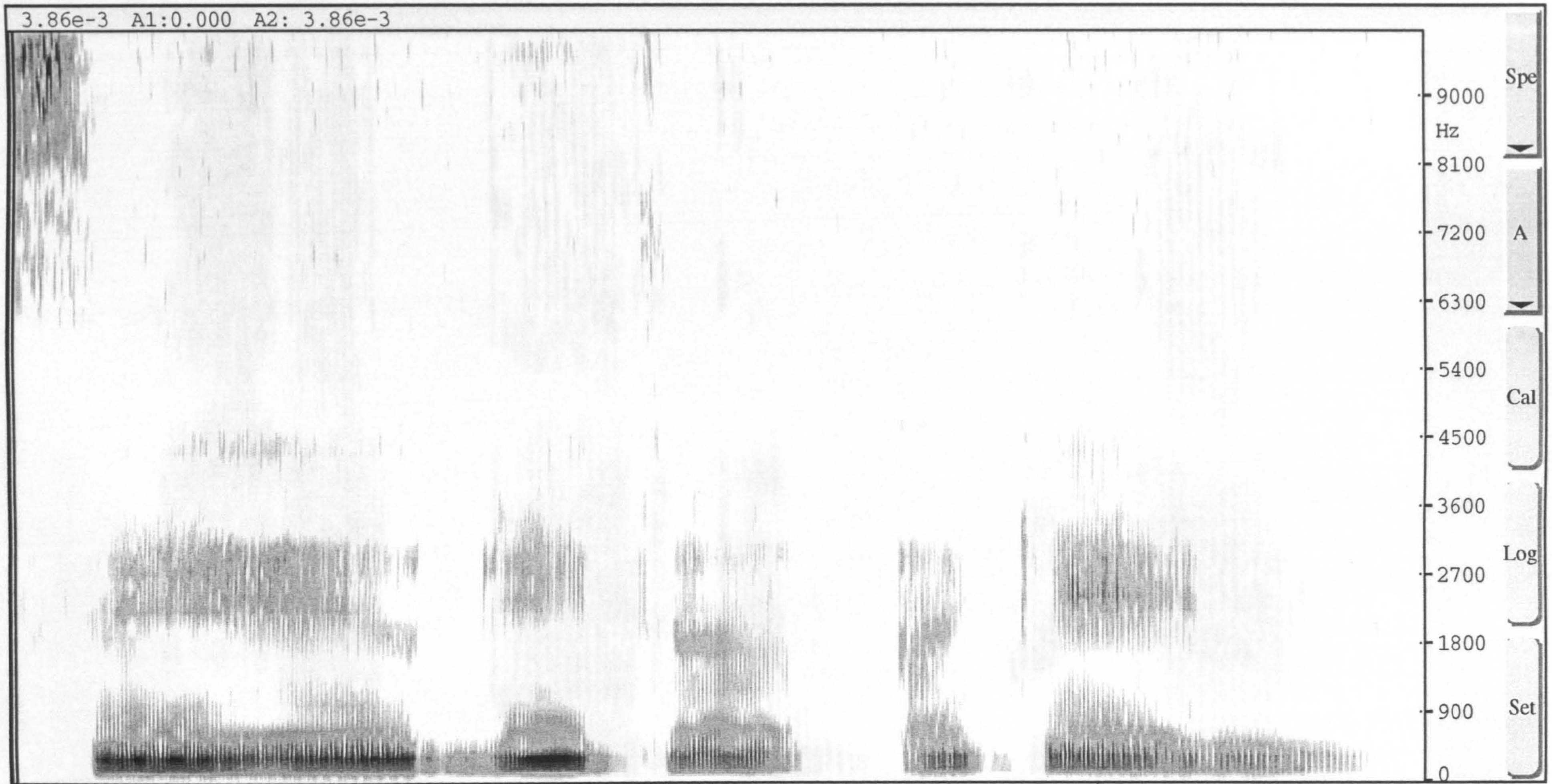
[s e b ɪ tʰ t̬ ðɾ θ ɾˠ ɪ ɡ ɛ̃ n]

GM3/21 Say "betrothal" again

frequency activity of the fundamental frequency. The momentary supraglottal closure of the vocal tract is reflected in the absence of any higher frequency trace for a few milliseconds. The subsequent lowering of the tongue from the alveolar ridge corresponds with a noise burst, i.e. a brief burst of noise over part of the frequency spectrum from about 1800 Hz to 3200 Hz. It is noticeable that the noise burst in this case does not cover as wide a range of frequencies as the noise burst of the /d/ that occurs a few segments later, but it is comparable with the range of frequencies covered by the noise burst of the /g/ in the following word, <again>. The noise burst is immediately followed by the onset of voiced formants that relate to the following vowel.

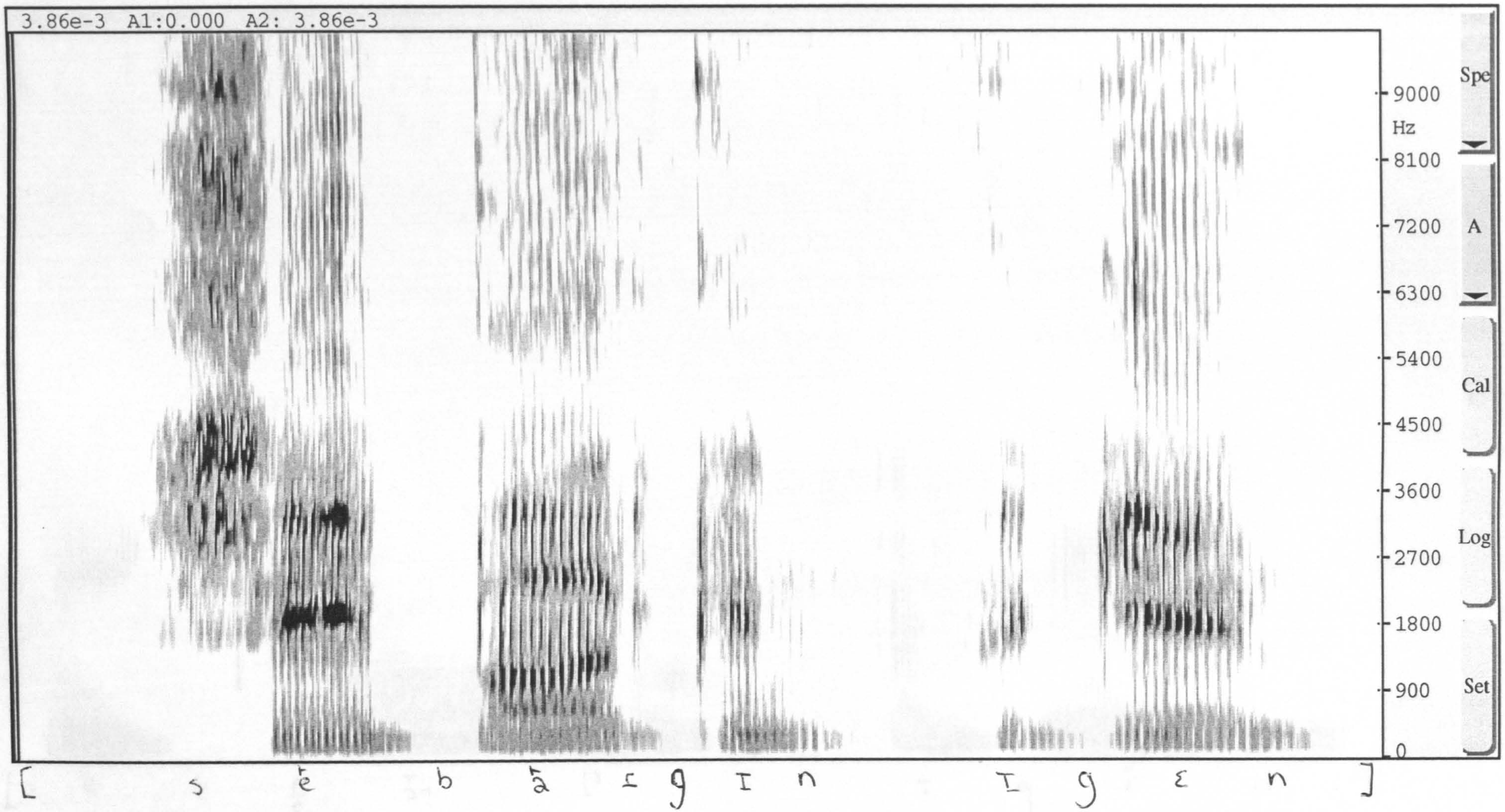
The second spectrogram of GM4/2 <bargain> also has the low frequency activity that indicates voice. The formants of the preceding vowel cease abruptly and there is no frequency trace above the fundamental for a few milliseconds, coinciding with the supraglottal closure. The characteristic noise burst of the release of a closure extends in this case from around 1200 to 4500 Hz, with some further activity above 6000Hz. It is to be noticed that the male speaker's noise burst extended over a wider frequency band than that of the female speaker. Immediately following the noise burst, all acoustic activity ceases, other than the fundamental frequency. This would seem to indicate that the closure period of the following plosive /g/ has begun.

It is worth drawing attention to the apparent length of the [ɾ] segment on each spectrogram. Familiarity with Kay Sonograms would lead one to assume that the duration of the female speaker's [ɾ] is greater than that of the males, as the trace takes up more physical space. It is perhaps worth reminding the reader that these spectrograms are made using Soundscope, where the ratio between the length of a segment and its duration is not constant, but specific to individual spectrograms. Thus it is not possible to base judgements of the relative duration of segments on two different spectrograms based on visual inspection.

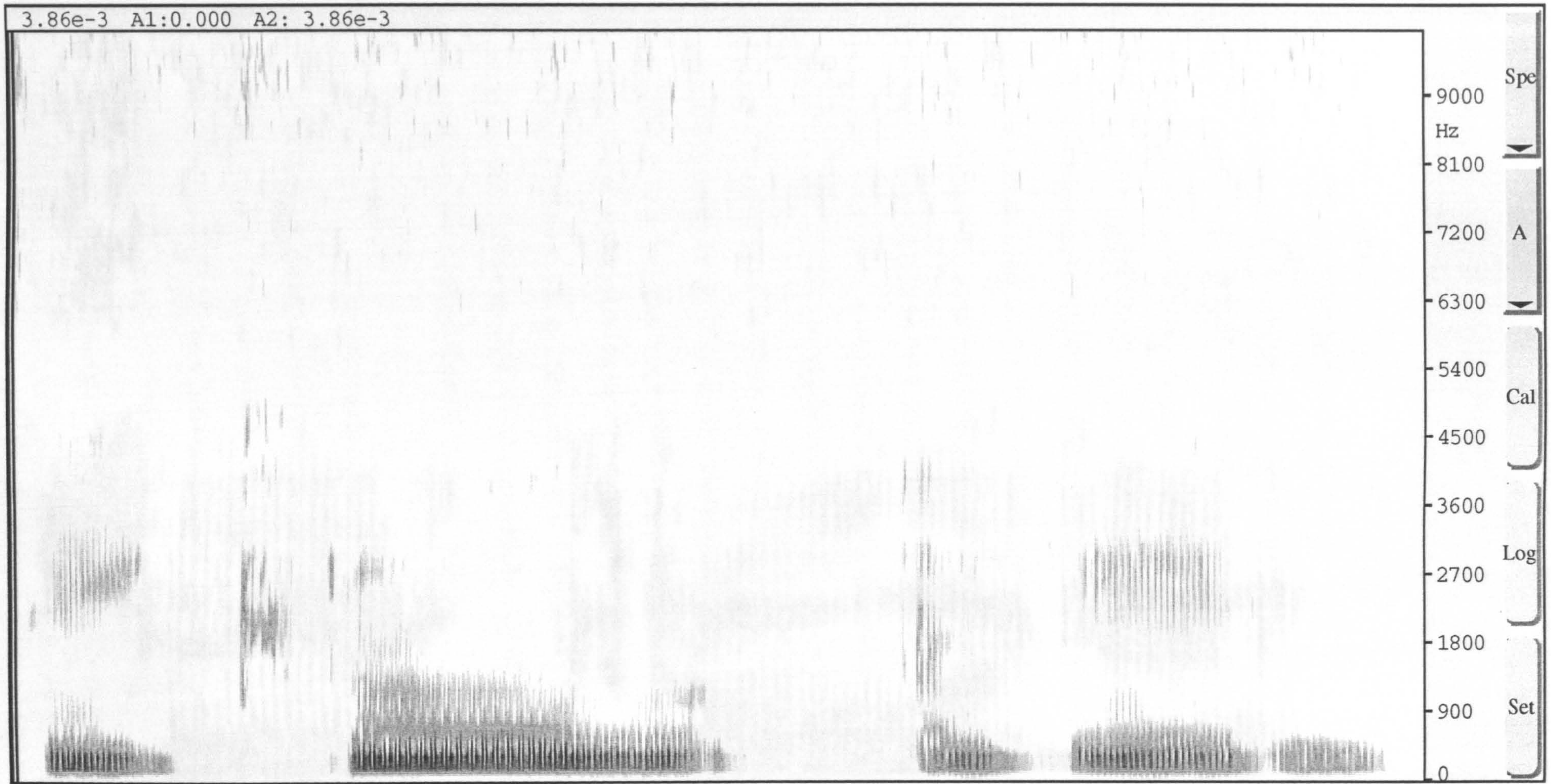


[s e̝ ɾ i d ɪ ɹ ɪ g ɛ̝ n]

GF5/1 Say "reader" again

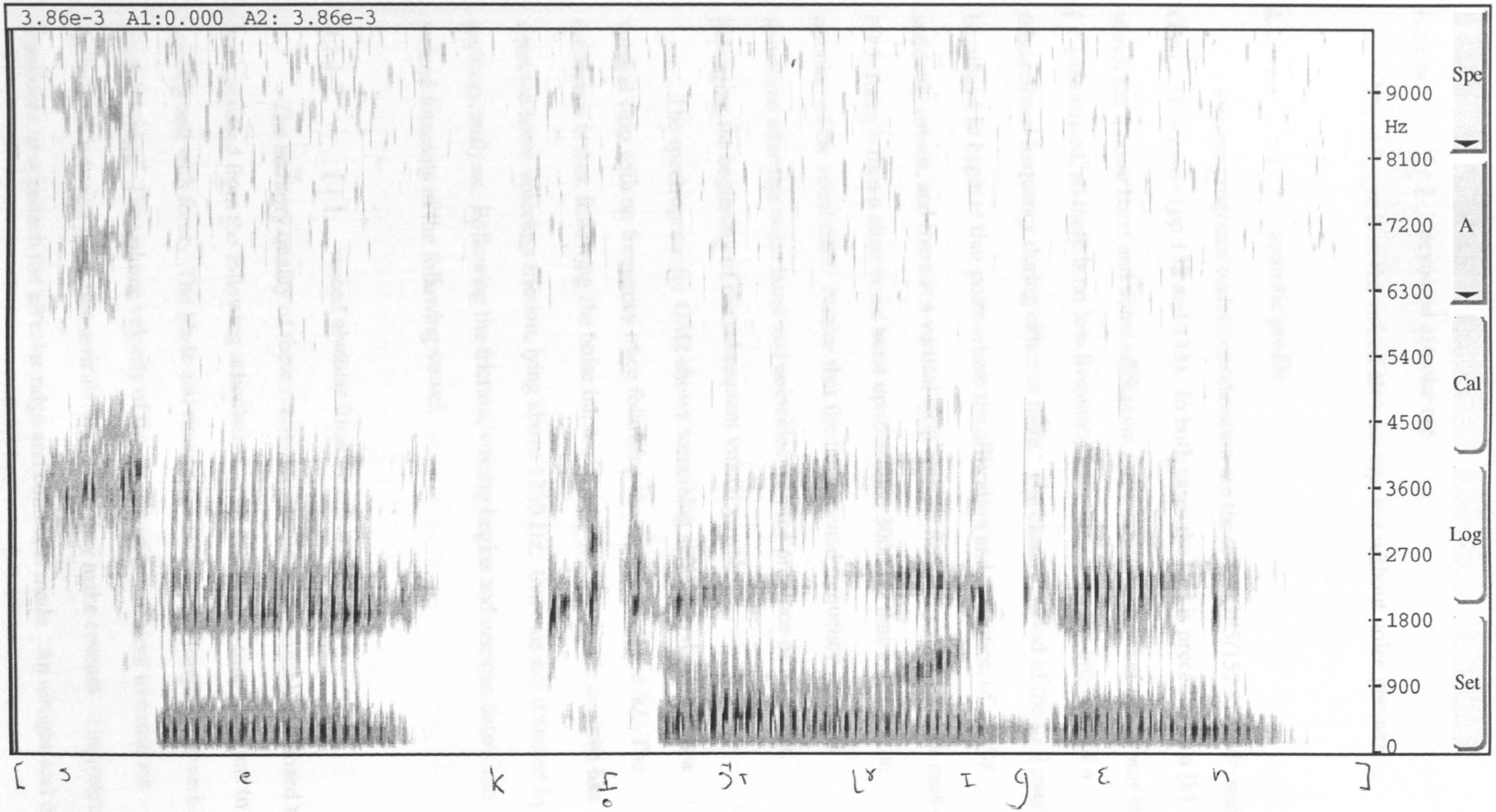


GM4/2 Say "bargain" again



[ˢ ɛ k ɾ̥ ɔ ɫˠ ɪ g ɛ̃ n]

GF5/152 Say "crawl" again



GM2/152 Say "crawl" again

4.2.1.6 [ɾ̥] devoiced alveolar tap

The stricture is as the voiced alveolar tap, but without voice phonation.

4.2.1.6.1 [ɾ̥] acoustic profile

The spectrograms under consideration are those for GF5/152 <crawl> and GM2/152 <crawl> (pp 132 and 133). In both cases the [ɾ̥] is preceded by a [k], which has a noise burst and some affrication and aspiration. Neither the /k/ nor the [ɾ̥] are voiced, so there is no low frequency trace indicating the presence of a fundamental frequency during either of them. The closure period of the [ɾ̥] may be judged to begin at that point where the affrication and aspiration of the /k/ suddenly ceases, and there is a vertical strip with no frequency trace. In the case of GF5, there is then a clear noise burst up to around 3000 Hz that indicates the opening of the vocal tract. Notice that the fundamental frequency registers sometime after this noise burst and coincides with the presence of formants, indicating the beginning of the subsequent voiced vowel.

The spectrogram for GM2 shows something similar, in that there is a vertical strip with no frequency trace following the aspiration of the /k/. The difference is that, following the noise burst of the [ɾ̥], the acoustic analysis has detected some voiceless friction, lying above 1200 Hz, that was not detected by auditory analysis. Following the friction, voicing begins and one can detect the voiced formants of the following vowel.

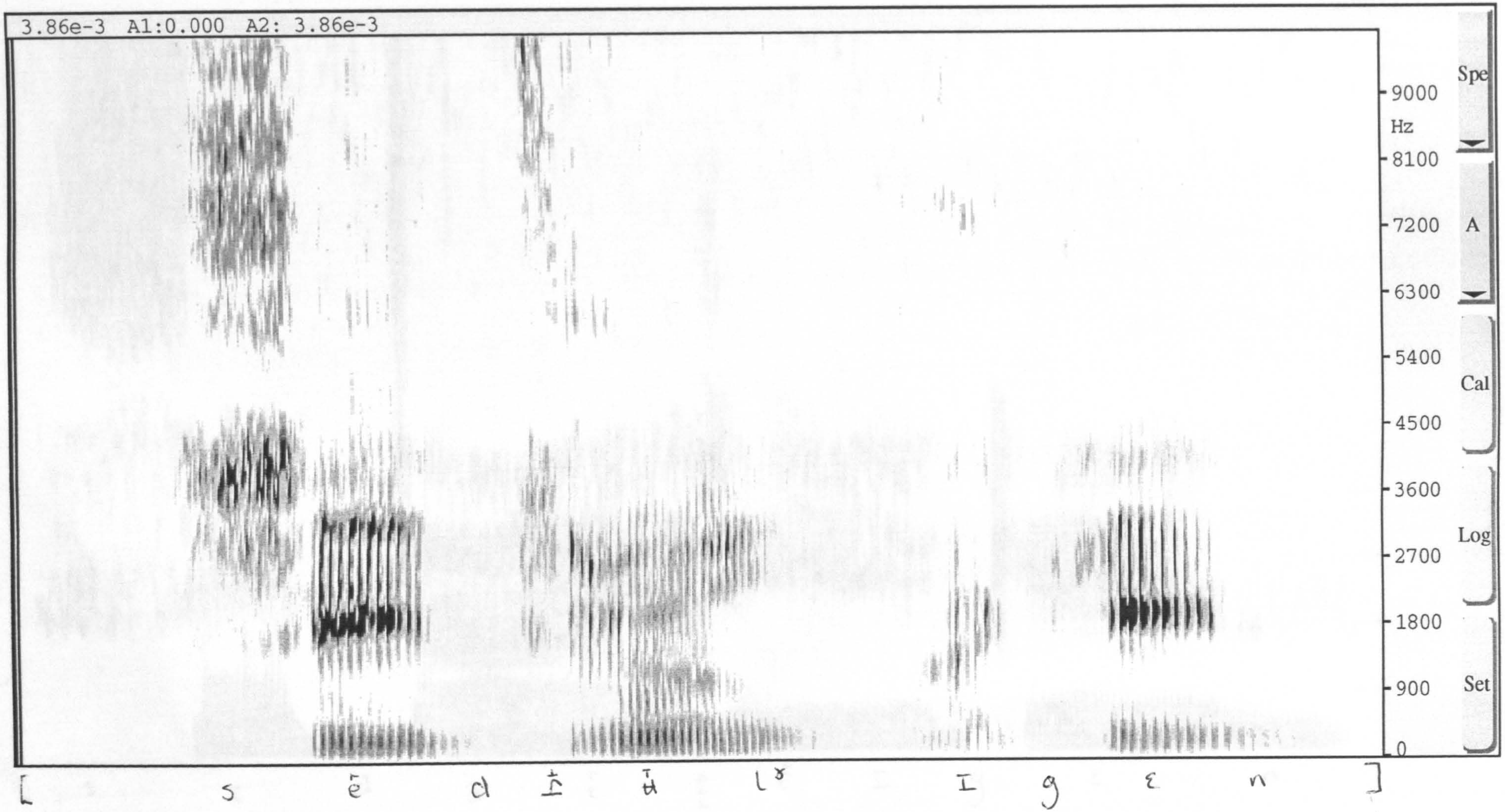
4.2.1.7 [ɾ̝] voiced alveolar fricative tap

The auditory quality of these realisations could be reasonably supposed to have resulted from the following articulation. The front of the tongue begins to rise quickly and with force. The blade and rims of the front of the tongue approach the alveolar ridge. The volume velocity of the air stream is sufficient to cause air turbulence between these two articulators before they make contact. The tongue continues to approach the alveolar ridge and contact is made. An airtight seal is maintained for about 15 milliseconds. The contact between the articulators is then broken and, as the tongue moves away from the alveolar ridge, air turbulence is created in the space between the two articulators. After a short time, the articulators are sufficiently far apart that air turbulence ceases. The phonation type is voice or includes voicing.

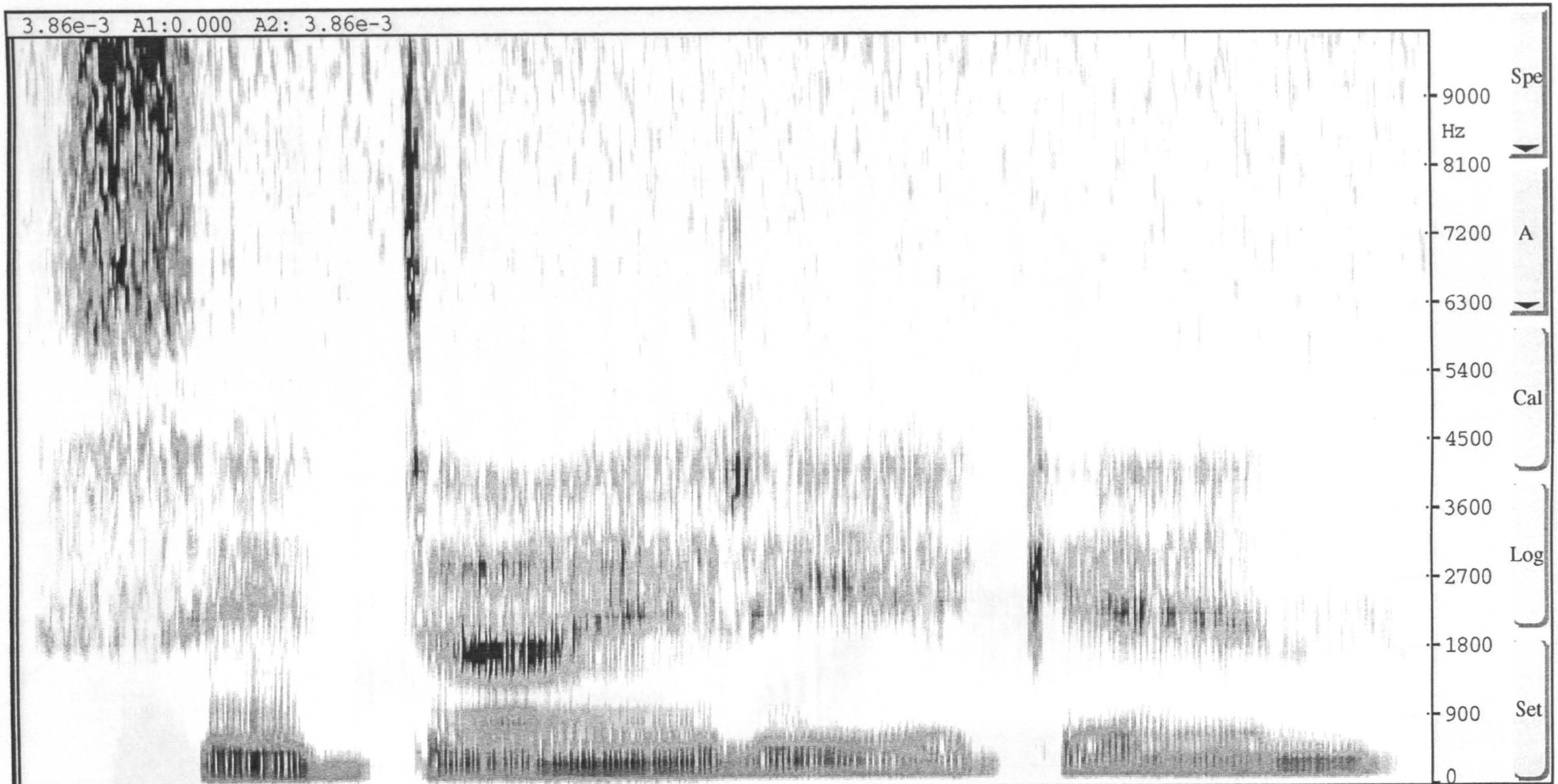
4.2.1.7.1 [ɾ̝] acoustic profile

Two spectrograms are included for consideration: GM4/205 <drool> and AF1/202 <diary> (pp 136 and 137). In the case of the former, voicing is seen to cease during the holding stage of the preceding /d/. The release stage of the /d/ is accompanied by a good deal of aspiration and affrication from above 1300Hz. There is then a brief vertical strip where no frequencies are recorded. This suggests the holding stage of the [ɾ̝]. Immediately following that a fundamental frequency appears, accompanied by voiced formants. This indicates that voicing has begun. It would appear, then, that there are some discrepancies between what the auditory analysis suggests and the acoustic analysis. The auditory analysis perceived that friction was present both before and after the holding stage of the [ɾ̝]. The spectrogram confirms the friction before but not after. The auditory analysis suggested that the segment is voiced. The acoustic analysis shows that the initial stages of the tap were in fact without voice. Once again, the acoustic analysis reveals aspects of the sound that the auditory analysis did not, or could not, perceive.

The spectrogram of AF1/202 <diary> is more problematic, in that it seems to conflict with the auditory analysis in some respects. Here the [ɾ̝] is intervocalic and is fully voiced, but there is no vertical line of white in the higher frequencies that would confirm the closure necessary for a [ɾ̝]. Instead, there is a minus transition of F1, and a small minus transition of F2 from about 2400 Hz to around 2000 Hz. At the same time there is trace of intensity in the higher frequencies, stretching to around 8000 Hz, suggesting the presence of friction. Subsequent to



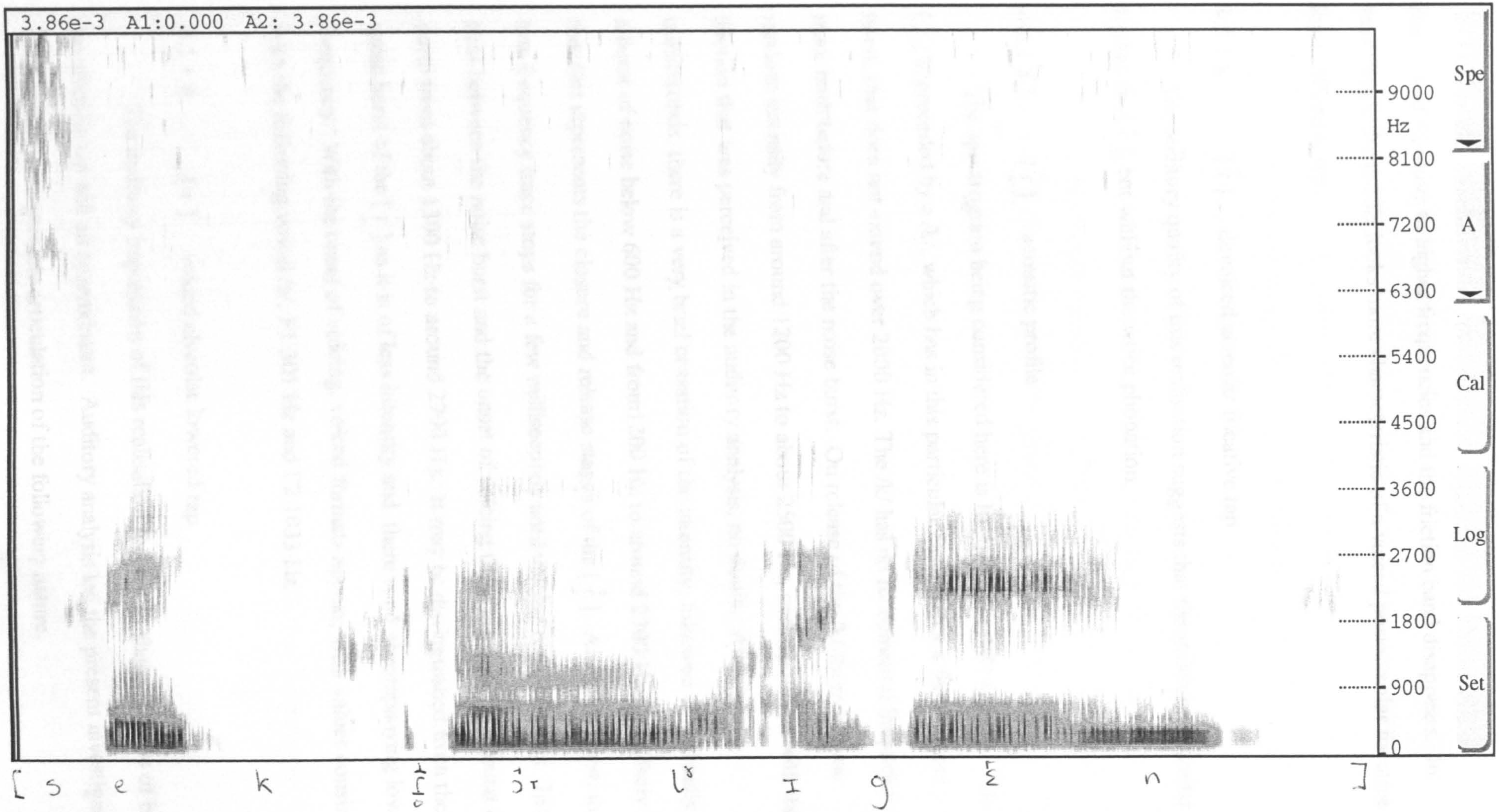
GM4/205 Say "drool" again



[s e d ä ẹ ɾ ē ɪ g ɛ n]

AF1/202 Say "diary" again

TEXT
CUT OFF IN THE
ORIGINAL



EF4/152 Say "crawl" again

this F1 and F2 move to higher frequencies and the friction band disappears. In many ways, the profile looks more characteristic of a voiced postalveolar fricative than a fricative tap.

4.2.1.8 [ɾ̝̊] devoiced alveolar fricative tap

The auditory quality of this realisation suggests that the stricture is similar to that for [ɾ̝], but without the voice phonation.

4.2.1.8.1 [ɾ̝̊] acoustic profile

The spectrogram being considered here is EF4/152 <crawl> (p138). The [ɾ̝̊] is preceded by a /k/, which has in this particular case, rather a feeble noise burst, that does not extend over 2000 Hz. The /k/ has no fundamental frequency trace both before and after the noise burst. On release of the /k/ there is some random intensity from around 1200 Hz to about 2500 Hz, corresponding with the friction that was perceived in the auditory analysis, no doubt. After a few milliseconds, there is a very brief cessation of the intensity, followed very rapidly by a burst of noise below 600 Hz and from1200 Hz to around 2700 Hz. It is likely that this represents the closure and release stages of the [ɾ̝̊]. After this burst, the low frequency trace stops for a few milliseconds until voicing recommences. In the time between the noise burst and the onset of voicing there is a very short burst of noise from about 1300 Hz to around 2700 Hz. It may be distinguished from the noise burst of the [ɾ̝̊] as it is of less intensity and there is no accompanying low frequency. With the onset of voicing, voiced formats appear, with values consistent with the following vowel /ɔ/: F1 301 Hz and F2 1033 Hz.

4.2.1.9 [ɾ] voiced alveolar lowered tap

The auditory impression of this realisation seemed to share features of both an alveolar tap and an approximant. Auditory analysis led the present investigator to speculate on a possible articulation of the following nature.

The front of the tongue begins to rise quickly and with some force. The blade and rims of the front of the tongue approach the alveolar ridge but no contact is made. Momentarily, a stricture of open approximation is achieved. The front of the tongue is quickly pulled back from the alveolar ridge, with some force. The phonation type is voiced or includes voicing.

This realisation is not attested elsewhere in phonetic literature and therefore requires further explanation. The term "lowered tap" has been chosen for it.

Firstly, how can one account for the presence of such an articulation? Catford argues that both the tap and the plosive are ballistic movements, trajectories formed by two muscular "twitches" on the part of the tongue: a movement towards the passive articulator and a movement away from the passive articulator.[12] The difference between the plosive and the tap, he suggests, is the starting point of the trajectory: the tap starts further away than the plosive, and thus has space to complete its trajectory, whereas the plosive starts closer to the passive articulator and therefore its trajectory is arrested prior to completion (Catford 1977:129-130).

Elsewhere in the data from the present study, it is possible to find "plosive" articulations, which are not actually plosives. An example is GM1's realisation of the /d/ in the word 1 <reader> (see spectrogram on p118). Comparison of GM1's realisation of the /d/ with that of GF1 (p117) shows that there is a different profile for the /d/s. The spectrogram of GF2's /d/ has the characteristics of a plosive: the abrupt cessation of formant frequencies, the sudden noise burst over a range of frequencies. GM1 produces a similar realisation of /d/ in word 112 <fodder>.[13] On another occasion GM1 produces a similar realisation of /t/ (word 96 <rotten>).

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12 In this sense, the tap is similar to plosives, rather than trills, which depend on the Bernoulli effect for their articulation.

13 Similar examples exist in the data. For example EM1 realises the /n/ of word 56 <dinner> with a alveolar lowered nasal.

It is suggested that such realisations are not the result of a conscious attempt on the part of the speaker to produce an approximant or a fricative, but that, for some reason, the trajectory of the plosive is completed prior to contact being made with the passive articulator so that a brief fricative, rather than a plosive, results. Perhaps the trajectory began further from the passive articulator than usual, or perhaps the second muscular impulse occurred sooner than usual. Whatever the reason, the fact remains that a handful of "plosives" in the present body of data are realised as fricatives, and that the acoustic data backs up the auditory impression.

This type of plosive phoneme realisation would argue for the presence of the incomplete, lowered tap. It is suggested that either the trajectory is begun further from the passive articulator than normal or that the second muscular movement is begun earlier than usual for a tap. Either way, the movement of the tongue is characteristic of a tap but, crucially, contact is not made with the alveolar ridge.

The former hypothesis would find some precedence in Butcher's data on fricative phonemes which were realised as approximants (1977). He discusses how, in fast tempo speech, the motor commands to the articulators may follow into each other very rapidly, so that the articulators are not able to complete one movement before the next motor command is issued. If the articulators have already reached their maximum speed, they will increase the rate of utterance still further by abandoning one movement in order to perform the following one. Thus, in his data, a fricative phoneme is realised as an approximant and, in this case, an "intended" tap may not include a period of contact between the tongue and the alveolar ridge.

Finally, it is problematic to know quite how to classify this segment in terms of manner of articulation. In this study it is called a tap, yet, the fact that the tongue does not make contact with the passive articulator would argue for its inclusion in the approximant category. To do this, however, would mask the characteristic "ballistic" nature of this articulation, as the tongue movement possesses the speed and force as well as the transitory nature characteristic of a tap (cf. Ladefoged 1975: 145). Moreover, the resulting auditory effect is quite different to that of, for example, the post-alveolar approximant. Thus it has been decided to refer to this realisation as a lowered tap, and to symbolise it using a tap symbol with the diacritic for lowering.

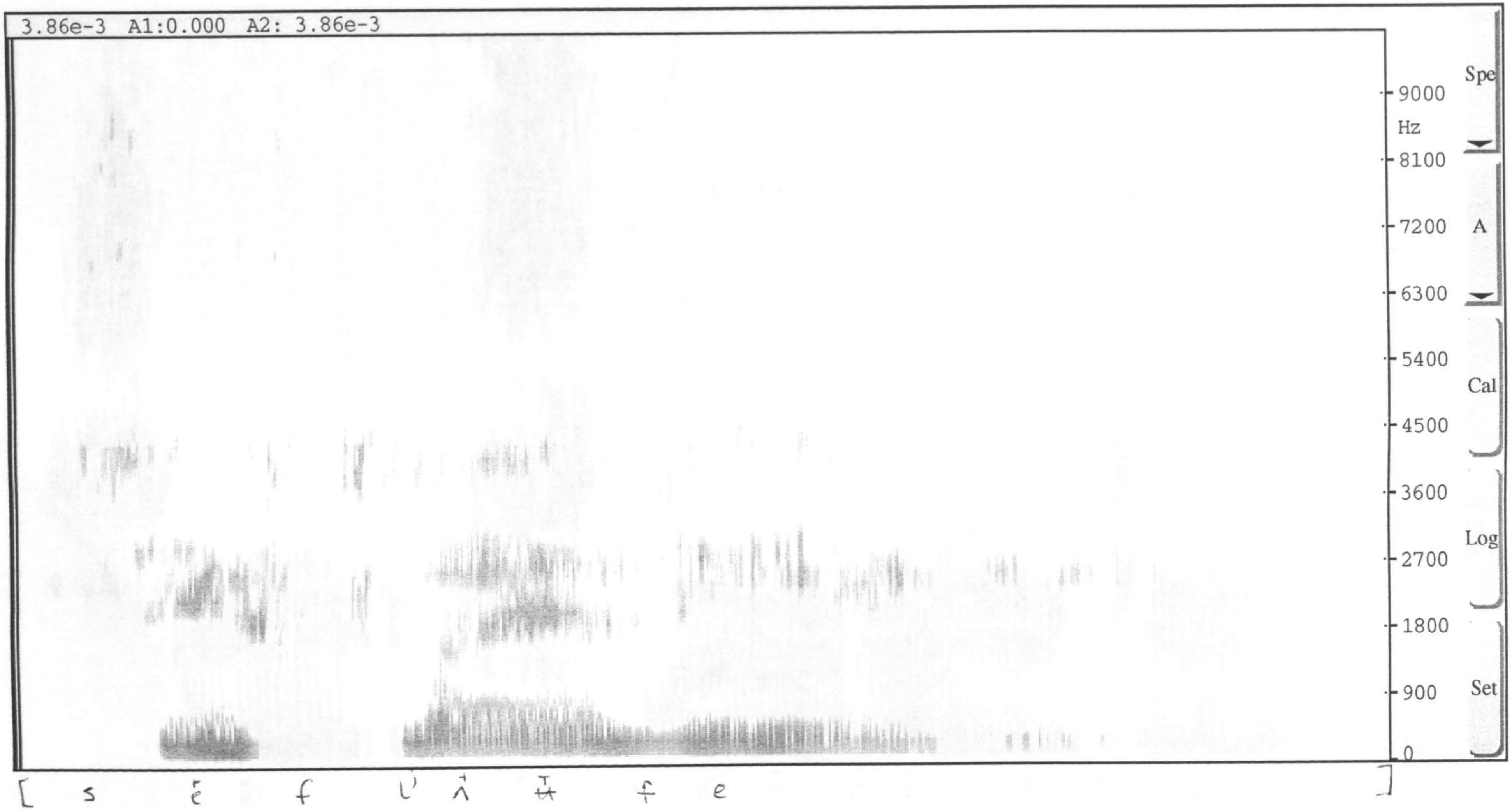
4.2.1.9.1 [ɾ̞] acoustic profile

The spectrograms under consideration are GF2/4 <flowery> and GM3/4 <flowery> (see spectrograms on pp 143 and 144). Each shows a low frequency band representing voicing. F1 in both cases undergoes a small minus transition. F2 and F3 of the preceding vowel appear to remain relatively steady, without the marked minus transition seen in [ɹ] realisations. Unlike the acoustic profile expected of [ɹ] both F2 and F3 cease for a few milliseconds. The spectrogram for GM3 is easier to read than that of GF2, but the formants can clearly be seen to resume without any accompanying noise burst. This profile, therefore, is distinct from that of the tap by the absence of a noise burst, and is unlike that of the approximant due to the cessation of F2 and F3.

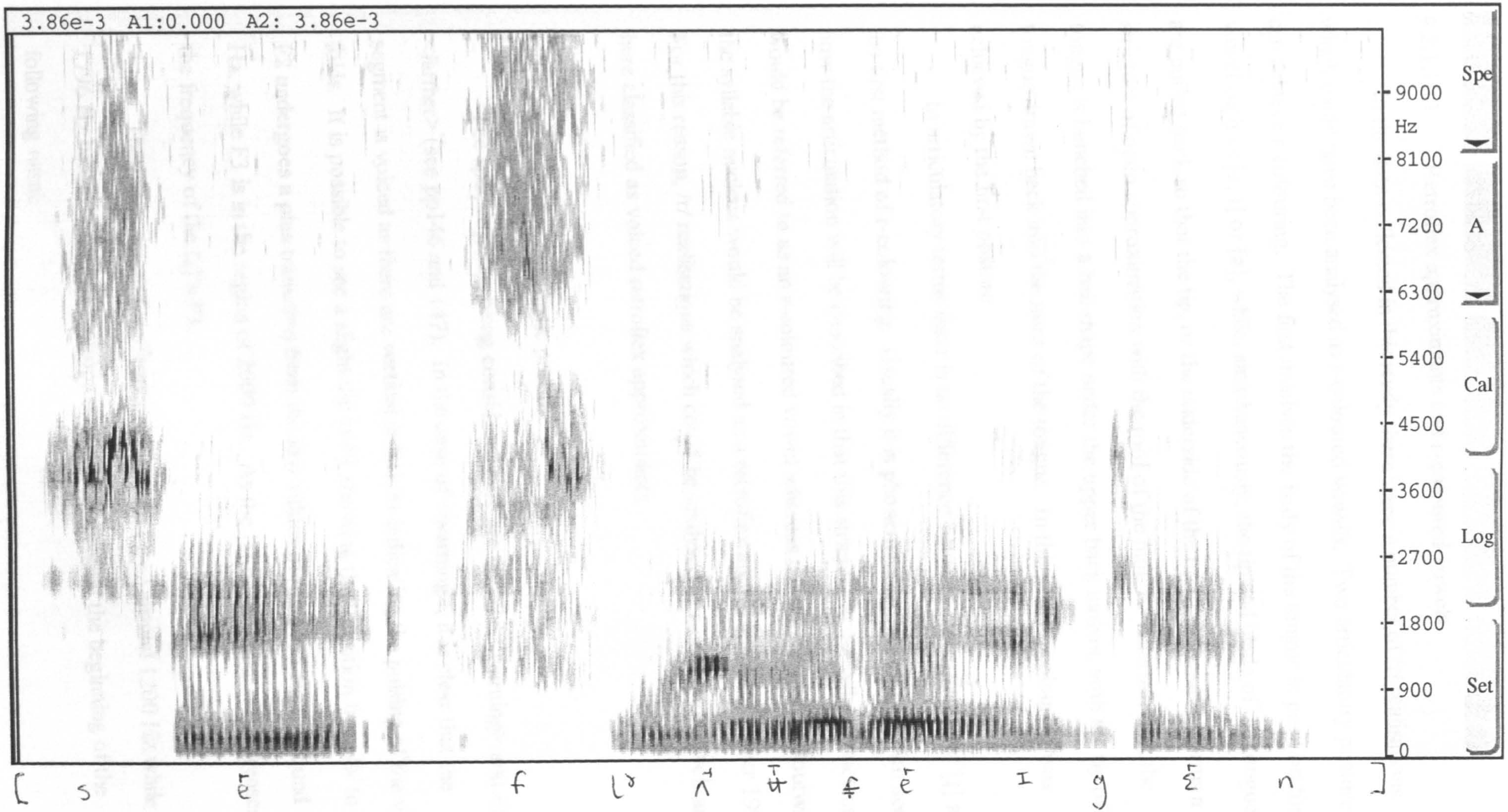
It is difficult, of course, to know what aspects of this acoustic profile are significant in terms of acoustic cues, as only perception tests would clarify these.

4.2.1.10 [ɻ] voiced retroflex approximant

The auditory impression was that characteristic of a retroflex articulation. This suggests an articulation in which the apex and blade of the tongue are curled back in such a way that there is a stricture between the underside of the apex of the tongue and the postalveolar ridge. As the realisations did not have a strong retroflex quality, it is supposed that the articulation does not involve a great degree of retroflection of the tongue. In these examples, the phonation type is voiced or includes voicing.



GF2/4 Say "flowery" again



GM3/4 Say "flowery" again

4.2.1.10.1 Retroflex approximants and r-coloured vowels

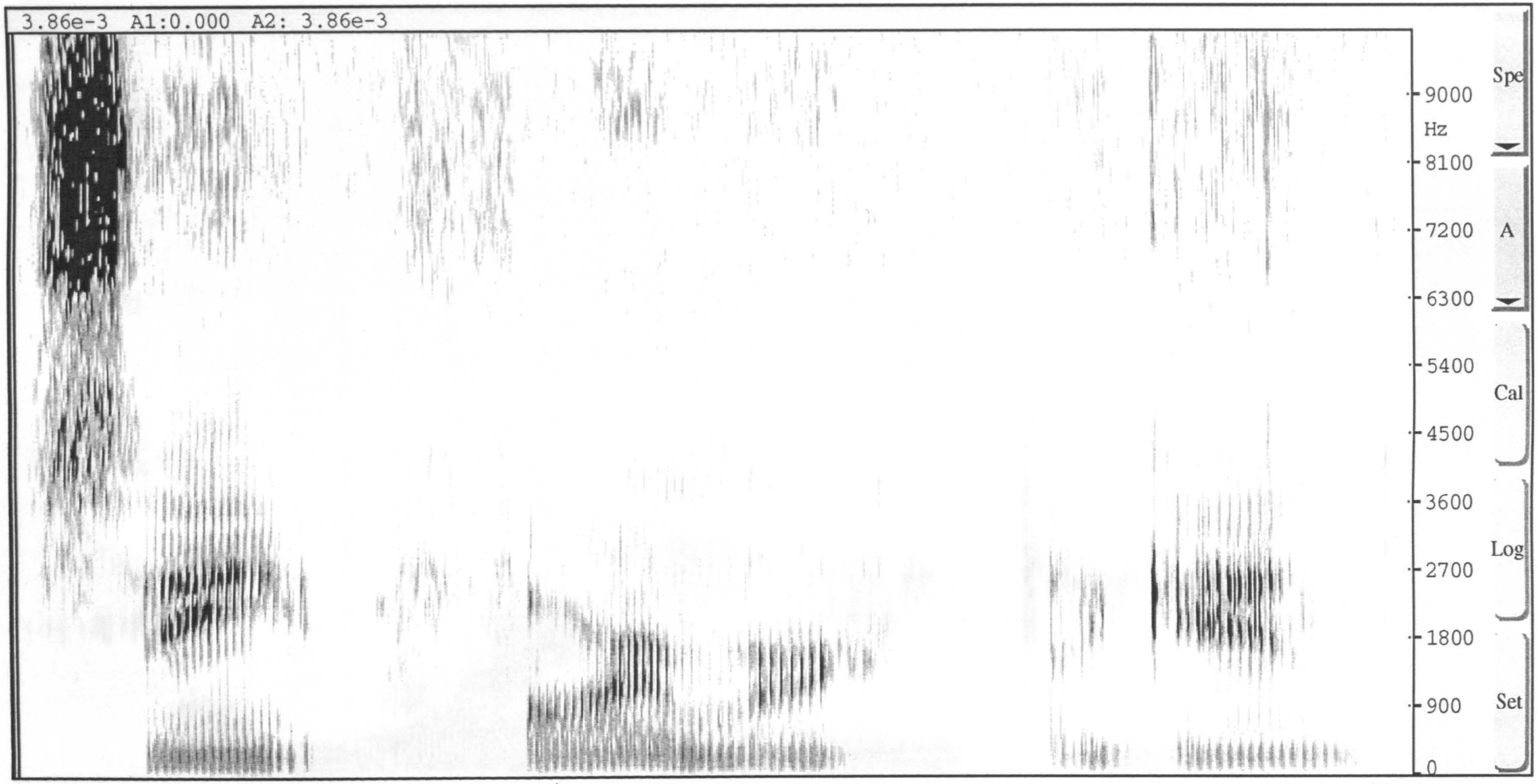
In the data collected in this study there were a number of /r/ realisations which could have been analysed as r-coloured vowels. Two articulatory postures can achieve r-colouring. The first involves the body of the tongue in position for a vowel such as [ɜ, ɪ] or [ə], while, simultaneously, the tip and blade of the tongue are curled back so that the tip, or the underside of the tip of the tongue, forms a stricture of open approximation with the roof of the mouth. Alternatively, the tongue is bunched into a ball shape under the upper back molars, with the tip of the tongue drawn back into the mass of the tongue. In this study r-colouring was achieved by the first posture.

In articulatory terms there is no difference between the stricture for [ɻ] and the first method of r-colouring. Usually it is phonemic considerations which decide how the articulation will be described in that this stricture in the syllabic nucleus would be referred to as an r-coloured vowel whereas the same realisation outwith the syllabic nucleus would be analysed as a retroflex approximant (cf. Laver 1994). For this reason, /r/ realisations which could be analysed as r-coloured vowels are here classified as voiced retroflex approximants.

4.2.1.10.2 [ɻ] acoustic profile

The spectrograms being considered here are GF2/12 <warning> and EM1/6 <farmer> (see pp146 and 147). In the case of <warning>, it is clear that the segment is voiced as there are vertical striations indicating the pulsing of the vocal folds. It is possible to see a slight dip in F1 showing the transition from /ɔ/ to [ɻ]. F2 undergoes a plus transition from the low values of /ɔ/, 1055 Hz to around 1700 Hz, while F3 is in the region of 2000 Hz. As the [ɻ] becomes /n/, F2 increases to the frequency of the [ɻ]'s F3.

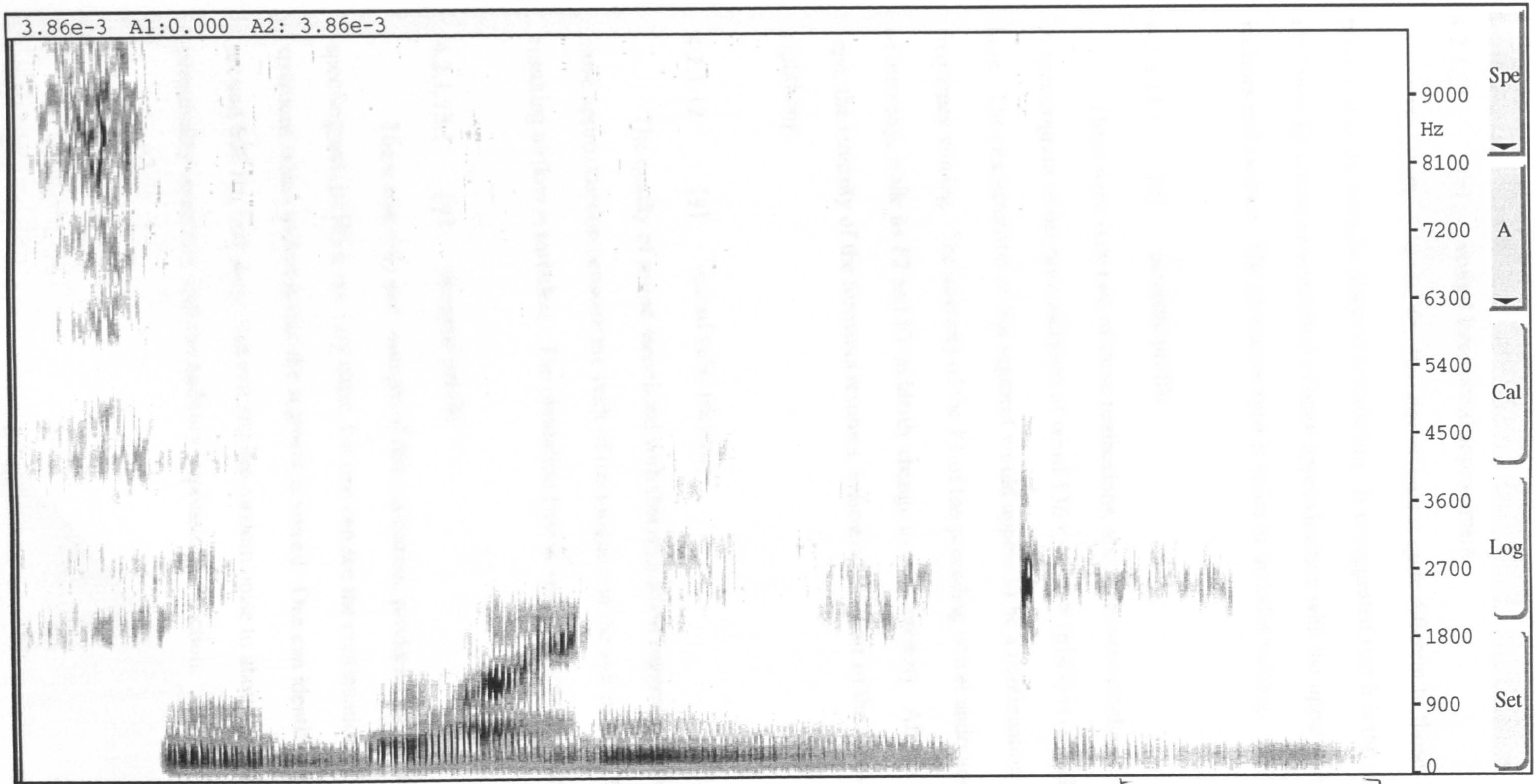
The spectrogram for <farmer> shows an F2 of around 1200 Hz while F2 is 1796 Hz before the intensity drops suddenly, indicating the beginning of the following nasal.



[s e f ȧ ɫ m ɪ ɫ ɪ g ɛ n]

EM1/6 Say "farmer" again

TEXT
CUT OFF IN THE
ORIGINAL



[s e w ɔ̝˞ ɻ n ɪ̃ ŋ ɪ g ɛ̝ n]

GF2/12 Say "warming" again

4.2.1.11 [ʋ] voiced labiodental approximant

The quality of sound for this approximant is quite different to those produced at the alveolar place of articulation. It is suggested that it is the result of the lower lip taking up a stricture of open approximation with the upper front incisors and canines. The phonation type is voice or includes voicing.

4.2.1.11.1 [ʋ] acoustic profile

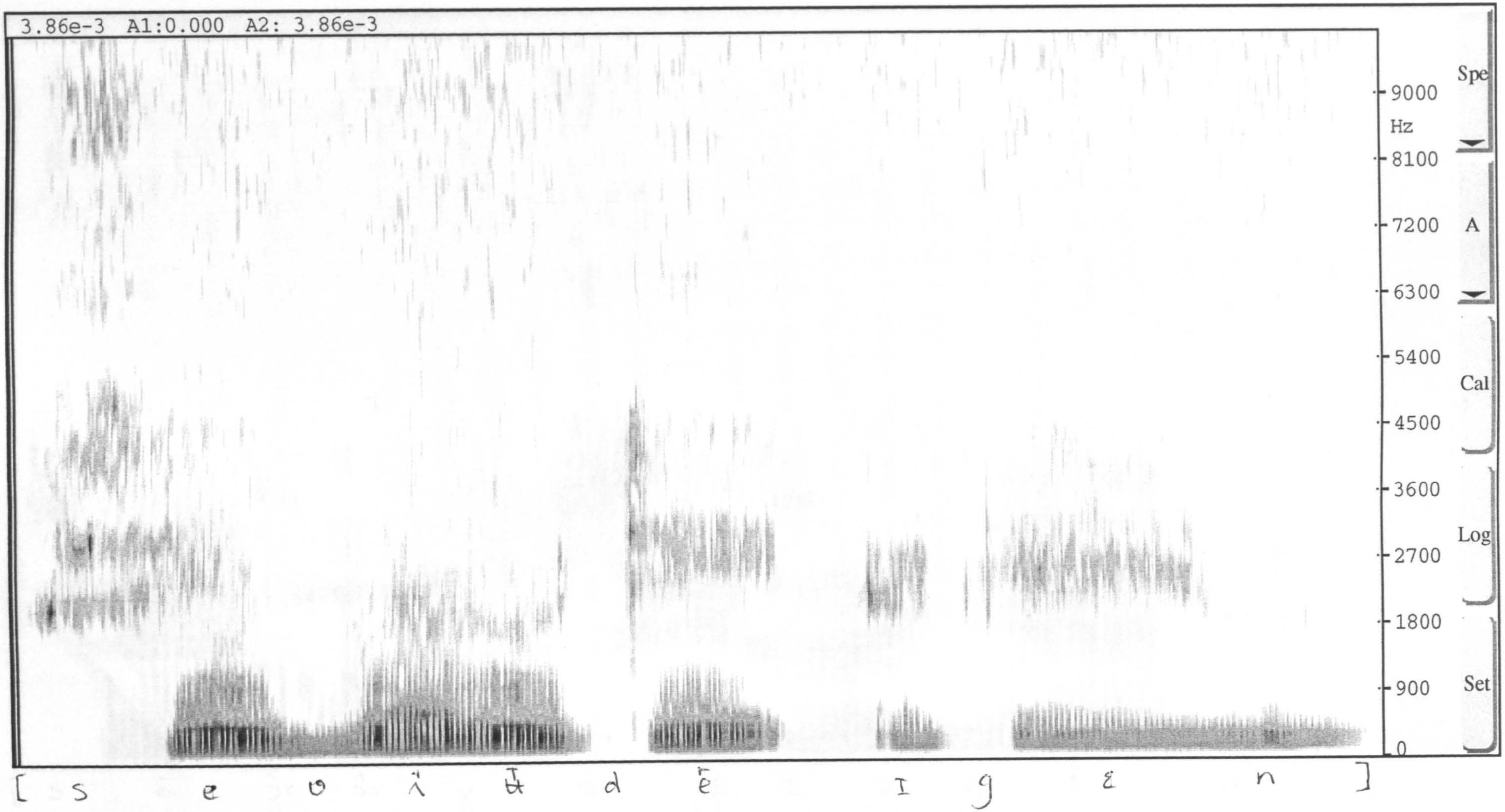
There were only two of these realisations, and both were produced by GF2. A spectrogram of her pronunciation of word 136 <rowdy> (p149) is considered here. The characteristic of this segment would appear to be a continuation of low frequency voicing. The intensity of the F1 of the preceding vowel undergoes a fall of intensity, while its F2 and F3 suddenly change to zero intensity. After a brief time, the intensity of the formants resumes, indicating the start of the following diphthong.

4.2.1.12 [ɣ] voiced velar fricative

The quality of sound associated with this realisation suggests a stricture of close approximation between the back of the tongue and the soft palate. The resulting airflow is turbulent. The phonation type is voice or includes voicing.

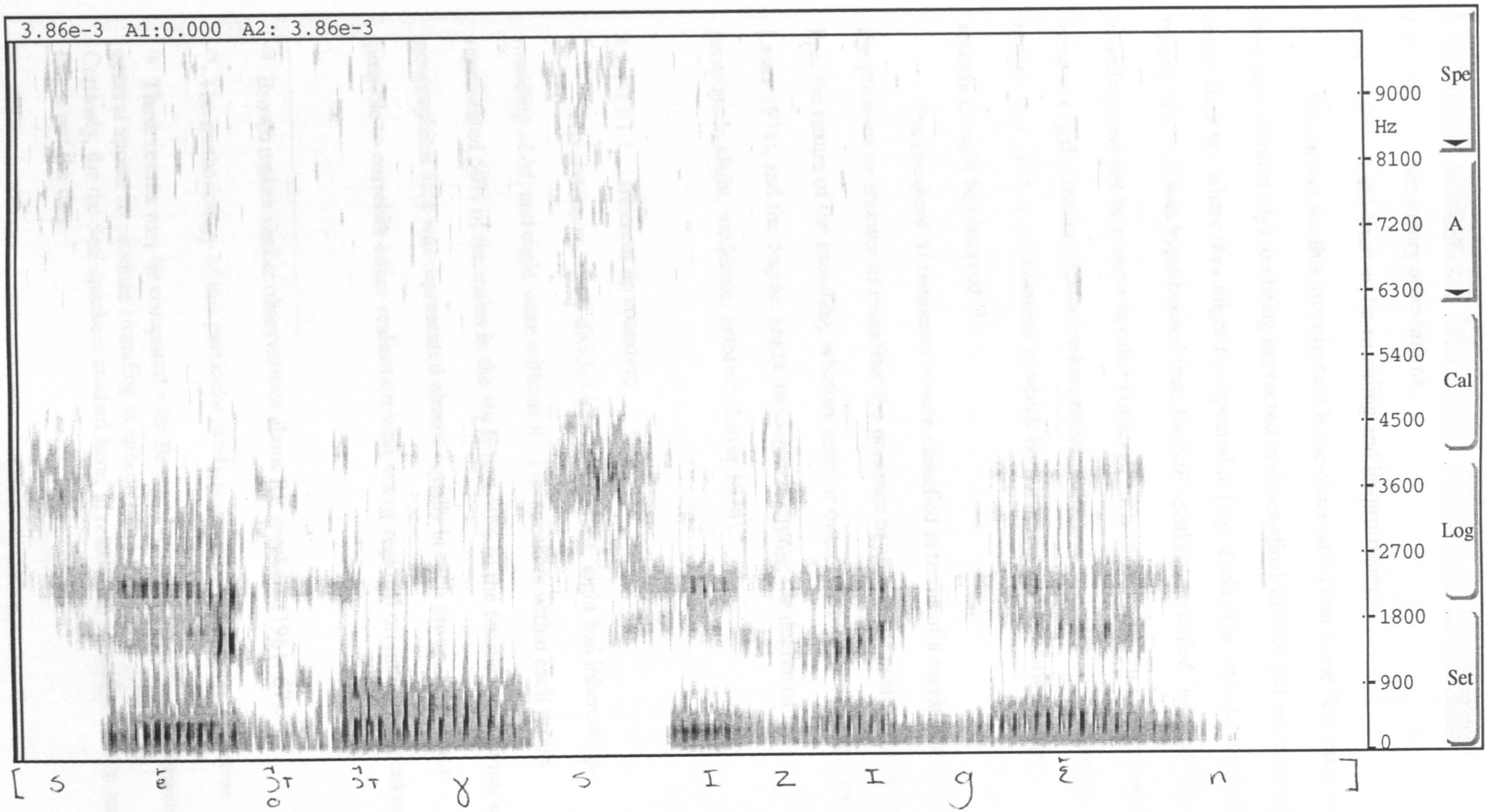
4.2.1.12.1 [ɣ] acoustic profile

There was only one example of this realisation, produced by GM2. The spectrogram (p150) is not very clear, but one can see the continuation of vertical striations which indicates that the segment is voiced. One can identify an F1 at around 600 Hz, and above this one can see random noise to about 4500 Hz, which presumably correlates with the auditory impression of friction.



GF2/136 Say "rowdy" again

TEXT
CUT OFF IN THE
ORIGINAL



GM2/14 Say "horses" again

4.2.1.13 Secondary articulations

4.2.1.13.1 Labialisation: lip-rounding and lip-protrusion

The motive for this investigation is the observation that some ScE speakers (not part of this study), on being instructed in the cardinal vowels, did not naturally round their lips where they might be expected to (e.g. during the articulation of [u, o] and [ɔ]).[14] It was hypothesised that, for ScE speakers, so called "inherent" lip-rounding may not be present in other contexts, such as /r/ realisations. Six words were selected: <reader, redder, rather, rotten, roll> and <rule>, which exhibit /r/ before /i, ɛ , a, ɔ, o, u/, contexts in which both inherent and conditioned lip-rounding might be observed.[15]

The speakers' /r/ realisations were classified in terms of a number of criteria: the presence or absence of rounding; the presence or absence of protrusion by the lips: the nature of the rounding, whether inner or outer (Catford 1977: 172-173; Laver 1978), and the degree: slight, moderate, extreme; the degree of the protrusion: slight, moderate, extreme (Laver 1978).

4.2.1.13.1.1 Inherent lip rounding

The sixteen speakers divided into two groups: eight had inherent lip-rounding of /r/, and eight were without it. The speakers within each group represented 50% of the males in the study and 50% of the females. Likewise, each geographical area was represented almost equally in each group, so it is not possible to correlate either realisation with sex or regional origin of the speaker.[16]

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[14] Brown makes similar observations about RP speakers (1981: 67).

[15] The methodology of this particular study is described in chapter 3, section 3.3.3.

[16] These results may be compared with Brown's statement that "women speakers in general appear to produce rounding in speech more than men" (1981 75). Certainly, for the ScE speakers studied here, in relation to /r/ realisations at least, this is not the case.

4.2.1.13.1.2 Contextual lip-rounding

Before rounded vowels the picture is very different with all but two of the speakers showing lip-rounding to some degree. EF1 and GF4 , exceptionally, showed rounding before all but one vowel: /ɔ/ and /o/ respectively.

4.2.1.13.1.3 Types and degrees of rounding

Inner rounding was the universal type exhibited by the speakers, but the degree of rounding varied. A slight inner-rounding was shown consistently by one speaker, whereas seven speakers exhibited it to a moderate degree. For six speakers the degree of rounding of /r/ increased before the back rounded vowels, becoming greater the closer the vowel. Two speakers were exceptional in having the greatest degree of rounding before /o/, and less before /ɔ/ and /u/.

It is impossible to correlate these results with either the sex or origin of the speaker. They appear to be random in those respects, so perhaps lip-rounding on /r/ is a feature of idiolect. It may also be connected with the anatomy and physiology of an individual's lips and cheeks.

4.2.1.13.1.4 Lip-protrusion

There were four main types of articulatory behaviour. Two speakers showed no lip-protrusion at all; three showed moderate lip-protrusion throughout; five showed slight protrusion before the unrounded vowels, and moderate protrusion before the rounded vowels; the remaining five showed no protrusion before unrounded vowels, but slight to moderate protrusion before rounded vowels.

As with lip-rounding, it is impossible to correlate these results with the sex or regional origin of the speaker. It is possible to say that lip-rounding will tend to be an a priori feature for lip protrusion, but it is not always the case, as one speaker (AM1) exhibited lip-protrusion on /r/ before unrounded vowels without lip-rounding.

4.2.1.13.1.5 Results

The speakers' performances were diverse, but the hypothesis that ScE speakers would not exhibit consistent inherent and conditioned lip-rounding was proven.

4.2.1.13.2 Velarisation

The realisations [ɹ, ɹ̜ , ɹ̞] and [ɹ̞] could be subject to velarisation prior or subsequent to back close vowels.

4.2.2 Realisation by word position and phonemic context

The distribution of the /r/ realisations in different phonemic contexts will now be outlined. All speakers in the study were rhotic.

4.2.2.1 Initial position

/r/ was examined before vowels and in consonant clusters before vowels.

4.2.2.1.1 #/r/V

/r/ was examined before /i, e, ɛ, a, ɔ, o, u, ʌ, ɪ, ae, ɔe, ʌi/ and /ʌu/ with 15 tokens being elicited per speaker. The results are described below. In these and all following calculations in this chapter, percentage values are calculated within +/- 0.1% of 100%.

4.2.2.1.1.1 Glasgow

From the nine Glasgow speakers the total number of tokens was 135. The range of realisations and overall percentage of their occurrence was:
[ɹ] 77.0 %; [r] 11.1 %; [ɹ̞] 6.7 %; [ɾ̝] 4.5 %; [ʋ] 0.7 %

4.2.2.1.1.2 Edinburgh

From the five Edinburgh speakers the total number of tokens was 75. The range of realisations and overall percentage of their occurrence was:

[ɹ] 77.3 %; [ɹ̝] 21.4%; [ɻ] 1.3 %

4.2.2.1.1.3 Aberdeen

For the two Aberdeen speakers the total of tokens was 30. The range of realisations and overall percentage of their occurrence was:

[ɹ̝] 66.7 %; [ɹ] 33.3 %

4.2.2.1.1.4 All regions

The overall total number of tokens is 220. The range and percentage of the use of each realisation was:

[ɹ] 72.0 %; [ɹ̝] 18.4 %; [ɾ] 6.3%; [ɾ̞] 2.5 %; [ɻ] 0.4 %; [ʋ] 0.4 %

By far the most likely realisation for speakers from each region in this position is [ɹ].

4.2.2.1.2 #C/r/V

/r/ was investigated in this position after /p, t, k, b, d, g, θ, ʃ, f/ and a total of 12 words were used per speaker to elicit a total of 192 examples. In this case it was useful to identify the most likely /r/ realisation after each initial consonant.

4.2.2.1.2.1 Glasgow

To consider the Glasgow data first, the range and percentage usage was as follows:

/pr/: [ɹ̣] 44.4 %; [ɾ] 33.3 % ; [ɹ̝̊] 22.2 %
/tr/: [ɹ̝̊] 100 %
/kr/: [ɹ̝̊] 55.6 %; [ɾ̥] 33.3 %; [ɹ̣] 11.1 %
/br/: [ɾ] 66.7 %; [ɹ] 16.7 %; [ɹ̝] 11.1 %; [ɾ̞] 5.6 %

/dr/: [ɹ̞] 48.1 %; [ɾ] 40.7 %; [ɹ] 7.4 %; [ɾ̞] 3.7 %

/gr/: [ɹ] 44.4 %; [ɾ] 44.4 %; [ɾ̝] 11.1 %

/fr/: [ɾ] 55.6 %; [ɹ] 33.3 %; [ɾ̝] 11.1 %

/θr/: [ɾ] 77.8 %; [ɹ̞̊] 11.1 %; [ɹ̥] 11.1 %

/ʃr/: [ɹ] 88.9 %; [ɾ] 11.1 %

4.2.2.1.2.2 Edinburgh

For the Edinburgh data the results were as follows:

/pr/: [ɹ̞̊] 60.0 %; [ɹ̥] 20.0 %; [ɾ̝] 20.0 %

/tr/: [ɹ̞̊] 100 %

/kr/: [ɹ̞̊] 80.0 %; [ɾ̞̊] 20.0 %

/br/: [ɹ] 50.0 %; [ɾ] 30.0 %; [ɹ̞] 20.0 %

/dr/: [ɹ̞] 100%

/gr/: [ɹ] 80.0 %; [ɾ] 20.0 %

/θr/: [ɹ̞̊] 20.0 %; [ɹ] 20.0 %; [ɹ̞] 40.0 %; [ɾ] 20.0 %

/fr/: [ɹ] 60.0 %; [ɹ̞] 40.0 %

/ʃr/: [ɹ] 60.0 %; [ɹ̞] 40.0 %

4.2.2.1.2.3 Aberdeen

For Aberdeen the results in the same phonemic context were:

/pr/: [ɹ̞] 50.0 %; [ɹ̞̊] 50.0 %

/tr/: [ɹ̞̊] 100 %

/kr/: [ɹ̞̊] 100 %

/br/: [ɾ] 75.0 %; [ɹ] 25.0 %

/dr/: [ɹ̞] 83.3 %; [ɹ] 16.7 %

/gr/: [ɹ] 50.0 %; [ɹ̞] 50.0 %

/θr/: [ɹ̞] 50.0 %; [ɹ̞̊] 50.0 %

/fr/: [ɹ] 50.0 %; [ɹ̞̊] 50.0 %

/ʃr/: [ɹ] 50.0 %; [ɹ̞] 50.0 %

4.2.2.1.2.4 All regions

The total percentage usage by the speakers as a whole per environment was:

/pr/: [ɹ̝̊] 37.5 %; [ɹ̊] 31.3 %; [ɾ] 18.7 %; [ɾ̞] 6.3 %; [ɹ̝] 6.3 %

/tr/: [ɹ̝̊] 100 %

/kr/: [ɹ̝̊] 56.2 %; [ɾ̇] 18.8 %; [ɹ̝] 12.5 %; [ɾ̝̊] 6.2 %; [ɹ̊] 6.2 %

/br/: [ɾ] 56.3 %; [ɹ] 28.2 %; [ɹ̝] 12.5 %; [ɾ̞] 3.1 %

/dr/: [ɹ̝] 68.8 %; [ɾ] 22.9 %; [ɹ] 6.2 %; [ɾ̝] 2.1 %

/gr/: [ɹ] 56.2 %; [ɾ] 31.2 %; [ɾ̞] 6.3 %; [ɹ̝] 6.3 %

/θr/ [ɾ] 50.0%; [ɹ̝̊] 18.7 %; [ɹ̝] 18.7 %; [ɹ̇] 6.3 %; [ɹ] 6.3 %

/fr/: [ɹ] 43.8 %; [ɾ] 31.2 %; [ɹ̝] 12.5 %; [ɾ̞] 6.3 %; [ɹ̝̊] 6.3 %

/ʃr/: [ɹ] 75.0 %; [ɹ̝] 18.7 %; [ɾ] 6.3 %

4.2.2.1.2.5 /r/ realisations in initial consonant clusters

It is possible, using this articulatory data, to investigate which allophones of /r/ are more likely to appear in initial C/r/ cluster. Among the Glasgow speakers, the popularity of each realisation is as follows:

[ɾ]	39.8 %
[ɹ]	19.4 %
[ɹ̝̇]	17.6 %
[ɹ̝]	12.0 %
[ɹ̇]	4.6 %
[ɾ̇]	2.8 %
[ɾ̝]	2.8 %
[ɾ̞]	0.9 %

Thus it can be seen that, in this data, [ɾ] was the realisation with the largest percentage of occurrence in this position, which would seem to fit with the traditional account of Scottish /r/ realisations which were reported earlier as more likely to be taps or trills. However, if one considers the data overall, it can be seen that approximant realisations are just as likely in this position as taps:

approximants	53.7 %
taps	46.3 %

The occurance of realisations in the Edinburgh data is slighly different, as can be seen from the following table:

[ɹ̝]	41.6 %
[ɹ]	26.6 %
[ɹ̝̊]	16.7 %
[ɾ]	8.3 %
[ɾ̞̊]	5.0 %
[ɹ̊]	1.7 %

Moreover, the Edinburgh speakers have a strong preference for approximant realisations, as figures below indicate:

approximants	88.3 %
taps	11.7 %

The Aberdeen speakers have a more restricted range of realisations due in part, no doubt, to the fact that they are the smallest group of speakers in the survey:

[ɹ̝]	37.5 %
[ɹ]	25.0 %
[ɹ̝̊]	25.0 %
[ɾ]	12.5 %

It is immediately clear that the Aberdeen speakers, like the Edinburgh informants are far more inclined to use an approximant realisation than a tap:

approximants 87.5 %

taps 12.5 %

The following calculations combined the occurrences of allophones across the 16 speakers, so it must be born in mind that the Glasgow data, being the product of the numerically largest group (9 out of 16 speakers), will out-weigh the Aberdeen and Edinburgh data (7 out of 16 speakers). Nevertheless, considering the data as a whole, it becomes clear that there are what one might regard as major and minor realisations. The following four realisations could be regarded as the most likely to occur in the group as a whole, as they amount to just over 90 % of all the #C/r/ realisations found in this data:

[ɾ] 26.6 %

[ɹ̝] 24.4 %

[ɹ] 23.0 %

[ɹ̝̊] 18.2 %

The five realisations listed below could be regarded as relatively rare realisations as, combined, they account for the remaining 7.8 % of /r/ allophones found in this data in this position:

[ɹ̊] 3.1 %

[ɾ̞] 1.6 %

[ɾ̊] 1.6 %

[ɾ̞̊] 1.0 %

[ɾ̝] 0.5 %

One last point that can be made is that, when the data is considered as a whole, the 16 speakers are more likely to use an aproximant realisation in this position than a tap:

approximants	68.7%
taps	31.3 %

4.2.2.1.3 #CC/r/V

/r/ was examined in the context of /#spr/, /#skr/ and /#str/. The results were as follows:

4.2.2.1.3.1 Glasgow

[ɹ]	51.9 %
[ɾ]	33.3 %
[ɹ̝̊]	7.4 %
[ɹ̊]	3.7 %
[ɾ̞]	3.7 %

4.2.2.1.3.2 Edinburgh

[ɹ]	46.7 %
[ɹ̊]	26.7 %
[ɾ]	13.3 %
[ɹ̝]	6.7 %
[ɹ̝̊]	6.7 %

4.2.2.1.3.3 Aberdeen

[ɹ̝]	50 %
[ɹ̝̊]	50 %

4.2.2.1.3.4 Totals for all regions

[ɹ] 43.8 %

[ɾ] 22.9 %

[ɹ̞̊] 12.5 %

[ɹ̊] 10.4 %

[ɹ̞] 8.3 %

[ɾ̝] 2.1 %

Once again, it would appear that these speakers are more likely to use an approximant realisation rather than a tap, as approximants account for 75 % of the recorded allophones in #CC/r/ position.

4.2.2.2 Medial position

/r/ was investigated between vowels both on its own and in consonant clusters.

4.2.2.2.1 Intervocalic position: V/r/V

4.2.2.2.1.1 Glasgow

The range of realisations was [ɾ, ɾ̝, ɹ, ɻ], and the percentage occurrence was:

[ɾ] 45.4 %

[ɾ̝] 30.6 %

[ɹ] 23.2 %

[ɻ] 0.9 %

4.2.2.2.1.2 Edinburgh

The range of realisations was [ɹ, ɾ, ɾ̞, ɹ̝] and the percentage occurrence was:

[ɹ] 78.3 %

[ɾ] 11.7 %

[ɾ̞] 8.3 %

[ɹ̝] 1.7 %

4.2.2.2.1.3 Aberdeen

The range of realisations was [ɹ, ɾ, ɹ̝, ɾ̞], and the percentage occurrence was:

[ɹ] 70.8 %

[ɾ] 20.8 %

[ɹ̝] 4.2 %

[ɾ̞] 4.2 %

4.2.2.2.1.4 Combined regional totals

The range and percentage use of each allophone by all speakers is as follows:

[ɹ] 46.4 %

[ɾ] 31.8 %

[ɾ̞] 19.8 %

[ɹ̝] 1.0 %

[ɾ̝] 0.5 %

[ɻ] 0.5 %

There is a very large range of realisations, which are basically either approximants or taps. The choice of realisation is not entirely in keeping with what the literature would lead one to expect, in that, although the Glasgow speakers do favour a tap in intervocalic postion, both the Edinburgh and Aberdeen speakers prefer approximants. Overall, however, tap realisations are slightly more usual.

4.2.2.2.2 Medially in V/r/CV position

4.2.2.2.2 1 Glasgow

The range of /r/ realisations and their percentage use was as follows:

[ɹ] 84.1 %

[ɾ] 4.8 %

[ɻ] 4.8 %

[ɹ̝̊] 3.2 %

[ɣ] 1.6 %

[ɹ̊] 0.8 %

[ɹ̝] 0.8 %

4.2.2.2.2.2 Edinburgh

The range of /r/ realisations and their percentage use was as follows:

[ɹ] 80.0 %

[ɻ] 15.7 %

[ɜ˞, ə˞, ʌ˞] 4.3 %

4.2.2.2.2.3 Aberdeen

The range of /r/ realisations and their percentage use was as follows:

[ɹ] 92.9 %

[ɜ˞, ʌ˞] 7.1 %

4.2.2.2.2.4 Combined regional totals

The range of /r/ realisations and their percentage use was as follows:

[ɹ] 83.8 %

[ɻ] 7.6 %

[ɾ]	2.8 %
[ɜ˞, ə˞, ʌ˞]	2.2 %
[ɹ̊˔]	1.8 %
[ɣ]	0.9 %
[ɹ̊]	0.4 %
[ɹ˔]	0.4 %

This data reveals the speakers' preference for approximant realisations in this context, although they use a wide range overall. There are not enough examples in this data to merit investigation of whether a particular preceding vowel or following consonant correlates with a particular /r/ realisation.

4.2.2.3 Final position

The realisation of /r/ in final position was investigated in the contexts V/r/# and V/r/C#. The results were as follows:

4.2.2.3.1 V/r/#

4.2.2.3.1.1 Glasgow

[ɹ]	59.6 %
[ɾ]	17.2 %
[ɾ̞]	13.1 %
[ɹ˔]	9.1 %
[ɻ]	1.0 %

4.2.2.3.1.2 Edinburgh

[ɹ]	91.0 %
[ɻ]	9.1 %

4.2.2.3.1.3 Aberdeen

[ɹ] 100 %

4.2.2.3.1.4 Overall regional totals

[ɹ] 74.4 %

[ɾ] 9.7 %

[ɾ̞] 7.4 %

[ɹ̝] 5.1 %

[ɻ] 3.4 %

One might have expected the presence of a following vowel to have affected the outcome of this section of the study. It will be remembered that the words in the study were uttered by the speakers in the carrier sentence, e.g. "Say "here" again". Thus the speakers could have chosen to treat the final /r/ in the test word as an intervocalic /r/. If one considers the speakers /r/ realisations in intervocalic position, it will be remembered that the Glasgow speakers were the only group to favour tap realisations, whereas the Edinburgh and Aberdeen group tended to select approximant realisations.

The results show that, in fact, approximant realisations were used on the majority of occasions, even by the Glaswegian speakers (although almost a fifth of the Glaswegian realisations were taps). The explanation for the favouring of approximants over tap realisations by the Glaswegians may be the tendency of many of the speakers to pause both before and after the test word. (See Chapter 3, section 3.3.2 for discussion of this phenomenon.) Thus for those speakers the final /r/ in the test word was pre-pausal /r/, thus more likely to have realisations in common with utterance final /r/ rather than intervocalic /r/.

4.2.2.3.2 Finally in VrC# position

4.2.2.3.2.1 Glasgow

[ɹ] 89.6 %

[ɹ̝] 7.0 %

[ɾ] 2.8 %

[ɻ] 0.7 %

4.2.2.3.2.2 Edinburgh

[ɹ] 90.0 %

[ɻ] 6.3 %

[ɹ̝] 2.5 %

[ɝ] 1.3 %

4.2.2.3.2.3 Aberdeen

[ɹ] 90.6 %

[ɝ] 9.4 %

4.2.2.3.2.4 Overall regional totals

[ɹ] 89.9 %

[ɹ̝̊] 4.3 %

[ɻ] 2.3 %

[ɾ] 1.6 %

[ɝ] 1.6 %

[ɹ̝] 0.4 %

The results in this section show the almost overwhelming tendency of speakers to use an approximant realisation in this position (96.9 %). Although other realisations do occur, they are infrequent in comparison.

4.2.2.4 Discussion

This section of the study has shown that, although there is a large range of /r/ realisations to be heard from Scottish speakers, the post-alveolar approximant is the most common realisation for all speakers in all positions. This data would therefore support Aitken's view (1979: 114) that, among ScE speakers, the tap and trill realisations of /r/ are losing ground to approximant realisations before consonants and word finally. Moreover, the data gives reason to think that the same process is at work in word initial position. The only exception to this is /r/, by itself, in intervocalic position, where the Glasgow speakers alone used a tap realisation most frequently.

One other feature to note is that at no point in this entire study of /r/, in all possible word and phonotactic positions, does any speaker make use of the trill realisation, i.e. [r].

4.2.3 Vowel before /r/

Three phenomena were observed happening to vowels before /r/: retracting, breaking, and r-colouring.

4.2.3.1 Retracting

Only the /a/ vowel phoneme was affected here. It can be retracted from its usual realisation of an unrounded, retracted front vowel to a position forward of cardinal vowel 5. An example is EF3's pronunciation of word 2 <bargain> [bɑɹgɪn], compared with her pronunciation of word 5 <panel> [pʰanɪlˠ].

4.2.3.2 Breaking[17]

This phenomenon can affect all vowels except for /a/ and /ɪ/, which are never diphthongised in the data gathered for this study. It typically involves the vowel in the syllable being followed by a second vowel, usually [ɪ] or [ə]. This second vowel is usually a brief glide vowel. An example is word 129 <nowhere> which may be pronounced [nowe^{I}ɹ].

The cause of breaking is the movement made by the body of the tongue from the position for the vowel and the position for the /r/. During the vowel articulation the tongue is in a convex shape. In moving from the vowel position and into position for the /r/, not only will the tip and blade of the tongue move to form a stricture of some sort, but the remainder of the tongue may shift its position away from the previous posture. This latter movement will have the auditory effect of a central vowel. The body of the tongue may move down (e.g. after [ʉ], see word 48, <pure>), back (e.g. after [e] and [ɛ], see word 129 <nowhere> and word 53 <err>), or forwards (e.g. after [o], see word 61 <pour>). Presumably /ʌ/, /ɪ/ and /a/ before /r/ do not tend to break because the body of the tongue is either in or close to the position it will assume for /r/.

The syllabicity of the word is not usually affected, unless the original vowel was a diphthong. There is then a strong possibility that the syllable will become disyllabic. An example of this is the word 74 <sour>, which occasionally remains monosyllabic: [sʌu^{ə}ɹ], but is more likely to be pronounced as a disyllabic word: [sʌu#əɹ] (where # indicates a syllable boundary).[18]

The following table indicates the frequency of occurrence of breaking of monophthongs and diphthongs observed in the current study.

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[17] Aitken (1979) has used the term "diphthongising" for this phenomenon. This term is rejected here as some of the vowels affected are diphthongs, and it seems illogical to the present writer to discuss the "diphthongising" of diphthongs.

[18] Twelve of the sixteen speakers pronounced this word in a disyllabic form: GF3, GF4 and GF5; GM1, GM2, GM3 and GM4; EF1, EF3 and EF4; EM1 and AM1.

Consideration of these results indicates that a vowel before /r/ is more likely to break if it is a front open-mid to close monophthong, or a diphthong whose finishing point is a front open-mid to close position. Similarly, back rounded open-mid and close-mid vowels, and diphthongs whose finishing point is in that area, will have a tendency to break.

/e/	75.0 %
/ɛ/	43.8 %
/a/	0.0 %
/ɔ/	23.0 %
/o/	50.0 %
/u/	18.8 %
/ɪ/	0.0 %
/ʌ/	6.3 %
/ae/[19]	84.4 %
/ʌu/	93.8 %[20]

4.2.3.3 R-colouring

R-colouring of vowels in this body of data appears to affect only /ʌ/ and /ɛ/, and may occur before [ɹ] and [ɻ]. In these cases the vowel progressively assimilates to the following /r/ by anticipating the position of the apex and blade of the tongue (as described in the previous section). Thus the nature of the exact apical and laminal position of the tongue during the vowel depends upon the following /r/ realisation. Examples of r-colouring in this data are set out below.

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[19] Note that /ae/ could be realised as [ʌi] or as [ʌe] before /r/ by the Aberdonian speakers (see words 60 and 63).

[20] Note that /ɔe/ before /r/ is not a phonotactic possibility in ScE.

66	/fʌr/	EM1	[fʌ̞+ɻ]	GF1 [fʌ̞+ɻ]	
81	/hʌrt/	EM1	[ʌ̟̊ʌ̟˞ɻʔ̚t]	GF1 [ʌ̟̊ʌ̟˞ɻʔ̚t]	EF4 [ʌ̟̊ʌ̟˞ɻt]
89	/tʃʌrtʃ/	GF1	[tʃʌ̟˞ɹʔ̚tʃ]	EF3 [tʃʌ̟˞ɹʔ̚tʃ]	
130	/ʌrdʒ/	EM1	[ʌ̞˞+ɹdʒ]	AF1 [ɝɹdʒ]	
9	/sɛrvɪs/	GF1	[sɝɹvɪs]	AF1 [sɝɻvɪs]	
98	/kɛrb/	EF2	[kɚɹb]	EM1 [kʌ̟˞ɹb]	

4.2.4 Summary and conclusion

This study began by trying to establish what information was available to phoneticians about the nature of /r/ realisations in ScE. It continued by describing the range of realisations and their distribution in the pronunciation of sixteen ScE speakers.

The most striking point to emerge is the increase and diversity in /r/ realisations which can be observed in the twentieth century. Moreover there is an observable change in the most frequently occurring allophones with [r] becoming quite rare. These changes continue to occur. For example, [ɻ], first noticed in the late sixties by Speitel (1969), and said then to be limited to Edinburgh school girls, is much more widespread now, as can be seen from the data presented in this study. Vowel breaking, noted by Aitken (1979), is also common, and its occurrence can be seen to conform to a general pattern. One feature which has not been found in the present study is non-rhoticity, which Romaine (1978) and Macafee (1983) both recorded and which Romaine predicted might become common among ScE speakers. One last point worth noting is the presence in the data collected for this study of two realisations which earlier writers (e.g. McAllister 1938, Mutschmann 1909) regarded as "inaccurate" or "unacceptable" forms of /r/, namely [ʋ] and [ɣ]. These idiosyncratic realisations can still be heard.

An in-depth study of /r/ such as this reveals a number of things. Firstly it shows what a complex phenomenon /r/ is in ScE. Thirteen separate realisations are observed in this data, but that is not to say that yet others do not exist. Moreover, amid such diversity there can also be observed general patterns of distribution. Secondly, from a phonetician's standpoint, such a study reveals much of interest. It makes clear how limited our previous knowledge of /r/ was, and raises, in turn, doubts about the completeness of our knowledge of the realisation of other phonemes. It should also cause us to consider what other realisations individuals might be articulating that we are unaware of. Lastly, it reminds us that our theory must always be challenged and tested with articulatory data. In this case, the lowered tap caused the present researcher problems concerning the appropriateness of describing it using existing articulatory categories.

Chapter 5: /l/ realisations

5.0 Introduction

This chapter focuses upon the realisation of /l/ among ScE speakers. It begins with an account and an evaluation of what is already known about the realisation of /l/ in ScE, and continues with the presentation of the analysis of the data elicited by the present study. Finally, it concludes by providing evidence that /l/ is subject to more variation than has previously been noted.

5.1 Previous accounts of /l/

ScE /l/ realisations have not attracted the same quantity of description as /r/ realisations, although the quality of the coverage is similar. This is most probably due to two facts. Firstly, whereas the distribution of /r/ is a major structural difference between the phonology of ScE and that of the majority of English English accents, /l/ causes no such distinction, so it is not worthy of special mention on that account. Secondly, writers have been aware of the existence of a wide variety of /r/ realisations in ScE, whereas /l/ has, by comparison, a relative paucity.[1] Even so, there exists a generally received wisdom about /l/ in ScE that it is characterised by being velarised in all positions. As this section shows, this is not quite the case.

5.1.1 /l/ in the nineteenth century

Nineteenth-century writers present one allophone of /l/. It is a voiced lateral with a "deep guttural character, due to concavity of the front and retraction of the back of the tongue" (Sweet 1877:45). Such a description would indicate velarisation. Bell (1849) describes the velarisation as "a Scotch peculiarity".

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[1] See chapter 4, pp 90 - 108.

5.1.2 /l/ in the twentieth century

In the twentieth century the most commonly encountered description of the realisation of the /l/ phoneme in ScE remains a voiced lateral, velarised in all positions (e.g. Aitken 1984a: 102; Wells 1982: 411-412). Further details, occasionally conflicting, may be found elsewhere. Catford, for example, is more specific about the degree of velarisation: "in most types of Scottish English /l/ is slightly velarised in all positions" (1977: 193). Williams, on the other hand, describes the velarisation as more extreme than that: "the hollowing is much more considerable than in (English) English and the l still darker...among less educated speakers this is exaggerated to the extent of totally altering the preceding vowel..." (1909: 47). Speitel attests that in Midlothian velarisation is present in all positions, but may be more extreme in final position (1969: 53).

McAllister (1938), Grant (1913) and Grant and Robson (1926) advance the notion that other secondary articulations may be present, Grant and Robson identifying velarisation and palatalisation (1926: 57-59) and McAllister noting palatalised, velarised and nasalised forms (1938: 104-106). Wells (1982) suggests the possibility of a pharyngealised variety of /l/ in Glasgow, which gives the resulting articulation a CV 13 quality. In the south west of the country, he states, there is a palatalised variety of /l/, a realisation which Grant and Robson localise to Galloway and Wigtown (1926: 59).

The place of articulation is not uniform. McAllister (1938: 104-106), Williams (loc. cit.), and Grant (loc. cit.) note an alveolar place of articulation, which may be apico-alveolar (McAllister loc. cit., Grant loc. cit.), whereas Aitken mentions a dental realisation (1984a: 102). Grant and Robson go on to note that the lateral opening may be bi- or uni-lateral (1926: 57 - 59).

As for the manner of articulation , one cannot always assume that one is dealing with a lateral. Grant (op. cit.: 59) describes an articulation which "is formed without point contact while the air current glides along one side of the back of the tongue. This could either be a lateral with a palatal or velar place of articulation (IPA [ʎ] or [ʟ]), or it could be a median velar approximant realisation (IPA[ɰ]). The latter realisation is noted by Ladefoged who describes it as a "back unrounded vowel" (1975: 81), rather than in terms of an approximant. McAllister notes and proscribes the use of "w, r, or j" for /l/, describing them as a "residue of baby speech" (op. cit..: 106), and she condemns the use of nasalised [l] or [ɣ], as the "ugliest defect" (loc. cit.).

Devoiced laterals are noted as a variant of /l/ where the lateral is surrounded by voiceless segments (Grant 1913: 34).

5.1.3 Syllabicity and /l/

Murray (1873) makes reference to the effect which /l/ has on the syllabicity of a word when it precedes an /m/, describing the resulting effect as "ell'm, hell'm, fil'm" for <elm, helm> and <film> (op. cit..: 123). This would suggest the alteration of the monosyllable to a disyllabic word, facilitated by the insertion of an epenthetic vowel after the /l/. However, it is not entirely certain if this is what Murray is attempting to convey as he could have been indicating that the /l/ causes the nasal to become syllabic: [ɛlm̩].

It is possible for /l/ to function as the nucleus of a syllable (Grant and Robson 1926: 57), although this is not universal, as Catford notes (1977: 251).

5.1.4 /l/ in Gaelic-speaking areas

Palatalised laterals are reported by Wells as being present in Gaelic-speaking and post-Gaelic-speaking areas (1982: 412), although elsewhere "Irish or Celtic l" is described as a retroflex lateral approximant (IPA [ɭ]) (McAllister 1938: 105-106).

5.1.5 /l/ realisations, word position, and phonemic context

There is very limited information as to which /l/ realisation is likely in a particular context. Aitken (1984a: 102) states that alveolar laterals are more likely in pre-vocalic position, whereas dental laterals will tend to appear in post-vocalic position. Devoiced laterals are said to occur between voiceless phonemes (Grant and Robson 1926: 59).

5.1.6 Summary and evaluation

As with descriptions of /r/, discussed previously in Chapter 4, nineteenth-century accounts of /l/ are far less informative and diverse than those of the twentieth century. Whether this reflects a genuine increase in the number and change in the nature of /l/ realisations in the present century, a more competent level of descriptive ability in later writers, or, simply, a larger field of investigators in the twentieth century, who have focused their attentions on Scottish pronunciation, is open to debate. The present writer would argue that it is probably a combination of the first and the third reason rather than the second.[2]

It is clear that there exists a degree of diversity in ScE /l/ realisations: assimilatory devoicing is possible; the place of articulation may be either dental or alveolar; the active articulator is either the apex or blade of the tongue; there is the possibility of /l/ deletion and vocalisation. Additionally, /l/ may affect the syllabicity of the word. There is a suggestion that the position of /l/ in the word may have an effect upon its realisation, but this particular point has not been investigated more fully. There is no instrumental investigation of ScE /l/ realisations reported in the literature.

There remain a number of questions and uncertainties concerning /l/ realisations in ScE. For example, to what extent do different allophones coexist within an accent? Are there any other /l/ allophones being used by speakers which are, to date, unattested? Is there any pattern to the distribution of allophones?

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[2] For consideration of the abilities of the nineteenth-century writers see chapter 2, pp 25 – 43.

What are the acoustic characteristics of the allophones? It is in an attempt to answer these questions that the following study is presented.

5.2 An auditory and acoustic study of /l/ in present day ScE

In this section the results of an articulatory and acoustic investigation of /l/ realisations in ScE are set out and examined. The data were gathered from a total of 64 words containing /l/, in various word positions, and with a variety of vowels preceding and following it in order that the effect (if any) of word position and phonetic environment may be observed. Word position is an important factor in the choice of /l/ realisation, as certain realisations, e.g. [ɰ], do not appear word-initially (e.g. see section 5.2.1.2.2.4 below). Likewise phonetic context is important as the selection of certain realisations, e.g. [lʲ], may be influenced by the nature of the following vowel (see section 5.2.1.2.1.1. below).

/l/ was examined in word initial position #/l/V before the range of vowels that are phonotactic possibilities, namely: /i, e, ɛ, a, ɔ, o, u, ɪ, ʌ, ɔe, ʌu, ae, ʌi/. The original word list was thus designed to have thirteen words which exemplified /l/ before all of these vowels. However, when the analysis was carried out, it was realised that there were an additional six words, originally chosen for other purposes, that could be included in the study. Thus there were two examples each for /li, lɛ, la, lɔ, lu/ and /lɪ/. The resulting nineteen words are <lever, leaked, laser, leather, leopard, lacks, lather, lots, locked, loader, loops, looked, liver, licked, luck, loiter, louder, lie> and <liked>.

/l/ occurs in initial consonant clusters #C/l/ and #CC/l/. In the first case, it occurs after /p, b, k, g, f, s/ and /v/, and so seven words were originally chosen. The remaining word list yielded an additional four relevant words, so that there are three examples of /#pl/, two of /#gl/ and two of /#fl/. The eleven words ultimately used are <plucked, played, plugged, blinked, clean, globes, glutton, flowery, flag, slammed> and <Vlad>.

In #CC/l/ environment, there are two possibilities: /skl/ and /spl/. The words which elicited these clusters were <skliff> and <split>.

In word medial position /l/ was elicited in V/l/V position, and medial consonant cluster position. The words selected were <twilight, curler, explode, million> and <seldom>.

In word final position /l/ was analysed in V/l/# and V/l/C# position. In the first case, this involved including words which exemplified /l/ after the range of vowels that are phonotactic possibilities, namely: /i, e, ɛ, a, ɔ, o, u, ɪ, ʌ, ɔe, ʌu, ae, ʌi/. The words used were <wheel, veil, well, pal, crawl, roll, drool, shrill, dull, boil, howl, tile, trial, dial>.

In word final consonant cluster, /l/ was elicited before plosives, nasals, fricatives and affricates, in order that all phonotactic possibilities were included. In the case of plosives <gulp, bulb, salt, child, wield, milk> illustrated /l/ before /p, b, t, d/ and /k/. <film> and <kiln> elicited /l/ before nasals; <twelve, health> and <Welsh> before the fricatives /v, θ/ and /ʃ/; <filch and <bulge> before the affricates /tʃ/ and /dʒ/.

The pronunciation of the words is analysed both auditorily and acoustically in order to contribute to the existing knowledge and to enhance it with instrumental information.[3] It is not suggested that the following study presents a complete picture of /l/ in ScE today, but, rather, that it reflects the general situation which one may expect to find among Scottish speakers, and that it highlights the sort of data which can be investigated.

5.2.1 The study

The pronunciation of sixteen speakers was transcribed. Attention was paid to the range and distribution of /l/ allophones. Overall, four major allophones were

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[3] The methodology of the entire study is explained more fully in chapter 3, pp 60 – 89.

identified: [lˠ], which made up 75% of the entire realisations; [lʲ], which accounted for 6.8% overall; [l], which occurred on 0.3% of occasions; and [ɰ], which was used 17.8% of the time. In addition to the main allophones, the present investigator noted the effect of /l/ on preceding vowels and the occurrence of syllabic laterals.

The presentation of the acoustic data reflects the fact that men will generally have a lower fundamental frequency and lower formant frequency values than women, due to anatomical differences between the sexes. Thus the formant values for each sex are presented separately. The regional categories are also observed, but this is not to suggest that regional differences are present. Indeed, as the results refer to the speakers' realisations of a particular allophone, it is argued that the acoustic characteristics of that allophone should be similar, and the respective formant values should lie in the same general area, whether pronounced by a male from any of the three cities, or by a female from any of the three cities.

5.2.1.1 The realisations

The following sections are intended to give further information on the nature of the realisations. As far as articulatory information is concerned, there was no use made of an investigative technique which focussed specifically on articulatory information. What is presented here then is an attempt to correlate auditory impressions with general articulatory phonetic theory. IPA symbols are used to record a phonetician's impression of what is heard, and those symbols are read and interpreted as relating to articulatory postures and gestures. So, in presenting an "articulatory" description of the sounds that the present investigator heard, it is argued that this is no more than an elaboration of that same process.

In addition, the description extends to consideration of the acoustic characteristics of each type of realisation. This material was analysed via 45 Hz and 300 Hz spectrograms of all of the realisations, with data on relevant information, such as formant values, being recorded. A number of illustrative spectrograms, made with a 300 Hz filter, were printed and are included to exemplify some of the major characteristics under discussion. However, as not every spectrogram that was made is included here, the description of the acoustic features of each type of realisation may not correspond exactly with the illustrative spectrogram included here.

All the /l/ realisations in this study were vocoids. Thus, from an acoustic standpoint they are all characterised by the presence of formant bands. How each realisation is separated off from surrounding realisations is explained in the acoustic profile section pertaining to each realisation.

5.2.1.1.1 [lˠ]

Of the 1024 /l/ realisations that were produced by the speakers, 770 of them were velarised laterals. The nature of the auditory impression suggests a realisation that involves the tip or blade of the tongue making contact with the dental or alveolar region (for a discussion of dental and alveolar place of articulation, see below, section 5.2.1.1.5). Depending on the individual's articulation, the rims of the tongue are lowered from the upper canines and premolars (with the rims at the back of the tongue sometimes making contact with the upper molars), so that air flowing from the lungs exits the oral cavity laterally. Alternatively, the rim at one or other side of the tongue may make contact with the canines, premolars and molars, so that the airflow's egress is via one side only. The front of the tongue exhibits some concavity in its shape. The back of the tongue is raised in a convex position to the soft palate so that a stricture of open approximation exists. Lips may be rounded in the context of a rounded segment. The auditory effect is that of a lateral with an accompanying vowel quality close to close back. Devoiced variants of this allophone may be found in initial and final utterance position, as well as in clusters with voiceless consonants.

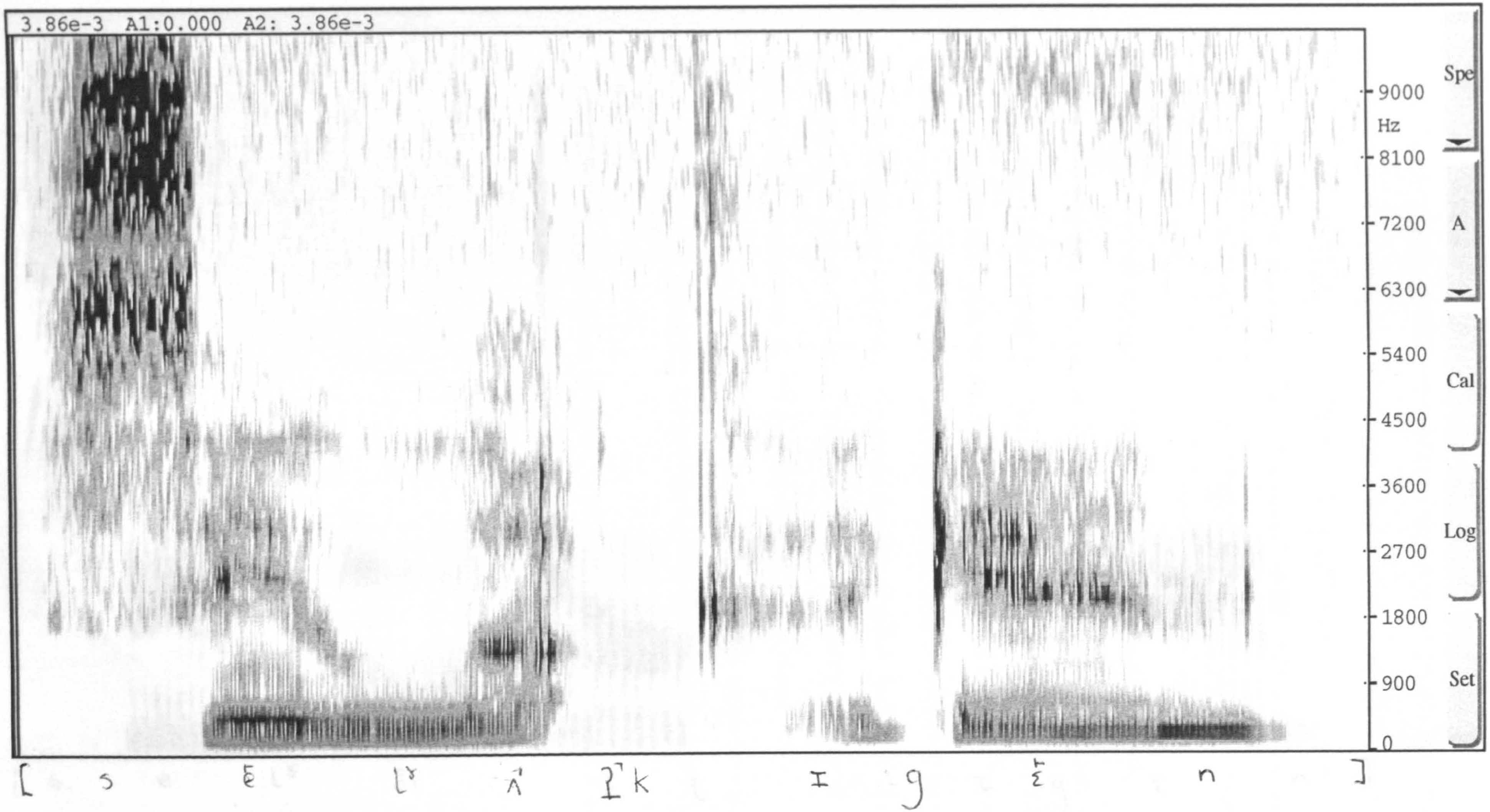
5.2.1.1.1.1 Acoustic profile

In general terms, one would expect a voiced lateral to have certain characteristics. Thus, in medial position, between voiced vowels, the lateral is characterised by the presence of vertical striations, indicating voicing. The first formant is a low frequency band, which exhibits no notable transitions and is consistent with the first formant of the preceding and following vowels. F2 consists of a steady state, around 750 - 1000 Hz, with a plus or minus transition on each side, depending on the adjacent vowel. F3 tends not to exhibit any transition, although, again, this depends to some extent upon the surrounding segments.

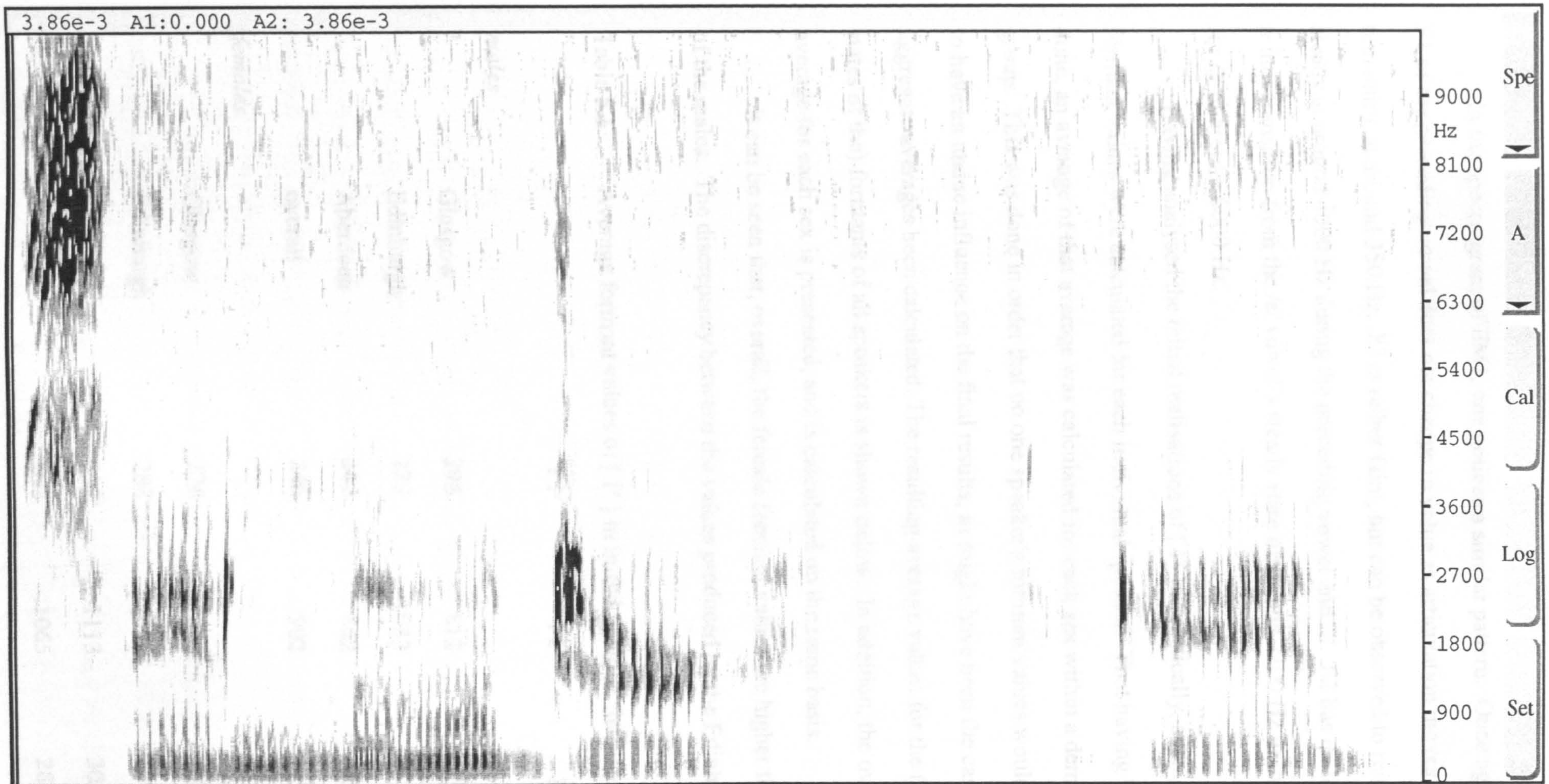
If a lateral is in utterance-initial position, or where a voiceless segment precedes the lateral, it is possible that F2 and F3 will not show at all. Alternatively, if the lateral is partially devoiced so that voicing begins within the lateral, the steady state of F2 and the plus transition of that formant into the following segment may be displayed, whereas F3 might not be seen to begin until the following segment. F3 may be of low intensity, although neither F1 nor F2 are necessarily of lower intensity to the surrounding segments. In some cases, even when the lateral is intervocalic, the third formant is hard to see.

In final position, F1 stays steady, but slowly and gradually loses intensity as voicing ceases. F2 will consist of a plus transition from the preceding segment and a steady state, which loses intensity in advance of F1, as does F3.

Two spectrograms are included for particular consideration: AF1/15 "Say luck again" and EM1/143 "Say leaked again" (pp180 and 181). In both cases, the /l/, although in word initial position, is actually between two voiced vowels and is fully voiced. To consider AF1 first, The F1of the preceding /e/ vowel exhibits no transition as it becomes the F1 of the /l/, remaining at around 290 Hz. The F2 of the /e/ vowel undergoes a minus transition from a steady state of around 2200 Hz to around 800 Hz for the F2 of the /l/. F3 remains constant at around 4400 Hz. As the /l/ is completed and the following vowel is realised, the /l/'s F2 undergoes a plus transition to the vowel's F2 value of around 1300 Hz.



AF1/15 Say "luck" again



[s e lˠ ɔ̆˔ d ɪ ɫ ɪ g ɛ n]

EM1/38 Say "loader" again

In the spectrogram of EM1, one notices a similar pattern. Once again the F1 of the preceding vowel does not change in value as articulation moves to the /l/, remaining at around 350 Hz. F3 is rather faint, but can be observed to remain steady at around 4000 Hz during the preceding vowel and /l/. F2 has quite a rapid minus transition from the /e/ vowel's steady state of around 2100 Hz to the value for /l/ of around 6000 Hz.

Having analysed the initial realisations of [lˠ] acoustically, average formant values were calculated for each individual speaker. That having been done, an average of that average was calculated for each sex within a demographic group. This was done in order that no one speaker's formant values would be able to have an undue influence on the final results, as might have been the case had aggregate averages been calculated. The resulting average values for the (steady states of the) formants of all speakers is shown below. In addition, the overall average for each sex is presented, and is calculated on the same basis.

It can be seen that, overall, the female formant values are higher than those of the males. The discrepancy between the values produced by the Edinburgh male

Table 5.1 Average formant values of [lˠ] in initial position for all speakers

		F1	F2	F3
males				
	Glasgow	295	812	2358
	Edinburgh	239	1033	2670
	Aberdeen	242	862	2459
	overall	246	902	2495
females				
	Glasgow	276	1028	2679
	Edinburgh	288	1055	2690
	Aberdeen	317	1113	3036
	overall	293	1065	2801

and those of the Glasgow and Aberdeen males may be due to the fact that there was only one Edinburgh male in the study. The values produced by this individual may lie at the upper extreme of male values in general.

5.2.1.1.2 [lʲ]

There were 69 realisations that were judged to be palatalised laterals. The nature of the sound quality would lead one to suggest that this realisation involves the tip or blade of the tongue making contact with the dental or alveolar region (see below, section 5.2.1.1.3). The rims of the tongue are lowered from about the upper premolars, with the rims at the back of the tongue making contact with the upper molars, so that air flowing from the lungs exits the oral cavity laterally. Alternatively, the rim at one or other side of the tongue may make contact with the canines, premolars and molars, so that egress is via one side only. The front of the tongue is raised to a position of open approximation with the hard palate. The back of the tongue slopes away. Lips may be contextually rounded. The auditory effect is a clear /l/, a lateral with an accompanying quality of a front vowel. Devoiced variants of this allophone are found in initial and final utterance position, as well as in clusters with voiceless consonants.

5.2.1.1.2.1 Acoustic profile

The acoustic profile of this realisation displays transition patterns which are generally similar to the velarised lateral described above. The acoustic distinction is the value for F2, which tends to lie between 1100 to 1600 Hz for males, and between 1550 and 1850 Hz for females overall. As a result the transitions to and from the F2 steady state are not as steep as those for [lˠ].

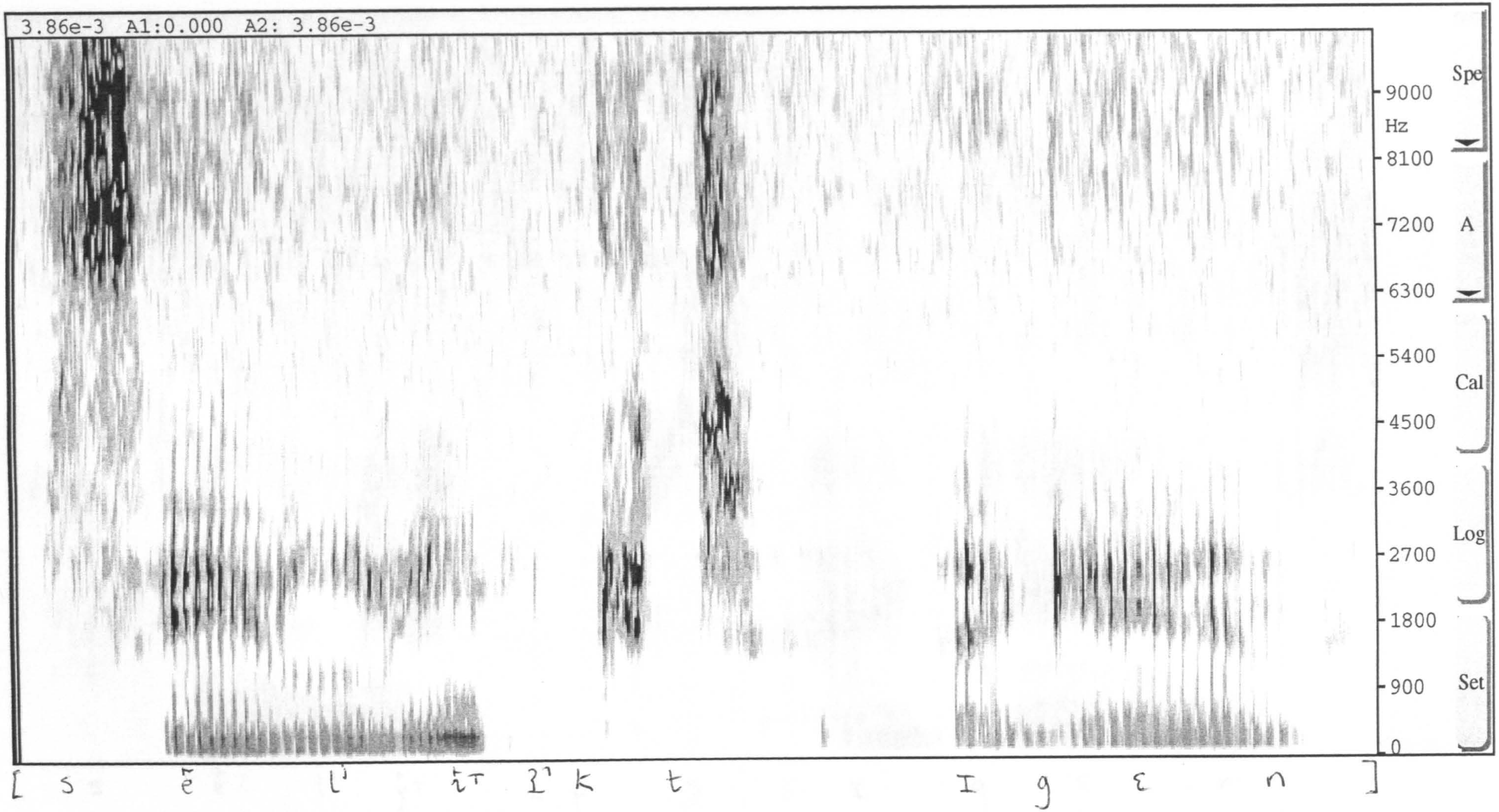
Two spectrograms are included for particular consideration: EM1/52 "Say liver again" and GF1/152 "Say loops again" (pp185 and 186). In the case of EM1, one can observe that the F1 of the preceding /e/ vowel stays at a similar value, around 250 Hz, as the articulation of the /l/ begins. The F2 of /e/ has a steady state of about 1800 Hz and undergoes a minus transition to around 800 Hz as the /l/ is articulated. As the spectrogram traces the following vowel, one can observe plus transition of the /l/ F2 to around 2700 Hz.

In the case of GF1, a similar pattern is noted. F1 remains constant throughout the articulation of the /e/ vowel and the /l/ that succeeds it, whereas the vowel's F2 undergoes a minus transition from around 2600 Hz to around 1800 Hz. Due to the nature of the following vowel, /u/, whose F2 is around 900 Hz, we observe the /l/'s F2 make a minus transition as the /u/ is articulated.

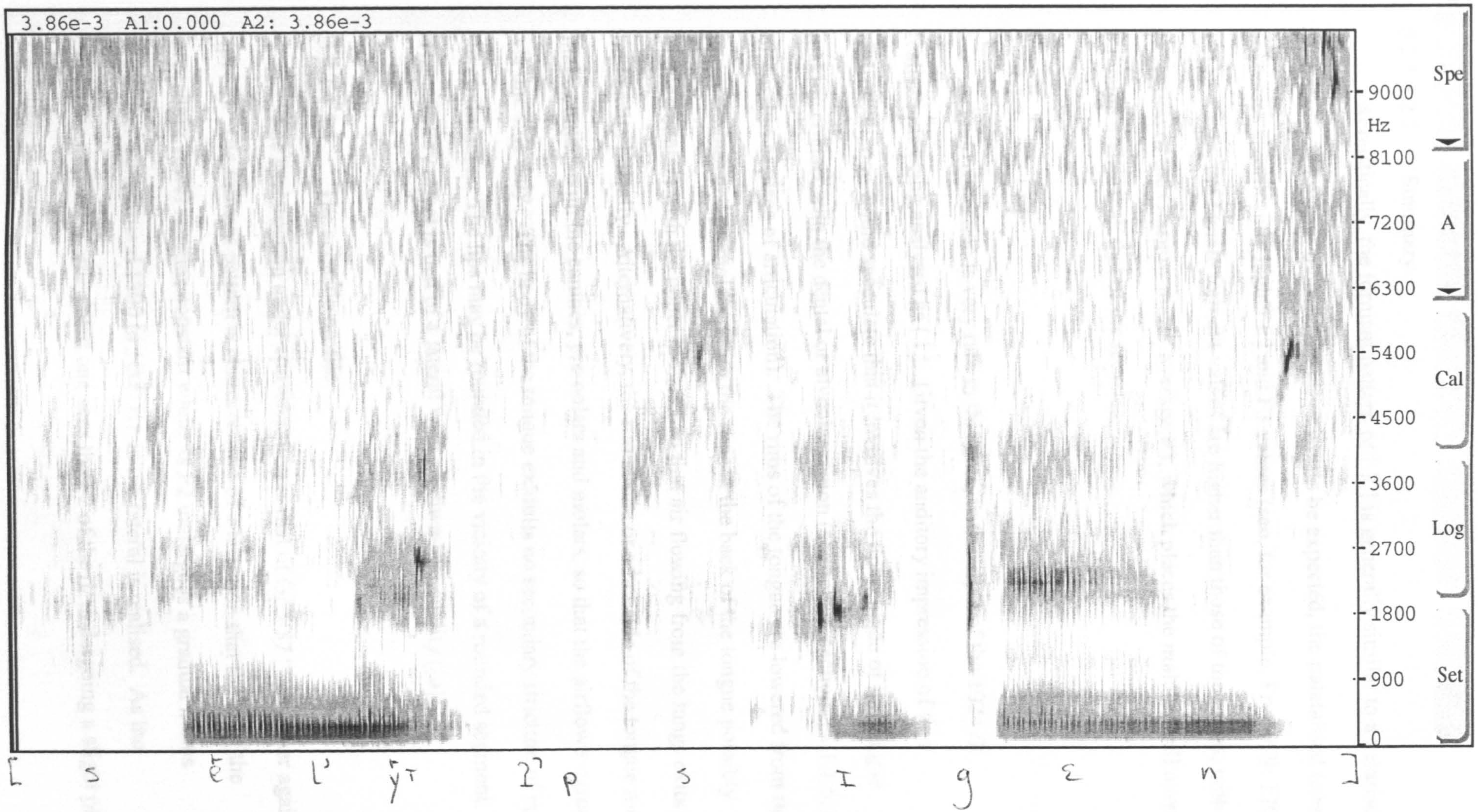
The formant values for all speakers are shown in Table 5.2 below. (It should be noted that AM1 did not produce this realisation; therefore there are no values given for Aberdeen male speakers. Likewise, the Edinburgh male speaker used this realisation once, so the amount of data informing this average is very small.)

Table 5.2 Average formant values of [l^j] for all speakers

		F1	F2	F3
males				
	Glasgow	185	1593	3186
	Edinburgh	215	1125	2627
	Aberdeen	-	-	-
	overall	200	1359	2906
females				
	Glasgow	352	1706	3027
	Edinburgh	264	1853	2768
	Aberdeen	280	1572	2691
	overall	298	1710	2828



EM1/143 Say "leaked" again



GF1/125 Say "loops" again

5.2.1.1.2.2 Summary

Acoustically, the formant pattern of [l^j] is generally similar to a velarised /l/ in terms of formant transitions but, as would be expected, the palatalised lateral possesses significantly higher F2 and F3 values (see, for example, Fry 1979: 120-121). Again, the female formant values are higher than those of the males, with the exception of the Glasgow males' average F3, which places the male overall average F3 value higher than that of the females.

5.2.1.1.3 [l]

This realisation is very rare in this data, with only 3 of the 1024 /l/ realisations being analysed as [l]. Given the auditory impression of this realisation, one would speculate that it involves the tip or blade of the tongue making contact with the dental or alveolar region (see below, section 5.2.1.1.5, for discussion of place of articulation). The rims of the tongue are lowered from the upper canines and premolars (with the rims at the back of the tongue possibly making contact with the upper molars), so that air flowing from the lungs exits the oral cavity laterally. Alternatively, the rim at one or other side of the tongue may make contact with the canines, premolars and molars, so that the airflow's egress is via one side only. The body of the tongue exhibits no secondary stricture of open approximation. The lips may be rounded in the vicinity of a rounded segment. The auditory effect is that of a lateral with a schwa-like quality ([ə]).

5.2.1.1.3.1 The acoustic profile

The spectrogram under consideration is that of GF3/57 "Say lather again" (p188). The formant pattern is characteristic of a lateral in that the F1of the preceding vowel remains constant while its F2 undergoes a gradual minus transition from around 1800 to 1000 Hz as the lateral is realised. As the succeeding vowel is articulated one sees the F2 of the /l/ undergoing a slight plus transition to around

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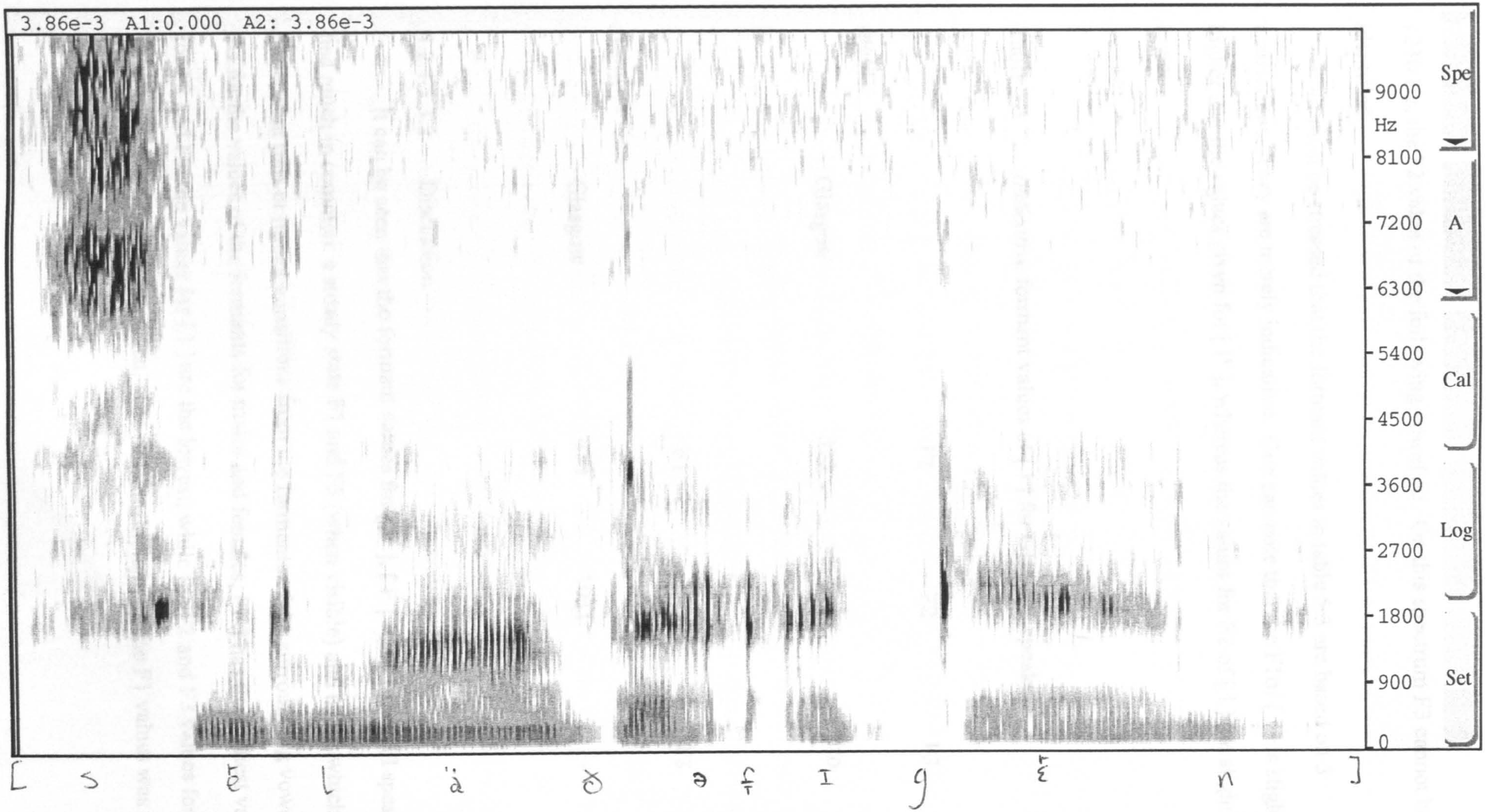

GF3/57 Say "lather" again

1230 Hz, the F2 value of the following vowel /a/. On this spectrum F3 cannot be identified.

It must be stressed that the formant values in table 5.3 are based on 3 realisations. They are merely indicative. One can note that the F1of [ɫ] is slightly higher that the values given for [lˠ], whereas the values for F2 of [ɫ] are slightly lower.

Table 5.3 *Indicative* formant values of [ɫ] for Glasgow speakers

		F1	F2	F3
male				
	Glasgow	333	795	2270
		F1	F2	F3
female				
	Glasgow	430	1031	-

5.2.1.1.3.2 Discussion

It can be seen that the formant values for [lˠ], [lʲ] and [ɫ] for all speakers had much in common: a steady state F1 and F3 (when visible) and an F2 which underwent plus or minus transitions from the formants of the surrounding vowels. As for the values of the formants for males and females, [lʲ] has the highest values for F2 and F3, the values for [ɫ] are the lowest, while the F2 and F3 values for realisations of [lˠ] lie in between. The relationship among the F1 values was not consistent.

5.2.1.1.4 [ɰ]

This realisation was the second most frequent to occur, as there were 182 tokens amid the 1025 realisations of /l/. The auditory quality suggests articulatory characteristics that are similar to those of a vowel around about CV 15. (See below for more precise characteristics) The body of the tongue assumes a convex posture, with the highest point of the tongue forming a stricture of open approximation below the soft palate.

The resulting voiced velar approximant could also be analysed as a vowel around CV 15 [ɤ]. The present writer has chosen to symbolise the segment with a consonant symbol to reflect that it is the allophone of a consonant, but either symbol would be appropriate and [ɤ] would in fact be a more accurate indication of the phonetic characteristics of the realisation.

/l/ vocalisation is the term used to indicate that the /l/ phoneme is being realised as a vowel rather than as a lateral, i.e. the articulation lacks any contact between the tongue and central area of the roof of the mouth. It is attested in other accents of English elsewhere (e.g. Ladefoged 1975: 184) and has been investigated instrumentally in English English accents (Hardcastle and Barry 1989), but its presence in ScE has not been specifically noted. One reason for this oversight may be the perceptual similarity between this realisation and [lˠ]. Indeed, for some investigators this similarity has led them to the opinion that these two segments cannot be distinguished reliably by ear alone and that any investigation of them should be carried out instrumentally by EPG. Although the present investigator has some sympathy with that view, she would argue that the two realisations are, with careful listening, distinguishable for the most part. The lateral has a lateral quality to its realisation, whereas the [ɰ] has not. Its auditory qualities are entirely those of a velar approximant. On that account she is reasonably confident of her ability to distinguish the majority of lateral and approximant realisations of /l/.[4]

The acoustic similarity between [ɰ] and [l] and [lˠ] partially explains the former's existence as a non-lateral realisation of /l/. The [ɰ] realisation will be perceived as an allophone of the /l/ phoneme, although this may be influenced to some extent by the phonetic and phonemic context of the [ɰ] (Hardcastle and Barry, op. cit.: 16). Another argument for its use is that in the stream of speech, it is, in some circumstances, a more efficient realisation to articulate: it gives the auditory impression of an /l/ phoneme without the movement of the blade of the tongue to the passive articulator. To take word 39, <Welsh>, as an example, if this word were realised as [wɛlˠʃ], the tongue, after articulating the vowel, would have to assume two basic postures for [lˠ]: contact between the blade of the tongue and the passive articulator, and velarisation of the back of the tongue. In order to move to the next target, the [ʃ], the blade of the tongue would have to leave its position and assume the stricture for the palato-alveolar fricative. The back of the tongue could, arguably, remain in a velarised position. The alternative realisation of the same word [wɛɰʃ], produces a similar auditory result, but achieves it with less movement of the articulators. The tongue, having articulated the vowel, positions the back of the tongue for the [ɰ], then moves the front of the tongue into position for the [ʃ]. The resulting articulation is more efficient, in that it involves less gross tongue movement, and produces an auditory effect which is perceived as a realisation of /wɛlʃ/.

It is arguably the case then, that whenever the use of [ɰ] would result in an /l/ realisation which is auditorily similar enough to [lˠ], or [l], to be perceived

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4 Having said that, there are a number of realisations where it is extremely difficult to be certain as to the exact realisation of the phoneme. These have been noted in the transcriptions (see Appendix 8). In calculations of the frequency of occurrence of all allophones, these questionable segments have been counted as laterals, in order that the estimate of the occurrence of [ɰ] is a conservative one rather than a radical one.

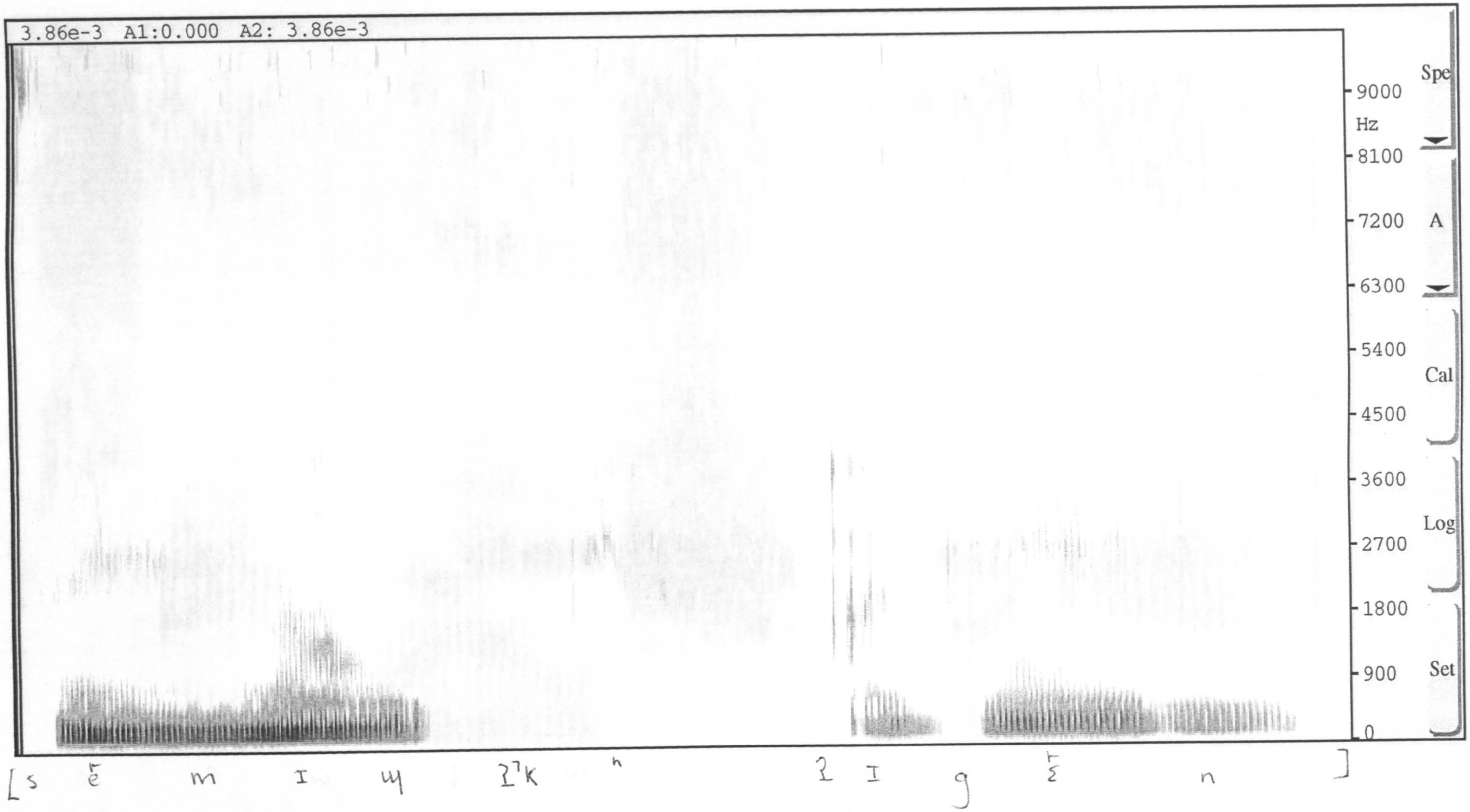
as an /l/ realisation, and wherever the use of [ɰ] results in articulatory efficiency, then it is an option for ScE speakers. (The specific instances in which it is used are outlined in section 5.2.1.2.2.4 below.)

Table 5.4 Average formant values for [ɰ] for all speakers

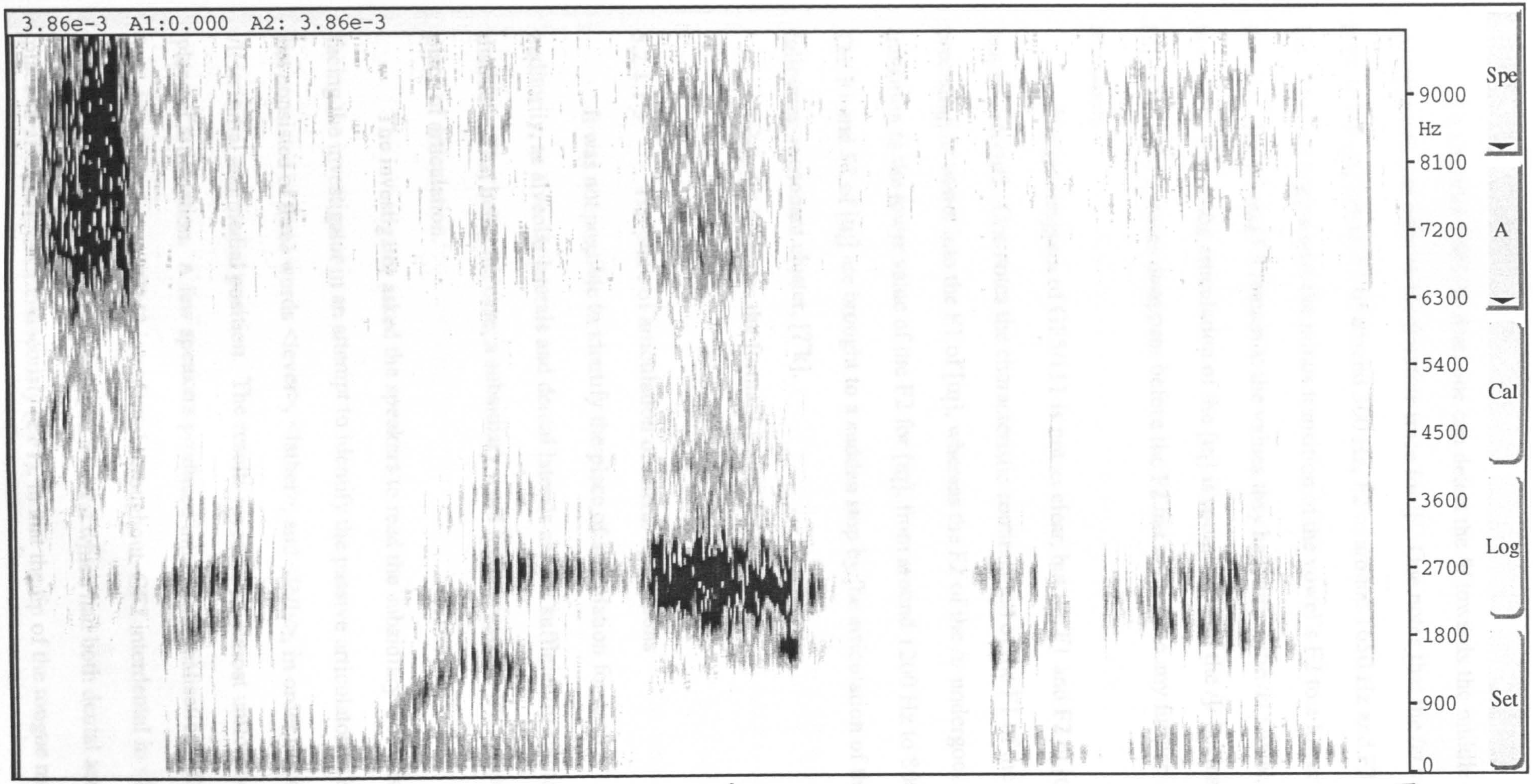
		F1	F2	F3
males				
	Glasgow	301	852	2354
	Edinburgh	234	818	2670
	Aberdeen	344	796	2535
	overall	293	822	2519
females				
	Glasgow	280	1184	2832
	Edinburgh	322	1259	2730
	Aberdeen	336	1242	3108
	overall	312	1228	2890

5.2.1.1.4.1 Acoustic characteristics

As one would expect from the auditory similarity of the vocalised realisation to the velarised lateral, the vocalised realisation is also very similar acoustically. It exhibits the same formant profile, with F1 and F3 (where visible) showing no notable transitions and F2 exhibiting clear transitions before and after its steady state. GF5/111 "Say milk again" and EM1/39 "Say Welsh again" are included here to illustrate the lateral-like quality of the acoustic profile (pp 193 and 194).



GF5/111 Say "milk" again



[s ẽ w ɛ̃ ɰ ʃ ɪ g ɛ n]

EM1/39 Say "Welsh" again

To consider EM1/39 first, one can detect the /l/ towards the middle of the spectrogram, just prior to the fricative trace for /ʃ/. One notes that the /ɛ/ vowel prior to the [ɰ] has an F1 of around 300 Hz, F2 of around 1650 Hz and F3 of 2650 Hz. The [ɰ] begins with the minus transition of the vowel's F2 to a lower value of 800 Hz. The F1 and F3 remain at the values they had during the /ɛ/ vowel. It is noticeable that as the articulation of the [ɰ] is completed and the /ʃ/ begins, the [ɰ]'s F1 and F2 traces disappear before the F2 has undergone any further transition.

The spectrogram of GF5/111 is not as clear, but the F1 and F2 of [ɰ] can just be detected. One notes the characteristic continuation of the F1 of the preceding /ɪ/ vowel into the F1 of [ɰ], whereas the F2 of the /ɪ/ undergoes a minus transition to the lower value of the F2 for [ɰ], from around 1200 Hz to 800 Hz. The F1 and F2 of [ɰ] are brought to a sudden stop by the articulation of the following consonant cluster, [ʔ˺k].

Table 5.4 indicates the formant values for [ɰ].

5.2.1.1.5 The place of articulation of lateral realisations

It was not possible to identify the place of articulation for each /l/ auditorily, as alveolar laterals and dental laterals are not sufficiently auditorily distinct. That being the case, a subsidiary word list was used to try to identify the place of articulation.

The investigator asked the speakers to read the subsidiary word list while facing the investigator in an attempt to identify the passive articulator. The word list consisted of three words <lever>, <lather>, and <lolly>, in order to exemplify /l/ in initial and medial position. The results revealed an almost uniform dental place of articulation. A few speakers produced interdental realisations (EF4 interdental in <lever>, GM2 interdental throughout, GF2 interdental in <lather>) and one speaker consistently produced a lateral which had both dental and alveolar place of articulation simultaneously (EF1), in that the tip of the tongue makes contact with the inner edge of the upper incisors while the blade of the tongue rests against the alveolar ridge.[5]

Although one cannot assume from this that dental articulations will be universal for most speakers one can predict that the majority of laterals in this study are dental. In addition, one can observe that Aitken's observation on the tendency towards alveolar nasals in prevocalic position (1984a: 102) is not borne out here. One might also note the presence of an interdental place of articulation for laterals, which has not been noted previously in the literature as a ScE feature.

5.2.1.2 The distribution of /l/ realisations

As detailed in section 5.2 above, examples of /l/ realisations were elicited in word-initial, word-medial and word-final position, both in consonant clusters and singly. Word position is an important factor in the choice of /l/ realisation as certain realisations, e.g. [ɰ̪], do not appear word-initially (see section 5.2.1.2.2.4 below). Likewise phonetic context is important as the selection of certain realisations, e.g. [l̪ʲ], is influence by the nature of the following vowel (see section 5.2.1.2.1.1 below). This section will outline the general distribution trends of the various /l/ realisations by word position and by phonetic context.

5.2.1.2.1 Word initial position

Examples of /l/ in three contexts were elicited from the speakers. As noted above (section 5.2) each speaker provided nineteen examples of /l/ in #/l/V position, with the words exhibiting every phonotactic combination of /l/ and a vowel permitted in ScE accents. There were eleven examples of /l/ in #C/l/V

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[5] This speaker was phonetically trained and was able to inform the investigator of the exact nature of tongue contact with the passive articulator. This raises the question of how many other realisations, analysed as dental by the investigator, actually involved both the dental region and alveolar-ridge simultaneously as a place of articulation.

position, where the consonant clusters included every phonotactic possibility for /l/ in that position, and two examples of /l/ in #CC/l/V position, as the only phonotactic possibilities are /#skl/ and /#spl/.

5.2.1.2.1.1 #/l/V

Three realisations were noted in this position: [lˠ , lʲ] and [l].

Glasgow

[lˠ] 83.6 %

[lʲ] 14.6 %

[l] 1.8 %

Edinburgh

[lˠ] 89.5 %

[lʲ] 10.5 %

Aberdeen

[lˠ] 97.4 %

[lʲ] 2.6 %

All regions

[lˠ] 87.2 %

[lʲ] 11.8 %

[l] 1.0 %

Among all the speakers [lˠ] was the most common realisation in this position. It was used equally by men and women and its use was not dependent upon any particular following vowel.

The next most common realisation was [lʲ]. Among the Glaswegians, this realisation was, more or less, restricted to the female speakers, with only Glasgow males producing a non-velarised realisation, which is more accurately described as pre-velarised than palatalised. Among the women, it tended to be the same individuals who used the palatal realisation consistently (GF1 and GF2). For one of them (GF1), there was no doubt that she had moderate to extreme palatalisation as part of her voice quality. For example, she combined palatalised laterals with extremely fronted versions of vowels such as /u/ to produce pronunciations such as [lʲyps] (word 125, see Appendix 9). For GF2, though, there seemed to be a correlation between the use of [lʲ] and the presence of a following front close vowel. Thus among the Glaswegians, the use of [lʲ] is to some extent dictated by one's sex, by the following segment, and, at the level of the idiolect, by the individual's voice quality.

For the Edinburgh speakers, all uses of the [lʲ] realisation in initial position coincided with a front close, close-mid, or central close to close-mid vowel, suggesting that they were phonetically conditioned. As with the Glasgow results, there was only one use of this realisation made in initial position by a male speaker. However, since there is only one Edinburgh male speaker in the study, it is not possible to see any significance in this finding for Edinburgh males as a whole.

The existence of palatal realisations of /l/ in ScE is confirmed. Furthermore, what emerges from this data is that, in initial position, they may be found more commonly among women speakers than among men, and those speakers who do use them tend to do so consistently. Furthermore, they may be conditioned by a following front, central, close or close-mid vowel. They may also be present as a by-product of a palatalised voice quality.

5.2.1.2.1.2 #C/l/V

In this environment two realisations occur in the data: [$l^{ɣ}$] and [l^{j}]. The percentage use of each is presented in the following tables.

Glasgow

[$l^{ɣ}$]	87.9 %
[l^{j}]	12 1 %

Edinburgh

[$l^{ɣ}$]	83.6 %
[l^{j}]	16.4 %

Aberdeen

[$l^{ɣ}$]	95.5 %
[l^{j}]	4.5 %

For all speakers, then, [$l^{ɣ}$] is the preferred realisation, accounting for 87.5 % of all /l/ allophones in this position.

Among the Glaswegians it is not possible to correlate the use of any allophone with any particular phonetic environment. It would appear that the use of [l^{j}] can be accounted for by the pronunciation of one speaker (GF1) who has a palatalisation as part of her voice quality.

Among the Edinburgh speakers the use of [l^{j}] correlates with front close and close-mid vowels. It also appears in one speaker's pronunciation of the word <globes>, but on that occasion /o/ is realised as a very fronted vowel: [gl^{j}ɵbz] .

Among the Aberdeen speakers, [l^{j}] is used once, before a front close vowel (e.g. in word number 67, <clean>)[6], which may suggest phonetic

6 Note that the effect of the vowel has overcome any potential conditioning factor of the velar plosive.

conditioning. However, with reference to this study, there is insufficient data to pursue this speculation any further.

5.2.1.2.1.3 #CC/l/V

The range of realisations remained the same in this context for the Glasgow and Edinburgh speakers, but diminished for the Aberdeen group, as the following figures show:

Glasgow

[l^{γ}] 88.9 %

[l^{j}] 11.1 %

Edinburgh

[l^{γ}] 90.0 %

[l^{j}] 10.0 %

Aberdeen

[l^{γ}] 100.0 %

All speakers

[l^{γ}] 90.6 %

[l^{j}] 9.4 %

Glasgow's continuing use of [l^{j}] is entirely due to GF1, who has a palatalised voice quality (see above, section 5.2.1.2.1.1). The use of [l^{j}], arguably, is a feature of her idiolect rather than of Glasgow speakers as a whole. Edinburgh's use of [l^{j}] is more widespread among the female speakers.

5.2.1.2.2 Medial position

/l/ was investigated in intervocalic position (word 16 <twilight>) and in word-medial consonant-cluster position: /lj/ in word 193 <million>, /rl/ in word 30 <curler>, /ld/ in word 203 <seldom>, and /kspl/ in word 205 <explode>.

5.2.1.2.2.1 Glasgow

In intervocalic position the speakers used three allophones in the following percentages:

[lˠ] 77.8 %

[lʲ] 11.1 %

[l] 11.1%

In medial consonant cluster they used three realisations in this order of preference:

[ɰ] 58.3 %

[lˠ] 33.3 %

[lʲ] 8.3 %

5.2.1.2.2.2 Edinburgh

In intervocalic position the Edinburgh speakers made exclusive use of [lˠ]. However, in medial consonant cluster a wider range of allophones is used:

[lˠ] 65.0 %

[ɰ] 30.0 %

[lʲ] 5.0 %.

5.2.1.2.2.3 Aberdeen

Like the Edinburgh speakers, the Aberdeen speakers used only [lˠ] in intervocalic position, whereas in medial consonant-clusters they used two:

[lˠ] 62.5 %

[ɰ] 37.5 %.

5.2.1.2.2.4 All speakers

The percentage use of each allophone in medial position was calculated as follows:

[lˠ] 87.5 %

[lʲ] 6.3 %

[l] 6.3 %

In medial consonant cluster the usage of each allophone presents a different pattern:

[lˠ] 46.9 %

[ɰ] 46.9 %

[lʲ] 6.2 %.

5.2.1.2.2.5 Discussion

The [ɰ] allophone appears in the data for the first time, and the nature of the environment in which it is selected begins to become evident. Firstly, in this sample, it is not used in medial position where the /l/ belongs to the beginning of the second syllable (<twilight, curler, explode>), but it may be used where the /l/ phoneme is associated with the end of the first syllable (<million, seldom>). This would suggest a third criterion for the use of the [ɰ] allophone to add to the two identified earlier (see section 5.2.1.1.4): the /l/ phoneme must be in syllable-final position, either solely or in a consonant cluster. (The type of consonant cluster making its selection more likely becomes evident in the following section, which examines /l/ in comparable word-final position before phonotactically permitted consonants.)

It is useful to comment on the selection of [ɰ] in the word <million> in order to see how it conforms to the two criteria for the selection of the [ɰ] allophone, established above: auditory similarity to [lˠ], and articulatory efficiency (see section 5.2.1.1.4).

Firstly, in this context, the /l/ lies between a retracted front, lowered close unrounded vowel [ɪ], and a voiced palatal approximant. In this environment the auditory effect of the voiced velar approximant is sufficiently distinct from the surrounding segments to make its identification with the /l/ phoneme extremely likely (Hardcastle and Barry 1989:16). Secondly, the use of [ɰ̹] rather than a lateral realisation makes it possible to articulate the entire word (except the final /n/) without moving the tip and blade of the tongue, thus reducing the articulatory movements necessary to produce the word. It is suggested that, as a result of the fulfilment of these two criteria, it is very likely that /l/ will be realised as [ɰ̹] in this word. Indeed, in the case of this particular word, [ɰ̹] accounts for 85.7% of Glaswegian realisations of /l/, for 60% of Edinburgh realisations, and 50% of the Aberdeen realisations, which is 65.2% of the realisations for the speakers overall.

5.2.1.2.3 Final position

Words were chosen to elicit /l/ in final position V/l/# , where V represented each vowel phoneme possible before /l/. Additionally, words were selected which illustrated /l/ in final consonant cluster V/l/C#.

5.2.1.2.3.1 The range of /l/ allophones in final position

In this section, we identify the /l/ allophones used by the speakers and calculate the frequency of their occurrence.

5.2.1.2.3.1.1 Glasgow

In final position /l/ has three allophones:

[lˠ] 95.2 %

[ɰ̹] 4.0 %

[lʲ] 0.8%

In final consonant cluster the range is reduced to two allophones:

[ɰ] 61.1 %

[lˠ] 38.9 %

5.2.1.2.3.1.2 Edinburgh

In final position /l/ has two allophones:

[lˠ] 90.0 %

[ɰ] 10.0 %

In final consonant cluster Edinburgh speakers use those same two allophones, but reverse the order of preference:

[ɰ] 71.4 %

[lˠ] 28.6 %.

5.2.1.2.3.1.3 Aberdeen

In final position the Aberdonians use [lˠ] exclusively. In final consonant cluster they have two allophones:

[lˠ] 55.6 %

[ɰ] 46.4 %.

5.2.1.2.3.1.4 All speakers

In this section, we present the range and usage of /l/ allophones overall. In final position /l/ has three realisations which are used in the following fashion:

[lˠ] 94.2 %

[ɰ] 5.4 %

[lʲ] 0.4 %

In final consonant cluster, there are two realisations noted in this data:

[ɰ] 62.5 % [lˠ] 37.5 %

5.2.1.2.3.1.5 Preliminary discussion

In final position the velar lateral is by far the most likely realisation, while the [ɰ] realisation and [lʲ] occurs rather infrequently. The order of preference is changed in final consonant clusters, with [ɰ] being the most used realisation, with the velarised lateral accounting for the remaining realisations.

The results for the [ɰ] allophone in this context suggest a fourth criterion for its use: that it is more likely in final consonant cluster than in final position by itself. It is suggested that this is the case because of the second criterion for [ɰ] which is coarticulation. That is to say, if the use of the [ɰ] allophone results in less overall articulatory movement in the realisation of the consonant cluster, then it may be used . To examine this, each /l/ allophone will be investigated in the light of the following segment in the next section.

5.2.1.2.3.2 /l/ allophones in final consonant clusters

In this section, the percentage occurrence of /l/ allophones is examined with reference to the manner and place of articulation of the preceding consonant. This is done in order to establish whether there is any correlation between the /l/ allophone used and the nature of the preceding consonant.

5.2.1.2.3.2.1 Plosives

Words were included in the word list which illustrated /l/ before /p, t, k, b/ and /d/. In all cases, there were only two /l/ allophones used by the speakers: [lˠ] and [ɰ]. The tables below present the percentage use by all regions of each /l/ allophone preceding each plosive.

	/lp/	/lt/	/lk/	/lb/	/ld/
[ɰ]	62.5 %	81.5 %	100 %	50.0 %	64.6 %
[lˠ]	37.5 %	18.7 %	0 %	50.0 %	35.4 %

5.2.1.2.3.2.2 Nasals

The word list included words with both /ln/ and /lm/ in final position in order to elicit examples of /l/ allophones before nasals. However, the data collected revealed a number of examples of a phenomenon known as vowel epenthesis after /l/ (see further, section 5.2.1.5, below), in which a vowel is placed between the lateral and the nasal so that a word such as <film> is pronounced [filˠɪm]. As such a pronunciation results in the potential final consonant cluster not being realised, such examples were excluded from this section. The remaining results gave rise to the following figures:

	/lm/	/ln/
[ɰ]	64.3 %	26.7 %
[lˠ]	35.7 %	73.3 %

5.2.1.2.3.2.3 Fricatives

The word list contained words with final fricatives. Once again, there were only two /l/ allophones used by the speakers: [lˠ] and [ɰ].

	/lv/	/lθ/	/lʃ/
[ɰ]	93.7 %	56.3 %	93.7 %
[lˠ]	6.3 %	43.7 %	6.3 %

5.2.1.2.3.2.4 Affricates

The /l/ realisations in final /ltʃ/ and /ldʒ/ clusters were as follows:

	/ltʃ/	/ldʒ/
[ɰ]	37.5 %	43.7 %
[lˠ]	62.5 %	56.3 %

5.2.1.2.3.2.5 Discussion

In the case of /l/ followed by a fricative, the use of a lateral realisation necessitates the removal of the central contact of the lateral before the fricative is articulated. The use of [ɰ] makes such a movement redundant. This is true of dental fricatives (55.2 %), palato-alveolar fricatives (93.3 %), and labio-dental fricatives (96.3 %) studied here.[7]

In the case of /l/ followed by a plosive or an affricate, there would seem to be no gain in efficiency of articulation where the following plosive or affricate is bilabial or alveolar. Although the figures for the voiced bilabial plosive /b/ is in keeping with this speculation, being preceded by [ɰ] only 28.1 % of the time, the situation for the voiceless counterpart is reversed, with [ɰ] being realised 71.9 % of the time. (In each case the vowel before the /l/ is /ʌ/.) This may suggest that there is some other factor affecting the speakers' choice of allophone. Where the following plosive or affricate is alveolar, 55.7 % of /l/s before /d/ and 75.9 % of /l/s before /t/ are realised as [ɰ] in this sample. /l/s before affricates are less likely to be realised as [ɰ] (34.8 % before /dʒ/ and 41.1 % before /tʃ/). Considerations of co-articulation would seem to argue for the likelihood of [ɰ] before /k/ and the figures reflect this with 100% of /l/ realisations in this position being [ɰ]. This figure may be influenced by the fact that the word used to show /l/ before /k/ in this study is 111 <milk>, which has a front retracted close lowered vowel before the /l/, which would fulfil the first criteria of the use of [ɰ], i.e. articulatory contrast with surrounding segments. It is arguable that a test word such as <bulk> would be less likely to have [ɰ] as its /l/ realisation.[8]

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[7] Of course, final /ls/ and /lz/ are also phonotactic possibilities, but there was a failure to include examples in the final word list.

[8] Note that Hardcastle and Barry came to this conclusion in their investigation of /l/ vocalisation in English English (1989: 16).

One fact that emerges from the previous set of figures is that [ɰ] seems more likely before a voiceless segment than before a voiced one. At the present time, however, it is impossible to speculate on why this is the case.

The fourth type of segment to follow /l/ in this sample is nasal phonemes. In the two words used to elicit these realisations (123 <film>, 134 <kiln>), the /l/ is preceded by [ɪ], so it may be assumed that for each word, the first criterion of auditory distinction from surrounding segments and identification of the [ɰ] with a lateral is fulfilled. In this sample, alveolar or dental nasals are more likely to have a lateral following them than a [ɰ] (which occurs 24.2 % of the time). This lower figure is most likely due to the fact that /n/ is a voiced segment and has the same place of articulation as the lateral. Before /m/, on the other hand, it is arguable that [ɰ] results in articulatory efficiency as the entire word may be articulated without the movement of the tip and blade of the tongue. This is reflected in the higher percentage use of [ɰ] before /m/: 48.1 %.

It is now possible to establish a set of criteria for the use of [ɰ] as an /l/ realisation, which, it is suggested, apply in this order:

1. the /l/ phoneme must be in syllable-final or word-final position;
2. [ɰ] is more likely in final consonant-clusters before another C;
3. the [ɰ] must have sufficient auditory closeness to [lˠ] in the context to be perceived as /l/;
4. the use of [ɰ] should result in articulatory efficiency, in that movement of the apex and blade of the tongue is avoided due to the effect of co-articulation.

If these criteria apply, then the use of [ɰ] is very likely.

5.2.1.3 Syllabic laterals

As has been mentioned (5.1.3 above), it is possible for /l/ to function as the nucleus of a syllable. Typically, /l/ can function syllabically in final position of a disyllabic word. For example, none of the monosyllables with final /l/ in this data produced a syllabic lateral: <well> *[wl̩], <drool> *[dɹl̩]. With disyllabic words the syllabic /l/ is possible: <kettle> [kɛtl̩], <apple> [apl̩]. It was decided to examine what proportion of the laterals which could be syllabic were in fact pronounced as syllabic. Therefore, twenty-two disyllabic words with /l/ in final position were selected, in which the first syllable is stressed and the second syllable is unstressed. The resulting number of totals is 198 examples from the Glasgow speakers, 110 from the Edinburgh speakers, and 44 from the Aberdeen speakers.

Syllabic laterals were produced by the members of each group, but they were by no means the most common realisation. For Glasgow speakers 26% of the words were produced with a syllabic lateral, for Edinburgh 36% of the words had a syllabic lateral, and for Aberdeen 22%. It is obvious that for these speakers syllabic laterals are less common than non-syllabic laterals.

Linked to the use of syllabic laterals is the use of lateral release of plosives. This phenomenon may occur when a lateral follows a homorganic plosive and involves the release stage of the plosive being lateral rather than central. Thus in ScE, as in all varieties of English, the consonant clusters potentially affected are /tl/ and /dl/ (e.g. twaddle, kettle, dwindle).

The auditory effect of this is a plosive followed by a lateral with no intervening vowel, the presence of which would argue for a central oral release of the plosive, a vowel, and then a lateral.

Yet the distinction may not be as straightforward as this. 20 out of 22 plosives with lateral release were followed by a velarised lateral. In the articulation of such a lateral the back of the tongue will move towards the velum (see above Section 5.2.1.1.1). If this movement coincides with the lateral release, it will produce the auditory effect of a central or back vowel. As a result a genuine lateral release into a syllabic lateral will have auditory characteristics in the region of [t^{ə}l^{ɣ}] or [t^{ɣ} l^{ɣ}].

This feature could only be reliably investigated by EPG, which would reveal the true nature of tongue/roof of mouth contact throughout such articulations.[9] Until this instrumental technique is used we must be satisfied with the results of an auditory description of the type used above.

5.2.1.4 Vowel before /l/

A phenomenon which is noticeable in the pronunciation of these speakers is the tendency for them to produce certain vowels before /l/ with a central vowel off-glide.[10] This effect in other environments has been termed "diphthongisation" elsewhere (Aitken 1984a), but in this study it is referred to as "breaking", simply because the effect is observed occurring after both monophthongs and diphthongs, and the term "diphthongisation" would be counter-intuitive if applied to diphthongs.

The vowels affected in this data are /i, e, ɛ, ɔ, ʌu, ʌi, ae/ and /ɔi/. In all cases the /l/ realisation was [lˠ] (See section 5.2.1.1.1 above). The relative frequency with which breaking occurred following these vowels is expressed as a percentage in Table 5.5. From these data it can be seen that V before /l/ is most likely to break if the V is /ɔi, e, ae, ʌi/ or /ʌu/.

In some cases the off-glide is of such duration that it results in the auditory impression of a separate syllable. This occurred with the words <dial> and <trail>, where the Glaswegians, for example, produced disyllabic realisations 33.4% of the time.

Consideration of the vowels noted above which undergo breaking in this sample will show that the monophthongs have a highest point of tongue position which is retracted from front, or is central, and which is lowered from close or is close-mid. The diphthongs have finishing points in the same general area. The

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[9] Although see the remarks in Chapter 3 concerning the intrusive nature of EPG and the likely resulting interference in the speaker's articulation.

[10] A similar effect was observed happening to vowels before /r/ in chapter 4.

only vowel which does not fall into this category is /ɔ/, which has a tongue position lowered and fronted from back open-mid.

The phenomenon of vowel breaking before /l/ can be accounted for by the articulatory factors involved in moving between the realisation of these vowels and [lˠ]. The highest point of the tongue will leave the particular vowel's position and change to a stricture of open approximation below the soft palate. It is this back of tongue movement which accounts for the auditory effect of a central or back close vowel between the original vowel and the lateral.

Table 5.5 The occurrence of breaking of each affected vowel before /l/ as expressed as a percentage

	Glasgow	Edinburgh	Aberdeen	average
/i/	11.1	10	0	7.0
/e/	88.9	100	50	79.3
/ɛ/	0	20	0	6.7
/ɔ/	11.1	0	0	3.7
/ʌu/	44.4	80	50	58.0
/ʌi/	66.7	40	100	68.7
/ae/	48.4	70	100	72.7
/ɔi/	100	60	100	86.7

5.2.1.5 Vowel epenthesis after /l/

This feature, first mentioned by Murray in the nineteenth century, is still present in ScE accents (See 5.1.3 above). In this data, it occurs only with laterals in word-final consonant-clusters, where the lateral precedes the other consonant, and where the other consonant is a nasal (e.g. <film> [filˠɪm], <kiln> [kɪlˠɪn]).

Table 5.6 The percentage occurrence of vowel epenthesis after /l/

	film	kiln
Glasgow	22.2%	11.1%
Edinburgh	0%	0%
Aberdeen	0%	0%

The word is altered from monosyllabic to disyllabic. The phenomenon is not common in this data, and is restricted to the Glaswegian speakers.[11] The figures in this study are given in Table 5.6.

It can be regarded as a similar phenomenon to vowel breaking as described above: just as vowel breaking is as the result of the tongue's movement towards a stricture of open approximation with the soft palate, so the movement away from that stricture may result in the perception of an unrounded central schwa-like vowel between the lateral and the following consonant.

5.3 Summary and conclusion

In this section, the phonetic literature pertaining to /l/ realisations in ScE has been reviewed. A range of realisations and their geographical locations were noted, as were a number of other phenomena, such as syllabic laterals and /l/ deletion. It was also noted that there was no published information on the instrumental characteristics of /l/ in ScE.

In an attempt to test the accuracy of the literature as it applies to present day speakers and to present some acoustic information, the results of an auditory and acoustic investigation of /l/, as pronounced by Glasgow, Edinburgh, and Aberdeen speakers, were presented. Four main realisations have been identified:

[11] It must be remembered, though, that the smaller number of speakers from Edinburgh and Aberdeen makes them less representative of their wider populations. Given a larger sample, vowel epenthesis may indeed be found among Aberdeen and Edinburgh speakers.

[[lˠ], [l], [lʲ], and [ɰ], and their articulatory and their acoustic characteristics described. It was noted that [ɰ] is a previously unattested allophone for ScE speakers. Moreover, an attempt was made to identify the likely distribution of these allophones in word initial, word medial and word final position, and some general observations could be made. For example, [lˠ] is by far the most frequent allophone for all speakers in all positions, [lʲ] may be contextually conditioned by the presence of front close vowels, and [ɰ] is limited to syllable final position, especially in consonant-clusters.

Syllabic laterals are found among all speakers, but are not common, most speakers preferring to retain the vowel as the nucleus of the syllable.

The presence of /l/ may affect preceding vowels, causing them to break. The vowels most susceptible to this were noted and the articulatory factors involved were accounted for.

Finally, it was noted that, for a few Glaswegian speakers, the combination of a lateral plus a nasal in final consonant cluster could result in epenthesis.

Such a detailed study of the realisation of one phoneme has proved to be worthwhile in that a range of facts has been established. Firstly, as with /r/ in the previous chapter, a new realisation has been identified and, moreover, the circumstances of its use have been outlined in some detail. Secondly, the distribution of all of the allophones has been investigated and the results presented for each regional group. In addition, the acoustic characteristics of these realisations have been presented for the first time. Lastly, the circumstances surrounding the occurrence of other phenomena associated with the /l/ phoneme have been outlined.

The discovery and investigation of a new allophone both justifies this sort of phonetic investigation and serves as a reminder that our description of the phonetic characteristics of ScE, as well as of other accents of English, is not complete.

Chapter 6 /w/ and /ʍ/ in ScE

6.0 Introduction

In this chapter the phonetic characteristics of two ScE phonemes come under investigation: /w/ and /ʍ/.[1] These phonemes are being studied for two reasons. Firstly because, as is discussed below, their respective lexical distributions appear to be undergoing some change and, secondly, because the amount of information available concerning their phonetic realisation is extremely limited.

In the process, the allophones of both phonemes are examined and their auditory and acoustic profiles are outlined. In the auditory analysis, questions are raised as to the nature of the manners of articulation subsumed in the categories "fricative" and "approximant", and issues concerning the nature of the distinction between these categories are addressed. The auditory phonetic analysis of the realisations is presented in terms of traditional phonetic labels (e.g. voiced labial velar approximant), occasionally augmented by the use of parametric transcriptions (after Catford 1988). The chapter goes on to consider the phonemic status of these allophones by means of distinctive feature classification. The pattern of the lexical distribution of the phonemes is then examined.

This chapter ends with two conclusions: that there is a sound change in progress involving the /ʍ/ and /w/ phoneme, and that the realisations of each phoneme are much more varied than the phonetic literature would suggest. Lastly, possible explanations of the cause of the sound change are discussed.

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1 Some writers (e.g. Wells, 1982) use /hw/ in preference to /ʍ/ as the symbol for this phoneme. The reason for this is often that the phonetic realisation is analysed as being initially voiceless and then voiced. In this respect /hw/ could have been used here, as some realisations do have changes of phonation type occurring within them (see below, section 6.2.1.1.4.1.2). However, two of the most numerically common realisations of this phoneme are [ʍ] and [ɸˠ], which are both voiceless throughout. For this reason /ʍ/ is used in preference to /hw/.

6.1 Previous accounts of ScE /w/ and /ʍ/

The distribution of the /w/ and /ʍ/ phonemes in Scottish English has been described traditionally in terms of orthography. Thus, /ʍ/ is held to be distributed where the spelling <wh-> occurs, in words such as <where> and <somewhere>, while /w/ is distributed where the spelling <w-> occurs, in words such as <wear> and <win> (Abercrombie 1984: 101, Wells 1982: 408-409). In addition, /ʍ/ is said to be a phonotactic possibility in the initial consonant clusters of words such as <twit> and <queen> (Grant and Robson 1926: 63-64).

However the lexical incidence is not as straightforward as this, in that there is a small group of words which, despite having the initial spelling <wh>, have the /w/ phoneme, such as the word <whelk>, and another group of words which, despite the <w> spelling, may have the /ʍ/ phoneme, such as the word <weasel> (Wells 1982: loc. cit.). Moreover, Macafee reports the replacement of /ʍ/ by /w/ in the speech of young Glaswegians, although she does not indicate the extent of the replacement or the circumstances in which it occurs (1983).

Descriptions of the lexical incidence and phonetic realisation of the /w/ and /ʍ/ phonemes appear in the literature from the nineteenth century up to the present day. The realisation of /w/ often draws no particular comment from writers as it is not regarded as a particularly Scottish feature. Murray, for example, does not devote any time to it other than to note that it, along with some other phonemes, is "used with (its) recognised English powers" (1873: 118). Ellis describes the realisation of /w/ in the "preliminary matter" section of EEP . He symbolises it in palaeotype as (w), and analyses it as " a peculiarly English buzzed consonant with nearly closed lips, which are compressed in the middle, but inflated on each side by the emitted voice, the back of the tongue raised as for (u)" (1889: 87*); this can be equated with IPA $[w^{w}]$, where the rounding is inner and there is a degree of lip protrusion. Later writers (e.g., Speitel 1969, Wells 1982, Wilson 1909) provide no further information about /w/ realisations.

Despite the unremarkableness of the realisation of /w/, it is worth noting that it had a wider lexical incidence in the nineteenth century, at least in the southern counties of Scotland, in that it could appear in the word initial consonant cluster /wr-/, e.g. <wrong>: /wraŋ/ (Ellis 1869: 313, Murray 1873: 130). In the twentieth century there is no mention of initial /wr/ continuing as a phonotactic possibility.

The treatment of /ʍ/ in the literature is altogether different, due, no doubt, to its status as a characteristically Scottish sound. Although no exact statement of the lexical incidence of /ʍ/ is given, the indication is that it corresponds with the <wh> graphemes (Murray 1873: 118). There is no suggestion of /w/ appearing in this position.

Descriptions of the realisation of /ʍ/ indicate a number of allophones whose distribution would appear to vary geographically. Murray indicates two realisations in the southern counties, the first being a fricative with an accompanying secondary articulation (palaeotype (k*w*h)). It involves a labial approximation and a simultaneous "back" or "guttural" place of articulation. He does not specify a manner of articulation for this sound, but from his later description of the palaeotype symbol (kh), one can conclude that it is a fricative. It is proposed that an IPA symbol for this sound would be [x^w] (or, perhaps [χ^w], if the place of articulation is nearer the uvula). The second realisation is "'lip-mixed' or true Wh" (Murray 1873: 119), which, from Ellis's description of this category elsewhere (EEP: 86*), we can equate with IPA [ʍ]. Ellis indicates two /ʍ/ realisations widespread throughout Scotland, and which are those described by Murray, above. In addition, in the comparative specimens from Keith and Arbroath (Ellis 1889: 684 ff), he notes the incidence of the /f/ phoneme in positions where other Scottish speakers use the /ʍ/ phoneme. Bell notes a similar phenomenon in Caithness. Ellis palaeotypes the realisation as (fh), and Bell represents it with the Visible Speech symbol (Bell 1867: 59). It is a voiceless labiodental fricative with velarisation: IPA [f^{γ}].

Descriptions of /ʍ/ realisations in the twentieth century may be couched in modern phonetic terminology and symbols but, essentially, they amount to the same. /ʍ/ is a voiceless labial-velar fricative or a labial fricative with velarisation.

6.2 An auditory and acoustic investigation of /w/ and /ʍ/

In this section the results of an auditory and acoustic investigation of /w/ and /ʍ/ are presented. Prior to this, the theoretical backgrounds to both parts of the study are discussed.

6.2.1 The auditory study

As outlined above, the realisations associated with these phonemes are approximants and fricatives. The existence of two such terms may suggest that each has a clear and easily understood meaning, but in fact that is not necessarily so. The term approximant, for example is a relatively recent one, whereas the term fricative has had many meanings over the past century (for example, see the discussion of McAllister's (1938) use of the term "fricative" in chapter 4 of this thesis). That being the case it is felt that these terms must be examined and that the meanings that they have in this study should be clearly established.

6.2.1.1 Dividing the stricture continuum

It is generally implied and occasionally stated as a starting point to articulatory phonetic taxonomy that all articulatory strictures lie on a continuum between, on the one hand, complete closure of the articulators and, on the other, maximum opening. Consequently, for the purposes of phonetic description, it is necessary to divide this continuum in a logical, non-arbitrary fashion (e.g. Catford 1977: 118; Heffner 1950: 117).

There are a number of systematic methods which can be applied. For example, one can use auditory criteria. Jones (1918: 23-24) distinguishes between two classes of articulatory stricture, which he terms "vowel" and "consonant", on the basis of the auditory quality "sonority". It is possible to use articulatory criteria alone to divide the stricture continuum. Sweet sets up five classes of stricture on this basis (1877: 33-34, 39; 1890: 32-35). A combination of auditory and articulatory criteria can be used. Abercrombie (1967: 39), for example, sets up five major divisions based on the manner in which the "passage of air is either cut down or stopped" by the articulators, but which also makes use of auditory characteristics. O'Connor (1973: 46) uses an identical combination to establish three main divisions of the continuum.

Each of these approaches applies a different, yet equally valid, set of criteria to the division of the stricture continuum. The value of these differing classifications, it is suggested, may be judged by their ability to deal with separate sets of phonetic data. The phonetic nature of the phonemes under investigation in this part of the study places them in the area of the continuum which one could designate as that extending from close approximation to open approximation. This is an area which has been classified in a number of ways. It is proposed at this point to consider how this area of the continuum has been divided; to evaluate the usefulness of each approach to the analysis of the data in this study; and, thereby, to justify the use of the particular phonetic categories employed here.

6.2.1.1.1 Open

Sweet uses the term "open" to denote articulations "in which the passage is simply narrowed without any contact...The restriction as to contact applies only to the actual friction channel, and even then there may be slight contact provided the current of breath is not impeded" (1877: 39). In the subsequent analysis (1877: 35-43) Sweet, although aware that sounds in this class may have different auditory characteristics (i.e. presence or absence of air turbulence), does not regard this as important to his phonetic theory.

A similar approach is seen in Heffner's classification. His (1950/1964) analysis includes the "open" class, "for which the closure is partial" (op. cit.: 118).

His further sub-division of the open class results in three types of open consonant, one of which is fricatives. Heffner regards the fricative class as a 'catch all' category, defining it as "open consonants which are not nasal and not lateral" (op. cit.: 146). Unlike Sweet, Heffner states that there may be a case for further dividing the fricative class, using the presence or absence of friction (i.e. air turbulence) as a dividing line. However, he rejects the theoretical necessity of such a division (op. cit.: 146). Thus the presence or absence of friction is regarded as a variable which does not necessitate a classificatory division.

Such an approach would be unsuitable for the present study, as the presence or absence of air turbulence is one of the factors which differentiates the allophones. Thus it is rejected for the present purposes.

6.2.1.1.2 Fricatives and frictionless continuants

To other writers the presence or absence of air turbulence is an important distinction which they have incorporated into their phonetic theory. Therefore they divide this area of the continuum accordingly.

Jones adopts this auditory procedure to establish two classes: fricative and frictionless continuant (1918: 47). Jones goes on to set up a third category of semi-vowel, which overlaps with frictionless continuants. It has been argued by Pike (1943: 74), convincingly in the view of the present writer, that this third category cannot be justified from a phonetic standpoint as it is an attempt to incorporate information about these segments' function in the syllable. It is a phonemic distinction "masquerading" as a phonetic distinction.

Gimson's approach is broadly similar to that of Jones (1962: 178, 205-206). However, the reasoning which is behind his semi-vowel category is clearly stated as being functional (op. cit.: 35).

Likewise, Ladefoged falls into line with the previous two authors. Two classes are established on auditory and articulatory grounds: fricative: "close approximation of the two articulators so that the air stream is partially obstructed and turbulent air flow is produced", and approximant: "the approach of one articulator towards another but without the tract being narrowed to such an extent that a turbulent air stream is produced" (1975: 9 - 10).

The use of air turbulence as a classificatory factor is extremely useful to the present study. The term semi-vowel will not be used for the reasons outlined above.

6.2.1.1.3 Local friction, cavity friction and resonant orals

In many aspects, Pike's (1943) phonetic theory is radically different to those dealt with earlier, and this is mirrored in his approach to the classification of the area of the articulatory continuum with which we are concerned.

His use of the term "stricture" is different to its use here, in that it denotes an interruption of any of three airways (nasal, oral, pharyngeal). Two strictures (in his sense) are established: complete and partial. He defines the former as strictures which "completely close a passageway" whereas "partial strictures diminish the size of a passageway, but not so much that the air cannot pass through" (op. cit.: 138).

What is interesting from our point of view is Pike's statement that audible friction is not homogeneous, and his development of that point into a subdivision of strictures on acoustic grounds into those involving "local" friction and those involving "cavity" friction (op. cit.: 71). The two types are basically defined as follows: local friction is the result of a stricture at a single point, cavity friction is the voiceless resonance of a chamber as a whole. The presence or absence of voice does not influence local friction, which is audible in either case. However, cavity friction is masked by voice and is only audible if the sound is voiceless or devoiced.

This distinction is extremely useful in the phonetic analysis of the present data. There are some realisations which involve devoiced approximant strictures, e.g. [w̥], where friction is present, but it is not of a similar nature to the friction present in the realisation of, for example, [ʍ]. The difference lies in the source of the friction, in that the [w̥] has cavity friction, and the [ʍ] has local friction.

6.2.1.1.4 Fricatives, approximants and resonants

Catford's (1977) treatment of the continuum has some similarities to Pike's inasmuch as air pressures, volume velocity and the presence or absence of voice are all variables. However, the analysis is quite different.

He establishes three degrees of articulatory stricture: fricative, in which friction is present whether or not voicing occurs; approximant, in which friction is present without voicing and absent with voicing; and resonant, in which the air stream has laminar flow both with and without voicing (op. cit.: 119-121).

The auditory differences are said to be as a result of the relationship between (1) the cross section of the oral channel, (2) the cross section of the glottal channel and (3) varied air pressures and volume velocities. Assuming a norm for (3), Catford proceeds to give values for a range of oral channel and glottal channel cross sections, and to establish the relationships necessary for fricatives, approximants and resonants.

6.2.1.1.4.1 Some reservations

The theory of fricative, approximant and resonant, advanced by Catford, is very useful from an articulatory standpoint (1968, 1977, 1988). However, if one attempts to utilise the categories in auditory analysis it can pose a number of problems. The problems encountered in this study are now discussed.

It is simple to distinguish a voiced fricative from a voiced approximant. It is fairly easy for a phonetically trained listener to distinguish a voiced approximant from a voiced resonant. (One can simply empathise and then cease to voice the segment. The resulting turbulent or laminar flow enables classification of the sound.) But there are certain difficulties in distinguishing, auditorily, between a voiceless fricative stricture, a devoiced fricative stricture, a voiceless approximant stricture, a devoiced approximant stricture, a voiceless resonant stricture and a devoiced resonant stricture, all with homorganic place of articulation.

6.2.1.1.4.1.1 Voiceless fricatives and voiceless approximants

Catford mentions only one auditory distinction between a voiceless fricative and approximant: intensity of friction (1988: 65-66). Presumably by intensity he is referring to levels of loudness (or prominence) of the fricative noise. The implication would seem to be that a voiceless fricative stricture can be differentiated from a voiceless approximant stricture on an auditory basis. However, the assumption that the relationship between auditory and articulatory parameters is so straightforward is misleading for the following reasons.

It is suggested here that intensity as an auditory quality is too vague and too ill defined to be used with any precision in auditory analysis. In the first place, there exists no agreed auditory scale of values of intensity by which one can unambiguously describe the degree of friction (i.e. one not demanding the use of instrumentation). Thus it is necessary for each phonetician to establish his own relative scale of intensity, possibly with reference to his own speech, possibly with reference to the speaker whose fricatives he is analysing (in a manner similar to that in which listeners apparently assess vowel quality with reference to the formant frequency relationships in any portion of speech, past or present, that a speaker utters). Such a scale, by the nature of things, is necessarily subject to fluctuation.

If, however, we accept that in practice phoneticians do use their own sliding scale of friction-intensity then, presumably, those articulations which are at either end of the intensity scale can be easily categorised, with those at the high intensity level being fricatives and those at the lower end being approximants. But what about those which lie somewhere along this continuum? It may be that speakers operate a binary system of friction intensity in a similar way in which they appear to operate a binary voicing system (Pisoni 1977): plus so much intensity is a fricative, minus so much intensity is an approximant. At the moment, however, it seems that we must recognise that it is not possible to be totally certain of the point at which a voiceless fricative stricture becomes a homorganic voiceless approximant stricture, based on auditory impressions of intensity of friction.

In the second place there is the question of whether one can compare friction intensity levels of non-homorganic articulations using the same intensity scale, or whether separate scales of intensity are necessary for different places of articulation. Compare, for instance, the maximum level of intensity possible in the production of an alveolar fricative with that of a uvular fricative.

Strevens presents tentative spectrographic evidence that fricatives can be arranged in a rank scale of intensity depending on their place of articulation (1960: 35-37). This has implications for the analysis of certain /W/ realisations,[2] in which we attempt to judge the auditory properties of two simultaneous fricative strictures, or of one fricative stricture and a secondary approximant stricture, or of a fricative stricture and a resonant stricture (e.g. [ʍ, ɸˠ, xʷ]). Strevens' evidence suggests that the labial fricative would have a lower intensity level than that of the velar fricative. However, when they are combined in a double articulation, the characteristic high frequencies of the velar element (which are related to high intensity levels) are attenuated by the filtering effect of the anterior bilabial stricture (Ohala 1979: 45; Ohala & Lorentz 1977: 588).

Thus, despite the presence of a dorso-velar fricative stricture, the acoustic properties of the vocal tract change the characteristic acoustic/auditory correlate of such a stricture, making the acoustic/auditory output an unreliable guide to the nature of the oral strictures. Furthermore, if either stricture is an approximant then

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[2] The symbol /W/ is used as a shorthand to stand for both /w/ and /ʍ/ in this chapter. In addition, due to the fact that there is some confusion over the distribution of these phonemes and, as a result, allophones cannot be confidently attributed to either phoneme at this stage in the study, this symbol is used to represent an archiphoneme until the phonemic status of the allophones is investigated in section 6.3 below.

the intensity levels of the friction and the relations between them will be different again.

It is apparent that, at the moment, the notion of auditory intensity of friction which Catford mentions is not as straightforward as he indicates. Here it is reasonable to ask whether it is possible to make reliable judgements about the nature of fricative, approximant and resonant strictures involved in a /W/ realisation which are based on auditory output. It may be the case that, for auditory analysis, a two way distinction between fricative and approximant, such as that described in 6.2.1.1.3 above, is as reliable an approach as the fricative ≠ approximant ≠ resonant distinction. Despite the fact that some detail may be obscured, at least we are not left with data which are impossible to classify.

None of this is to dispute the fact that there is a phonetic difference between voiceless fricatives and voiceless approximants. Maddieson and Emmorey, in their instrumental study of voiceless lateral fricatives and voiceless lateral approximants, have shown significant phonetic differences in terms of duration, amplitude and spectral shape. They do note, however, the general view that such homorganic articulations lack salient auditory differences (1984: 187).

6.2.1.1.4.1.2 Devoiced fricatives, approximants and resonants

Theoretically, we distinguish devoiced approximants and fricatives from their voiceless equivalents by their phonation type. Yet, in the examples of devoiced /W/ contained in this data, the noise component of, for example, whisper or breath phonation, or a combination of these, tends to enhance levels of supra-glottal friction in a way which makes devoiced fricatives and approximants quite indistinguishable from each other and, occasionally, indistinguishable from voiceless fricatives and approximants (on a purely auditory basis). Moreover, in the course of this study, it was occasionally impossible to establish whether the friction being analysed was purely glottal in source or a combination of glottal and supra-glottal. Thus, on the occasions when the phonation type was breath, it was often difficult to decide whether the supra-glottal stricture was that of a fricative, a resonant or an approximant.

6.2.1.1.5 Some conclusions

As noted earlier, articulations resulting in auditory friction involve a relationship between supra-glottal strictures and phonation types. It may well be the case that auditory analysis which attempts to treat of all these variables will founder on the fact that their combined auditory effects are often very similar. It is proposed that the fine distinctions between supra-glottal strictures which Catford has established on an articulatory basis are, in fact, too fine for use in auditory analysis.

6.2.1.1.6 Primary and secondary articulations

It is possible, due to the perception of the relationship between F1 and F2 of [w], to be certain that the voiced realisations of /w/ which occur consist of a co-ordination of a stricture of open approximation at the lips and a similar stricture between the dorsum and the velum. That is to say, one can use the methods of vowel classification to ascertain the realisation of [w] (since, of course, [w] is phonetically a vocoid).

When one considers the realisations of /ʍ/ and voiceless and devoiced [w] it is not always possible to state with certainty whether one is hearing co-ordinate strictures of close approximation at the lips and the velum, a primary stricture at the lips accompanied by a secondary stricture of open approximation at the velum, or vice versa. Due to the levels of friction intensity at each place of articulation and how they affect each other (see above section 6.2.1.1.4.1), such judgements are always suspect, often difficult and occasionally impossible. It would appear that the articulatory parameters established by Catford, when combined with the notion of co-ordinate and secondary articulations, may again give rise to more problems than they solve.

6.2.1.1.7 Implications for this data

The nature of the phonetic data which emerges in this study (see sections 6.2.3.1 - 6.2.3.3.6 below) is such that the use of a theory such as that exemplified in 6.2.1.1.1 above would prevent adequate analysis. The class "open" is too all-encompassing, and major phonetic distinctions and resulting phonological distinctions would be obscured, as it would not be possible to distinguish phonetically between [w] and [ʍ]. The second approach (section 6.2.1.1.2 above) is more useful as it does enable the separation of [w] and [ʍ]. However, it does not allow the analysis and the possible significance of, for example, different degrees of friction. Pike's (1943) approach is helpful in this respect. For example, the distinction between cavity friction and local friction is useful in classifying the different auditory effects of a devoiced approximant, which is often non-specifically located friction, and a voiceless fricative, which tends to have local friction.

Catford's categories of fricative, approximant and resonant have been rejected as categories of analysis of the present data. Given the reservations stated above, it is suggested that it is not always possible to distinguish auditorily between voiceless fricatives, voiceless approximants, devoiced approximants and devoiced resonants in a totally accurate or consistent fashion. Instead, the two-way contrast of fricative ≠ approximant, and the concept of local and cavity friction proves much more useful as a basis for the analysis of the present data.

6.2.2 The acoustic study

There is no published description of the acoustic properties of either /w/ or /ʍ/ as realised in ScE accents. However data exist for /w/ in other accents as well as for other fricatives which are very similar to certain /ʍ/ allophones (e.g. [ɸ]). These will give some indication of what one might expect to find in the acoustic profile of ScE /w/ and /ʍ/.

The realisations that are examined here are of a diverse nature. In segmenting the allophones from surrounding segments, different criteria had to be employed depending on the segment in question. For example, fully voiced approximants are characterised by voiced formants. The pattern of these formants tends to involve a transition from the steady state of the preceding vowel's F1, F2 and F3 to a lower value for the [w], and then a plus transition towards the higher formant values of the following vowel (although this may vary, given the nature of the surrounding vowels' formant values.) Fricative elements, on the other hand, may appeal to other criteria, such as the presence of random noise across a variety of frequencies. The acoustic nature of each realisation is examined in the following sections.

6.2.2.1 Previous analyses of /w/

The acoustic profile of /w/ has been determined by perception tests using synthesised signals (Liberman et al 1956; Lisker 1957; O'Connor et al 1957). The results of these have been summarised elsewhere (Ainsworth 1976; Fry 1979). The characteristic feature of /w/ would appear to be the presence of voiced formants which undergo relatively slow transitions. More specifically, in initial position, the F2 of /w/ begins at a low frequency (c 360 - 840 Hz, depending on the following vowel) and undergoes a plus transition to the F2 steady state of the following vowel. This transition has an optimal duration of between 50 - 100 ms, as a lesser or greater duration leads to the perception of other phonemes (/b/ if the transitions are less than 50 ms and /u/ if they are greater than 100 ms). The F1 of /w/ has its onset in the region of 240 Hz, and should be no higher than 360 Hz. The pattern of F3 contributes little to the identification of /w/ (O'Connor et al op. cit.: 34).

Lisker (1957), investigating medial /w/, suggests that of the two cues (transitions and duration) it is the former which plays the greater part in /w/ perception. He segments the acoustic pattern of /w/ into three stages: a plus transition of F2, a steady state, and a second plus F2 transition. He also notes that there is an optimum duration of 50 ms for each stage which results in a good success rate of /w/ identification.

6.2.2.2 Acoustic characteristics of [ʍ]

The distinguishing feature of the acoustic profile of a fricative is the presence of random noise scattered over the frequency spectrum, with certain frequencies exhibiting greater intensity than others (Fry 1979: 121-122). However, Lehiste reports that the spectrograms she analysed of American English speakers uttering [ʍ] in word initial position did not display well-defined formants, but that "the pattern was very diffuse" (1964: 149).

Thus it is expected that the fricative articulations contained in this section of the study will be characterised by noise over all or part of the spectrum. Whether the noise is concentrated around particular frequencies remains to be seen.

6.2.2.3 Segmentation of the spectrograms

In this study the following criteria were applied in the segmentation of the /W/. In spectrograms where the /W/ was realised as an approximant, with voiced formants, /W/ was judged to begin where the F2 of the preceding vowel (e.g. the /e/ of <say> in <say "wear" again> left its steady state and began a minus transition. /W/ was judged to have finished when its F2 completed its plus transition and the steady state of the following vowel's F2 was achieved (e.g. the steady state of the F2 of the /i/ vowel in <weed> in <say "weed" again>. On the occasions where the /W/ was realised as a fricative, /W/ was judged to include the section of the spectrogram where there was random noise indicated.

On those occasions where /W/ was in morpheme initial position, and preceded by a nasal, an additional cue to the beginning of /W/ was where the low intensity signal of the nasal was replaced by the higher intensity signal of the /W/. In the contexts /#tW/, /#kW/ , /#dW/ /#gW/ and /#skW/, /W/ was judged to begin immediately after the noise burst of the plosive, and it was judged to have finished when the plus transition of F2 to the steady state of the following vowel was complete. Additionally, those allophones which were characterised by voicelessness or devoicing could be delimited by the cessation of voicing.

Bearing in mind the fact that the ear and the acoustic analysis program are not the same and that they may interpret the same acoustic facts in different ways, it is not surprising that, when the auditory impressions are correlated with the spectrograms, the two do not always correspond. In reality, although it is possible to see broad acoustic similarities among the three groups of realisations outlined below (see 6.2.3 below), it is not always possible to consistently distinguish , for example, the spectrographic pattern of sounds perceived as [ϕ^{Y}w] and [ϕ^{Yw}].[3] As a result, an indication of the general nature of each class will be given, which outlines its main characteristics.

6.2.3 The range of realisations

Each speaker pronounced eighteen words with /W/ in word-initial position that had the spelling <w> or <wh> followed by a range of vowel phonemes. The words used were <wield, weeds, wear, Welsh, well, warn, warning, watt, warm, wheel, whistle, where, when, whack, what, whoa, whiter, why>). For the word-initial consonant cluster /tW/ seven words were selected: < tweed, twit, Twain, twelve, twang, twaddle, twice, twilight>. Ten words illustrated /kW/ in initial position: <queen, quid, quit, quaint, question, quack, quarrel, quote, choir, quite>. One word elicited /skW/ in initial position, <squat>, and four words elicited /W/ in morpheme-initial position e.g. <nowhere, everywhere, somewhere, anywhere>. In addition each speaker read the words <dwindle> and <Gwen> to exemplify /W/

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[3] In this chapter, from this point onwards, the use of a superscript [^{w}] does not indicate the secondary articulation of labialisation, but a brief voiced labial velar approximant.

after a voiced plosive. The resulting totals were 373 tokens for the Glasgow speakers, 210 for the Edinburgh speakers and 84 for the Aberdeen speakers.

Overall there are twelve realisations, which can be divided into three types. There are approximants: [w, ̥w, w̫], fricatives: [ʍ,ɸ, ɸˠ], and realisations involving fricatives which become approximants: [ɸˠʷ, ᶲˠw, ᶲˠw̧, ʍʷ , ᶬw, ɸˠw]. Their auditory and acoustic properties will be described below. As in previous chapters the articulatory description that follows is based on the premise that an auditory impression is conventionally described in terms of articulatory movements. There is no suggestion that the following articulatory information was gathered using any specific instrumental approach.

6.2.3.1 Approximants

6.2.3.1.1 Voiced labial-velar approximant [w]

Voicing is present throughout. The back of the tongue moves towards the soft palate, and the lips undergo inner rounding with horizontal contraction. The exact position of the stricture between the back of the tongue and roof of the mouth may vary from post-palatalisation to velarisation. The result is a brief moment of open approximation between the back of the tongue and the soft palate, and between the lips. There is neither cavity nor local friction.

6.2.3.1.2 Partially-devoiced labial-velar approximant [̥w]

The stricture is as 6.2.3.1.1, but voicing is not present until the articulators have reached their articulatory stricture, or until they are moving away from it. During that devoiced section there is no friction but a brief period of silence, as the volume velocity of the air is not sufficient to create turbulence.

6.2.3.1.3 Devoiced labial-velar approximant [w̥]

The articulatory movements are as described in 6.2.3.1, but voicing is absent throughout. The auditory result is silence as there is neither cavity nor local friction.

6.2.3.1.4 Acoustic profile

On the broadband spectrogram the fully voiced approximant has typical vertical striations throughout F1, F2, and F3. Spectrograms included to illustrate this are EF2/12 "Say warning again" and EM1/39 "Say Welsh again" (pp 232 and 233). The partially voiced segments have striations corresponding to the voiced sections. For example, GF5/186 "Say Twain again" and GM2/186 "Say Twain again". The devoiced segments either show no striations or indicate some residual voicing in F1.

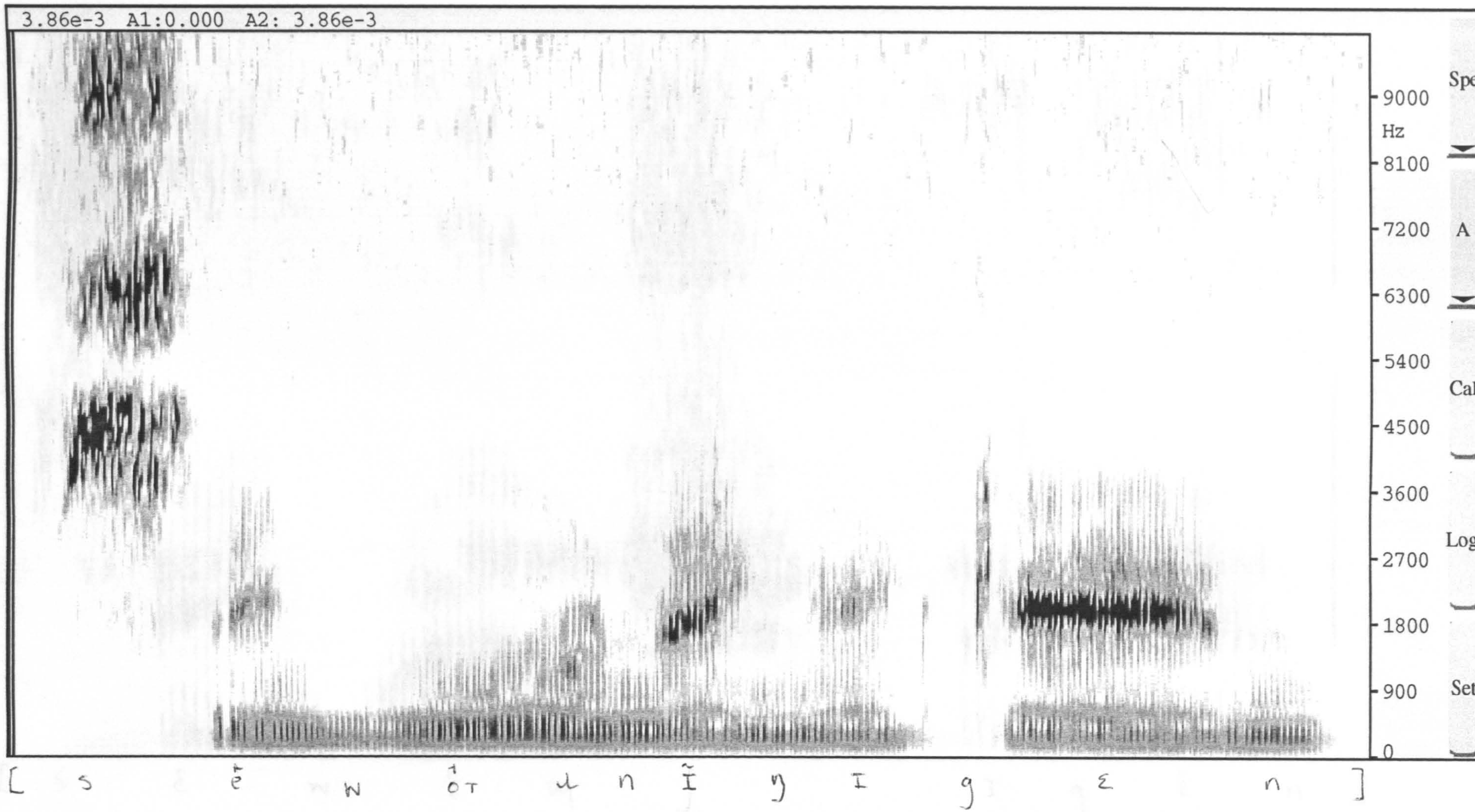
The fully voiced approximant has an F1 around 258 Hz. The plus transition of F2 has a starting point which is dependent upon the F2 of the previous vowel. F2 falls to around 950 Hz for the female speakers and to 766 Hz for the male speakers. The following plus transition will end when the F2 frequency of the following vowel is achieved.

The average duration of the approximants was 98 ms for the Glasgow speakers, 150 ms for the Edinburgh speakers and 124 ms for the Aberdeen speakers.

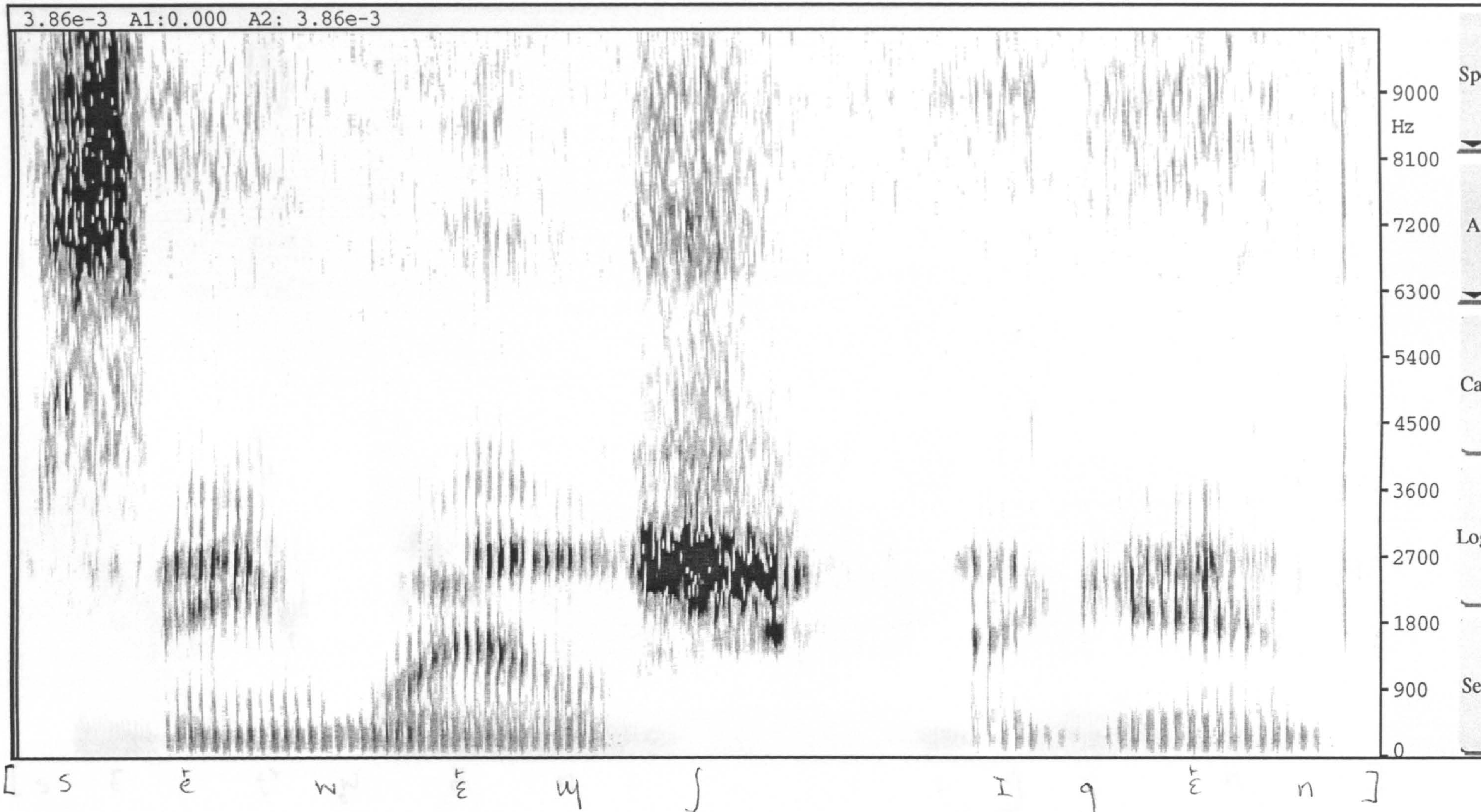
6.2.3.2 Fricatives

6.2.3.2.1 Voiceless labial-velar fricative [ʍ]

The articulation is entirely voiceless and involves simultaneous strictures of equal rank between the lips, and between the tongue dorsum and the soft palate. The auditory result was of relatively intense friction at each location.

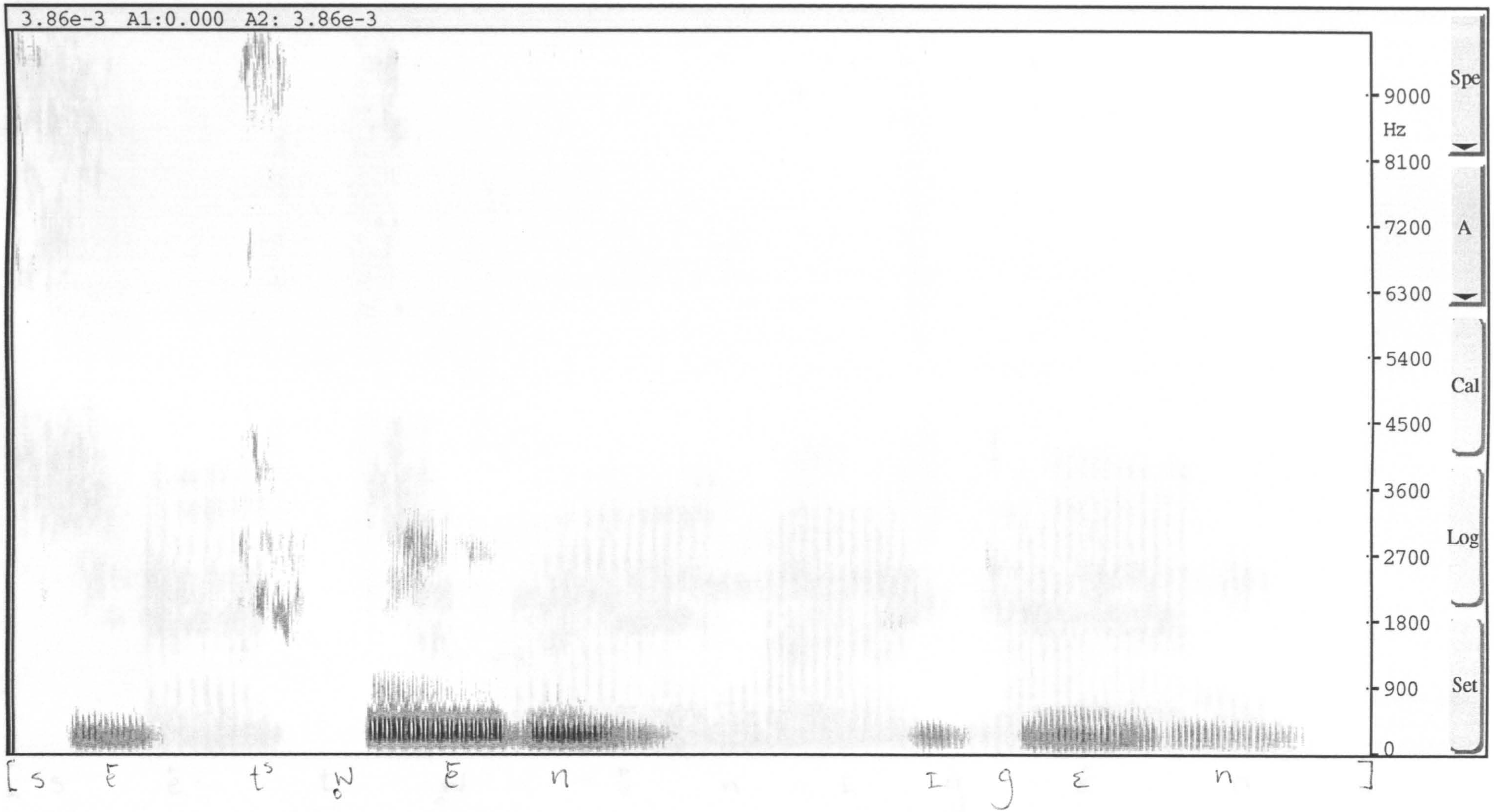


EF2/12 Say "warning" again

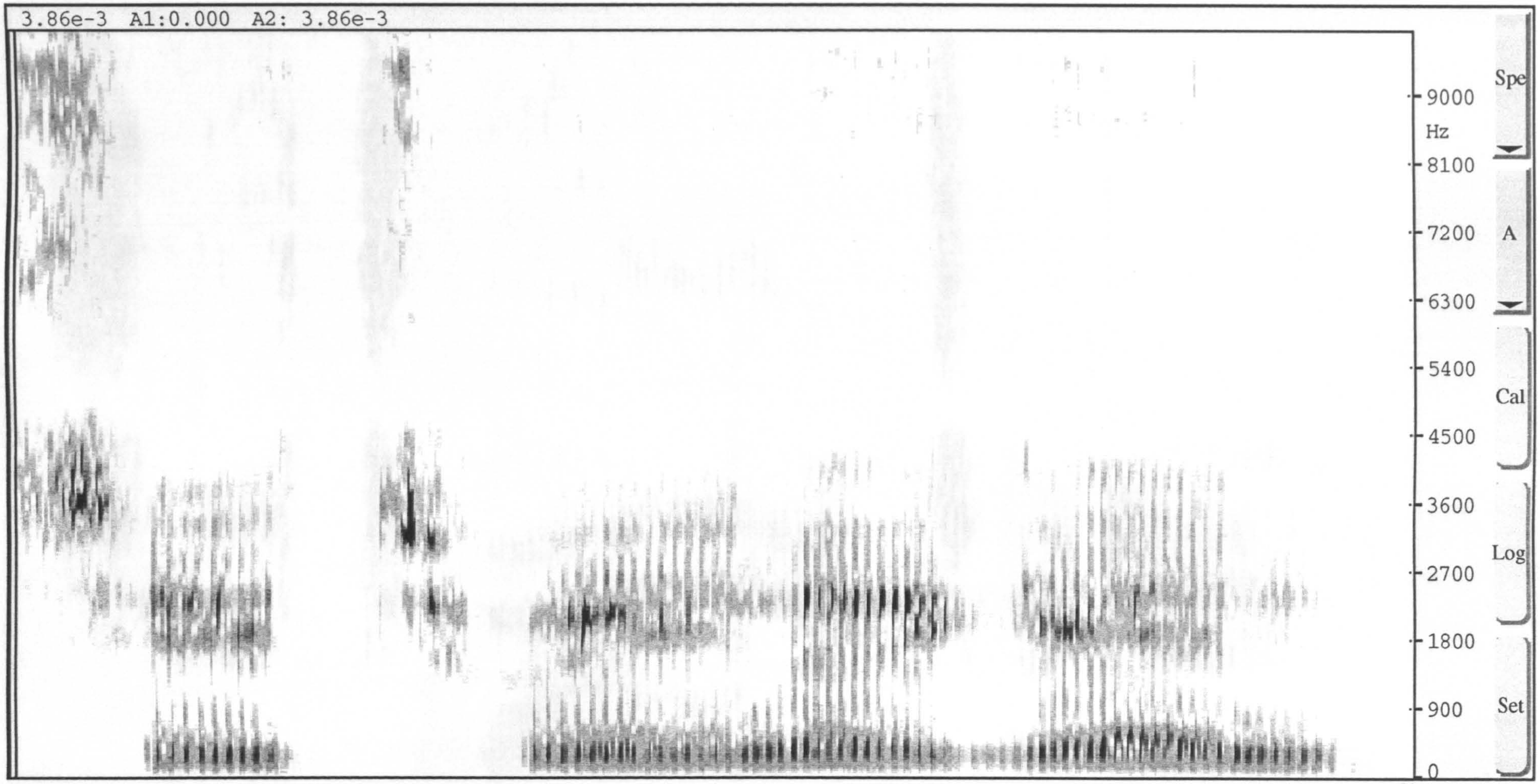


EM1/39 Say "Welsh" again

TEXT
CUT OFF IN THE
ORIGINAL

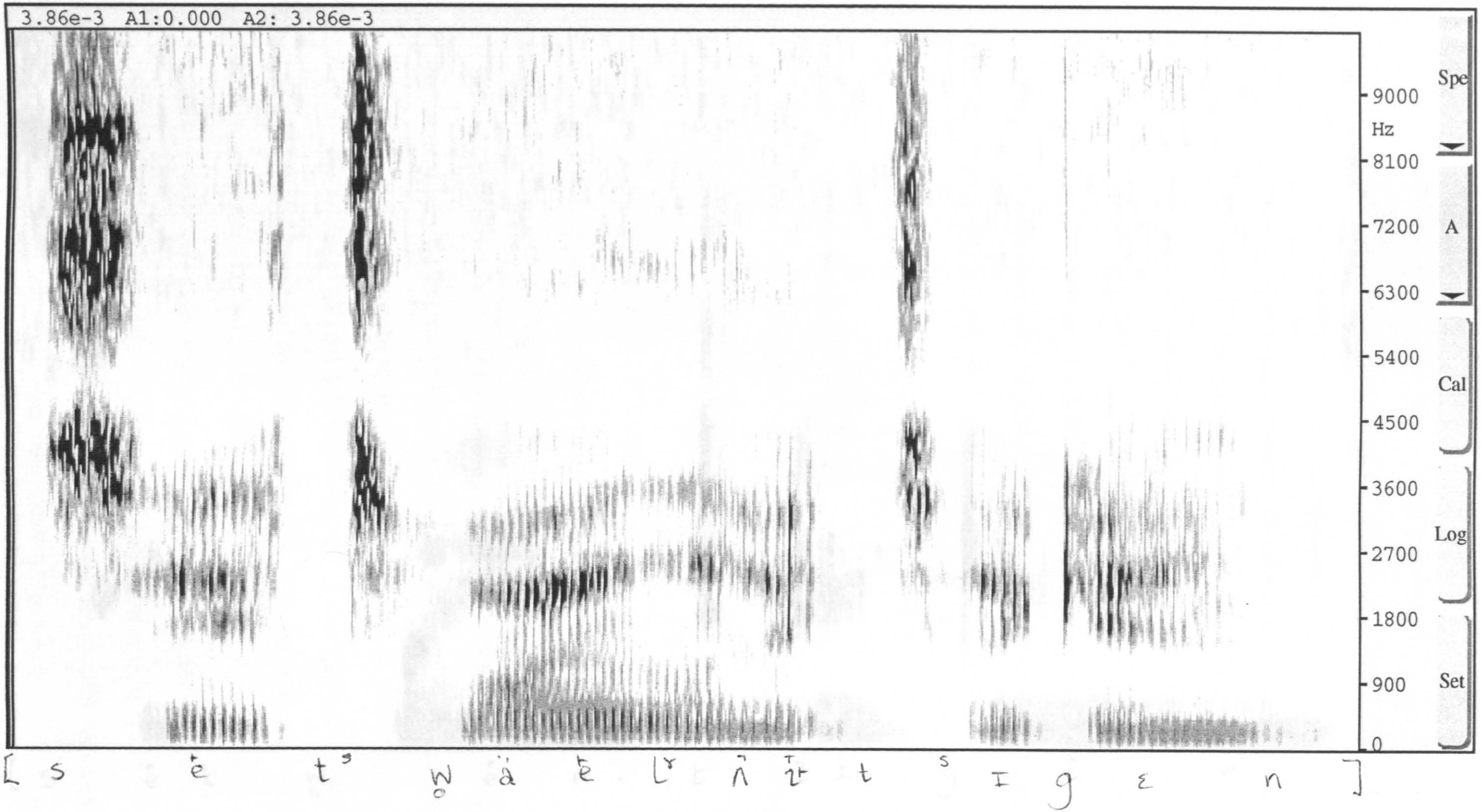


GF5/186 Say "Twain" again

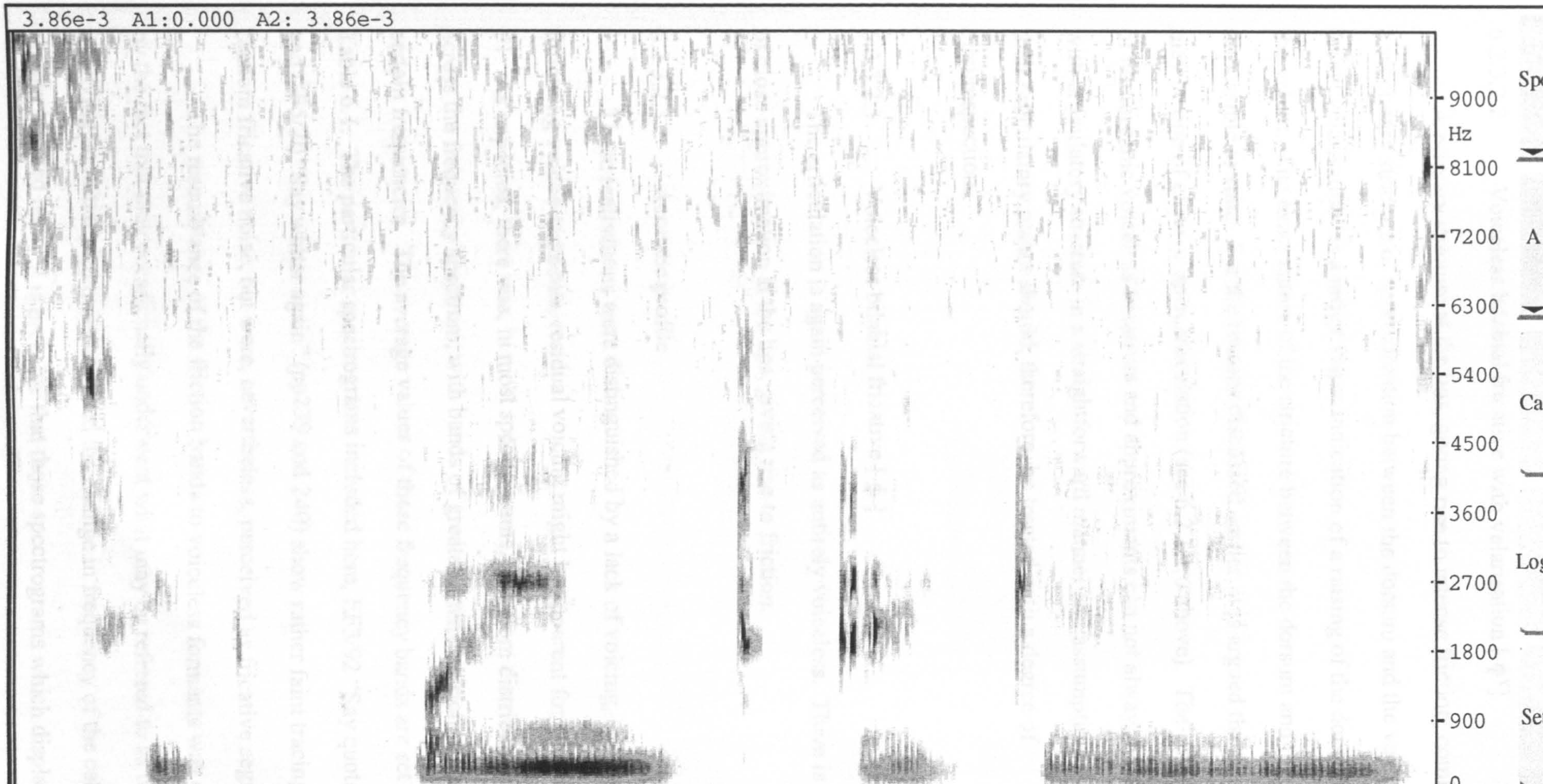


[s ẽ t w̥ ẽ n ɪ g ɛ̃ n]

GM2/186 Say "Twain" again



AM1/16 Say "twilight" again



[s ẹ k w̥ ẹ n t ɪ ɪ g ɛ n

GF1/73 Say "quaint" again

6.2.3.2.2 Voiceless bilabial fricative with velarisation [ϕ^{γ}]

A primary stricture at the lips, giving rise to intense friction, combines with a secondary stricture of approximation between the dorsum and the velum. The label "velarisation" is a rather vague indication of a raising of the dorsum towards the velum. The exact nature of the stricture between the dorsum and the velum is impossible to state. For the reasons discussed earlier, it is argued that the stricture may be one of close or open articulation (see 6.2.1.1.6 above). The auditory output of homorganic voiceless fricatives and approximants can not always be correlated with articulatory stricture in a straightforward manner and assumptions concerning their articulatory nature should, therefore, be treated with a degree of circumspection.

6.2.3.2.3 Voiceless bilabial fricative [ϕ]

The articulation is again perceived as entirely voiceless. There is a stricture of close approximation at the lips, giving rise to friction.

6.2.3.2.3 Acoustic profile

These realisations were distinguished by a lack of voicing, although, following voiced segments, residual voicing might be apparent for 10 ms or so in F1. As expected, there was, in most spectrograms, a random distribution of energy across the frequency spectrum, with bands of greater intensity friction apparent at certain frequencies. The average values of these frequency bands are set out in Table 6.1. The particular spectrograms included here, EF3/92 "Say quote again" and GF5/20 "Say whiter again" (pp239 and 240) show rather faint tracings of the random fricative noise, but were, nevertheless, perceived as fricative segments.

The resemblance of the friction bands to voiceless formants was enhanced by the fact that they occasionally underwent what may be referred to as transitions, involving an initial plus transition, and the change in frequency of the centres of gravity is noted here. It is probable that those spectrograms which display no plus

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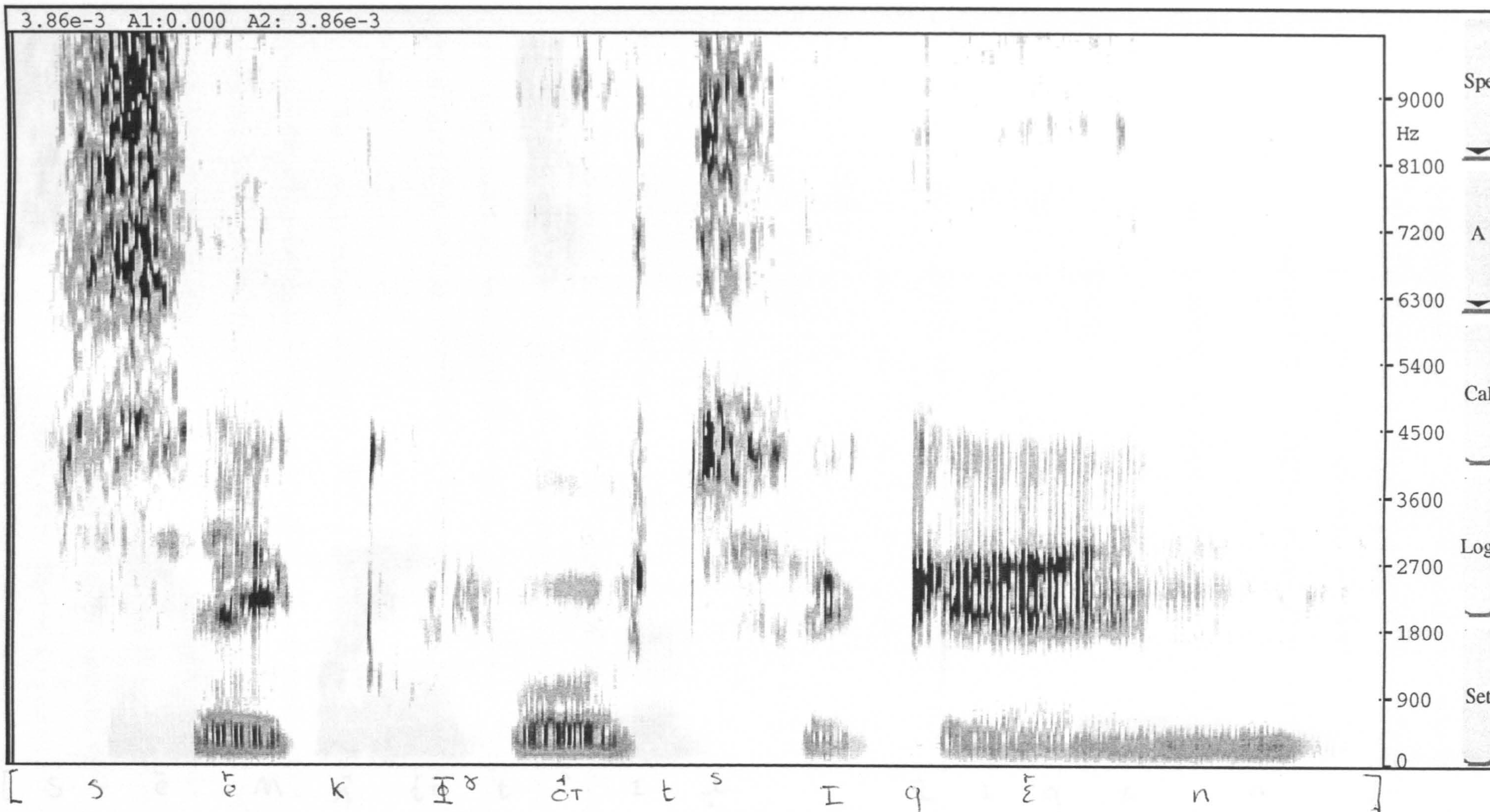
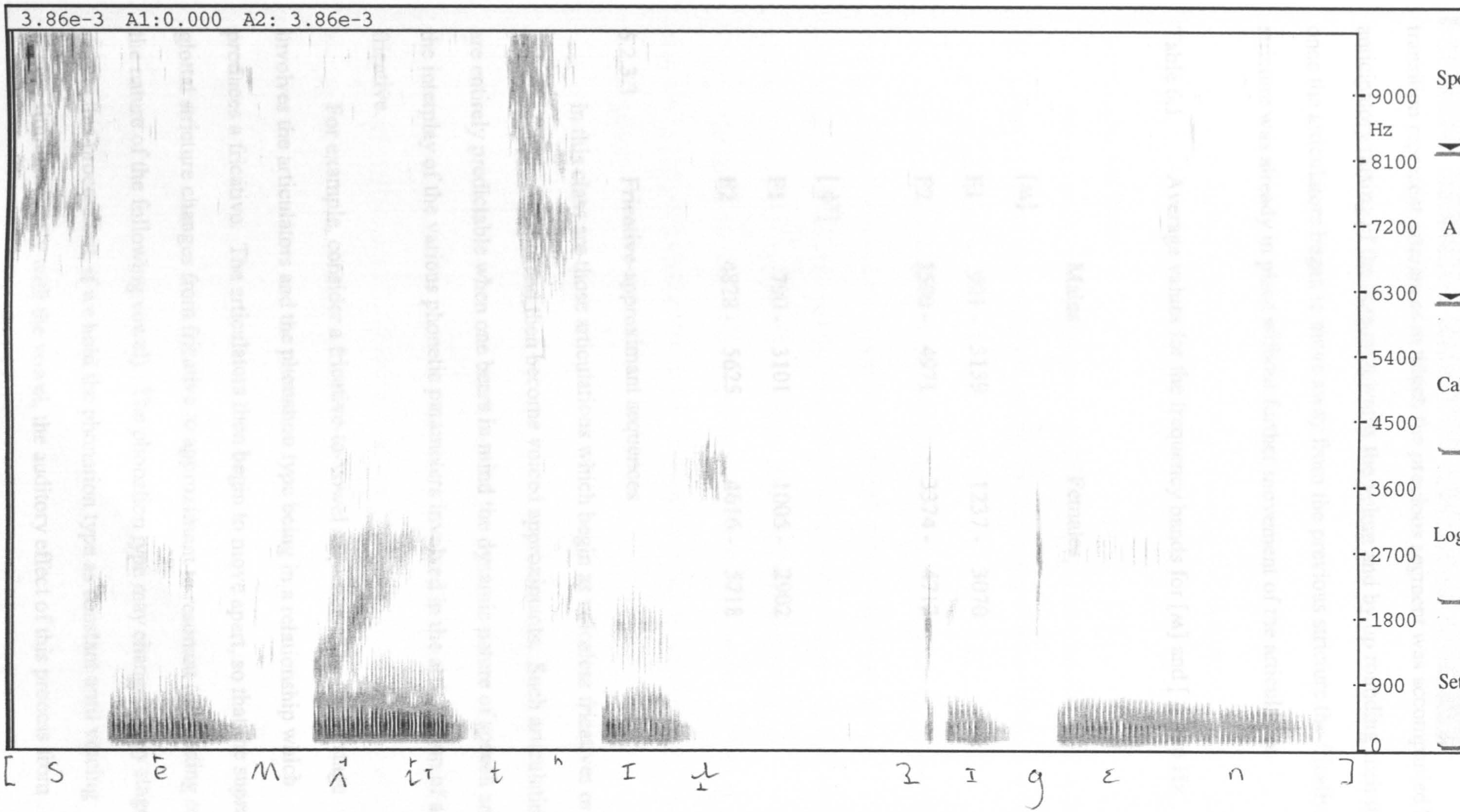


EF3/92 Say "quote" again



GF5/20 Say "whiter" again

transition represent utterances in which the previous segment was accompanied by anticipatory raising of the dorsum towards the velum and by lip rounding such that, once the articulators began to move away from the previous stricture the fricative stricture was already in place without further movement of the articulators.

Table 6.1 Average values for the frequency bands for [ʍ] and [ɸʸ] in Hz

	Males		Females	
[ʍ]				
F1	901 -	3139	1237 -	3070
F2	3500 -	4971	3374 -	4712
[ɸʸ]				
F1	790 -	3101	1005 -	2902
F2	4828 -	5625	4616 -	5718

6.2.3.3 Fricative-approximant sequences

In this class are those articulations which begin as voiceless fricatives or voiceless approximants and then become voiced approximants. Such articulations are entirely predictable when one bears in mind the dynamic nature of speech and the interplay of the various phonetic parameters involved in the articulation of a fricative.

For example, consider a fricative-to-vowel sequence. The initial stage involves the articulators and the phonation type being in a relationship which produces a fricative. The articulators then begin to move apart, so that the supra-glottal stricture changes from fricative to approximant to resonant (depending on the nature of the following vowel). The phonation type may change at any stage during this process but, if we hold the phonation type as constant until voicing occurs simultaneously with the vowel, the auditory effect of this process from fricative to vowel is: 1) friction 2) less intense friction 3) silence 4) voiced vowel. (Note that the silence is as a result of the approximant stricture combined with lowered air-flow rate as the vocal folds adduct prior to voicing.) In reality, the actual realisation is a result of the interplay of a number of parameters: the relationship of the supra-glottal articulators; the nature of the phonation type; the onset point of voicing; and the nature of the following vowel. Thus the articulatory possibilities are many.

The durations of any of these stages can vary, so that in some realisations the fricative element, the silent portion and the laminar element are judged to be equal to or greater or lesser than each other.

The use of a parametric method of transcription can clarify this articulation further. Figure 6.1 contains a parametric analysis of two realisations of /#tW/. It will be noted that in each case the glottal and supra-glottal movements are similar but that their relative timings are different. Auditory differences result.

The durations implied are impressionistic rather than exact. In that sense they are no less accurate than that implied in conventional orthographic transcription.

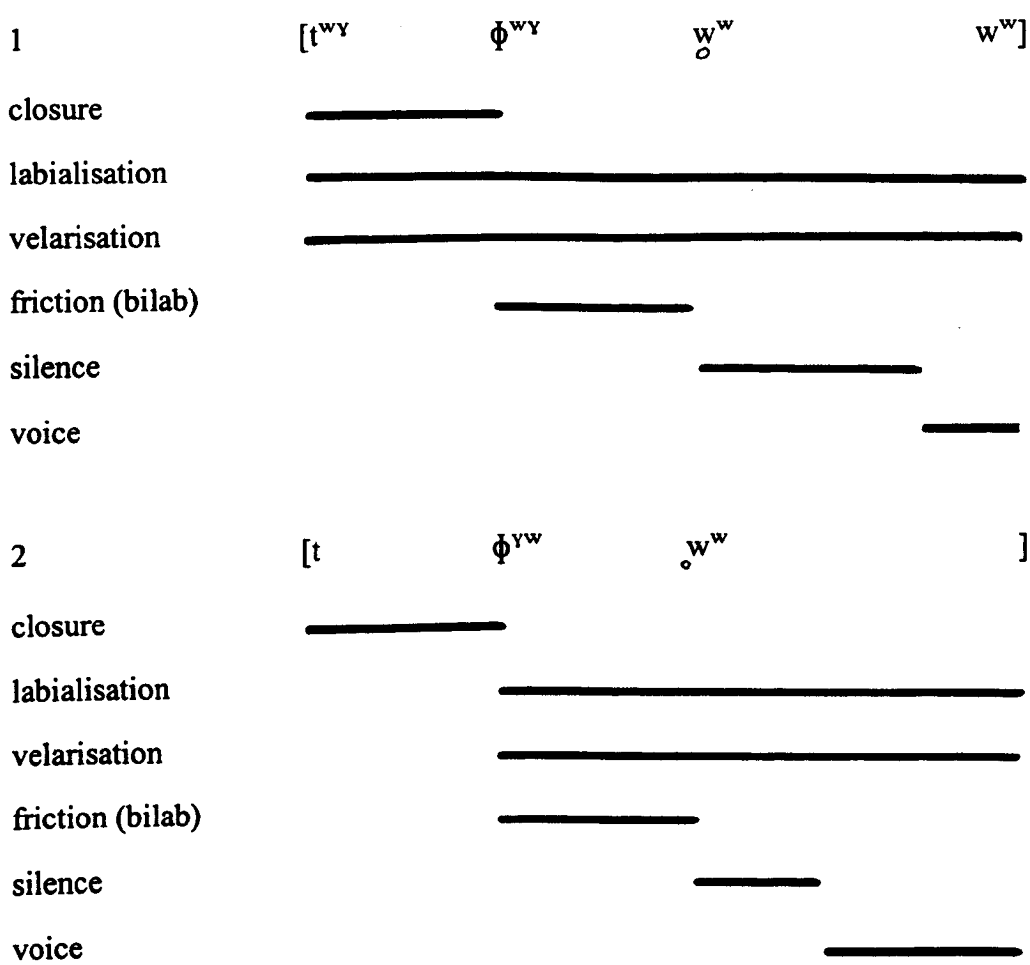
6.2.3.3.1 Voiceless bilabial fricative with velarisation followed by a brief voiced labial-velar approximant [$\phi^{\text{ɣw}}$]

The respective realisations of the constituent elements are as described in sections 6.2.3.2.2 and 6.2.3.1.1 above. The first element was judged to be of a longer duration than the second.

6.2.3.3.2 Brief voiceless bilabial fricative with velarisation followed by a voiced labial-velar approximant [$^{\phi\text{ɣ}}$w]

The respective realisations of the constituent elements are as described in sections 6.2.3.2.2 and 6.2.3.1.1 above. The second element was judged to be of a longer duration than the first.

Figure 6.1 Parametric transcription of two realisations of /#tWV/. Time is running left to right[4]



6.2.3.3.3 Brief voiceless bilabial fricative with velarisation followed by a partially devoiced labial-velar approximant [$ɸ^{ɣ}$w̥]

The respective realisations of the constituent elements are as described in sections 6.2.3.2.2 and 6.2.3.1.2 above. The second element was judged to be of a longer duration than the first .

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4 For the purposes of the two phonetic transcriptions in Figure 6.1, the diacritic [ʷ] indicates labialisation.

6.2.3.3.4 Voiceless labial-velar fricative followed by a brief voiced labial-velar approximant [ʍ^{w}]

The respective realisations of the constituent elements are as described in sections 6.2.3.2.1 and 6.2.3.1.1 above. Each element was judged to be of an equal duration.

6.2.3.3.5 Brief voiceless labial-velar fricative followed by a voiced labial-velar approximant [^{ʍ}w]

The respective realisations of the constituent elements are as described in sections 6.2.3.1.1 and 6.2.3.2.1 above. The second element was judged to be of greater duration than the first.

6.2.3.3.6 Voiceless labial fricative with velarisation followed by a voiced labial velar approximant [ɸ^{ɣ}w]

The respective realisations of the constituent elements are as described in sections 6.2.3.2.2 and 6.2.3.1.1. The fricative element and the approximant element were judged to be of equal length.

6.2.3.3.7 Acoustic profile

In this group of allophones it was extremely difficult to correlate specific spectrographic features with individual allophones. However it is possible to outline the general acoustic features of allophones of this type.

For example, consider a fricative-to-vowel sequence, such as that illustrated on the spectrogram EM1/44 “Say queen again” (p246). The initial stage involves the articulators and the phonation type being in a relationship which produces a fricative. Thus one can see, after the noise burst of the preceding /k/, a period of voiceless noise in the region of around 700-1200 Hz. The articulators then begin to move apart, so that the supra-glottal stricture changes from fricative to approximant (or to resonant, depending on the nature of the following vowel). One notices that, after the period of voiceless friction, there is a period of no trace, corresponding to silence. With the onset of voicing, we see the characteristic transition of a voiced F2 towards the higher F2 value of the following vowel, in this case /i/.

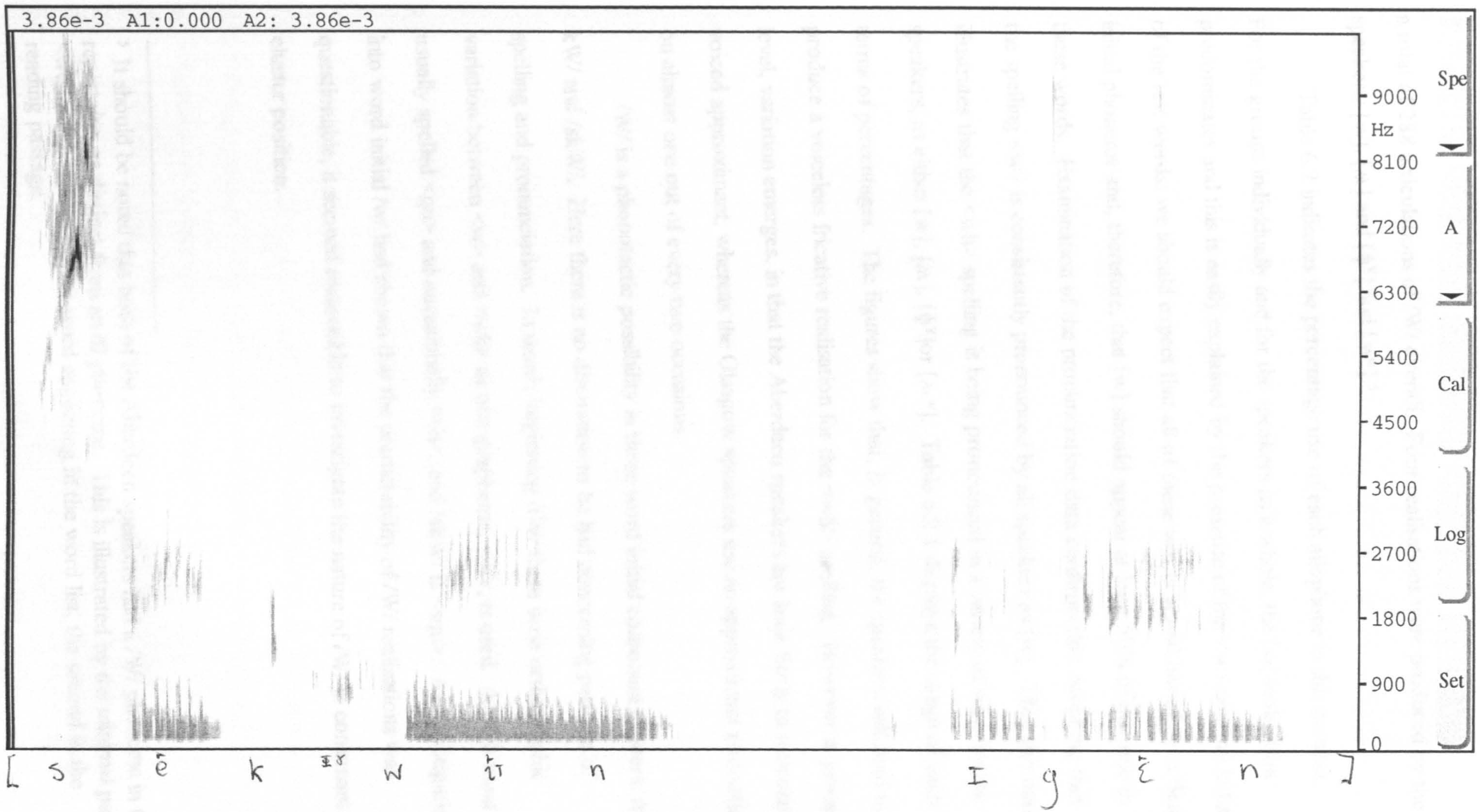
Generally, then these spectrograms began with a period of voiceless random energy scattered over the frequency range. If the fricative element lasted long enough it would often be possible to identify a band of more intense friction identifiable as F2. On some spectrograms this band underwent a plus transition. On some spectrograms an unmarked portion of spectrogram would follow the fricative section. Presumably this correlated with a brief moment of silence due to the articulators being in a stricture of open approximation combined with a lowered airflow rate as the vocal folds adduct prior to voicing. With the onset of voicing, voiced formants would appear. F1 would have frequency values as indicated above (see Table 6.1), and F2 would begin a plus transition.

The exact duration of each of these elements would vary. In some, the fricative element was longer, in others the approximant section. Often, elements would appear on the spectrogram which had not been perceived by the ear (e.g. periods of silence) and vice versa (e.g. slight friction), underlining the point that the ear and the acoustic program may interpret the same acoustic events differently.

In general, then, it can be said that these realisations` tended to be characterised by a voiceless fricative element (random energy centred around a specific frequency), an optional silent period (an unmarked section of the spectrograph), and an approximant element (voiced formants, with F2 undergoing a plus transition).

6.2.4 The incidence of the allophones

Each speaker produced eighteen tokens of /W/ in word initial position, pronouncing nine words with the spelling <w>, and nine with the spelling <wh>. This resulted in



EM1/44 Say "queen" again

a total of 288 articulations of /W/ overall. Four realisations were produced by the speakers: [w], [ʍ] and [ϕ^{γ}] and [ʍ^{w}].[5]

Table 6.2 indicates the percentage use of each allophone in this context. For the groups individually and for the speakers as a whole, the [w] realisation predominates and this is easily explained by the presence of the <w> spelling in half of the test words: we should expect that all of these words would have [w] as their initial phoneme and, therefore, that [w] should appear at least 50% of the time in these words. Examination of the pronunciation data confirms this, revealing that the spelling <w> is consistently pronounced by all speakers as [w]. Thus this data illustrates that the <wh> spelling is being pronounced in a variety of ways by the speakers, as either [w], [ʍ], [ϕ^{γ}]or [ʍ^{w}]. Table 6.2.1 displays the usage of each in terms of percentages. The figures show that, in general, the speakers will tend to produce a voiceless fricative realisation for the <wh> spelling. However at group level, variation emerges, in that the Aberdeen speakers are least likely to articulate a voiced approximant, whereas the Glasgow speakers use an approximant realisation on almost one out of every two occasions.

/W/ is a phonotactic possibility in three word initial consonant clusters: /tW, kW/ and /skW/. Here there is no discussion to be had concerning patterns of spelling and pronunciation. In words beginning /tW/ there is no orthographic variation between <w> and <wh> as one grapheme, <w>, is used. /kW/ is most usually spelled <qu> and occasionally <ch>, and /skW/ is <squ>. As investigation into word initial /w/ had shown that the predictability of /W/ realisations was questionable, it seemed reasonable to investigate the nature of /W/ in consonant cluster position.

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[5] It should be noted that both of the Aberdeen speakers had a /W/ phoneme in their repertoire, as distinct from an /f/ phoneme. This is illustrated by the minimal pair <well> and <fell>, the first word appearing in the word list, the second in the reading passage.

Table 6.2 Percentage use of /W/ realisations in /#W/ position in words with both <w> and <wh> spellings

	[w]	[ʍ]	[ϕ^{γ}]	[ʍ^{w}]
Glasgow	73.5	19.8	6.8	0
Edinburgh	62.2	10.0	26.7	1.1
Aberdeen	58.3	33.3	8.3	0
All spkrs	68.1	18.4	13.2	0.3

Table 6.2.1 Percentage use of /W/ realisations in /#W/ position in words with <wh> spellings

	[w]	[ʍ]	[ϕ^{γ}]	[ʍ^{w}]
Glasgow	47.0	39.5	13.5	0
Edinburgh	24.4	20.0	53.4	2.2
Aberdeen	16.6	66.7	16.6	0
All spkrs	36.2	36.8	26.4	0.6

The first point to note is that range of allophones is larger. For /#tW/ the range is [w, $_{c}$w, w̥, ϕ, ϕ^{γ}, $\phi^{\gamma w}$, ϕ^{γ}w, $^{\phi\gamma}$w, $^{\phi\gamma}$w̥, ʍ, ^{ʍ}w]. The percentage use of these realisations is presented in Table 6.3. The Glasgow speakers tend to use three main realisations: [ϕ^{γ}, ʍ] and [w̥] account for 77.8 % of their realisations overall. Edinburgh speakers favour approximant realisations over fricatives, as 80 % of their realisations are accounted for by two realisations: [w̥] and [w]. The situation with the Aberdeen speakers is not so clear cut although they use [ʍ] the most frequently, [w̥] accounts for 25%.

Table 6.3 Percentage use of /W/ realisations in the context /#tW/

	Glasgow	Edinburgh	Aberdeen	All speakers
w	2.8	20.0	12.5	9.4
w̥	1.4	0	12.5	2.3
w̜	25.0	60.0	25.0	35.9
$ɸ^{ɣ}$	41.7	7.5	0	25.8
$ɸ^{ɣw}$	1.4	0	0	0.8
$ɸ^{ɣ}$w	4.1	0	0	2.3
$ɸ^{ɣ}$w̥	5.6	10.0	0	6.3
ʍ	11.1	0	31.3	10.2
^{ʍ}w	0	0	12.5	1.6
$ɸ^{ɣ}$w	4.1	2.5	6.2	3.9
ɸ	2.8	0	0	1.6

For /#kW/ the range is [w, w̜, w̜, $ɸ^{ɣ}$, $ɸ^{ɣ}$w, ʍ, $ʍ^{w}$]. The percentage use of these allophones is presented in Table 6.4. The Glaswegian speakers do not appear to have one preferred realisation in this position, as [ʍ, $ɸ^{ɣ}$] and [w] are all used frequently. Edinburgh speakers again prefer [w̜], with [$ɸ^{ɣ}$] as a common alternative. The Aberdonian speakers favour [ʍ] above all other realisations.

In word initial /skW/ position the range of realisations is [w, w̜, $ɸ^{ɣ}$w, $ɸ^{ɣ}$w̜] and the percentage occurrence of these allophones is set out in Table 6.5. [w] is the most popular realisation overall, although Edinburgh and Aberdeen speakers will use the partially devoiced allophone [w̜] just as frequently.

In the contexts /#gW/ and /#dW/ one /W/ allophone is used throughout by all speakers: [w].

Table 6.4 Percentage use of allophones in /#kW/ position

	Glasgow	Edinburgh	Aberdeen	All speakers
w	14.4	12.0	15.0	13.8
˳w	20.0	36.0	10.0	23.8
w̥	4.4	8.0	0	5.0
ɸˠ	23.3	22.0	5.0	20.6
ɸˠw	5.6	12.0	10.0	8.1
ʍ	31.1	10.0	55.0	27.5
ʍʷ	1.1	0	5.0	1.3

6.3 The phonemic status of the allophones

The aim of this section is to outline the distinctive features which are associated with the /w/ and /ʍ/ phonemes in order to allocate the allophones to a phoneme. Having done that, it will be possible to state how the phonemes are distributed for these speakers.

Both phonemes share the same places of articulation, so that particular criterion will not be useful as a distinctive feature. The /w/ phoneme is [+voice], whereas /ʍ/ is the opposite [-voice]. However, there are some allophones which are not dealt with well if we impose this two-way distinction. For example [w̥] is both voiced and devoiced.

One way to resolve the first problem is to view devoiced (elements of) allophones as a variation of voiced elements, inasmuch as they are elements which have a type of phonation (e.g. breath, creak) involving movement of the vocal folds. That is to say that they represent a type of voiced sound. The voiceless allophones are separate from both the voiced and devoiced ones.

Table 6.5 The percentage occurrence of /W/ allophones in /#skW/ position

	Glasgow	Edinburgh	Aberdeen	All speakers
w	66.7	40.0	50.0	56.3
w	11.1	40.0	50.0	25.0
ϕ^{Y}w	11.1	0	0	6.2
ϕ^{Y}w	11.1	20	0	12.5

A second distinctive feature concerns the manner of articulation of the phonemes: /w/ is [+approximant] whereas /ʍ/ is [-approximant]. This two-way distinction causes some initial difficulties with allophones such as [ϕ^{Yw}] which have both a [+approximant] and a [-approximant] feature. In order to resolve this difficulty it would seem reasonable to use the element with the longer duration as the basis of classification. The shorter element is, phonetically, a transition element, reflecting the effect of contiguous elements on the [ϕ^{Y}]. In Chapter 4 of this thesis pronunciations such as [po^{ə}ɹ] were noted. The [ə] element was regarded as a glide vowel, a transition element, which has no effect upon the phonology of the word, which remains /por/. If this reasoning is accepted then one can analyse allophones such as [ϕ^{Yw}] as [-approximant] and those such as [w^{ʍ}]as [+approximant].

Analysing all of the allophones in this manner divides them between /w/ and /ʍ/ thus: /w/ [w, w̥, w̜, ϕ^{Y}w, ϕ^{Y}w̜, ^{ʍ} w]

/ʍ/ [ʍ, ϕ, ϕ^{Y}, ϕ^{Yw}, ʍ^{w}]

leaving only [ϕ^{Y}w] unaccounted for.

6.3.1 The lexical distribution of the phonemes

The first stage in this investigation is to establish whether all the speakers make a phonemic distinction between /w/ and /ʍ/. There are two potential minimal pairs in the word list: <wear> ≠ <where>, and <watt> ≠ <what>. In addition /w/ and /ʍ/ are potentially in complementary distribution in the following sets of words:

<wheel> ≠ <wield>, <when> ≠ <well>, and <what> ≠ <warm>. Examination of the lexical incidence of /w/ and /ʍ/ in these contexts, set out in Table 6.6 and 6.7, reveals that GM1, GM2, and GM4 use /w/ in both words in each set; therefore they have no /ʍ/ phoneme. GF1 and EM1 use /w/ and /ʍ/ variably. The remainder of the speakers have a consistent /w/ ≠ /ʍ/ distinction.

Although GM1, GM2 and GM4 have no /ʍ/ phoneme, they do have realisations which occur after /t/ and /k/, that are voiceless fricatives. These can be regarded as phonetically conditioned allophones that have been assimilated to the voicelessness of the preceding plosives.

6.3.3 Discussion

The aim of this section was to allocate the /W/ realisations to either /w/ or /ʍ/ and then to examine the lexical distribution of each phoneme. What emerges is the distribution of both phonemes appears to be in flux. Some speakers are consistent either in maintaining or not maintaining a distinction; other speakers appear to be variable in their distribution of the phonemes.

Diachronically, we are able to state that we are observing a sound change in progress, in that the distribution pattern of these phonemes has changed much in the last hundred years or so. The present sample confirms Macafee's view that the change involves Glasgow speakers (1983). Not only do three speakers (GM1, GM2, GM3) make no use of /ʍ/ at all, but another speaker (GF1) shows an inconsistency in her use of /w/ and /ʍ/.

The study also reveals that the replacement of /ʍ/ by /w/ is geographically more widespread, in that an Edinburgh speaker, EM1, is inconsistent in his distribution of /ʍ/ and /w/.

The Aberdeen speakers in this sample do not appear to be participating in this sound change, in that they both consistently maintain the /w/ ≠ /ʍ/ distinction. In that respect, they are the most conservative of the three groups. However, we

Table 6.6 Distribution of /w/ and /ʍ/ in potential minimal pairs[6]

	<wear>	<where>	<watt>	<what>
GF1	w	ʍ	w	w
GF2	w	ʍ	w	ʍ
GF3	w	ʍ	w	ʍ
GF4	w	ʍ	w	ʍ
GF5	w	ʍ	w	ʍ
GM1	w	w	w	w
GM2	w	w	w	w
GM3	w	ʍ	w	ʍ
GM4	w	w	w	w
EF1	w	ʍ	w	ʍ
EF2	w	ʍ	w	ʍ
EF3	w	ʍ	w	ʍ
EF4	w	ʍ	w	ʍ
EM1	w	w	w	w
AF1	w	ʍ	w	ʍ
AM1	w	ʍ	w	ʍ

must bear in mind that the Aberdeen sample is very small and cannot be relied on to be wholly representative of the wider population it represents. A larger sample would be necessary to confirm or deny the linguistic conservatism of Aberdeen speakers in general.

[6] The lexical distribution of the phonemes in all positions is set out in Appendix 5.

It seems likely that sociolinguists will look for a sociolinguistic trigger for this sound change and account for it in terms of the effect of a prestigious phonological model (e.g. RP, near-RP and various other English English accents), widely exposed via an all-pervasive media, being adopted by younger Scottish English speakers. This may be the case. However, it may be that the change has a phonetic basis, in that /ʍ/ has an inherent susceptibility to becoming a homorganic (voiced) approximant.

This study has underlined the fact that homorganic fricative, approximant and resonant strictures can have similar auditory results. Moreover, phonetic analysis of /w/ and /ʍ/ has shown that the change is not as abrupt as the phonemic statement might suggest, in that, phonetically, /w/ and /ʍ/ realisations often include the same elements in different durations. In addition, the articulatory strictures which give rise to the auditory output are not grossly different and distinct, but progress by gradual degrees along a very small section of the articulatory continuum, from fricative to approximant to resonant. Sweet (1891: 238) discusses how this situation can result in a sound change caused by what he calls "acoustic imitation", so that diachronically one articulation takes the place of another because their auditory output is similar. Ohala and Lorentz also discuss this phenomenon with reference to labial-velars (1977: 588-589 and references there).

In addition to segmental factors we must also bear in mind the effect of suprasegmental factors. Butcher has shown that, when articulated at speed, the articulation of voiceless fricatives in general, changes in the direction of homorganic approximants. In order to increase the speed of an articulation the duration between motor commands decreases so that "the opening muscles are exercising a braking effect on the closing muscles, thus, in the case of fricatives, reducing the increase in air-flow resistance and thereby diminishing turbulence until ultimately no friction is heard" (1977: 201). As for the voicing distinction between /ʍ/ and /w/, Butcher notes that this too is influenced by fast utterance tempo. Thus a speaker may "delay or completely (omit) abduction of the vocal folds" in order to "achieve

Table 6.7 Distribution of phonemes in potential parallel distribution

	<wheel ≠	wield	when ≠	well	what ≠	warm>
GF1	ʍ	w	w	w	w	w
GF2	ʍ	w	ʍ	w	ʍ	w
GF3	ʍ	w	ʍ	w	ʍ	w
GF4	ʍ	w	ʍ	w	ʍ	w
GF5	ʍ	w	ʍ	w	ʍ	w
GM1	w	w	w	w	w	w
GM2	w	w	w	w	w	w
GM3	ʍ	w	ʍ	w	ʍ	w
GM4	w	w	w	w	w	w
EF1	ʍ	w	ʍ	w	ʍ	w
EF2	ʍ	w	ʍ	w	ʍ	w
EF3	ʍ	w	ʍ	w	ʍ	w
EF4	ʍ	w	ʍ	w	ʍ	w
EM1	ʍ	w	w	w	w	w
AF1	ʍ	w	ʍ	w	ʍ	w
AM1	ʍ	w	ʍ	w	ʍ	w

faster approximation of the articulators" (op. cit.: 180).

Therefore, although it would seem at first sight obvious to attribute this sound change to sociolinguistic factors, it may be the case that it is at least being assisted by the nature of the articulation of fricatives at speed, and to the phonetic characteristics of the articulation of voiceless labial-velar fricatives in particular.

6.4 Summary and conclusion

In this chapter the phonetic and phonemic status of /w/ and /ʍ/ has been examined. At the phonetic level, the ways in which different phoneticians have attempted to divide the stricture continuum from an articulatory standpoint have been outlined, and special attention has been paid to the area of the continuum in which approximants, resonants and fricatives are articulated. The validity of using auditory information as a basis for judgements concerning such articulatory strictures has been called into question. Likewise, the usefulness of attempting to mirror articulatory categories in auditory descriptive categories has been disputed. Data from ScE /w/ and /ʍ/ has been used to illustrate the difficulties involved.

/w/ and /ʍ/ were established by means of the distinctive features [± voice] and [± approximant]. The lexical distribution of the phonemes was seen to be inconsistent between the speakers. Some speakers did not distinguish between the two phonemes and were judged to possess only one phoneme /w/. Others were variable, but the majority of speakers did maintain a consistent distinction. It would appear from this evidence that there is a sound change in progress concerning these two phonemes.

Once again, the close examination of two ScE phonemes has yielded a wealth of hitherto unreported phonetic detail about certain Scottish accents. In turn, this detail has necessitated the examination of an area of phonetic theory: in this case, the relationship between the articulatory nature of fricatives, approximants and resonants and their auditory output. That such data should cause phoneticians to re-examine their theoretical standpoint is justification enough for such a study. That it also enables us to observe a phonological sound change in progress is a bonus.

Chapter 7 Voice onset times of initial voiceless plosives[1]

7.0 Introduction

In this chapter the last feature of ScE is examined: voice onset times (VOTs) of voiceless plosives. Previous statements concerning VOTs in ScE are judged to be inadequate, in that no measurements of ScE VOTs are presented and no research is discussed. As a response to this situation, the results of an investigation into ScE VOTs are presented.

The findings are examined in order that a more accurate statement about VOT values can be made about ScE speakers, for males versus females, for the individual regions, and for separate phonetic environments. In the process, the VOT values are subjected to various statistical analyses in order that the significance (or otherwise) of the findings is clarified. Moreover, in subjecting the measurements to stringent statistical tests insights are gained as to the statistical significance of the other results presented throughout this thesis.

7.1 A definition of VOT

VOT is defined by Lisker and Abramson (1964) as "the time-lapse between the onset of the aspirative noise burst (of the plosive), and the onset of the vowel-related voicing" (Estrang and Lodhi 1985:175). It is generally held that in English there is usually a difference between the VOTs of voiced and voiceless plosives, with the former

[1] The writer is indebted to Stephen Revell of the Department of Politics, University of Glasgow, for his advice on the statistical analysis of the VOT data.

tending to have shorter VOTs than the latter (cf. Gimson 1968:153-154),[2] and that this difference is a factor in their perception by the listener.[3]

In articulatory terms, VOTs are determined by the timing relationship between the oral release of the plosive and the adduction of the vocal folds for voicing (cf. Kim 1970, Dixit 1979). A glottographic study of Danish plosives has shown two distinct types: the first involves adduction of the vocal folds just prior to or simultaneous with oral release, whereas the second type involves considerable abduction of the vocal folds at the moment of the plosive's release (Hutters 1985).[4] The former arrangement results in relatively sooner voicing of the following vowel than the latter situation, which results in a "voicing lag".

The term "aspiration" has been used to refer to the auditory equivalent of this voicing lag, which is described as a "breathy release of a voiceless consonant" (Fant 1973: 112). As a result, voiceless plosives are referred to by some authors as "aspirated" and their voiced equivalents as "unaspirated". The use of such terms has been criticised by some acoustic phoneticians as "not reflect(ing) the detail that acoustic phoneticians are concerned with" (Henderson & Repp 1982: 80), as many voiced, so-called "unaspirated", plosives may have as much as 40 ms of voicelessness between the noise burst and the onset of voicing when examined acoustically.[5] However, it seems to the present writer

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[2] However Abramson and Lisker (1967) indicated that the ranges of VOT measurements for homorganic voiced and voiceless plosives overlap to an extent. This fact was also seen in the present study.

[3] Other acoustic factors are involved, such as a change in the Fo (Köhler 1982, Fujimura 1977: 280 - 281); and, in the perception of place of articulation, the frequency of the noise burst of the plosive and the nature of the formant transitions into the following segment (Dorman *et al*: 1977).

[4] This typology would not be appropriate universally. For example Korean homorganic stops are of three types: unaspirated, slightly aspirated and heavily aspirated (Kim 1970).

[5] This measurement is taken from the present study of VOTs.

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[4] This typology would not be appropriate universally. For example Korean homorganic stops are of three types: unaspirated, slightly aspirated and heavily aspirated (Kim 1970).

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that, given the fact that the ear and acoustic instruments, such as sound spectrographs, interpret the same acoustic facts differently, it is entirely reasonable for there to exist two alternate terms: VOT referring to the instrumentally measurable acoustic information, and "aspiration" referring to the same phenomenon as perceived by the human ear.

7.3 Previous accounts of ScE VOTs

There are two instances in the phonetic literature where the nature of ScE voiceless plosives is referred to. The first is Aitken's statement that ScE accents are characterised by the presence of "little or no aspiration" (1979: 101), and the second is a reiteration of this by Wells (1982: 409). These statements are not entirely helpful to the phonetician attempting to gain an impression of ScE. First of all it is not clear whether the term "aspiration" is being used as a synonym for VOT, as defined above, or whether it relates to the perception of a voiceless version of the following vowel. Given the fact that nowhere in any of his writing does Aitken refer to using any instrumental phonetic technique, it seems reasonable to assume that for him "aspiration" refers to the impressionistic analysis of the presence of the breathy release of a voiceless consonant.

Secondly, although "little or no" is a perfectly adequate impressionistic judgement, it is possible for phoneticians to discover the actual duration of VOT values associated with ScE voiceless plosives

In conclusion, it is clear that much remains to be discovered about the nature of voiceless plosives in ScE. As a response to this the present study of VOTs of ScE voiceless plosives is now presented.

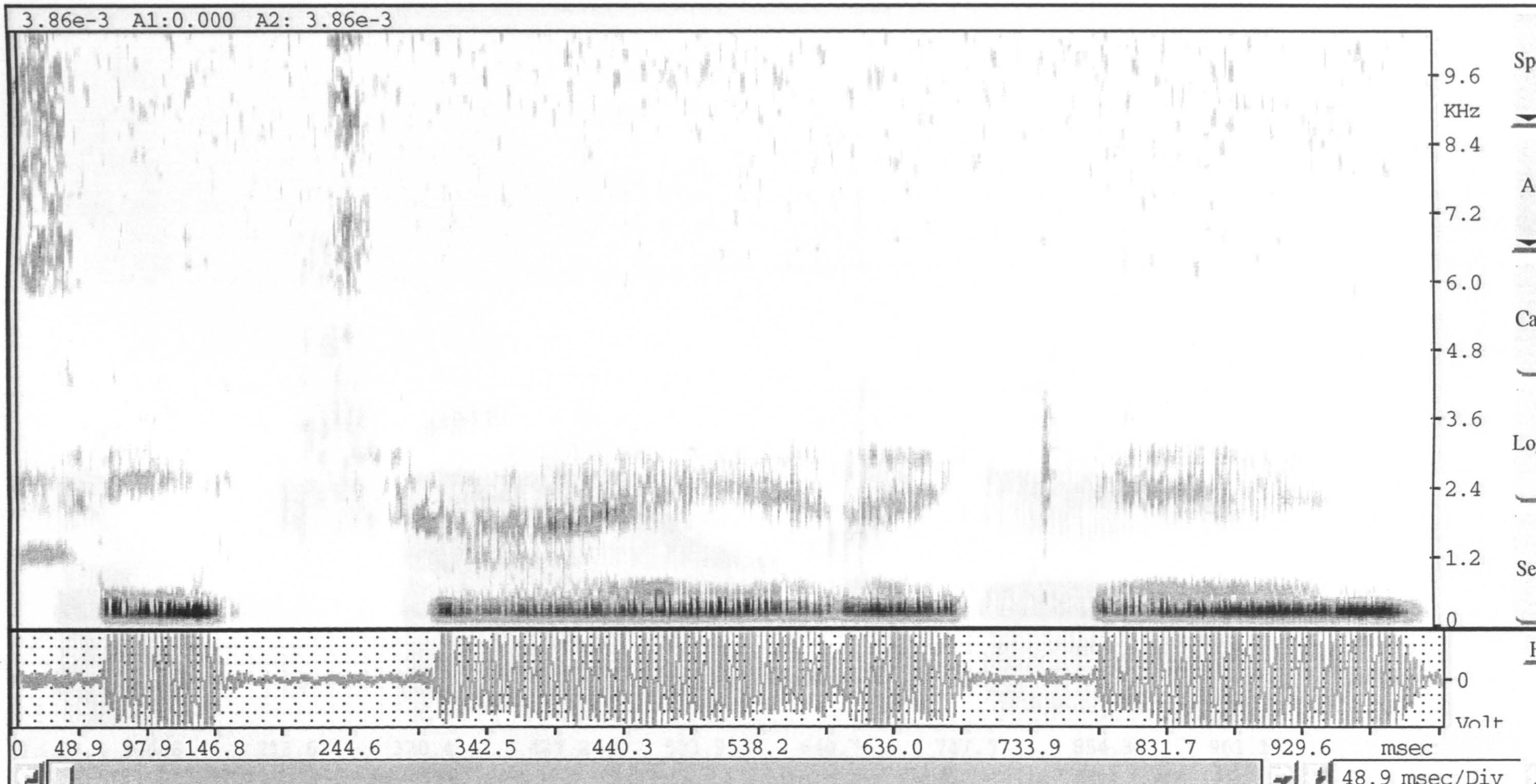
7.3 An acoustic and statistical study of VOT values for voiceless plosives in ScE

Whereas previous chapters of this thesis have focused upon allophonic variation of individual phonemes which involved qualitatively different realisations, that approach is not suitable here. In this chapter the variation centres around a quantitative measurement. In order to make sense of these quantities various statistical analysis techniques are employed. In that way it is possible to obtain an overall picture of how the measurements are distributed, how individuals behave in comparison with the group, and how separate groups of speakers compare with others. For example, the average VOT in ms for AM1 is 84.12; for EF3 87.19; for GM1 103.88; and for GM2 54.47. Are these figures random, or do they derive from factors associated with the region or sex of the speaker? In addition, it is possible to test the reliability of the sample, both as a whole and when it is divided demographically or on a phonemic basis. This will assist the evaluation of the reliability of the sample data and its representativeness of the wider population of speakers which it attempts to represent. These findings are not just applicable to the study of VOTs, but also to the study of the other aspects of ScE pronunciation contained within this thesis.

7.3.1 The acoustic measurements

Measurements were obtained of the VOTs of word-initial voiceless plosives as uttered by sixteen speakers. The plosives were placed in words occupying stressed position within a short carrier sentence. The plosives were followed either by a vowel or by a voiced consonant phoneme: /l, r, j, w/. The thirty-two words used are presented in Table 7.1.

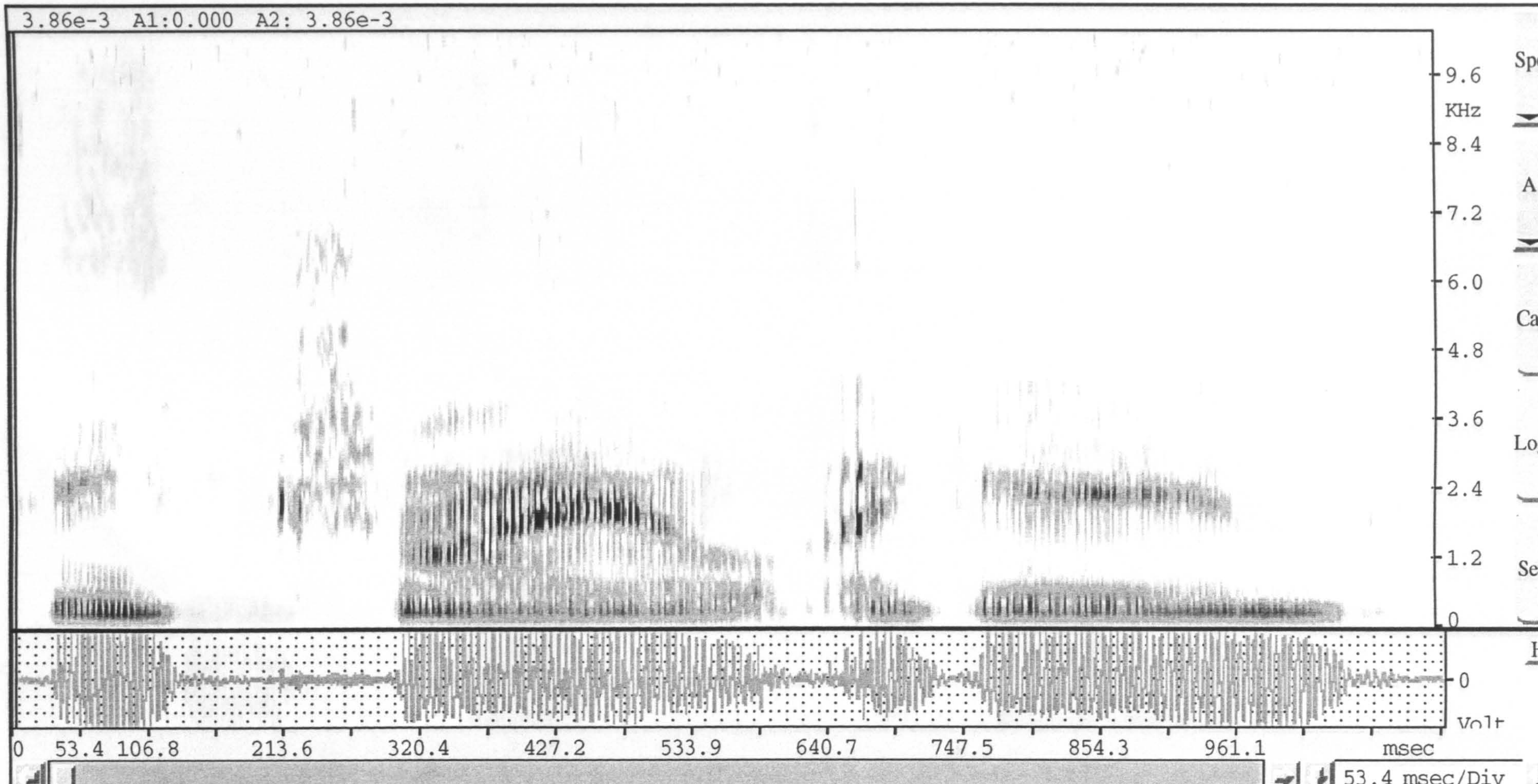
The measurements were taken from the noise burst of the plosive to the onset of following voiced striations, as seen in the sound spectrograms between pp 261 and 266. The individual VOT measurements for each word as pronounced by every speaker are given in Appendix 5. On two occasions measurements could not be obtained as there was no noise burst to be seen on the acoustic record (GF2 <twilight>, GM3 <kettle>). Although each utterance was re-analysed several times, a noise burst could not be detected. The explanation for this is that on those occasions the speaker did not make an airtight seal between the articulators and that, as a result, a homorganic fricative was



[s ẽ t ʰ ä ẽ ɹ ɪ g ɛ n]

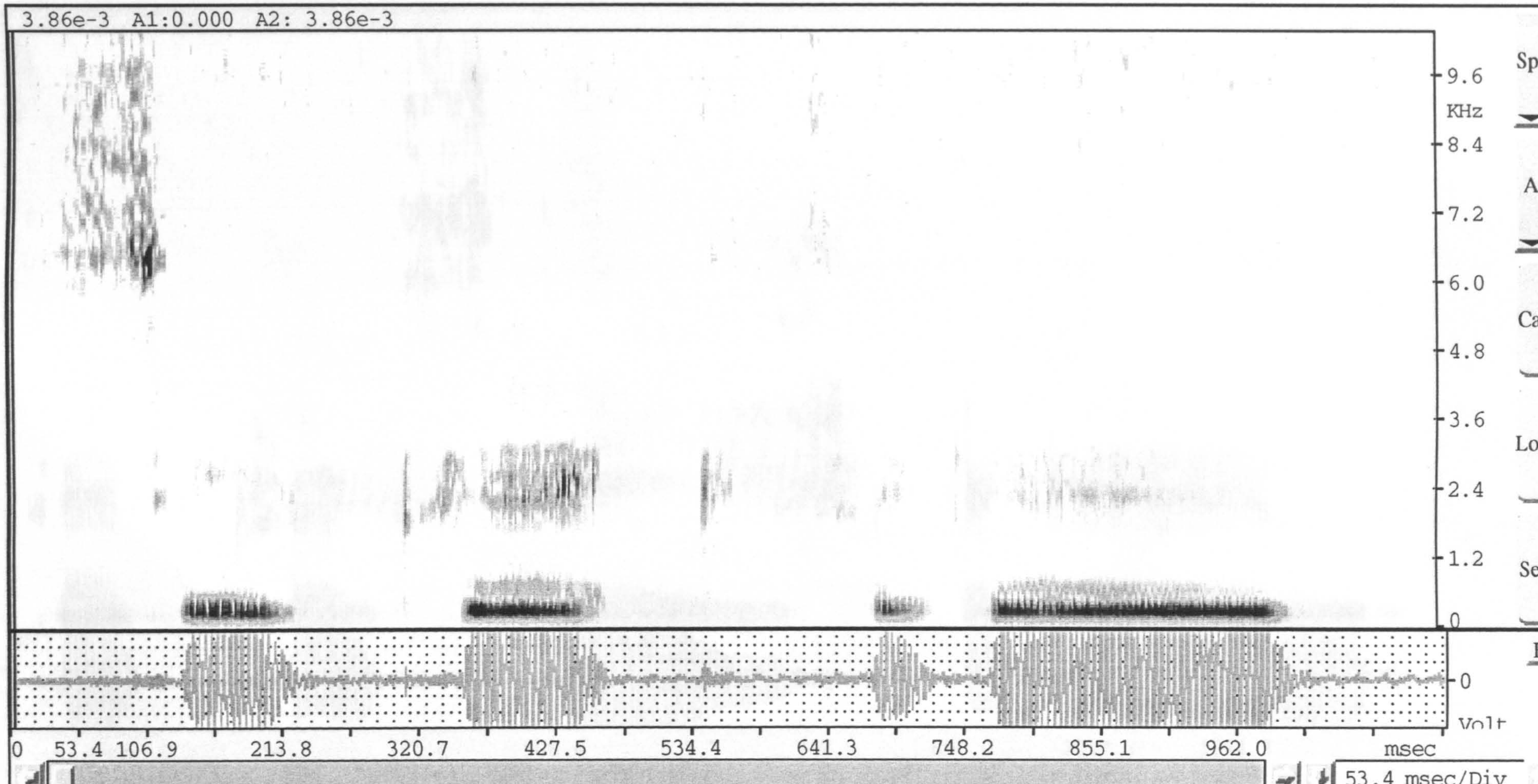
GF4/60 Say "tyre" again

TEXT
CUT OFF IN THE
ORIGINAL



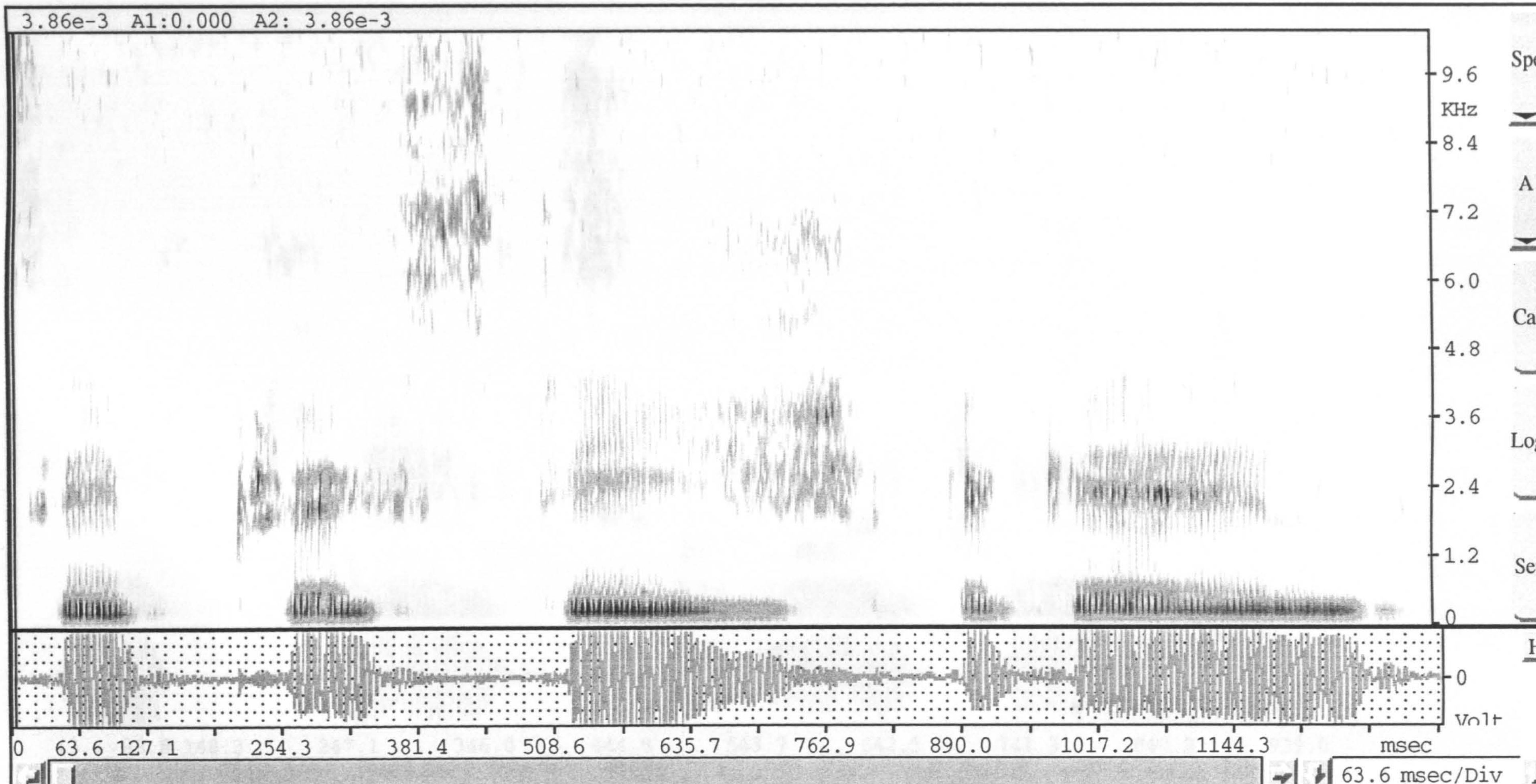
[s e t ʰ ɻ̝ ä ē ɭʳ ɪ g ɛ n]

GF4/155 Say "trial" again



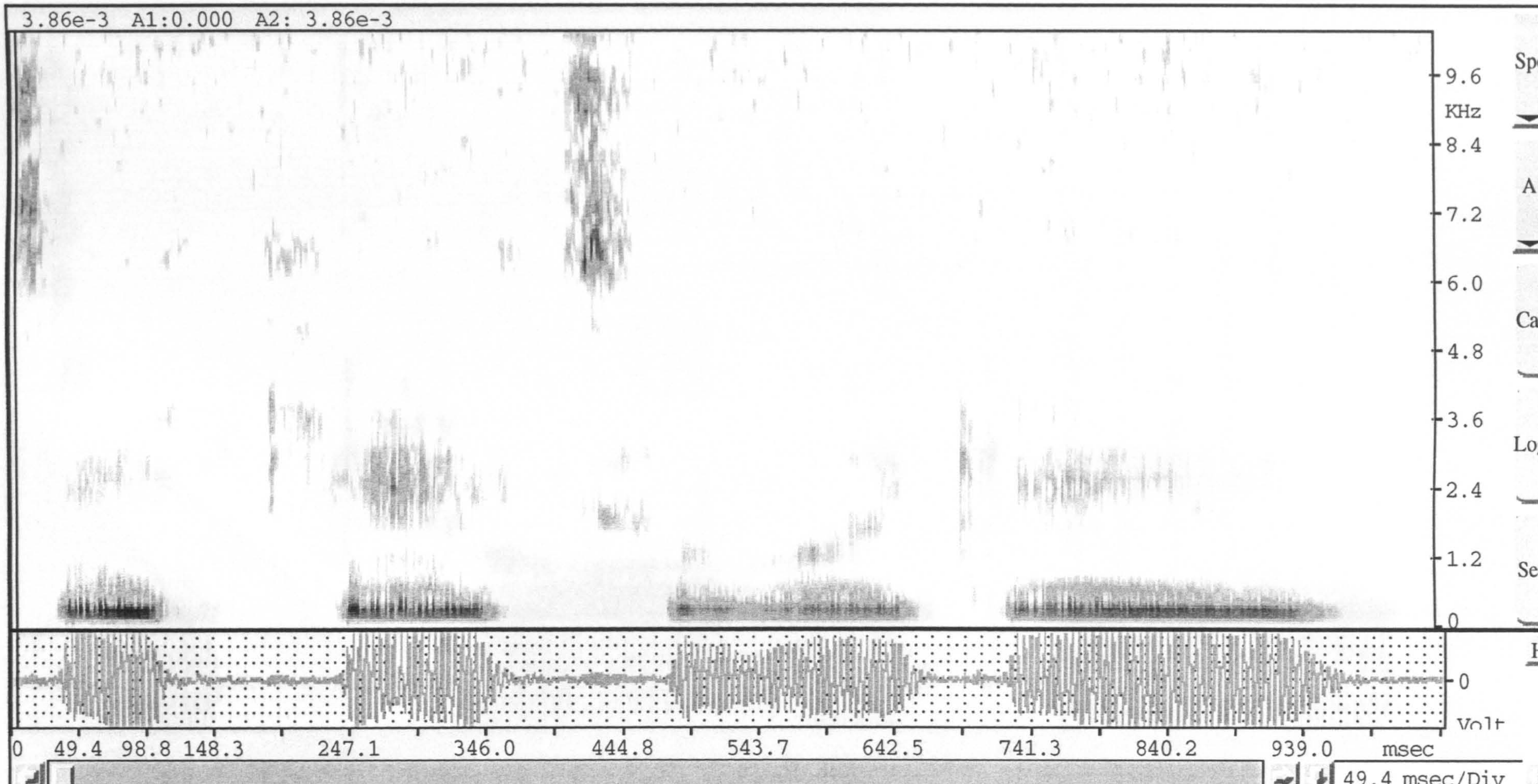
[s e pʰ ɛ ʔ k t ɪ g ɛ n]

GF4/11 Say "pecked" again



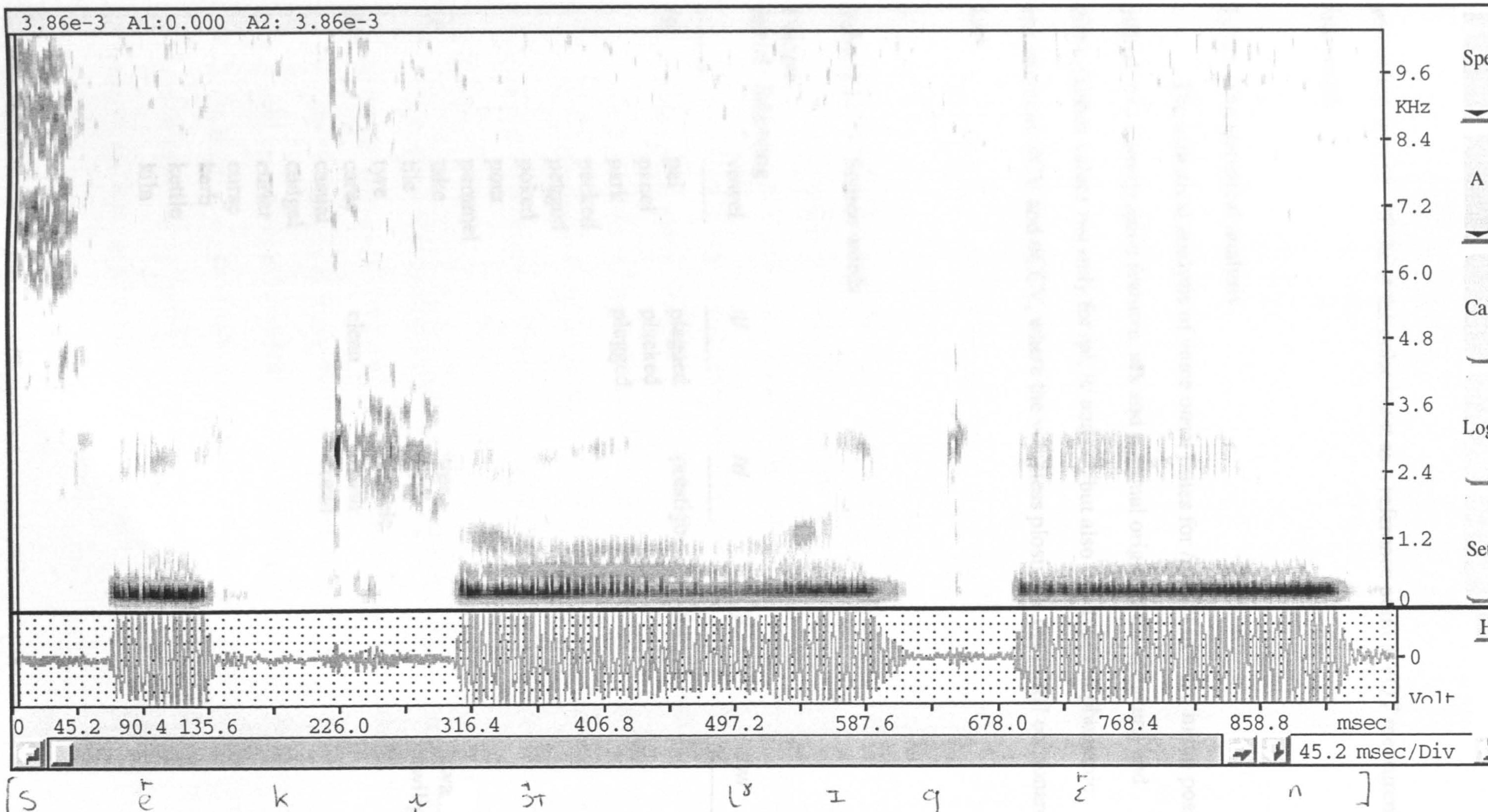
[s ẽ p ʤ̊ ɛ s t tʳ ʒ ɪ g ɛ n]

GF4/144 Say "prestige" again



[s e kʰ ɛ̃ tʰ ɪ lˠ ɪ g ɛ̃ n]

GF4/10 Say "kettle" again



GF4/152 Say "crawl" again

articulated instead. Without the noise burst as a reference point a VOT measurement was impossible.

7.3.2 The statistical analysis

The statistical analysis of voice onset times for /p, t, k/ in word initial position utilises two demographic features, sex and regional origin of the speakers, and distinguishes values not only for /p/, /t/ and /k/, but also two types of phonemic environment: #CV and #CCV, where the voiceless plosive is the initial consonant in each case.

Table 7.1 Source words

Feature: initial	following vowel	/l/	/r/	/j/	/w/
/p/	pal	plagued	prestige	pure	
	panel	plucked			
	park	plugged			
	pecked				
	pegged				
	poked				
	pour				
	pummel				
/t/	take		tree		twaddle
	tile		trial		twilight
	tyre		trouble		
/k/	cares	clean	crash		
	casual		crawl		
	cudgel				
	curler				
	curse				
	kerb				
	kettle				
	kiln				

Table 7.2 Demographic characteristics of the speakers

Region	female	male	total
Aberdeen	1	1	2
Edinburgh	4	1	5
Glasgow	5	4	9
total	10	6	16

The distribution of the 16 speakers between the two demographic categories is shown in Table 7.2.

As noted, the data are taken from the speakers' performance of 32 words which, in total, produces a possible 512 values (32 words by 16 speakers). As discussed, usable values were obtained in all but two cases. Thus a total of 510 values was available.

It is possible to use standard statistical tests to identify similarities and differences within the sample of words tested for VOT. These tests involve consideration not only of the average VOT values, but also of the statistical significance of the values. The analysis begins by investigating how the frequency of the VOT values is distributed, firstly because this is the basis of the subsequent tests, and secondly because it is a feature of interest in its own right.

There are two approaches to the analysis of the VOT values: one is to calculate, for example, an average VOT for each speaker in order to generalise from those findings; and the other is to calculate, to use the same example, an average VOT value based on each datum, irrespective of the individual. The advantage of the former approach is that one obtains information about individual speakers, their similarities and differences. Moreover it shows up any individual who exhibits strikingly divergent values. The advantage in the latter approach is that it is possible to analyse the data as discrete items not bound to particular individuals. The reason for considering this is that in statistical terms we obtain a more reliable result from 510 items of data than from a limited sample of individuals. The key assumption that is made in the aggregate approach is that the various instances of realisation, in all their diversity, provided by the speakers, are typical of what is produced more generally, or to put the matter another way, that the same averages, proportions, etc, would be found if the data were drawn from 510 individuals rather than 16 speakers.

7.3.2.1 Normal distribution of VOT

In this section the frequency distribution of the VOTs is presented. As noted, VOT is a quantity measurement. As such the values can be any values, i.e. they may vary within an observable range. The frequency with which particular values occur generally shows a strong central tendency with a scatter of less frequent occurrence at points further from the average. This pattern broadly corresponds to what is known in statistics as a normal distribution (Hayslett 1967/1974: 80 - 81).

In order to show how the values are distributed, the standard deviation (SD) has been calculated. This is the regular way of measuring the range within which given proportions of the total frequency occur (Hayslett op. cit.: 27).

As an illustration of this we shall examine the frequency distribution of all of the data. The SD was calculated using the following formula (Hayslett op. cit.: 27), where s is the population standard deviation, N is the number of VOT values, and X is the VOT value, ΣX is the sum of X, and ΣX_2 is the sum of X squared.

$$s = \sqrt{\frac{\Sigma X^2 - (\Sigma X)^2 / N}{N}} \qquad (equation\ 1)$$

The resulting SD is 25.16 ms. In a normal distribution of values 38.3% of the values should lie within ±0.5 SD of the mean.[6] As shown in Table 7.3, for these data 39.41% of values actually lie within this range.

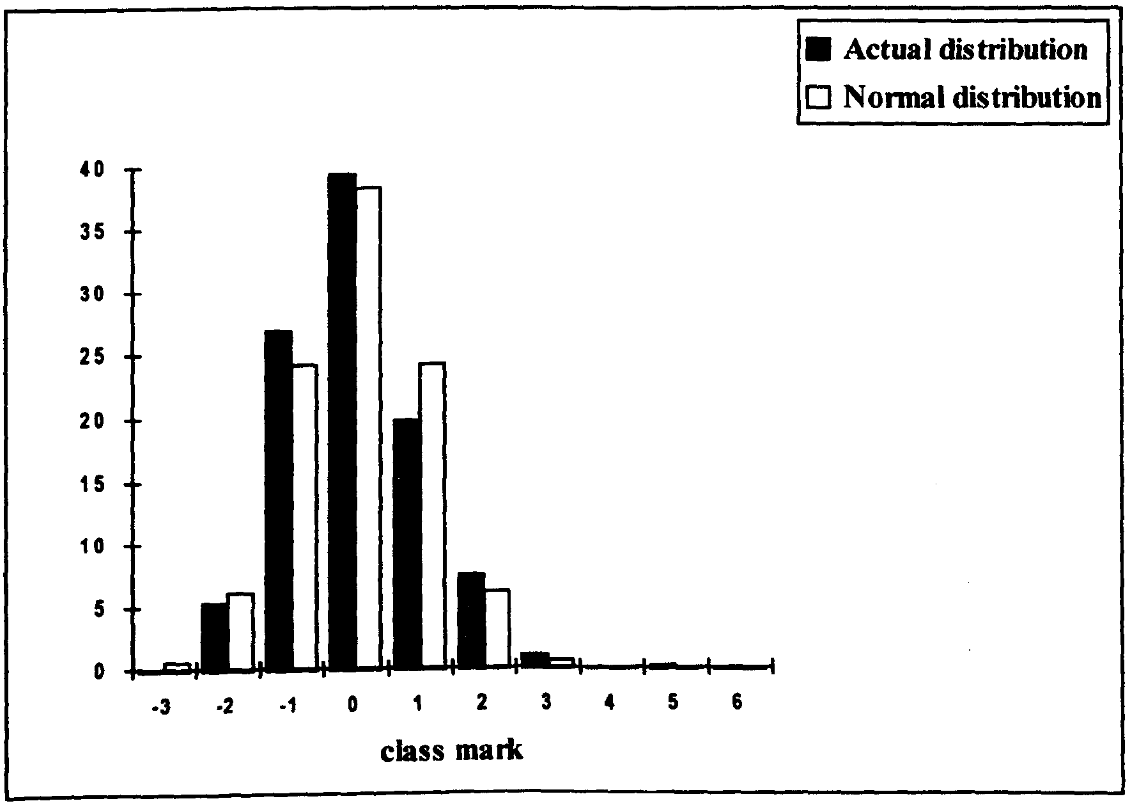
The remainder of Table 7.3 shows in Column 1 the class mark, the mid-point of each class which has a range of 1 SD. Column 2 indicates the total number of values actually lying within this range in the sample. Column 3 illustrates that number as a percentage of the total. Column 4 expresses the expected frequency in a perfectly regular normal distribution. Comparison of columns 3 and 4 shows how closely the VOT values follow a normal distribution. Figure 7.1 illustrates this comparison. (See p 271.)

Table 7.3 Frequency distribution of all the data, in classes of one SD about the mean; N = 510

Class mark	Total number	Total as %	normal distrib (%)
-3			.60
-2	27	5.29	6.06
-1	137	26.86	24.17
0	201	39.41	38.30
1	101	19.80	24.17
2	38	7.4	6.06
3	5	.98	.60
4			.02
5	1	.20	0.00
6			0.00

[6] This figure is taken from the table Area of the Standard Normal Distribution in Hayslett 1967;1978: 226.

Figure 7.1 Frequency distribution of all the data, in classes of one SD about the mean; N = 510, contrasted with a normal frequency distribution



7.3.2.2 Males versus females

What has been so far considered is the sample as a whole. It is also possible to consider analogous aggregate values for sets of data. For example, one could compute the mean and SD for the male and female components of the sample, to investigate the presence of similarities and differences in the results. The mean value for the whole sample is 78.01 ms, the female mean is 77.80 ms, and the male 78.36 ms. This gives a difference between the male and female samples of 0.56 ms. In this case it seems intuitively obvious that this margin is not significant due to its brief duration. However, not all differences are of this magnitude and cannot be analysed using such a purely intuitive approach. A systematic measurement of significance must be employed.

Likewise the SD of male and female values can be calculated and compared. The SD for the entire sample, as previously defined, is 25.16 ms, the male SD is 27.77 ms, and the female value is 23.46 ms. Statistical theory holds that if a set of values is distributed normally, 68.3% of those values the VOT values would lie within ±1 SD about the mean. So, if the distribution of, for example, the VOT values of the entire sample is normal, statistically, 68.3% of the VOT values should lie within ±1 SD about the mean, i.e. within ±25.16 ms of 78.01 ms. Figure 7.1 shows how closely the VOT values in this sample follow a normal pattern of distribution.

Standard statistical tests exist which can be used to evaluate the significance of the difference in mean values, such as the male and female values above. An interpretative method rather than a formal test is used to evaluate the differences in SD. The formal test applied to the mean values is illustrated here.

Two possibilities of interpretation exist: that the difference between the male and female means is significant or that it is insignificant. As the difference is evaluated as a function that is normally distributed, a conventional test relates that difference to the SD of the expected divergence of any sample from the source population of samples. By convention a *z* score is formulated for the difference. The *z* score consists of the difference of the means of the samples divided by a compound form of the SD, having the formula

$$\sigma = \sqrt{\frac{s_1^2}{N_1} + \frac{s_2^2}{N_2}} \qquad \textit{(equation 2)}$$

where σ is the SD of the sample, s_1 and s_2 are the SDs estimated for the two source samples, and N_1 and N_2 the size of the respective samples. Thus the z score is obtained from

$$z = \frac{\Sigma X_1/N_1 - \Sigma X_2/N_2}{\sigma} \qquad \textit{(equation 3)}$$

where $\Sigma X_1/N_1$ and $\Sigma X_2/N_2$ are the means of two populations, which in this instance can be taken as the female and male samples.

The normal distribution expects that in 95 cases out of a 100 a function will occur with a z score within ±1.96 of the mean, and within ±2.56 in 99 cases out a 100.[7] In other words, we can say that the z score will lie within the given limits with the probability of 1 in 20, or 1 in 100. The required calculations in the present case are obtained thus. The absolute difference of means: 77.80 (female) - 78.36 (male) = -0.56. And

	N	SD	s^2/N
female	319	23.46	1.725
male	191	27.77	4.038

Thus $\sigma = \sqrt{5.763} = 2.401$, and $z = -0.56 / 2.401 = -0.233$. This value lies well within the range expected at either a 5% or 1% level of confidence in the result, and we can say that there is no significant difference in the mean value of these two populations. This confirms in a formal way the intuitive interpretation that was offered earlier and allows us

[7] See the table Area of the Standard Normal Distribution in Hayslett 1967;1978: 226 - 227.

Table 7.4 Example of individual frequency distribution, in classes of 1 SD about the mean of EF4; N = 32

Class mark	Expected from normal distribution unrounded	rounded	Actual for EF4
-3	0.19	0	0
-2	1.94	2	2
-1	7.73	8	9
0	12.26	12	12
1	7.73	8	7
2	1.94	2	2
3	0.19	0	0

to state with certainty that there is no difference between the aggregate mean VOT values of ScE speakers.

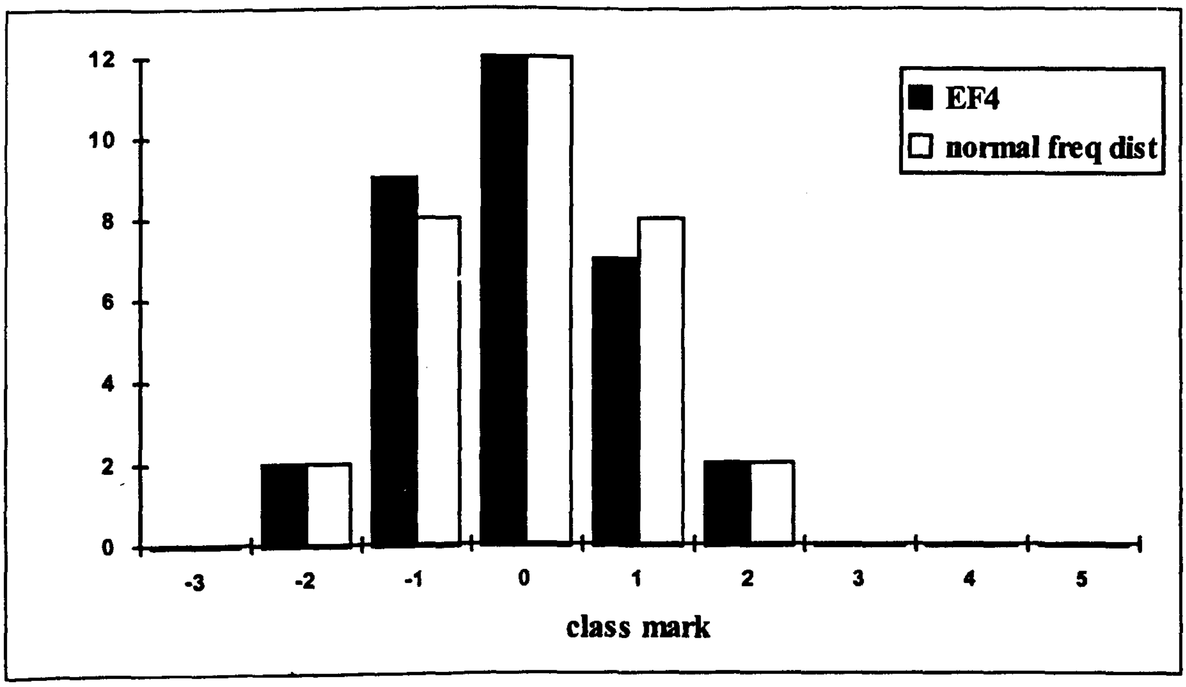
7.3.2.3 An individual speaker compared with the aggregate

We now turn our attention to a brief illustration of how one individual's values compare with the aggregate pattern. The individual being considered is EF4, whose distribution happens to be close to the normal distribution.

EF4 has a mean VOT of 76.06 ms, on the basis of 32 measurements, which is not strikingly different from the aggregate female average. The SD of her values is 19.55 ms, which indicates a smaller range of values than the aggregate range (25.16 ms for all speakers, 23.46 for female speakers), as is shown in Table 7.4, where her distribution is compared with a normal frequency distribution. This is illustrated in Figure 7.2. (Note that the classes are based on the SD for EF4.)

The general point to be made from this example is that in looking at an individual we find a configuration that is similar to the aggregate, though not identical.

Figure 7.2 Example of individual frequency distribution, in classes of 1 SD about the mean of EF4; N = 32, contrasted with normal distribution



7.3.2.4 Individual average VOTs

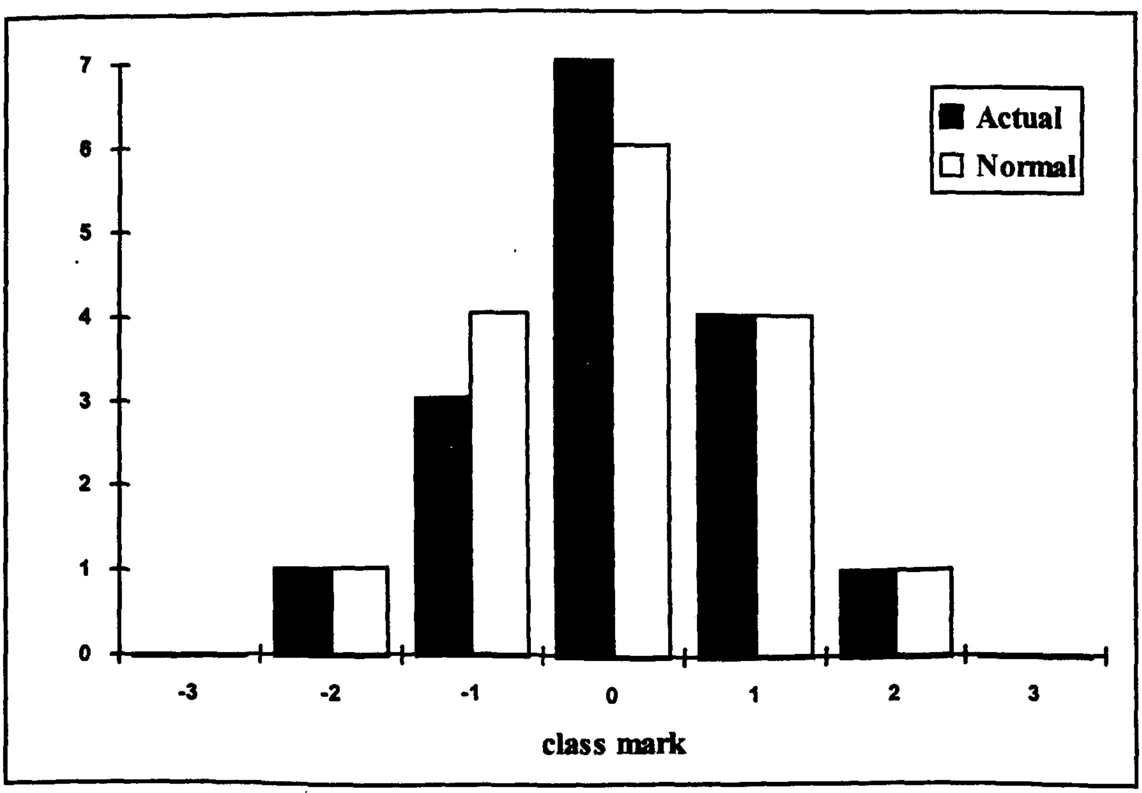
In this section we examine the frequency distribution of the individual average VOT values for the 16 speakers. The individual averages are given in Table 7.5.

The SD of this set of data is 12.96 ms, which indicates a smaller range of values than is seen in the calculation of the aggregate SD. Table 7.6 contains in column 1 the mid-point classes, each class with a width of 1 SD. Column 2 shows the percentage of values expected to lie within the specified bands in a normal distribution. Column 3 contains the actual frequency of the average values in the given classes, whereas column 4 shows the expected frequency translated into comparable whole numbers. Comparison of

Table 7.5 Individual average VOT for 16 speakers in ms

speaker	total
AF1	76.00
AM1	84.12
EF1	64.62
EF2	69.19
EF3	87.19
EF4	76.06
EM1	91.59
GF1	93.81
GF2	74.16
GF3	77.09
GF4	72.16
GF5	87.59
GM1	103.88
GM2	54.47
GM3	76.16
GM4	59.84

Figure 7.3 Frequency distribution of the 16 individual mean values, in classes of 1 SD about the mean of these 16 values; N = 16, compared with the normal distribution



columns 3 and 4 shows general similarity between the expected and actual distributions. Figure 7.3 illustrates these frequency distributions.

This shows us that all but two of the individuals produce average VOT values that lie within ±1.5 SD or ±19.44 ms about the average. This is rather a large margin and it raises a number of points. Firstly, individuals must be producing VOT values of both relatively short and relatively long durations. Secondly, arising from this, can we identify any correlation between these diverse VOT values and any phonemic environment? If so, what phonemic conditions result in longer and shorter VOT? If not, why should VOT values be so diverse?

All of these issues will be explored systematically in the course of a series of statistical tests.

Table 7.6 Frequency distribution of the 16 individual mean values, in classes of 1 SD about the mean of these 16 values; N = 16

Class mark	expected percent	actual freq	normal freq
-3	.60		0
-2	6.06	1	1
-1	24.17	3	4
0	38.30	7	6
1	24.17	4	4
2	6.06	1	1
3	.60		0

7.3.2.5 Formal statistical tests

The following sections contain the formal statistical tests applied to the sample. The first phase in this analysis considers in isolation each of the four sets of categories, two demographic (sex and regional origin), and two linguistic (place of articulation, and

#CV ≠ #CCV), while the second phase brings these into combination. When they are combined, and questions are asked, such as "how reliable are the mean VOT figures for Aberdonians, or for Edinburgh males?", the relatively small size of the sample begins to make itself felt: as the sample is disaggregated, the actual number of relevant observations drops to a level where the interpretation of the results becomes less reliable. In the process the coherence of the sample is tested and the quality of the formal findings is put into perspective.

7.3.2.5.1 Four primary sets of categories in aggregate analysis

As noted above, the data are first considered without using the contributing individuals as the units of analysis. As has already been noted, the mean for the whole set of data is 78.01 ms, that is the sum of the values divided by 510, the number of observations. Likewise, mean values and SD are computed for each of the classes in the four sets of categories; these are set out in Table 7.7.

These average values serve both as the means for general orientation and as one element in the formal evaluation of the significance of any similarities or differences. There appears to be relatively little variation in the mean values produced by the female and male speakers, and a similar comment can be made about the apparent effect of regional origin. It might be said that while there are perceived phonetic differences between the classes of these demographic categories, they are not strongly evident in the realisation of voice onset time, falling as they do within a range of 2 or 3 ms. In a more specific sense, it is expected that there would be a difference according to place of articulation (cf. Catford 1977: 113), but at this stage this is borne out only in a limited way. Less than 1 ms separates the mean values for /t/ and /k/, while a gap of some 16 ms lies between these and the value for /p/. A difference of a similar order of magnitude is found between the two types of phonemic environment that were evaluated. An interval

Table 7.7 Aggregate mean values and SD of VOT for primary classes

	category	N	MEAN	SD
	total	510	78.01	25.16
by region				
	Aberdeen	64	80.06	23.38
	Edinburgh	160	77.73	23.86
	Glasgow	286	77.70	26.21
by sex				
	female	319	77.80	23.46
	male	191	78.36	27.77
by place of articulation				
	/p/	208	68.25	24.05
	/t/	127	84.41	24.27
	/k/	175	84.95	23.22
by phonemic environment				
	1 #CV	303	70.09	19.85
	2 #CCV	207	89.59	27.51

of nearly 20 ms distinguishes the average VOT in the #CV environment from those in the #CCV environment.

7.3.2.5.1.1 Testing the difference

The procedure for testing the difference of means has been presented above (section 7.3.2.2, pp 192 ff.). This same procedure can now be applied to the other differences noted in Table 7.7.

7.3.2.5.1.1.1 Phonemic environment

It will be useful to consider next the largest absolute difference, that between the #CV and #CCV environments. The #CCV environment has a mean value that is 19.50

ms larger than the first type. When this is divided by the compound SD (values given in Table 7.7) the result is a *z* score of 8.760. This time the value lies well beyond any expected limit at either 5% (±1.96) or 1% (±2.56) level of confidence, and we can conclude that there is a real difference between these two types of phonemic environment. The #CV VOTs are significantly shorter than the #CCV values.

Before evaluating the other differences, it is worth noting that the contrast in the results of the two tests conducted so far stems primarily from the absolute difference in the means. The general similarity in the size of the constituent samples (*N*) and, more strikingly, in the SD for the components of the sample tends to produce a similar value for the compound SD that is used to compute the *z* score. On this basis, it is to be expected that the absolute differences in the average values that were outlined above will provide a reliable guide to the outcome of the statistical tests.

7.3.2.5.1.1.2 Regional origin

The evaluation of the differences by regional origin requires consideration of three classes, and potentially the relationship between any two of these classes. With the pair Aberdeen-Edinburgh the difference in the average values is 2.33 ms and, having computed the compound SD, the result is a *z* score of 0.670. This value is well within the limits of confidence so that it can be stated that there is no significant difference between the aggregate mean VOT values for these two cities.

A similar configuration is anticipated with the pair Aberdeen-Glasgow, given a difference in the average values of 2.36 ms. Here the *z* score is 0.713, and there is no significant difference between the Aberdeen and Glasgow mean VOTs.

Finally, the difference in average values for Glasgow and Edinburgh of only 0.03 ms is unlikely to produce a significant difference. The *z* score is calculated as 0.012, which proves this to be the case.

7.3.2.5.1.1.3 Place of articulation (/p ≠ t ≠ k/)

The final element in the evaluation of the differences is the contrast between /p/, /t/ and /k/, where it is anticipated that the average values become progressively larger. The *z* score for the difference between /p/ and /t/ is underpinned by an absolute difference in the mean values of 16.16 ms, and the resultant value for z is 5.933.[8] In the normal distribution 5% of the instances lie in one area ±1.645 standard units about the mean, and 1% are found with the *z* score ±2.33. In this instance the decision clearly lies in favour of there being a significant difference in the mean values of the two samples. This is not the case with the contrast between /t/ and /k/, where the mean values differ by only 0.54 ms, and the z score is 0.194, which suggests that there is no significant difference between the mean values.

In this section the aggregate data for VOTs has been examined by region, by sex, by place of articulation and by phonemic environment. In the data there is no significant difference between the average VOTs between the sexes and between the regions. The phonemic environment of the plosive does appear to be important as a significant difference was found between the VOT values for #CV and #CCV. As for place of articulation, a significant difference distinguished the mean VOTs for /p/ and /t/, but /t/ and /k/ did not show a significant difference.

7.3.2.5.1.1.4 Standard deviations

In the earlier calculations it was found that the SD for the female population was 23.46 ms, and that for the males 27.77 ms. This indicates that the dispersion is greater in

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[8] Here the threshold value should be calculated in a different way: the previous tests were concerned with showing the potential for divergence that was either greater or smaller and draw on both "tails" of the distribution of the sampling function. In this instance, however, the proposition is more directed in that it is anticipated that one value will be greater than another, and thus the critical region is taken from only one "tail" of the distribution curve.

the male population, or, to put the matter another way, that the band within which similar proportions of the respective totals occur is broader. This difference is not particularly strong. Nevertheless, if there is any difference in the values produced by men and women, then it appears to lie in this aspect. Much the same may be said for the dispersion of values according to the regional origin of the speaker, though it may be difficult to interpret any useful distinction in this respect. Aberdeen (23.38 ms) and Edinburgh (23.86 ms) have values that lie very close together, while Glasgow (26.21 ms) exhibits a slightly divergent value. On the other hand there is a distinct difference in the dispersion of values associated with the two types of phonemic environment, with a SD of 19.85 ms found in the VOTs associated with #CV, but 27.51 ms in those associated with #CCV. Finally, the dispersion associated with the grouping of the data by place of articulation is very similar in each instance (/p/ 24.05 ms, /t/ 24.27 ms, /k/ 23.22 ms).

7.3.2.5.2 Four primary sets of categories in individual analysis

The previous examination of the data made the assumption that it is possible to approach the data as discrete items not bound to particular individuals. In this section the individual speaker appears as the primary unit of analysis. It is expected, nonetheless, that the resulting configurations will resemble those found in the preceding section.

Although the same basic statistical method is used, it requires adaptation to take account of the smaller number of units of analysis. One further general remark about the statistical method has to be made at the outset. The data that are being processed are the averages for each speaker in a given category. At most there are 32 values contributing to the computation of that average, for example when the speakers are considered by their regional origin. But there are only 8 values informing the average value for /t/, and at this level it is conceivable that sampling error may distort the picture. This prompts some caution in interpreting the results of the specific tests.

The adaptation of the statistical method is provided by "Student's t" distribution for small or exact sampling (Hayslett 1967;1978: 114, 124 -125). This involves two elements: one is a modification of the compound SD, and the other is a variable interpretation of the confidence limits that depends on the number of items in the sample. Otherwise the method uses the same general principle of qualifying the absolute difference between mean values by means of a compound SD. Analogous to *equation 2* is this form of the SD, where σ stands for the SD of a sample (as opposed to s, which stands for the SD of a population):

$$\sigma = \sqrt{\frac{N_1 s_1^2 + N_2 s_2^2}{N_1 + N_2 - 2}} \qquad \textit{(equation 4)}$$

where, as previously, s_1 and s_2 are the SDs for the two source populations, and N_1 and N_2 the size of the respective populations. The t score is obtained thus

$$t = \frac{\Sigma X_1/N_1 - \Sigma X_2/N_2}{\sigma\sqrt{1/N_1 + 1/N_2}} \qquad \textit{(equation 5)}$$

The expected distribution of a statistic such as the mean depends, as already noted, on the size of the sample, and this is rendered in the particular expression $N_1 + N_2 - 2$, known as the number of degrees of freedom, and found as the lower term of the SD as defined in *equation 4*.

7.3.2.5.2.1 Averages

The values used in the computations are based on the averages for the individual speakers. This method produces mean values that are close to, if not identical with those obtained in the aggregate analysis, but a different range for the values for the SD. The values used in the computations are summarised in Table 7.8.

Table 7.8 Values used in computing *t*

	category	N	Mean	SD
	---------	--	-----	-----
	total	16	78.00	12.96
by sex				
	female	10	77.79	9.07
	male	6	78.34	18.86
by region				
	Aberdeen	2	80.06	5.75
	Edinburgh	5	77.73	11.50
	Glasgow	9	77.69	15.60
by phonemic environment				
	1 #CV	16	70.06	13.72
	2 #CCV	16	89.61	13.19
by place of articulation				
	/p/	16	68.25	14.91
	/t/	16	84.33	12.03
	/k/	16	84.95	14.21

7.3.2.5.2.1.1 Males versus females

In accordance with the formula for *t* shown in *equation 5*, a value of 0.083 is obtained for the difference in the mean values of female and male speakers. The number of degrees of freedom is 10 + 6 - 2 = 14.[9] Accordingly there is 95% probability that the mean values will lie within a range ±2.14, or 99% probability for the range ± 2.98, if there is no significant difference between the mean values.[10] The value for *t* falls well within both ranges, and we can therefore conclude that there is no significant difference

9 The number of degrees of freedom is calculated by adding together the number of individuals in each group. The number of estimated parameters (in this case 2) is then subtracted from that sum.

10 See Spiegel 1972: 344, Appendix III percentile values for "Student's *t*" Distribution.

in the average VOT for female and male speakers. This finding conforms with the earlier observation derived from the aggregate analysis.

7.3.2.5.2.1.2 Regional values

Results for the differences between speakers by regional origin are obtained by using the same procedure, and making appropriate adjustments for the number of degrees of freedom. These are summarised in Table 7.9. The findings are that there are no significant differences in the mean values, and again this accords with the previous observations made about the aggregate data.

Table 7.9 Test of differences of mean values by regional origin

Regions	degrees of freedom	95% limit	99% limit	*t*
Aberdeen-Edinburgh	5	2.57	4.03	-0.146
Aberdeen-Glasgow	9	2.26	3.25	-0.090
Edinburgh-Glasgow	12	2.18	3.06	-0.004

7.3.2.5.2.1.3 Phonemic environment and place of articulation

The remaining tests for differences in phonemic characteristics pose a problem that is not usually encountered in this type of procedure. The data for these classes derive in each instance from the same set of individuals, whereas the data by sex and by regional origin are taken from different speakers and are independent of each other. The number of degrees of freedom is intended to express the number of independent observations in the sample, i.e. the size of the sample, less the number of population parameters that have to be estimated from sample observations (in the current procedure two mean values are estimated). The demographic categories provide a clear and satisfactory interpretation of this rule. It is possible to apply the rule to the phonemic categories only if it is assumed that the sample consists of two sets of independent observations (each with $N = 16$), even though these observations actually stem from the same set of speakers. In effect, the population under examination is not directly the individuals constituting the sample, but the phonetic realisations associated with the individuals. In order to consider these features, it is necessary to take one step towards the conceptual approach that informs the aggregate analysis.

Otherwise the computations and their interpretation are straightforward. In each instance it is assumed that the alternative hypothesis takes the form of the proposition that one mean value is significantly larger than another. Under these terms the "one-tailed test" is applicable (cf. footnote 8), and the number of degrees of freedom is 16 + 16 - 2 = 30 (cf. footnote 9). Accordingly the threshold at the 95% level of confidence is 1.70, and at 99% 2.46.

The data for the two types of phonemic environment generate a *t* score of 3.98. Thus the conclusion is that there is a significant difference between the two. Similarly the computations for /p/ and /t/ yield a *t* score of 3.25, which confirms the hypothesis that the difference is significant. The comparison of the mean values for /t/ and /k/ produces a *t* score of 0.13. Therefore, in this case, the difference is too small to be statistically significant.

7.3.2.5.2.1.4 Summary

Altogether these findings correspond with the results obtained in the aggregate analysis. Notwithstanding initial reservations about the limited sample size, the general dispositions are also found at the individual level. There are no significant differences to be found in the demographic categories that have been applied to the sample. The phonetic categories indicate a significant difference between VOT for /p/ and /t/, but not for /t/ and /k/. There is a consistent and marked difference in VOTs of #CV and #CCV environments.

7.3.2.5.2.2 Dispersion of values

The other element of the present analysis, the dispersion of values, can also be engaged at this point. It was noted earlier that in the aggregate analysis there appeared to be a greater element of dispersion of values produced by the male speakers. It is now possible to consider how this arises from a combination of two sources. Either the male speakers tend to produce a wider range of values or their average values are more widely spaced. As is shown in Table 7.8, the dispersion of the average values produced by each speaker yields a SD of 9.07 ms among the female speakers, but 18.86 ms among the male ones. This then is part of the answer, in that there is a difference in the dispersion of

Table 7.10 Mean values and SD of individual performance

a) mean values

speaker	total	1 #CV	2 #CCV	/p/	/t/	/k/
AF1	76.00	72.53	81.08	65.00	76.00	89.00
AM1	84.12	77.84	93.31	76.38	80.00	96.27
EF1	64.62	52.74	82.00	49.92	84.88	67.27
EF2	69.19	60.05	82.54	57.31	78.25	76.64
EF3	87.19	78.47	99.92	71.31	99.38	97.09
EF4	76.06	70.95	83.54	65.85	84.75	81.82
EM1	91.59	85.37	100.69	75.23	93.62	109.45
GF1	93.81	88.63	101.38	88.62	92.50	100.91
GF2	74.16	62.26	93.00	73.38	74.43	74.91
GF3	77.09	71.89	84.69	67.92	85.25	82.00
GF4	72.16	66.68	80.15	70.23	71.12	75.18
GF5	87.59	76.42	103.92	79.38	95.75	91.36
GM1	103.88	96.16	115.15	100.00	109.75	104.18
GM2	54.47	46.79	65.69	42.69	61.88	63.00
GM3	76.16	61.06	97.08	62.38	87.50	85.00
GM4	59.84	53.16	69.62	46.46	74.25	65.18

b) standard deviation

speaker	total	1 #CV	2 #CCV	/p/	/t/	/k/
-------	-----	-----	-----	-----	-----	-----
AF1	22.10	12.19	31.49	12.73	26.51	22.00
AM1	24.62	13.15	33.95	17.92	30.53	24.24
EF1	24.13	13.34	26.19	17.84	27.49	16.64
EF2	17.47	11.12	16.65	14.24	17.80	13.05
EF3	22.76	13.79	27.52	13.52	21.81	22.34
EF4	19.55	15.74	22.66	21.00	22.19	8.82
EM1	24.58	18.00	30.39	16.50	20.96	23.17
GF1	19.93	19.52	18.69	16.72	17.24	24.40
GF2	33.58	18.66	43.28	46.59	25.12	19.94
GF3	17.85	14.88	19.64	18.40	16.46	14.24
GF4	13.07	12.29	9.88	12.07	13.01	14.84
GF5	25.44	19.19	25.16	22.98	28.72	25.28
GM1	21.07	18.00	20.69	19.94	26.06	19.39
GM2	16.63	11.39	17.04	10.94	17.77	13.74
GM3	25.34	12.20	24.06	16.68	26.27	27.53
GM4	19.03	14.46	21.16	15.84	17.88	12.96

average values in the two groups: the mean values of the male speakers are more widely spaced. The other dimension of the question requires that we consider how consistent or diverse are the values produced by each individual. The appropriate expression for this is the SD of the VOT values produced by each speaker (cf. Table 7.10). The average SD for the female speakers is 21.59, and that for the male speakers 21.88 (cf. Table 7.11).

The fact that these values are very close together indicates that the dispersion of values produced by individual men and women does not differ in any large degree, and that consequently the greater dispersion of values observed among men derives principally from the greater dispersion of average values produced by them.

7.3.2.5.2.2.1 Regional configurations

The analogous interpretation of any elements of dispersion in individual characteristics according to regional origin is hampered first of all by the small size of the

Table 7.11 Parameters of individual performance

category	SD of mean	mean of SD
total	12.96	21.70
by sex		
female	9.07	21.59
male	18.86	21.88
by region		
Aberdeen	5.75	23.36
Edinburgh	11.50	21.70
Glasgow	15.60	21.33
by place of articulation		
/p/	14.91	18.37
/t/	12.03	22.24
/k/	14.21	18.91
by phonemic environment		
1 #CV	13.72	14.87
2 #CCV	13.19	24.28

sample from Aberdeen (two speakers), and then by the fact that the five speakers from Edinburgh include only one male and that, as has just been established, there is some difference in the dispersion of average values by sex. This may then be reflected in the fact that Edinburgh shows a smaller range of average values than Glasgow. We also have the previous observation that men and women tend to produce a similar range of dispersion, albeit around a differing spread of average values. In line with this the range of individual dispersion associated with regional origin is very similar.

7.3.2.5.2.2.2 Place of articulation

In evaluating the dispersion of VOT in the aggregate data it was noted that there was little variation according to place of articulation. The analysis at the individual level shows how the two sources of dispersion inform this net similarity. The dispersion of averages produced by individuals yields a SD of mean values that is very similar for /p/ and /k/ (14.91 and 14.21 ms respectively), and in parallel with this the dispersion of values produced by the speakers is also very close (18.37 and 18.91). By contrast the production of /t/ yields a smaller SD of 12.03 ms in the spread of individual averages, and correspondingly a larger average dispersion (SD = 22.24) in the individual production of this feature. The difference between /t/ and the others is, however, probably not significant, and can be seen as a result of the small size of the sample.

7.3.2.5.2.2.3 Phonemic environment

Finally, it was noted in the examination of the aggregate data that there was greater dispersion associated with the #CCV environment than with the #CV environment. Again it is possible to ask how this arises. Here we see that the dispersion of averages is similar in both (SD = 13.72 and 13.19 ms), but there is distinct divergence in the spread of values produced by individuals (14.87 and 24.28). This means that the dispersion seen in the aggregate data derives more or less entirely from that fact that individuals as a whole produce a wider range of VOT values in the second type of phonemic environment, and not from a greater spread of average values produced by the speakers. This is the reverse of the pattern associated with the sex difference, where it is the dispersion of average values that provides the distinction. Indeed these two categories (sex and phonemic environment) provide the only reliable evidence of differences in the dispersion of values and both happen to exhibit a clear-cut distinction in the source of the dispersion.

7.3.2.5.2.2.4 Discussion

In the light of the discussion of the aggregate and individual levels of analysis in the overview, it can be seen that the results from the individual analysis of the two types of phonemic environment tend to confirm the view that the distributions found in the aggregate data are reproduced more or less uniformly in the performance of each individual: the difference in dispersion is a feature exhibited by all speakers. On the other hand, the greater aggregate dispersion of values among male speakers is not found to be typical of the male portion of the sample, and indeed they exhibit much the same range of dispersion as the female speakers; instead it is the greater dispersion of the individual average values which produces this effect, and in this sense the value of the individual analysis is vindicated, and the hypothesised similarities of distributions at the aggregate and individual levels cannot be fully maintained. It is not possible to reach any firm conclusions of a positive kind about the categories of regional origin or place of articulation. These categories provide no conclusive evidence that contradicts the proposition that features found at the aggregate level are reproduced at the individual level.

7.3.2.5.3 Combinations of categories in aggregate analysis

In the following section, demographic categories are combined with phonetic categories in order to identify significant similarities and differences. As the cross tabulations become more searching, the limitations of the samples begin to be revealed. There are simply not enough measurements in some classes for results to be conclusive. Indeed, in certain classes, results emerge which are divergent from the overall results.

7.3.2.5.3.1 Mean values

The similarities and differences between the average VOTs which have been identified so far can be further investigated by examining whether they are maintained when the categories are combined. For example, will the lack of any significant difference between male and female VOTs be maintained when it is examined regionally? The purpose of this section is to consider how the configurations which have been identified in the previous sections stand up under this sort of scrutiny.

At this more searching level, one limitation of the current sample becomes clear: in the creation of some categories a single speaker is the sole source of data for that category, so what purports to be, for example, an averaging of Edinburgh male examples is in fact the data from one individual. Whereas an averaging of a group of individuals' values would tend to compensate for any one individual's possibly idiosyncratic results, no such safeguards exist for the Edinburgh male data, the Aberdeen female data and the Aberdeen male data.

7.3.2.5.3.1.1 Sex and region

The combination of the two demographic categories, sex and regional origin, produce the weakest basis for any reliable test. The aggregate averages, as shown in the first part of Table 7.12, exhibit a divergence from each other that would suggest that the main proposition under consideration in this section does not hold good, i.e. that the general similarity of average values found in these categories singly is not found in the combination of them. The explanation for this is provided by some of the earlier observations about the configuration of individual values. The individuals matter not only because the combined categories are coterminous with single individuals (or simply close to these), but also because individuals exhibit a degree of diversity. The range of this diversity is encompassed by the predicted probability of sampling error, where the sample is sufficiently large. But here the combined demographic categories fall below the required level, and what is lacking in the resultant combined categories is the diversity typical of the larger population. This remark obviously applies to the analysis at the individual level, but here it can also be seen to have a noticeable effect at the level where the individual data are aggregated.

Table 7.12 Aggregate averages of primary categories in combination with demographic characteristics

region	female	male	
Aberdeen	76.00	84.12	
Edinburgh	74.27	91.59	
Glasgow	81.01	73.57	
sex	**/p/**	**/t/**	**/k/**
female	68.89	84.35	83.62
male	67.19	84.50	87.22
sex	**1 #CV**	**2 #CCV**	
female	70.06	89.19	
male	70.14	90.26	
region	**/p/**	**/t/**	**/k/**
Aberdeen	70.69	78.00	92.64
Edinburgh	63.92	88.18	86.45
Glasgow	70.12	83.73	82.39
region	**1 #CV**	**2 #CCV**	
Aberdeen	75.18	87.19	
Edinburgh	69.52	89.74	
Glasgow	69.28	90.05	

7.3.2.5.3.1.2 Demographic categories and phonetic categories

The other combinations shown in Table 7.12 involve one demographic category and one linguistic. Again the small class of speakers may affect the composition of the aggregate averages, and this applies most obviously in the case of data from the two speakers from Aberdeen. On the other hand, it is to be expected that the distinction by sex (10 female and 6 male speakers) could deliver a largely consistent outcome. The results show that the expected similarity of aggregate female and male values is found in /p/ and /t/, and thus the significant difference of mean values for these places of articulation will also obtain in both female and male populations. The difference in mean values of 3.6 ms for /k/ is not of an order that would be significant, and can be put down to sampling error (i.e. too few values informing the data). Again as expected, the aggregate male and female values for the two types of phonemic environment lie very close together, and this would reproduce the significant difference in aggregate average values between the two phonemic environments for both female and male populations.

When disaggregation by regional origin is considered, it is to be expected that the results from Aberdeen would tend to diverge most because of the limited base of the sample. This is indeed the case with the two types of phonemic environment, though the difference in aggregate mean values of only 12 ms (as opposed to the difference of 19.5 ms in the single category) is still of an order that will produce a statistically significant outcome. Glasgow and Edinburgh both deliver values that are very close to the overall average. In the averages by place of articulation, it is only Glasgow that produces an outcome that resembles the configuration found in the parent averages, and both Aberdeen and Edinburgh have noticeably divergent results. Nevertheless a significant difference in mean values between /p/ and /t/ is plausible for each group according to the regional origin. Aberdeen also manages to produce what is most probably a stray result, in that there is arguably a significant difference between /t/ and /k/ of 14.6 ms; otherwise the averages for Edinburgh and Glasgow are convergent.

The interim conclusion from these results is that similarities and differences found in the aggregate averages of the single categories are generally reproduced in the appropriate combined categories in much the same proportions. At the same time the limited size of the sample begins to have an impact here, even though it is the aggregation of data that is under consideration. In effect these tests also illustrate the limits that are encountered in data of this type. One result is that some tests can be shown to make demands on the data that cannot be adequately met. In particular, the category of regional origin cannot be examined effectively except in itself, and the attempt to combine it with another category is likely to come up against the limitations imposed by the number of speakers in the combined class.

7.3.2.5.3.2 Dispersion of values

In the light of these limitations the remarks about the dispersion of values associated with the combinations of categories that have been considered so far will be limited to two categories, sex and type of phonemic environment, which exhibit a stable profile in the test of mean values and which account for the only noticeable divergence in the SD taken from the aggregate values. It was found that there was greater concentration of values taken from female speakers (23.46 ms) than among their male counterparts (27.77 ms), a difference of 4.3 ms; similarly there was greater concentration of values associated with the #CV environment (19.85 ms) than with the #CCV environment (27.51 ms), a difference of 7.6 ms. Accordingly it is expected that these relative proportions will be reflected in the appropriate combined categories. The results are set out in Table 7.13. In each instance there is greater dispersion among the male speakers and in the #CCV environment, and the differences are broadly in line with the values indicated above. On the basis of this finding, it is plausible to suggest that in the individual analysis of these combined classes the source of the dispersion will be found to correspond with the previous observations that the difference between women and men results from the dispersion of average results and that the difference in the types of phonemic environment is generally typical of all speakers.

Table 7.13 Standard deviation of aggregate data by sex and type of phonemic environment

env. type	female	male	diff.
1 #CV	17.81	22.88	5.07
2 #CCV	26.00	29.84	3.84
difference	8.19	6.96	

7.3.2.5.3.2.1 Combination of the two linguistic categories

The final element in this review of combined categories in aggregate analysis considers the combination of the two linguistic categories, place of articulation and type of phonemic environment. The results, shown in Table 7.14, confirm firstly the distinct separation of mean values of the two phonemic environments for each pair of values according to place of articulation; in each instance the difference of mean values is of an order that is statistically significant. Secondly, the difference in mean values between /p/ and /t/ again confirms the significant separation of these features in both phonemic environments. But, thirdly, there appears to be a distinction in mean values between /t/ and /k/ that is of an order that would be statistically significant. Therefore it is necessary to evaluate the difference in mean values, to account for the appearance of this distinction, when previous analysis failed to reveal this expected feature, and to consider the possible implications for other findings that have been presented so far.

7.3.2.5.3.2.1.1 Evaluating the difference

The formal test of the difference in mean values uses the threshold of $z = +1.645$ at 95% level of confidence, and $z = +2.33$ at the 99% level, in a one-tailed test (cf.

Table 7.14 Aggregate averages of primary linguistic categories

Phonemic Environment	/p/	/t/	/k/
---------	------	------	------
1 #CV	62.70	71.48	77.02
2 #CCV	77.14	92.27	105.96
"corrected average"[11]	69.92	81.88	91.49

footnote 8). In the #CCV environment we obtain $z = 3.215$, which would confirm that there is a significant difference between /t/ and /k/. However, in the #CV environment the computations yield $z = 1.658$, which would satisfy the requirements of the alternative hypothesis at the 95% level, but not at the 99% level. In other words, we can detect a significant difference between /t/ and /k/ VOT values in the environment #CV with the certainty of 1 in 20, but not of 1 in 100.

7.3.2.5.3.2.1.2 /p, t, k/ and phonemic context

In the light of these findings, it is particularly relevant that we consider how the more or less significant distinction between /t/ and /k/ has only emerged in the present context. The difference did not show up before because of a feature in the source material for which no appropriate allowance was made in the earlier method.[12] The

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[11] The corrected average is calculated by adding the two average values and dividing them by two.

[12] The separation of VOT values for #CV and #CCV environments was not undertaken immediately. Although there are many comments concerning the effect on the VOT of a

apparent coincidence of the mean values for /t/ and /k/ arose because the aggregate average for /t/ was composed of 3 values per speaker for the #CV environment and 5 for the #CCV environment. Thus the average of these 8 was biased towards the average for the #CCV environment and therefore showed an inappropriately high value for /t/; and conversely the aggregate average for /k/ derived from 8 values for the #CV environment and 3 for the second, thus creating a bias towards the #CV environment and a subsequent reduced average for /k/.

A simple correction for this bias is also shown in Table 7.14 in the form of a "corrected average" which adds the two average values and divides them by 2. Here the result for /p/ is quite close to the value used in previous calculations, as there is better balance in the contributing material for the #CV and #CCV environment (8 and 5 values per speaker respectively). On the other hand, the average values for /t/ and /k/ separate out and show a difference of nearly 10 ms, a gap that, on previous experience, is likely to produce confirmation of a statistically significant distinction.

The question arises whether this uncorrected element of bias has affected the previous findings. Broadly speaking, these show congruence of similarities and differences in a series of tests, and as this analysis is directed primarily towards identifying these features, we can be satisfied that there are no major disproportions.

7.3.2.5.3.2.2 Males and females, place of articulation and phonemic environment

It is also possible to consider whether the distribution of similarities and differences would also be preserved if a further level of disaggregation were attempted, in which the distribution by place of articulation and by type of phonemic environment is combined with the distinction between female and male speakers. The averages are

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voiceless plosive by a preceding consonant (i.e. /pɪn/ ≠ /spɪn/), there was no indication that the presence of a following consonant (i.e. /tae/ ≠ /trae/) would make any difference to the VOT measurements.

Table 7.15 Average VOTs by sex, place of articulation and phonemic environment

sex	phon env	/p/	/t/	/k/
female	#CV	63.49	70.30	76.55
male	#CV	61.40	73.44	77.81
female	#CCV	77.54	92.96	102.47
male	#CCV	76.47	91.13	111.78

shown in Table 7.15. It is to be expected that the female and male speakers will exhibit generally similar average values for each cell in the cross-tabulation, and that the distribution by linguistic categories will be in line with the pattern noted above, namely a significant difference between each element.

7.3.2.5.3.2.2.1 Males and females

In the aggregate analysis the mean values for males and females were similar in each case. It is possible to ask whether the same holds true for male and female values when examined by place of articulation in both #CV and #CCV environments. Table 7.15 shows that the difference in mean values, with two exceptions, does not exceed 2 ms, a margin that is unlikely to indicate a significant difference. The exceptions concern a difference of 3.1 ms, separating the female and male averages for /t/ in #CV environment (again this is not likely to be significant), and 9.3 for /k/ in #CCV environment (potentially significant). As was noted above, these are the two classes whose averages draw on the smallest number of values (/#tV/ based on 2 words, /#kCV/ based on 3 words), and it is necessary to consider that these two divergent instances may result from an element of sampling error.

Based on previous findings, we would also expect that the mean VOT values for #CV would be different to those for #CCV. This clearly appears to be borne out in the distinction between types of phonemic environment throughout.

It also appears to be true for /p/ ≠ /t/ ≠ /k/ in the #CCV environment. The values for /k/, which are probably the least reliable due to the fact that they constitute the smallest sample base, seem to produce an average in the female population that is on the low side, yet still the difference between this value and the average for /t/ is some 9.5 ms, a margin falling within the range that would still make the difference statistically significant.

Within the #CV environment, while the differences between /p/ and /t/ appear to be secure, the differences between /t/ and /k/ require closer inspection (not least because the previous test showed that this difference could not be attested with the same degree of certainty that obtained elsewhere). In the female population the difference is 6.2 ms, and thus larger than the margin that previously produced the less conclusive result in the combination of male and female populations. In the male sample, the difference is only 4.4, a margin that would most probably fail to prove significant.

Again, as already noted, the values for /t/ in this environment are at least suspect, because only two measurements inform the average for each speaker. In addition, when one considers that there are 10 female but only 6 male speakers, it seems likely that the smaller male class will produce an average value that is less typical of ScE male speakers in general.

7.3.2.5.3.3 Summary

In the aggregate analysis significant distinctions were found to exist between the #CV and #CCV environments. This difference is maintained at the individual level. There has been some difficulty in showing significant differences between /p/, /t/, and /k/ at the individual level because of the low number of data for some categories. The values for /k/ in the #CCV environment and for /t/in the #CV environment are probably the least reliable. In the average values of the female and male samples only the more demanding tests failed in one instance to show expected similarity. The general similarity of values from speakers with different regional origins is the most difficult to verify; the tests soon encounter limitations that derive from the limited number of individuals in the sample.

7.3.2.5.4 Combinations of categories in individual analysis

As in the previous section, the general objective in this analysis at the level of individual speakers is to observe how the configurations of features identified in previous tests are also preserved in this context. The qualification of the results stems from limits that have already been outlined. The primary base of analysis is a relatively small number of speakers, and in addition the combination of categories decreases the number of values that informs the individual averages. In both cases it becomes more likely that sampling error may compromise a definitive result. To begin with, the combination of at least one demographic category is considered; the individual averages are shown in Table 7.16.

7.3.2.5.4.1 Average VOT values

As the individual averages differ only slightly from the aggregate averages shown in Table 7.12, it is expected that the same general configuration of similarities and differences will emerge.

7.3.2.5.4.1.1 Sex and regional origin

Again it is difficult to obtain a well defined result from the combination of the categories sex and regional origin: the expected similarity of values for female and male speakers is obscured by the sampling distribution, in that, in this combination, three of the classes consist of a sole individual.

7.3.2.5.4.1.2 Regional origin and /p, t, k/

In the combination of regional origin with linguistic categories Aberdeen provides only two cases, and as a result these averages tend to be unrepresentative. Both Glasgow and Edinburgh offer a better prospect of confirming significant differences between the #CV and #CCV environment, but in the contrast between /p/ and /t/ the perhaps untypically narrow difference associated with the Glasgow speakers seems less likely to confirm the pattern. Otherwise the cross-tabulation of individual averages by sex with

Table 7.16 Individual averages of primary categories in combination with demographic characteristics

region	female	male
Aberdeen	76.00	84.12
Edinburgh	74.27	91.59
Glasgow	81.01	73.57

sex	/p/	/t/	/k/
female	68.88	84.26	83.65
male	67.22	84.48	87.19

sex	1 #CV	2 #CCV
female	70.09	89.21
male	70.11	90.22

region	/p/	/t/	/k/
Aberdeen	70.69	78.00	92.64
Edinburgh	63.92	88.18	86.45
Glasgow	70.14	83.62	82.43

region	1 #CV	2 #CCV
Aberdeen	75.18	87.19
Edinburgh	69.52	89.74
Glasgow	69.28	90.04

the linguistic categories does confirm the expected similarity of VOTs.

7.3.2.5.4.1.3 Phonemic environment

In this section the individual averages for the male and female samples are examined in the environments #CV and #CCV. The difference in the mean values is much the same as in the aggregate data (Tables 7.12 and 7.16), but the fact that the individual data is gathered from a smaller sample (16 individuals) than the aggregate data (510 measurements) necessitates the use of the "Student's *t*" technique (***equation** 5*), which gives a proportionally greater influence to the size of the sample and its SD to allow for the sampling error.

The computation for evaluating the difference of the mean values of the two types of phonetic environment in the female population utilises the standard deviations of 10.21 and 9.38 ms respectively. This yields $t = 4.146$. For the difference to be significant with 99% certainty, t has to exceed 2.55 (a figure calculated using 10 + 10 - 2 = 18 degrees of freedom). It easily exceeds this and so it is possible to state that the difference is significant, with a 99% certainty.

The corresponding values for the standard deviation in the male population are 19.41 and 19.05 ms (first and second environment respectively), and this results in t = 1.661. At 6 + 6 - 2 = 10 degrees of freedom, the threshold value which t must exceed in order that the difference can bee seen as 95% certain is 1.81. In this case, t does not exceed this value, so the difference cannot be said to be significant. If we are prepared to accept a 1 in 10 margin of error, then the required t value would be 1.37. It is only with this lower level of certainty that we can regard the difference between the male VOT values as being significant.

7.3.2.5.4.1.3.1 Discussion

The contrast in the outcome of these tests derives to some extent from the

Table 7.17 Individual averages and SD of linguistic categories

	env. type	/p/	/t/	/k/
mean values				
	1 #CV	62.70	71.48	76.95
	2 #CCV	77.14	92.13	105.96
	difference	14.44	20.65	29.01
standard deviation				
	1 #CV	14.99	15.19	13.04
	2 #CCV	17.12	12.11	19.82

difference in the size of the samples, but mainly it is the difference in the values of the SD that affects the interpretation. The greater concentration of values in the female sample makes it easier to discern discrete points of concentration; but the greater spread of average values exhibited by the male sample entails a greater overlap in the distribution for the two types of environment, which makes it more difficult to detect the separation of the functions.

7.3.2.5.4.1.4 Place of articulation and phonemic environment

The remaining element in the combination of two categories brings together place of articulation and phonemic environment. It was this context which revealed the underlying difference in VOTs between /t/ and /k/, as was shown in the previous section. A "one-tailed test" of the two sets of data (those for #CV and #CCV) reveals that the VOT values for /p/ in the #CV environment differs significantly from those in the #CCV environment, with a 1 in 20 margin of error. The same is true of /k/ and /t/, but with a smaller margin of error of 1 in 100.

In conclusion, then, the distinction between the individual values for /p/, /t/ and /k/ in #CV and #CCV environments is shown to be significant.

The second area of investigation concerns whether the VOT for /k/ is greater than /t/, which is greater than /p/ in #CV and #CCV environments. When this was tested with the aggregate data, the #CCV environment produced a more reliable result than the #CV environment. With the individual averages the #CCV environment confirms the expected distinction between /p/ and /t/ at a 99% level of certainty. The difference between /t/ and /k/ is significant with 95% certainty.

In the #CV environment, the difference between /p/ and /t/ is significant with a margin of error of 1 in 10. The difference between /t/ and /k/ fails to produce the expected outcome even at the level of 90% certainty.

7.3.2.5.4.1.5 Discussion

The result here is due to the fact that the individual VOT values result in smaller differences, and smaller differences produce less reliable results. These tests make great demands of the data and reveal the weakness in having a small sample base. It is very likely that any attempt to disaggregate the sample further would be pointless in that the results would be extremely unreliable.

7.3.2.5.4.2 Dispersion of values

The previous tests have also generated a proposition on the dispersion of values, and this can now be examined. It was found earlier (section 7.3.2.2 ff, p271) that the greater dispersion of values in the male sample derived not from a wider spread common to all members of the class but from greater dispersion of the average values of the members of the class. Furthermore, it was found in the aggregate analysis of combined categories (section 7.3.2.5.1 to section 7.3.2.5.1.1.2, pp278-280) that distinct differences in dispersion occurred in both types of phonemic environment in conjunction with the disaggregation of the sample into female and male samples. The task here is to show whether the individual analysis can confirm that in both types of phonemic environment the greater element of dispersion in the male population similarly originates principally from the distribution of the individual averages.

7.3.2.5.4.2.1 Males and Females

One element has already been used above in evaluating the difference in mean values, the SD of the individual mean values, expressing the dispersion of the averages around which the individuals produce a range of values; these are summarised in Table 7.18 under the heading "SD of mean". These data would indicate that there is already strong evidence for accepting the present proposition, in that the values for the female and male samples show the same sort of difference in both types of phonemic environment as was encountered without this additional variable (9.07 ms and 18.86 ms respectively). The confirmation comes from considering how in general individuals disperse the values around a given average, that is the average of the SD produced by the relevant speakers; these data are shown in Table 7.18 under the heading "mean of SD". If these are similar, then the difference in dispersion exhibited by women and men does not derive principally from the fact that as a class they are characterised by a difference in the range of values that they produce. The values in Table 7.18 confirm the similarity: the appropriate averages lie within a ms of each other in both types of phonemic environment. In both instances the difference between male and female speakers lies mainly in the greater dispersion of the male averages, and not in any difference in the range of values produced by women and men.

7.3.2.5.4.2.2 Phonemic environment

The corollary of this is that the difference in dispersion found between the two types of phonemic environment occurs in similar measure in both the female and male sample. For example, in the female sample the dispersion of individual values is similar in both types of phonemic environment, but the environments are distinguished by a

Table 7.18 Parameters of individual performance

category		SD of mean	mean of SD
Env. type 1 #CV			
	female	10.21	15.07
	male	19.41	14.54
Env. type 2 #CCV			
	female	9.38	24.12
	male	19.05	24.55

marked difference in the range of values associated with them. The corresponding pattern is found in the male sample. This type of dispersion is common to all the speakers and has no obvious connection with the fact that individual averages are distributed in a different way in the female and male portions of the sample.

This finding confirms another expected configuration. The test corresponds in its components to the examination of the difference in mean values by sex and type of phonemic environment that was conducted earlier. The result there was that it was difficult to attest an expected difference between types of phonemic environment in the male sample, primarily because of the wider range over which the individual averages are spread. The parameter that undermined the reliability of the outcome from that test, the SD, provides, of course, the particular strength in the test that has just been presented. In terms of exploring how coherent given features are in the sample, we have reached a point in the disaggregation of the data where the persistence of one type of pattern impinges on the quality of the result from assessing another pattern.

7.3.2.5.4.2.3 Conclusion

The general conclusion from the examination of differences in mean values in the analysis of individual averages is that the combination of two categories still produces confirmation of the expected configurations in most cases, albeit sometimes with reduced reliability. The category of regional origin proved the most difficult to handle, but even the strong distinction between types of phonemic environment could not be ascertained in the male sample with the same high level of probability that was found elsewhere. The tests of distinctions by place of articulation also yielded less reliable results and, particularly in combination with the type of phonemic environment, the tests failed in some instances to confirm a significant difference. The attempt to identify expected configurations in a further level of disaggregation appears to have come up against the limits of coherence in the sample. Not only does the limited number of values used to obtain averages make the immediate result more prone to sampling error, but in this environment noticeable differences in the SD can also have an impact on the outcome.

7.3.2.5.5 Types of phonemic environment: a correlation, and the impact of differences in the following segment

The preceding method has examined the coherence of patterns and found some of them to be wanting. Thus it has tended to emphasise the potential weaknesses in the sample. The present section builds on some of the strengths that have been found and shows where the results of cross tabulations are, firstly, consistent with the aggregate results and, secondly, statistically reliable.

Two tests were conducted, both concerned with the #CV and #CCV environments. The first considered how the average VOT varies when considered as an individual attribute. The other explored why there appears to be greater variation in VOT in the #CCV environment than in the #CV environment.

The categories that have been used to analyse the sample can be seen as variables, but none of them is composed directly of continuously variable functions. The distinction between female and male speakers expresses two discrete classes rather than a continuum. Likewise, the category of regional origin is for the present purposes an either/or choice. In addition the speakers are not being evaluated as more or less representative of their wider urban groupings, but are held to be representative of one of the regional centres.

With the phonemic categories it is more plausible that the classes could in some respects be related to features that are continuously variable. At the phonetic level the place of articulation could vary from velar to bilabial via a sequence including pre-velar, post-alveolar, dental, and labio-dental. However in this section, place of articulation is being dealt with phonemically: the plosives are either /p/, /t/, or /k/, so the variation is of a tertiary rather than an infinite nature. Much the same has to be said about the definition of two types of phonemic environment that has been used here: the environments are either #CV or #CCV. Therefore, in no instance, then, do we have classes that are continuously variable. Rather, they are discrete.

7.3.2.5.5.1 Individual mean VOT values and phonemic environment

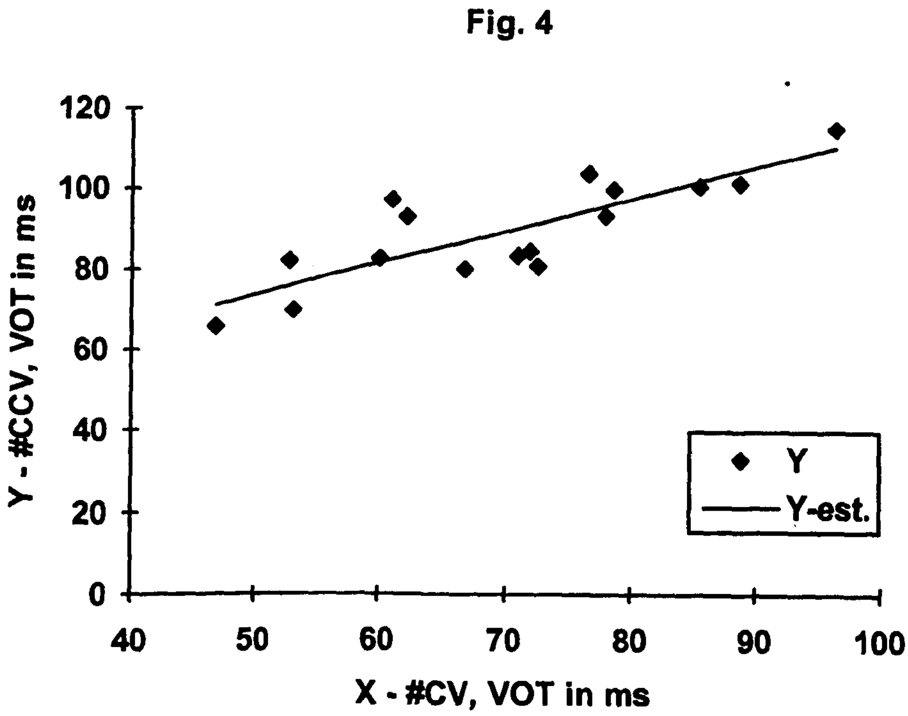
By contrast the VOT varies continuously, as the earlier tests amply demonstrate. What we can observe is how this variation occurs for each individual in two or more of the available classes. In broad terms the earlier tests show that the most coherent results emerge where the constituent sample is as large as possible. For the present purposes this means taking all the speakers as a group (and not sub-dividing by sex or regional origin), and choosing the phonemic category that is better supported in numeric terms. The data for the two types of phonemic environment meet this requirement. These have already been set out in Table 7.10 (part a), but are set out again in Table 7.19 in order of the ascending magnitude of the mean VOT value in the #CV environment. The relationship between the first type (#CV) as *X* and the second type (#CCV) as *Y* is evaluated as a linear function, and a regression line has been calculated (by the method of least squares) as an estimate of Y (Hayslett 1968/1974: 140 - 143). This relationship is illustrated in Figure 7.4

Table 7.19 Individual mean values by type of phonemic environment

speaker	X 1 #CV	Y 2 #CCV	Y-est.
-------	-----	-----	-----
GM2	46.79	65.69	70.97
EF1	52.74	82.00	75.73
GM4	53.16	69.62	76.07
EF2	60.05	82.54	81.59
GM3	61.06	97.08	82.40
GF2	62.26	93.00	83.36
GF4	66.68	80.15	86.90
EF4	70.95	83.54	90.32
GF3	71.89	84.69	91.08
AF1	72.53	81.08	91.58
GF5	76.42	103.92	94.70
AM1	77.84	93.31	95.84
EF3	78.47	99.92	96.35
EM1	85.37	100.69	101.87
GF1	88.63	101.38	104.49
GM1	96.16	115.15	110.51

One general remark has to be made before considering the detailed analysis. Our previous finding, using averages of various compositions, was that the mean value in the second environment was larger than that in the first. When we consider the individual data, we find that this relationship occurs in each of the 16 pairs of values and thus holds true for each speaker. While the average difference was of the order of nearly 20 ms, the individual differences vary. This variation is handled by the regression equation in a co-ordinated way. The equation has the form $Y = a + bX$. In this a is a constant that continually displaces the value of Y; and b is a coefficient that effects a displacement of Y in a fixed ratio to X. The results of the regression equation give $a = 33.49$ and $b = 0.801$. It is immediately evident that the mathematical interpretation does not distribute the average difference so that the constant displacement is close to 20 and the coefficient of X is a multiple close to 1. In the broadest terms, however, we do have confirmation that the difference produced by individual speakers is roughly similar over the whole

Figure 7.4 The relationship between X and Y and a regression line estimating Y



range that is presently available to us.

On closer inspection, an underlying secondary pattern (aside from random variation) perhaps emerges: as the value of *X* (the individual value in the #CV environment) increases, so the increment in the addition to the value of the second (*Y*) decreases. In other words, on average speakers who use a longer VOT in the #CV environment appear to produce a smaller absolute difference between this and the #CCV environment than those who use a shorter VOT. The effect of this is that, while around the centre of the *X* values, about 70 ms in the #CV environment, the interpreted difference (in EF4 for example) is indeed close to 20 ms, the difference at the extremes is interpreted by the regression equation as about 25 at the lowest (GM2), and 15 at the highest (GM1).

Two questions arise from these findings. The first is the general point that the relationship between the two sets of values is not a causal one: the regression analysis does not suggest that the individual's average VOT in the #CV environment causes a particular average level to occur in the #CCV environment. Rather, the speakers each deploy a similar pattern that is associated with the two types of phonemic environment.

7.3.2.5.5.1.1 The reliability of the findings

The second question concerns the reliability of these findings. The conventional means for expressing this is the coefficient of correlation, the ratio of the explained variation to the total variation. The present data yield $r = +0.833$, or in terms of the size of the sample, roughly 13 speakers out of 16. On the whole this is quite a good result, but it tends to lend support to the broad conclusion about the general relationship between the sets of average values rather than the secondary observation about their apparent convergence. It is possible to reformulate the latter: on the basis of the individual's overall average VOT, the higher the value the smaller the difference between the averages for the phonemic environments.

The formal test of the reformulated proposition uses the appropriate calculations from the above data and produces the constant $a = 22.98$, and the coefficient $b = -0.043$. Here the mathematical interpretation places the constant much closer to the expected difference of about 20 ms, but the impact of variation in the individual's general average VOT on the gap between the averages for the two phonemic environments is negligible, amounting to 4.3 in 100 ms, or to use the approximate span that occurs in the data, about 2 in 50, which can be compared with the discount of about 10 in 50 suggested by the first test. Most telling of all is the very low coefficient of correlation $r = -0.071$: the pattern is largely random.

In combination with the results from the previous test, we can say that there may be some convergence of the average values, but it is largely obscured by the random element, and that this same random element tends to confuse what is probably a fairly uniform relationship between the averages for the two types of phonemic environment.

7.3.2.5.5.2 The dispersion of values in the environment #CCV

Our focus now shifts to the second type of phonemic environment in particular and consideration of the question of why there is more dispersion in the range of values produced in the second type of phonemic environment than in the first. There is no intrinsic reason why there should be general similarity in the span of dispersion, but one reason for the difference is suggested by the fact that the words used to test the VOT have different phonemes between the plosive and the vowel, and that a different VOT is associated with the intervening segment.

Before considering new data in support of this argument, it is already possible to examine another dimension of the question by using the earlier analysis of averages by type of phonemic environment and place of articulation.

It has already been shown that the absolute difference between places of articulation is larger in the #CCV environment than in the #CV environment (cf. mean values in Tables 7.14 and 7.17). The required data are again presented in the first part of Table 7.20 under the respective columns headed "vowel" and "w. a." (that is, the weighted average of the components of the other following segments). These data show the sort of configuration that would lead to a greater span of dispersion: the constituent values of the #CCV environment are clustered around averages that are more widely spaced, covering an interval between /p/ and /k/ of nearly 30 ms, compared with an equivalent span of 15 ms in the #CV environment.

What would underpin this observation is a general similarity in the SD of the pairs of data for each phonemic environment by place of articulation. Here the answer is not so neat: in each instance the SD in the #CCV environment is somewhat larger, and we cannot attribute the wider span of dispersion solely to the fact that there are larger intervals between the constituent averages, though this feature undoubtedly contributes to the effect. The relevant data are also shown in the second part of Table 7.20 in the columns headed "vowel" and "total" (the SD of all the data constituting the other

Table 7.20 Aggregate mean values by place of articulation and following segment

mean values:

	vowel		other	segments		
		/r/	/l/	/w/	/j/	w. a.
----	------	------	------	------	------	------
total	70.09	89.53	84.14	96.50	98.62	
----	------	------	------	------	------	------
/p/	62.70	58.88	76.06		98.62	77.85
/t/	71.48	89.60		96.50		93.05
/k/	77.02	104.75	108.38			106.57
weighted average	70.40	84.41	92.22	96.50	98.62	

standard deviation:

	vowel		other	segments		
		/r/	/l/	/w/	/j/	total
----	------	------	------	------	------	------
total	19.85	27.18	32.07	19.98	18.38	27.51
----	------	------	------	------	------	------
/p/	19.22	13.98	29.87		18.38	28.00
/t/	20.50	24.80		19.98		22.29
/k/	17.47	22.66	26.23			23.24

consonant phonemes).

In turn, this finding prompts the question whether the other dimension to the composition of the data, the identity of the segment between the plosive and the vowel, has some bearing on the larger value for the SD in the second type of phonemic environment. The other data set out in Table 7.20 help to answer this.

It is not necessary to evaluate all the permutations by place of articulation and type of intervening segment. The overall mean values for the following segments will suffice, though, because of the differences in the number of data constituting these mean values, the first part of Table 7.20 gives both the aggregate average (the row "total") and the average of the values shown in the appropriate cells (the row "w. a."). Either way there is a fair indication in the range of nearly 15 ms between the highest and lowest averages that differences in the intervening segment also make a contribution to the diversity of values found in the second type of phonemic environment. An even more striking overview of this diversity is provided by the disaggregated averages, in which the lowest value (/pr/) and the highest value (/kl/) form an interval of nearly 50 ms. Of course, these two permutations carry limited weight in shaping the overall pattern of distribution, but they do illustrate how the class is internally differentiated in a way that is not found in the #CV environment.[13]

A complete comparison of values by place of articulation and by following segment is possible only in the case of #CV and #C/r/. The SD of all the data composing the class of plosive + /r/ is 27.18 ms, a figure close to the SD for all the data in the #CCV environment (27.51 ms), and thus suitable as an illustration of the contrast with the SD of 19.85 ms in the first type. In the component classes by place of articulation, the similarity in the SD is not particularly strong, and there is some evidence of the higher value that /r/ produces overall when it is the following segment. Against this there is the marked difference in the spacing of the three average values: as already noted, there is a range of 15 ms from /p/ to /k/ where the vowel follows immediately, but more than 45 ms where /r/ follows. The approximate conclusion from this is that the difference in dispersion derives largely from the disposition of the component averages rather than a general difference in the SD common to the components of each class.

For reasons already explained, this finding cannot be transferred directly to the other intervening segments. What we do have, though, is a benchmark in the SD in the classes by place of articulation in the environment where a vowel directly follows the

[13] The consonant cluster /tw/ was included in the sample from each speaker. Analysis of the distribution of /w/ and /ʍ/ has subsequently revealed that many speakers use the voiceless phoneme /ʍ/ in this position. This is most likely to be the reason why "/tw/" clusters have longer average VOT values than /tr/ clusters.

plosive. These three values are quite close to an approximate figure of 19 ms. We find similar values in the realisation of the sequences /pj/ and /tw/. Although these are characterised by average values that clearly mark them out from the sequences in which a vowel follows immediately, the speakers are here delivering these features with much the same measure of consistency as occurs when a vowel is the next segment. Only the permutation /pr/ is delivered with a noticeably narrower range of dispersion; otherwise the clusters /tr/ and /kr/ produce a spread that is somewhat larger than the benchmark figure.

This last point in the review of the present question draws attention to the one solution that was not available in this instance: general uniformity in the SD of the classes that make up the #CCV environment. Had this been present, then the analysis would have concentrated solely on the disposition of the mean values for the component classes. As it is, the higher SD in some classes has to be acknowledged as part of the greater span of dispersion where the selected segments follow the plosive. Otherwise it is the configuration of averages that produces the most conspicuous source of diversity. The structure in the disposition of the averages is partially obscured by some missing #CCV combinations. It seems that there are some differences between the particular intervening segments in terms of average VOT, and if the sample were large enough, it would be possible to determine in a reliable way whether these were statistically significant. The differences by place of articulation, where they can be attested, are more obvious. Not only do they follow the general pattern found in the first type of phonemic environment, but they even intensify the effect associated with the place of articulation.

7.3.2.5.6 Implications for the entire study

As stated in the introduction to this section, part of the rationale behind undertaking such an in-depth statistical analysis of the VOT values is to gain an overall impression of the statistical significance of the study.

What emerges is that, in general, the results for Glasgow and Edinburgh are more likely to be reliable reflections of their respective parent populations than the Aberdeen results are. This is due to the extremely small size of the Aberdeen sample compared with the reasonably sized Glasgow and Edinburgh samples. There have been occasions where the Aberdeen speakers have exhibited less variation in terms of allophones than the other regional groups, for example their lack of [ɾ], their limited use of [ɰ], and their consistent and predictable /w/ and /ʍ/ distribution. Arguably, this is as a result of the small sampling base rather than an indication that Aberdeen speakers are less prone to phonetic innovation.

Yet, despite the fact that there are only sixteen speakers informing this survey, it is possible to obtain statistically reliable findings from the results when the data are looked at in aggregate and individually. Moreover, the sample can withstand a good deal of dissagregation and still produce reliable results.

7.3.2.5.7 Summary and conclusion

This chapter has reviewed the literature pertaining to ScE VOT values for plosives and concludes that it is lacking in concrete data. It has presented the findings of a study of VOT values in #CV and #CCV position where a voiceless plosive is the initial consonant in each case and a series of statistical tests has been used to identify the underlying relationships between the data.

The results were analysed as aggregate data (510 results) and as the data of sixteen individuals. In the latter case the small size of the sample base hampered some tests in that reliable conclusions could not be reached (i.e. the dispersion of individual VOT values for Aberdeen speakers and Edinburgh male speakers), although techniques such as the Student's *t* test were used to compensate for this.

No significant differences were found between the female and male aggregate and individual average VOT values, although the average male values were more widely distributed than those for the female speakers. In addition, no significant differences were found between the aggregate and individual VOT values when examined by region.

It was expected that there would be a relationship between the values for /p/, /t/, and /k/ in that the VOT values of /p/ would be less than /t/, which would be less than /k/, but this was not entirely the case. Although the VOT values for /p/ were found to be significantly less than those for /t/, the values for /t/, although less than those for /k/, could not be shown to be significantly less.

An unexpected result was the consistent and marked distinction in VOT values for the #CV and #CCV environments in that the values of the former were always significantly less than those of the latter.

When the results were disaggregated by category, the combination of sex and region proved to be the least reliable cross-tabulation, due to the small sample size of Aberdeen speakers and Edinburgh male speakers. As a consequence, although the Glasgow results for male and female speakers were in line with the overall findings, those for Edinburgh were slightly divergent, and those for Aberdeen were even more so.

When VOT values for each place of articulation were examined by phonemic environment (e.g. #CV ≠ #CCV) reliable distinctions were found which illustrated that in both positions /p/ values were less than /t/ values, which in turn were less than the values for /k/.

Lastly, the #CV ≠ #CCV distinction was tested in the VOT values for individuals. It was found that while there was an average difference of 20 ms between the VOT values for the two environments, the differences between averages for each individual varied between 15 ms and 25 ms. Examination of the individual results showed traces of a pattern in which speakers with high VOT values for #CV environments produce less of a difference between these and their VOT values for #CCV environments than those speakers with low VOT values in #CV positions. In addition #CCV VOT values were more widely dispersed about the mean than the #CV values, largely reflecting greater intervals between the component average VOT values by place of articulation.

In this chapter certain facts about VOT values have been established. VOTs for /p/, /t/, and /k/ do not vary significantly between Glasgow, Edinburgh and Aberdeen, or between the sexes; VOT values do vary significantly between /p/, /t/, and /k/ in the same environment; and the VOT values of /p/, /t/, and /k/ are significantly different depending on their placement as the first element of a #CV or #CCV consonant cluster.

In addition statistical analysis has shown that the phonetic results are reliable. When divided by sex they are also reliable as the sample base is sufficiently large. Cross-tabulation by region and sex highlights one weakness: the lack of Aberdeen speakers and of Edinburgh male speakers. Thus, although one can be confident of the representativeness and reliability of the Glasgow data, and have some reservations about the Edinburgh data, the data relating to the Aberdeen speakers should not be regarded as an entirely reliable representation of the phonetic habits of Aberdeen speakers as a whole.

Chapter 8 Conclusion

8.0 Introduction

This chapter presents a review of the aims, the research method, and the findings of the entire thesis. In addition, it assesses the significance of those findings in terms of the extent to which one may generalise from them. The chapter then goes on to consider related issues which the thesis has raised, such as other areas of ScE which may prove fruitful for further research, and the importance, both to phonetics and phonology, of detailed phonetic investigation of all accents of English. It will finish by considering the methodology which future phonetic studies of ScE could adopt.

8.1 The original aim

The aim of this thesis was to expand existing knowledge of the phonetics of ScE, from both an articulatory and an acoustic standpoint. It set about this aim by first outlining and assessing the descriptions of ScE articulation contained within the existing literature. A record of ScE pronunciation exists from the eighteenth century onwards, and a selection of works spanning this period was reviewed. In general, the late-nineteenth century to the mid-twentieth century emerges as the period in which most research into ScE segmental features was carried out, although the late-twentieth century is the period where the investigation into certain suprasegmental features has begun in a systematic fashion. It was hypothesised that the existing description of the articulation of certain consonant phonemes was lacking in articulatory detail and was not a true reflection of the phonetic characteristics of those consonants. Moreover, the published accounts of ScE accents provided little instrumental data, of which none was acoustic data. It was in response to this situation that the present study was begun.

Certain consonant phonemes were selected for investigation: /r/, /l/, /ʍ/, and the VOT values of voiceless plosives. The choice was motivated by the fact that each of these phonemes has been discussed in the literature and that there exists an account of their realisations in ScE. The aim was to test the accuracy of those descriptions by investigating systematically the realisation of these phonemes.

Data was elicited from sixteen ScE speakers, and their utterances were recorded. The data was later analysed by the present writer both auditorily and acoustically. Thus a profile was established of the characteristics of the individual phoneme's realisations, and an articulatory and acoustic description of each allophone was presented.

The analysis of the data revealed much phonetic detail which was hitherto unattested in the literature. This was seen both in terms of the range of allophones of each phoneme (e.g. the fifteen allophones of /r/), the new allophones which emerged from the data (e.g. /l/ realised as [ɰ̩]), and in terms of the distribution of the allophones in different word positions, both by themselves and within consonant clusters (e.g. the constraints on the occurrence of [ɰ̩]). In addition, it was possible to investigate the changing pattern of the lexical distribution of the /ʍ/ phoneme, as well as gaining insight into the phonetic characteristics of /ʍ/. In general, it was seen that the phonetic realisation of the consonant phonemes contains much more diversity than the literature suggests. There are more allophones, and their distribution varies according to word position and the nature of the consonant cluster they are contained within.

Statistical analysis of the data enabled the general significance of the results to be appreciated. The data, considered as a whole, does produce results which are statistically significant (e.g. the aggregate VOT data for #CV environments as compared with #CCV environments). Moreover, when the data is broken down into smaller groups it continues to produce reliable and significant results (e.g. VOT values for male and female speakers). Some groups of data, however, are based on too small a sample of individuals to allow reliable generalisations to be made. For example, the Edinburgh male data, and the Aberdeen male and female data are all based on the pronunciation of one speaker per category. Although the results are reliable for the individual speaker, it would be wrong to suggest that they are an accurate representation of the phonetic characteristics of their respective parent populations, as the sample base is too small. Nevertheless, they can be regarded as indicative of the type of phonetic features which may be found generally in those particular accents.

This fact has implications for the way in which the thesis data as a whole is viewed. For example, the Glasgow speakers in this study were seen to be the group which exhibited the greatest amount of diversity, whereas the Aberdonians utilised the smallest range of allophones for individual phonemes, and the Edinburgh group lay somewhere in-between. However, this finding must be interpreted in the light of the fact that the size of each regional group was different: the Glasgow group contained almost five times as many speakers as the Aberdeen group and almost twice as many speakers as the Edinburgh group. If the groups had been of equal size then the range of diversity associated with each group may have been different.

8.2 Issues raised by this analysis

Although this study has revealed much about the phonetic characteristics of aspects of ScE, it has also raised questions. Close analysis of the data has suggested other areas of ScE which could benefit from further investigation. In addition, the thesis findings about the relationship between previously published accounts of ScE and how the sample group actually behaved phonetically raises questions concerning our knowledge of other accents. Furthermore, the quality of phonetic accounts of accents has implications not just for phonetics, but also for related fields such as phonology. These issues will now be discussed.

8.2.1 Areas of Scottish English for future investigation

This thesis has focussed on four aspects of ScE, but that is not to suggest that the accent does not contain more scope for further investigation. The data elicited from the sixteen speakers exhibits many other features, both segmental and suprasegmental, which would have been just as suitable for analysis. For example, the present writer was struck by the large number of ejective realisations of voiceless plosives in word-final position (e.g. word 15 <luck> was pronounced with a velar ejective [k'] by GF2, GF4, GM2 and EF2). Although ejective realisations of word-final /p, t, k/ are not mentioned in the literature on ScE accents, in this data at least, they are a very common feature.

Likewise, word-final glottalised plosives occur in this data, almost without exception. This confirms the present writer's own impression that word-final /p, t, k/ are almost always glottalised by ScE speakers, an impression based both on native-speaker intuition and on observations of other ScE speakers over a period of ten years. Word-final glottalised affricates are also present in the data. One might, for example, investigate the importance of glottalisation as a feature that listeners use to distinguish word-final voiced plosives and affricates from word-final voiceless plosive and affricates.

A puzzle to emerge from the reading-passage data is the reason for some of the speakers having an intrusive /r/ in the phrase "idea of", so that they say [aediɹ ɪv] or, more usually, [aediɾ ɪv].

The data could also be used for further investigation of VOTs in other contexts, for example, word-finally; word-initially in #CCV contexts (as the second consonant, e.g. the /p/ in /spaedɪr/); word-initially in #CCCV contexts (as the second consonant, e.g. the /p/ in /sprɪŋkl/); and medial contexts (e.g. the /p/ in /opɪn/). It may be that there are consistent relationships between these values, similar to that which exists between VOTs in #CV and #CCV contexts, relationships that are not dependent upon impressionistic analysis, but which will only emerge by means of an instrumental and statistical analysis, such as that presented in Chapter 7.

All suprasegmental features of ScE could be profitably investigated (see Chapter 2, section 3.2.3, p 46). One starting point could be the analysis of female voice qualities, using Laver's (1975) framework of analysis, as Esling did for Edinburgh male speakers (1978a, 1978b). Among the females in this sample, there were two with extreme creak, and one with moderate to extreme palatalisation. At our present state of knowledge, there is no way of knowing how widespread these features of voice quality are among the female population as a whole.

Finally, the acoustic information contained in this thesis may provide a context for the continued acoustic study of other ScE accents, in that it provides a bench mark for comparative studies of other groups of speakers.

8.2.2 Implications for other accents of English

The present research into ScE accents does not just have implications for the study of ScE: it should also cause us to reflect upon our knowledge of other accents of English. It was stated at the beginning of this thesis that ScE has not been subject to the scrutiny that other accents, such as RP and General American, have received. In that respect, more accents of English are in the position of ScE than of RP and General American. One implication of this fact is that phoneticians are denied access to a body of data which may enable them to refine their phonetic theory. Moreover, if the existing accounts of ScE allophones can be shown to be lacking in detail, to omit the majority of allophones of certain consonants, and to exhibit a paucity of instrumental information, then questions should be raised about the accuracy and thoroughness of the literature pertaining to the phonetic description of other accents of English. Take VOT measurements as an example. It is not possible to say whether other accents of English share the same relationship between #CV and #CCV VOT values identified in this thesis, as there are no similar studies of, for example, Liverpool English, Cardiff English, or

Basingstoke English with which to make a comparison. It would be of interest to the present writer to know if this timing relationship was a feature of ScE alone, or of all English accents.

8.2.3 Implications for phonetics

For the phonetician, there is no need to justify the phonetic study of an accent, as academic interest is reason enough. Nevertheless, it is possible to justify detailed phonetic examination of varieties of accents on a number of grounds. Firstly, there is the fact that such analysis ensures the ability of phonetic theory to analyse and describe all linguistically significant articulations. This can only be achieved by testing the theory with as much data as possible. In this study, for example, certain realisations of /w/ and /ʍ/ clarified the relationship between the articulatory categories of approximant, resonant and fricative, and the auditory categories of approximant and fricative. Similarly, the ScE data provides evidence that there exist articulations which, although they have the articulatory ballistic movement of taps, do not fulfil the criteria of contact between the apical/laminal area of the tongue and the alveolar ridge.[1] The writer has referred to these realisations as "lowered-taps". It is only by close analysis of the accent of individual speakers that such realisational detail is observed.

There are other reasons for undertaking the detailed analysis of specific accents. One example is the relevance of such information to the development of spoken-language engineering. As Fourcin argues, the lack of development of this technology "is due in large measure to a lack of application of phonetic knowledge and, perhaps as importantly a lack of phonetic knowledge itself" (1995: 10). It seems to the present writer that this is a very strong argument for the continuation of detailed phonetic studies of all accents of English.

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[1] The data also contains similar "plosive" and "nasal" realisations, but these were not investigated or discussed in as much depth as the lowered-tap realisations.

8.2.4 Implications for phonology

Many forms of phonological analysis use phonetic descriptions of an accent as a first step in phonological analysis. If the phonological analysis is to be accurate then the phonetic description which underpins it cannot afford to be unreliable. Kaminska's (1995) phonological analysis is a case in point. Her analysis of ScE /r/ in terms of the diachronic phonological processes which she argues it has been subject to, takes as its phonetic base a handful of /r/ allophones which she has obtained from various sources (all reviewed in Chapter 4 of this thesis), such as Romaine (1978). One can only speculate whether her discussion and conclusions would have been the same had she had available to her a more accurate picture of the diversity of /r/ realisations in ScE.

8.3 Future phonetic studies of ScE

This study has emphasised to the present writer the gulf that exists between what is written in the phonetic descriptions of ScE and how individuals are actually speaking. If this situation is to be remedied then it is necessary to investigate ScE further. With the benefit of hindsight, the present writer is of the opinion that the most important factor for future studies is that the sample base, in terms of the number of speakers, or the number of allophones or measurements of each feature, should be of a sufficient size to ensure the relevance of the results of the study to the source population. Studies based on one speaker (e.g. McClure 1977) are accurate only with reference to that individual and it is erroneous to attempt to generalise from such findings. Moreover, without analysing a sufficient number of speakers, one cannot be sure that one is capturing a true picture of the diversity of allophonic variation which exists.

Furthermore, it seems imperative that instrumental techniques are used in the future study of ScE, in addition to auditory analysis. Such techniques reveal areas of information concerning articulation which the ear is not capable of dealing with. Also, with such data to hand, it would be possible to equip language engineers so that computer speech technology is not confined to RP and General American but also includes other accents of ScE.

8.4 Conclusion

In this chapter it has been argued that the thesis has met the aims with which it set out, in that it has advanced existing knowledge of the phonetic characteristics of aspects of certain ScE accents. It has emphasised the importance both of an awareness of the statistical status of the data, and of the extent to which one can generalise from the data. The thesis has also illustrated the gap which exists between the published sources of information on ScE phonetics and the reality of speakers' pronunciation.

There remains much to learn about the phonetic characteristics of ScE and, by implication, of other accents of English. Whereas fifty years ago the importance of phonetics was secondary to that of phonology, advances in technology have changed this and have reinstated the necessity to continue the phonetic investigation of all accents of English. Specifically, if ScE speakers are not to be technologically disadvantaged in the future, the phonetic investigation of ScE accents should not be neglected.

Appendix 1 A regional listing of the accent illustrations of the Lowland Divisions (D33 - D42) contained in Ellis (1899 Vol 5)

The locations listed below are mapped on Figure Append 1 below. The numbers on the map correspond to the numbers on the list below. (A few illustrations originate from a large geographical area. It is noted below where it has been considered impracticable to map them.)

D33: south Lowland

1 Bewcastle (cs)

2 Hawick (cs)

3 Teviotdale (br and AMB's VS sentences)

4 "Liturgical Scotch-English, local South Lowlands, Vernacular South Lowlands" (100th Psalm - JAHM) - not mapped

5 Southern counties (wl taken from JAHM's DSS, augmented) - not mapped

6 Liddesdale (cwl - JGG)

D34: east mid Lowland

7 Edinburgh (cs)

8 Lothian and Fife (AMB's VS sentences - no exact origin specified) - not mapped

9 Peebles, Edinburgh, Fife, Roxburghshire, Aberdeenshire (numerals 1 - 12 and 20 from AMB's VS) - last 2 not mapped

10 Chirnside (dt and wl)

11 Edinburgh, Lothian, Fife, Chirnside, Central Scottish (cwl, gleaned from all the above sources and from a central Scottish wl from JAHM's DSS) - Lothian and Central Scottish not mapped

D35: western mid Lowland

12 Ayr (br - JAHM)

13 Clydesdale (AMB's VS sentences)

14 Coylton (dt)

15 General Ayrshire (Tam o'Shanter transcribed by a "committee of six...Ayrshire students" and others)

16 Ayr, Coylton, Glasgow, Kyle, Ochiltree, Lochwinnoch (cwl)

D36: southern mid Lowland

17 Stranraer (cs)

18 New Cumnock (AJE's palaeotype version of Duncan Grey)

19 Glenluce (wl)

20 Kirkpatrick Durham (wl)

D37: northern mid Lowland

21 Newbury on Tay (dt)

22 Whitelands (dt and cwl)

D38: southern north Lowland

23 Arbroath (cs)

24 Dundee (dt)

25 Glenfarquar (dt) - not mapped

26 Glenfarquar/Brechin (wl)

D39: mid north Lowland

27 Keith (cs and "notes and phrases")

28 Buchan (br - JAHM and AMB)

29 Cromar ("three examples") - not mapped

30 Aberdeen (AMB's VS sentences)

31 Various sources (cwl) - not mapped

D40: north north Lowland

32 Wick (cs)

33 Wick and other sources (cwl)

D41: south insular Lowland

34 Sanda (poem - AJE)

35 "Older Orkney speech" - not mapped

D42: north insular Lowland

36 Dunrossness (cs) - not mapped

37 Lerwick (parable)

38 Unst (parable - AJE)

39 General (cwl)

Key to abbreviations

br Book of Ruth

cs comparative specimen

cwl comparative word list

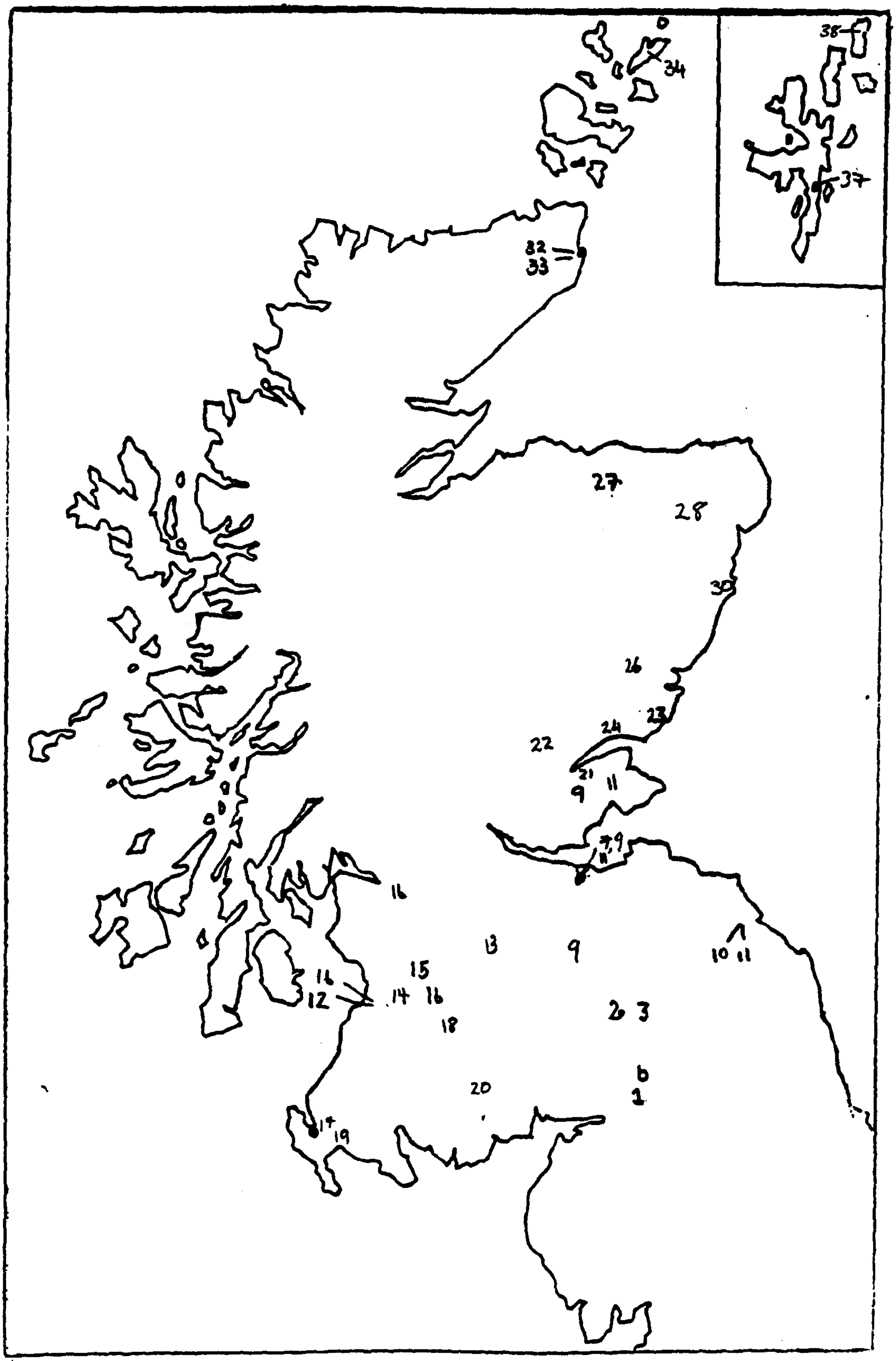
dt dialect test

wl word list

DSS	The Dialect of the Southern Counties of Scotland (Murray 1873)
VS	Visible Speech (Bell 1867)

AJE	Alexander John Ellis
AMB	Alexander Melville Bell
JGG	John George Goodchild
JAHM	James Aygustus Henry Murray

Figure Append 1 The geographical origin of accent illustrations of the Lowland Divisions (D33 - D42) contained in Ellis (1899 Vol 5)



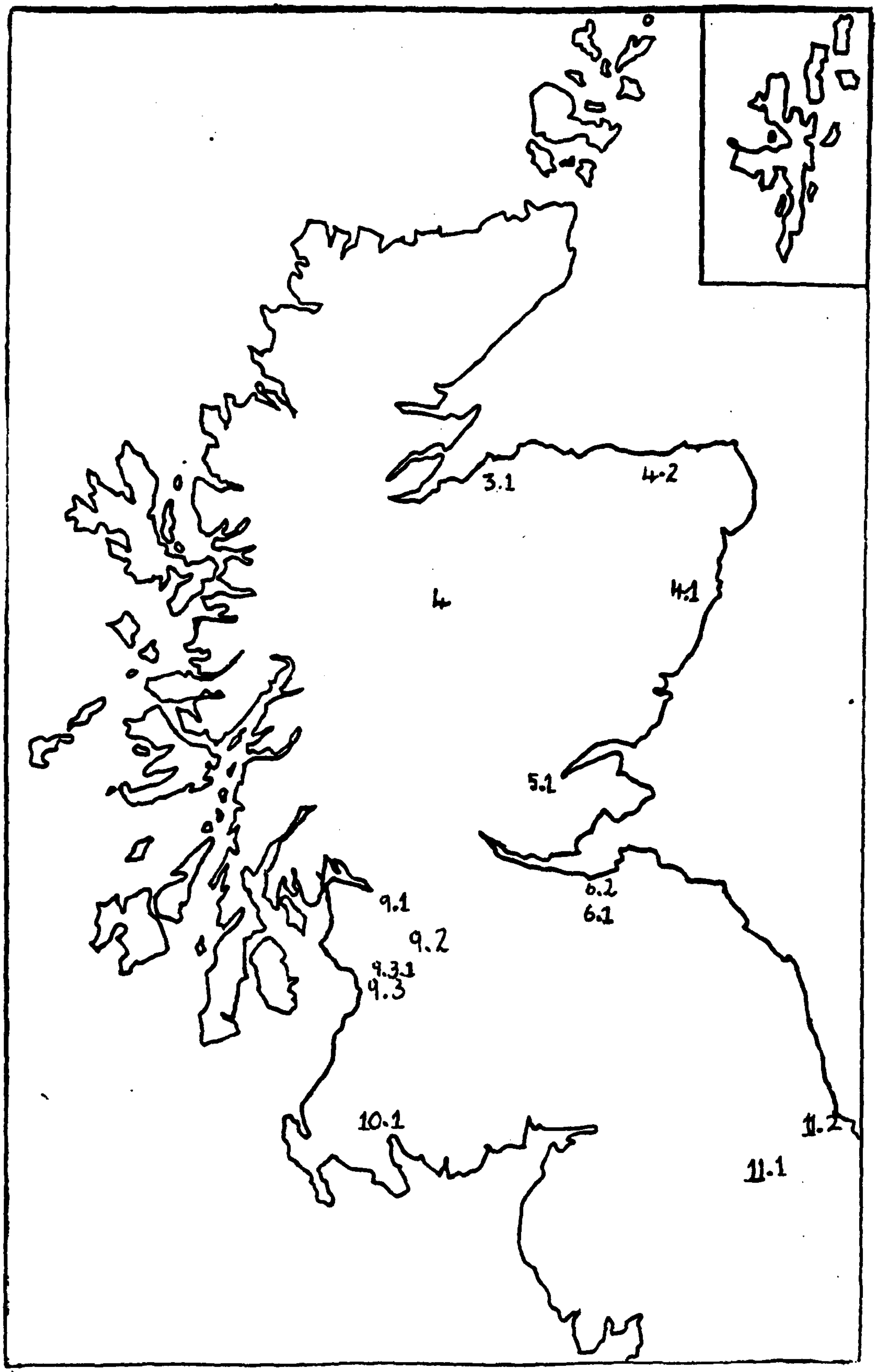
Appendix 2 A regional listing of descriptions of ScE accents and dialects in the twentieth century.

1	Orkney & Shetlands	nothing	
2	Western Islands	see Shuken	1984
3	Highlands		
3.1	Morayshire	Murison	1976
		Cairns	1910/11
4	Grampian	Mutschmann	1909
4.1	Aberdeenshire	Wilson	1912
		Nehls	1937
4.2	Buchan	Forrest	no date
		Dieth	1932
		Wölck	1965
5	Tayside		
5.1	Perthshire	Wilson	1915
6	Lothian		
6 .1	Midlothian	Speitel	1969
6 .2	Edinburgh	Hartig	1928
		Mather	1960
7	Central	nothing	
8	Fife	nothing	
9	Strathclyde		
9.1	Glasgow	Macafee	1983
9 .2	Lanarkshire	Scherer	1933
9 .3	Ayrshire	McNaught	1901
		Wilson	1923
		McClure	1970
9.3.1	Tarbolton	Wright	1929

10	Dumfries & Galloway		
10.1	Galloway	Riach	1978
11	Borders		
11.1	Morebattle	Zai	1942
11.2	Berwickshire	Wettstein	1942
12	General		
12.1	Central Scotland	Wilson	1926
12.2	Southern Scots	Taylor	1972
		Taylor	1974
12.3	more general	Graham	1933
		Köhler	1961
		Winston	1971

The geographical locations of the areas studied in the twentieth century are indicated in Figure Append 2. The numbers on the map relate to the areas listed in the table above. (The location of the general studies has not been indicated.)

Figure Append 2 The geographical locations of descriptions of ScE accents and dialects in the twentieth century



Appendix 3 The Questionnaire

0 Introduction

Each speaker was asked to complete a questionnaire concerning details of themselves which may have influenced their accent. The questions were aimed at eliciting three types of information.[1] The first concerned personal details, such as age and sex, as well as regional factors. The second concerned socio-economic information about the speaker. Lastly there were some questions designed to establish that the speaker had no history of speech or hearing problems and to discover whether the speaker had ever had any form of speech training, such as drama lessons or elocution lessons, which might have changed the his or her accent in any way.

1 Personal details and regional origin

The first question noted the sex and the age of the speaker. There were a total of 10 females and 6 males, and their ages ranged from 18 to 39. The distributions are shown in Figure Append 3.1 and Figure Append 3.2.

Another question enquired about where the speaker had lived during his or her life. It was deemed important to discover whether a speaker had lived in any other area of the country at any time in their lives, in order to help establish whether that experience had significantly influenced their accent.

Both Aberdonians had resided there for their entire life. Likewise the majority of the Edinburgh speakers had lived in Edinburgh until moving to Glasgow at 18 to take up their studies. The exceptions were EF1 who had lived in Strathaven until she was 5, and EF3 who had lived in Stranraer until she was 10. Neither of them viewed this as an influence on their present pronunciation. EF2 had lived in Edinburgh until moving to Glasgow to study at 18, and she felt that Glasgow and west coast accents had influenced her speech a little as a result. All Glasgow males had lived in various parts of Glasgow for their entire lives, as had all the females excepting two. GF2 had lived the first five years of her life in Aberdeen and GF5 had lived in London, Manchester and Yorkshire between the ages of 21 and 25. Neither of these speakers felt that their present accent reflected these regional influences. On the whole, then, all of the speakers viewed themselves as having accents representative of their regional origin.

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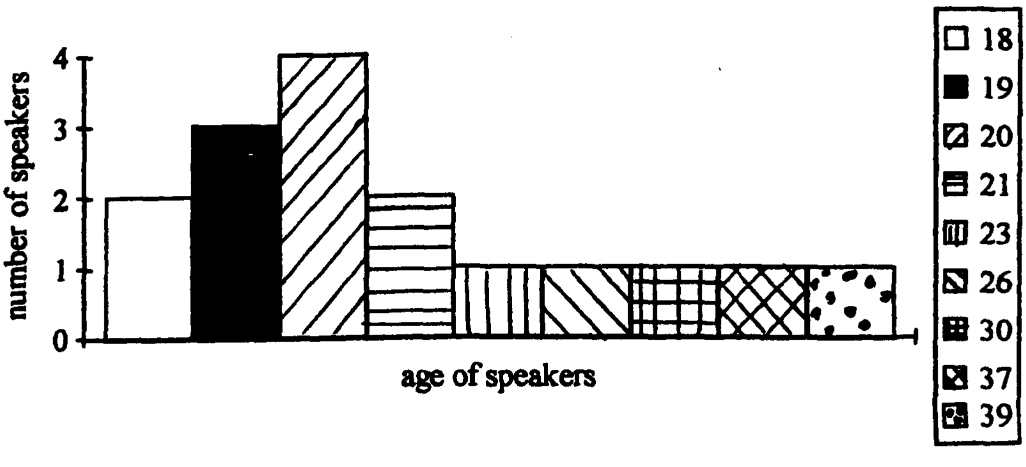
[1] The types of questions were not grouped together in the questionnaire.

Figure Append 3.1 The distribution of speakers by age and sex

Figure Append 3.2 The distribution of speakers by age



Other questions addressed the issue of the parents'/guardians' place of origin and accent as this could have influenced the speaker's accent. In fact, all of the speakers described their parents'/guardians' accents as Scottish. As for place of origin, none of the speakers had a parent/guardian born or brought up outwith Scotland. The parents/guardians had often moved about Scotland during their lifetime.[2]

2 The following summarises the diverse origins of the parents/guardians:

Speaker from	Parents from
Glasgow:	Glasgow, Paisley, East Kilbride, Greenock, Islay, Skye, Falkirk.
Edinburgh:	Aberdeen, Glasgow, St Andrews, Fife, Dunoon, Edinburgh, Perthshire.

Table Append 3.1 Number of speakers attending state or fee-paying schools

	female	male
state school	7	5
fee-paying school	3	1

In conclusion, then, it can be stated that the informants were all younger adults, who had lived for most or all of their lives in either Glasgow, Aberdeen or Edinburgh. They felt that their accents were representative of one of these cities and that their accents had not been influenced by the accent of any other region. The present writer was able to confirm this from her experience of listening to and speaking ScE over a long period of time.

2 Socio-economic information

Although this survey was not targeting a specific socio-economic group, it was felt that it would be useful to have an idea of the type of speaker who was contributing. There were two questions in this section. The first enquired as to the informant's secondary schooling and the second the parents'/guardians' occupations.

In the first question the speakers were given two choices: "state school" or "fee-paying school". It can be seen from the Table Append 3.1 below that although the majority of the speakers attended state school a quarter of them attended fee-paying institutions. This proportion of subjects from fee-paying school is a higher proportion than one would find in the country in general.

The second question in this group concerned the parents' occupation. As all but one of the speakers are students, one way of deciding their socio-economic rating is to use their parents'/guardians' occupation. The results are shown in Table Append 3.2.

It becomes clear that although the speakers were selected merely on the basis of regional accent, the actual sample seems to be weighted towards children of the professional and skilled classes, with fewer non-skilled and non-professional parents than one might expect. The outcome of the study is weighted, therefore, as far as socio-economic factors are concerned, towards the middle class.

It must be borne in mind, however, that the sample is taken from the population of Glasgow University, and may reflect the social mix of its student population, rather than that of the population of Scotland as a whole.

Table Append 3.2 The occupations of the parents'/guardians' of individual speakers

Speaker	Parents'/guardians' occupation (Mother first)	schooling
EM1	advice worker, insurance broker	fee
EF1	teacher, banker	state
EF2	advocate, solicitor	fee
EF3	secretary, solicitor	fee
EF4	secretary, tax officer	state
GM1	housewife, technician	state
GM2	auxiliary nurse, Customs and Excise officer	state
GM3	shop assistant, lorry driver	state
GM4	public transport worker, railway worker	state
GF1	child minder, senior Regional Planning officer	fee
GF2	assistant Head teacher, senior manager	state
GF3	housewife, environmental health director	state
GF4	factory worker, removal person	state
GF5	lab assistant, shipwright	state
AM1	teacher, garage proprietor	state
AF1	teacher, teacher	state

3 Other information

The first question in this group asked if the speaker had ever had any speech training, with elocution lessons given as an example. Such lessons could have significantly altered the speaker's regional characteristics. Two speakers had some type of speech training: one had had singing lessons , the other had had drama lessons for two years. Both felt that the effect upon their speech had been minimal, so it was decided not to exclude these subjects.

The second question asked about speech therapy, as this might hint at an unrepresentative speaker. In fact, one of the individuals who was originally recorded had undergone extensive speech therapy for his /r/ realisation. On analysing the recording of him, it was decided to exclude him as his /r/ realisations did not seem to lie in the normal range of Scottish allophones. (it was consistently [ʋ]).

The next question enquired whether the speaker had ever been diagnosed as having a hearing loss. It is important to exclude speakers with a significant hearing loss, especially if they have had it in childhood, as it will very probably have affected their ability to acquire the phonetics of their language to the same standard as a normally hearing person. None of the speakers reported such a condition.

Lastly, the speakers were given the opportunity to record any other factor that they thought might have influenced their accents. None of them offered any further information.

4 Conclusion

The questionnaire was useful in many ways. Firstly, it confirms that speakers were representative of a specific region of the country. Secondly, it allows insight into the socio-economic status of the group (although it is not the intention of the present study to interpret the data from a sociolinguistic standpoint). Lastly, it is necessary to ensure that none of the speakers had any physical condition which would bring their status as "normal speakers" into question, and also to ensure that their accents had not been purposefully altered.

The following is an example of the questionnaire completed by all the informants.

<u>Informants' Questionnaire</u>

The purpose of this questionnaire is to find out certain facts about you and your life which may have had an influence on the way you speak. Your name will not be used at any time.

1 Age:
Sex:

2 Where did you live between the ages of:

0 - 5

6 - 10

11 - 15

16 - 20

21 - 25

26 - 30

31 - 35

36 - 40

40 -

Please give any other information which you think is relevant:

3 What type of secondary school did you attend? (Please tick)

State school
Fee-paying school

4 Where were your parents/guardians born and brought up?

Mother:
Father:

5 What is/was their occupation? If retired or unemployed, please state their former occupation.

Mother:
Father:

6 How would you describe their accents? (e.g. working-class Falkirk)

Mother:
Father:

7 Have you ever had any form of speech training (e.g. elocution lessons, etc)? If so, for how long, approximately?

8 Have you ever received speech therapy? If so, for how long approximately?

9 Have you ever been diagnosed as suffering from hearing loss of any sort?

10 Is there any other factor which you feel may have influenced the way you speak?

Appendix 4 The distribution of /w/ and /ʍ/ in word- and morpheme-initial position.

Table Append 4.1 Lexical distribution of /w/ and /ʍ/ in initial position

	G	G	G	G	G	G	G	G	G	E	E	E	E	E	A	A
	F	F	F	F	F	M	M	M	M	F	F	F	F	M	F	M
	1	2	3	4	5	1	2	3	4	1	2	3	4	1	1	1
12 warning	w	w	w	w	w	w	w	w	w	w	w	w	w	w	w	w
39 Welsh	w	w	w	w	w	w	w	w	w	w	w	w	w	w	w	w
59 well	w	w	w	w	w	w	w	w	w	w	w	w	w	w	w	w
65 warm	w	w	w	w	w	w	w	w	w	w	w	w	w	w	w	w
78 worn	w	w	w	w	w	w	w	w	w	w	w	w	w	w	w	w
90 weeds	w	w	w	w	w	w	w	w	w	w	w	w	w	w	w	w
173 watt	w	w	w	w	w	w	w	w	w	w	w	w	w	w	w	w
194 wear	w	w	w	w	w	w	w	w	w	w	w	w	w	w	w	w
201 wield	w	w	w	w	w	w	w	w	w	w	w	w	w	w	w	w

	G	G	G	G	G	G	G	G	G	E	E	E	E	E	A	A
	F	F	F	F	F	M	M	M	M	F	F	F	F	M	F	M
	1	2	3	4	5	1	2	3	4	1	2	3	4	1	1	1
20 whiter	w	ʍ	ʍ	ʍ	ʍ	w	w	ʍ	w	ʍ	ʍ	ʍ	ʍ	w	ʍ	ʍ
23 whistle	w	ʍ	ʍ	ʍ	ʍ	w	w	ʍ	w	ʍ	ʍ	ʍ	ʍ	w	ʍ	ʍ
32 when	w	ʍ	ʍ	ʍ	ʍ	w	w	ʍ	w	ʍ	ʍ	ʍ	ʍ	w	ʍ	ʍ
49 where	w	ʍ	ʍ	ʍ	ʍ	w	w	ʍ	w	ʍ	ʍ	ʍ	ʍ	w	ʍ	ʍ
68 whack	w	ʍ	ʍ	w	ʍ	w	w	ʍ	w	ʍ	ʍ	ʍ	ʍ	w	ʍ	ʍ
99 what	w	ʍ	ʍ	ʍ	ʍ	w	w	ʍ	w	ʍ	ʍ	ʍ	ʍ	w	ʍ	ʍ
124 whoa	w	w	w	w	w	w	w	w	w	w	w	w	w	w	w	w
127 why	w	ʍ	ʍ	ʍ	ʍ	w	w	ʍ	w	ʍ	ʍ	ʍ	ʍ	ʍ	ʍ	ʍ
147 wheel	ʍ	ʍ	ʍ	ʍ	ʍ	w	w	ʍ	w	ʍ	ʍ	ʍ	ʍ	ʍ	ʍ	ʍ

Table Append 4.2 Lexical distribution of /w/ and /ʍ/ after /t/

	G	G	G	G	G	G	G	G	G	E	E	E	E	E	A	A
	F	F	F	F	F	M	M	M	M	F	F	F	F	M	F	M
	1	2	3	4	5	1	2	3	4	1	2	3	4	1	1	1
3 twice	w	w	w	ʍ	ʍ	w	w	ʍ	w	w	w	w	w	w	w	w
13 twang	w	ʍ	ʍ	ʍ	ʍ	w	w	w	w	w	w	w	w	w	w	w
16 twilight	w	w	ʍ	ʍ	ʍ	w	w	w	w	w	w	w	w	w	w	w
29 twaddle	w	w	ʍ	ʍ	ʍ	w	w	w	w	w	w	w	w	w	ʍ	w
176 tweed	ʍ	ʍ	ʍ	ʍ	ʍ	w	w	ʍ	w	w	ʍ	ʍ	w	w	w	ʍ
183 twit	ʍ	ʍ	ʍ	ʍ	ʍ	w	w	ʍ	w	w	w	w	w	w	ʍ	ʍ
186 twain	ʍ	ʍ	ʍ	ʍ	w	w	w	ʍ	w	w	w	w	w	w	w	ʍ
204 twelve	ʍ	ʍ	w	w	w	w	w	w	w	w	w	w	w	ʍ	w	w

Table Append 4.3 Lexical distribution of /w/ and /ʍ/ after /k/

	G	G	G	G	G	G	G	G	G	E	E	E	E	E	A	A
	F	F	F	F	F	M	M	M	M	F	F	F	F	M	F	M
	1	2	3	4	5	1	2	3	4	1	2	3	4	1	1	1
27 quid	ʍ	w	ʍ	ʍ	ʍ	w	w	w	w	w	ʍ	w	w	w	ʍ	w
44 queen	ʍ	w	ʍ	ʍ	ʍ	w	w	w	w	w	ʍ	ʍ	ʍ	w	ʍ	ʍ
54 quit	ʍ	w	ʍ	ʍ	ʍ	w	w	ʍ	w	w	ʍ	ʍ	ʍ	ʍ	ʍ	ʍ
63 choir	w	w	ʍ	ʍ	ʍ	w	w	w	w	w	w	w	w	w	ʍ	ʍ
73 quaint	w	w	ʍ	ʍ	ʍ	w	w	ʍ	w	w	w	w	w	ʍ	ʍ	w
83 quack	w	w	w	ʍ	ʍ	w	w	w	w	w	w	ʍ	w	w	ʍ	w
84 question	w	w	w	ʍ	w	w	w	ʍ	w	w	w	w	ʍ	w	w	w
87 quite	w	w	w	ʍ	ʍ	w	w	ʍ	w	w	w	ʍ	w	ʍ	ʍ	w
92 quote	w	w	ʍ	ʍ	ʍ	w	w	ʍ	w	w	w	ʍ	w	ʍ	ʍ	w
96 quarrel	w	w	ʍ	ʍ	ʍ	w	w	w	w	w	w	w	w	ʍ	ʍ	w

Table Append 4.4 Lexical distribution of /w/ and /ʍ/ following /sk/

	G	G	G	G	G	G	G	G	G	E	E	E	E	E	A	A
	F	F	F	F	F	M	M	M	M	F	F	F	F	M	F	M
	1	2	3	4	5	1	2	3	4	1	2	3	4	1	1	1
41 squat	w	w	w	w	w	w	w	w	w	w	w	w	w	w	w	w

Table Append 4.5 Lexical distribution of /w/ and /ʍ/ in morpheme-initial position

	G	G	G	G	G	G	G	G	G	E	E	E	E	E	A	A
	F	F	F	F	F	M	M	M	M	F	F	F	F	M	F	M
	1	2	3	4	5	1	2	3	4	1	2	3	4	1	1	1
129 nowhere	w	ʍ	w	ʍ	ʍ	w	w	ʍ	w	ʍ	ʍ	ʍ	ʍ	w	w	w
140 somewhere	w	w	w	ʍ	w	w	w	w	w	ʍ	w	ʍ	w	w	w	w
149 somewhat	w	w	ʍ	w	ʍ	w	w	w	w	w	w	ʍ	w	w	w	w
164 anywhere	w	w	w	ʍ	ʍ	w	w	ʍ	w	ʍ	w	ʍ	ʍ	w	w	w
165 everywhere	w	w	w	ʍ	ʍ	w	w	w	w	ʍ	ʍ	ʍ	ʍ	w	w	w

Table Append 4.6 Lexical distribution of /w/ and /ʍ/ after /d/ and /g/

	G	G	G	G	G	G	G	G	G	E	E	E	E	E	A	A
	F	F	F	F	F	M	M	M	M	F	F	F	F	M	F	M
	1	2	3	4	5	1	2	3	4	1	2	3	4	1	1	1
35 dwindle	w	w	w	w	w	w	w	w	w	w	w	w	w	w	w	w
41 Gwen	w	w	w	w	w	w	w	w	w	w	w	w	w	w	w	w

Appendix 5 VOT measurements in milliseconds by place of articulation, sequence of segments, and speaker

	Word	Word No.	Speaker AF1	AM1	EF1	EF2	EF3	EF4	EM1	GF1
----	-------	---	---	---	---	---	---	---	---	---
Environment type 1										
/p/V	panel	5	70	71	40	39	66	58	71	62
/p/V	pecked	11	78	52	29	53	49	46	66	65
/p/V	pummel	19	64	70	38	51	62	51	82	82
/p/V	pour	61	62	90	69	65	82	97	85	86
/p/V	park	93	73	73	44	47	70	62	68	93
/p/V	pal	114	67	75	21	47	66	74	56	90
/p/V	pegged	154	58	67	46	53	73	43	68	107
/p/V	poked	195	67	61	55	46	82	61	76	88
/t/V	tyre	60	78	84	62	53	93	72	100	80
/t/V	tile	174	82	69	65	65	83	78	97	111
/t/V	take	207	52	69	53	62	69	56	64	66
/k/V	kettle	10	76	79	63	61	84	77	76	55
/k/V	curler	30	59	77	60	66	101	72	99	71
/k/V	kerb	98	82	82	54	73	79	85	114	104
/k/V	curse	121	67	94	59	69	103	93	118	106
/k/V	cudgel	126	67	94	56	69	69	74	86	76
/k/V	kiln	134	99	85	69	71	92	77	110	113
/k/V	cares	145	82	109	54	75	89	94	93	118
/k/V	casual	162	95	78	65	76	79	78	93	111
Environment type 2										
/pr/	prestige	144	40	57	74	75	71	60	49	74
/pl/	plucked	80	49	69	34	59	66	79	70	88
/pl/	plagued	181	53	94	68	52	72	59	83	100
/pl/	plugged	196	85	102	55	66	62	50	89	92
/pj/	pure	48	79	112	76	92	106	116	115	125
/tr/	trial	155	32	129	104	91	129	92	118	100
/tr/	trouble	208	61	61	129	73	78	58	61	77
/tr/	tree	209	90	91	113	105	122	104	93	98
/tw/	twilight	16	113	108	84	92	109	116	114	116
/tw/	twaddle	29	100	29	69	85	112	102	102	92
/kr/	crawl	152	126	135	109	98	126	94	153	116
/kr/	crash	210	108	79	87	82	100	71	139	100
/kl/	clean	67	118	147	64	103	146	85	123	140

	Word	Word No.	Speaker GF2	GF3	GF4	GF5	GM1	GM2	GM3	GM4
----	-------	---	---	---	---	---	---	---	---	---
Environment type 1										
/p/V	panel	5	65	78	45	75	88	42	44	26
/p/V	pecked	11	23	70	62	65	106	33	47	51
/p/V	pummel	19	39	52	68	46	82	30	59	44
/p/V	pour	61	63	96	85	103	89	48	78	70
/p/V	park	93	66	58	55	71	111	37	43	35
/p/V	pal	114	38	59	58	84	103	37	37	27
/p/V	pegged	154	71	56	81	59	72	37	51	46
/p/V	poked	195	81	50	80	80	91	34	65	53
/t/V	tyre	60	89	77	70	82	106	50	71	50
/t/V	tile	174	68	96	56	86	154	51	58	58
/t/V	take	207	39	64	55	47	72	37	68	64
/k/V	kettle	10	49	58	57	80	88	44		54
/k/V	curler	30	56	77	63	84	113	51	60	45
/k/V	kerb	98	73	75	75	108	95	56	71	70
/k/V	curse	121	53	66	75	96	95	52	68	64
/k/V	cudgel	126	77	90	58	50	90	54	69	61
/k/V	kiln	134	61	93	72	81	92	68	75	76
/k/V	cares	145	93	84	92	103	94	68	74	71
/k/V	casual	162	79	67	60	52	86	60	61	45
Environment type 2										
/pr/	prestige	144	38	46	72	63	68	51	69	35
/pl/	plucked	80	64	63	72	81	130	46	78	51
/pl/	plagued	181	98	77	78	125	123	34	78	43
/pl/	plugged	196	208	69	75	64	121	63	73	41
/pj/	pure	48	100	109	82	116	116	63	89	82
/tr/	trial	155	85	112	89	112	135	78	101	94
/tr/	trouble	208	50	64	60	73	84	48	71	74
/tr/	tree	209	76	85	75	134	112	85	125	70
/tw/	twilight	16		93	82	121	112	80	81	81
/tw/	twaddle	29	114	91	82	111	103	66	125	103
/kr/	crawl	152	116	98	96	125	145	89	120	77
/kr/	crash	210	77	98	84	100	121	82	132	69
/kl/	clean	67	90	96	95	126	127	69	120	85

Appendix 6 The Reading Passage

The Story of Arthur the Rat

There was once a young rat named Arthur, who would never take the trouble to make up his mind. Whenever his friends asked him if he would like to go out with them, he would only answer "I don't know". He wouldn't say yes and he wouldn't say no either. He could never learn to make a choice. His Aunt Helen said to him "no-one will ever care for you if you carry on like this. You have no more mind than a blade of grass". Arthur looked wise, but said nothing.

One rainy day the rats heard a great noise in the loft where they lived. The pine rafters were all rotten and, at last, one of the joists had given way and fallen to the ground. The walls shook and all the rats' hair stood on end with fear and horror. "This won't do," said the old rat who was chief. "I'll send out scouts to search for a new home." Three hours later the seven scouts came back and said: "We have found a stone house which is just what we wanted. There is room and good food for us all. There is a kindly horse named Nelly, a cow, a calf, and a garden with an elm tree."

Just then the old rat caught sight of young Arthur. "Are you coming with us?" he asked. "I don't know," Arthur said, "the roof may not come down just yet". "Well," said the old rat angrily, "we can't wait all day for you to make up your mind. Right about face, march!" And they went off.

Arthur stood and watched the other rats hurrying away. The idea of an immediate decision was too much for him. "I'll go back to my hole for a bit," he said to himself, "just to make up my mind."

That night there was a great crash that shook the earth, and down came the whole roof. The next day some men rode up and looked at the ruins. One of them moved a board and under it they saw a young rat, lying on his side, quite dead, half in and half out of his hole.

Appendix 7 The sentence list read by each speaker

Say "reader" again.

Say "bargain" again.

Say "twice" again.

Say "flowery" again.

5 Say "panel"again.

Say "farmer" again.

Say "open" again.

Say "ached" again.

Say "service" again.

10 Say "kettle" again.

Say "pecked" again.

Say "warning" again.

Say "twang" again.

Say "horses" again.

15 Say "luck" again.

Say "twilight" again.

Say "burden" again.

Say "loiter" again.

Say "pummel" again.

20 Say "whiter" again.

Say "betrothal" again.

Say "artist" again.

Say "whistle" again.

Say "marshes" again.

25 Say "buckle" again.

Say "raider" again.

Say "quid" again.

Say "surface" again.

Say "twaddle" again.

30 Say "curler" again.

Say "Arthur" again.

Say "when" again.

Say "urchin" again.

Say "odder" again. (As in "more odd")

35 Say "dwindle" again.

Say "hear" again.

Say "redder" again.

Say "loader" again.

Say "Welsh" again.

40 Say "squat" again.

Say "Gwen" again.

Say "murky" again.

Say "urgent" again.

Say "queen" again.

45 Say "sadder" again.

Say "ruder" again.

Say "ribbon" again.

Say "pure" again.

Say "where" again.

50 Say "joiner" again.

Say "rather" again.

Say "liver" again.

Say "err" again.

Say "quit" again.

55 Say "jar" again.

Say "dinner" again.

Say "lather" again.

Say "rigged" again.

Say "well" again.

60 Say "tyre" again.

Say "pour" again.

Say "nor" again.

Say "choir" again.

Say "louder" again.

65 Say "warm" again.

Say "fur" again.

Say "clean" again.

Say "whack" again.

Say "leather" again.

70 Say "never" again.

Say "rudder" again. (As in the steering apparatus on a boat)

Say "Ethel" again.

Say "quaint" again.

Say "sour" again.

75 Say "roll" again.

Say "blinked" again.

Say "humour" again.

Say "worn" again.

Say "glutton" again.

80 Say "plucked" again.

Say "hurt" again.

Say "laser" again.

Say "quack" again.

Say "question" again.

85 Say "Tudor" again.

Say "absurd" again.

Say "quite" again.

Say "leopard" again.

Say "church" again.

90 Say "weeds" again.

Say "odour" again.

Say "quote" again.

Say "park" again.

Say "rotten" again.

95 Say "harp" again.

Say "quarrel" again.

Say "slammed" again.

Say "kerb" again.

Say "what" again.

100 Say "child" again.

Say "Vlad" again.

Say "serve" again.

Say "lever" again.

Say "flag" again.

105 Say "surf" again.

Say "rider" again.

Say "veil" again.

Say "yield" again.

Say "serve" again.

110 Say "split" again.

Say "milk" again.

Say "fodder" again.

Say "rise" again.

Say "pal" again. (As in the dog food!)

115 Say "howl" again.

Say "earth" again.

Say "gulp" again.

Say "skliff" again. (As in a segment of orange.)

Say "lacks" again.

120 Say "rags" again.

Say "curse" again.

Say "dull" again.

Say "film" again.

Say "whoa" again. (As said to horses to slow them.)

125 Say "loops" again.

Say "cudgel" again.

Say "why" again.

Say "spider" again.

Say "nowhere" again.

130 Say "urge" again.

Say "dial" again.

Say "fetch" again.

Say "lots" again.

Say "kiln" again.

135 Say "marsh" again.

Say "rowdy" again.

Say "filch" again.

Say "health" again.

Say "globes" again.

140 Say "somewhere" again.

Say "bulge" again.

Say "royal" again.

Say "leaked" again.

Say "prestige" again.

145 Say "cares" again.

Say "boil" again.

Say "wheel" again.

Say "brave" again.

Say "somewhat" again.

150 Say "liked" again.

Say "muzzle" again.

Say "crawl" again.

Say "Brechin" again.

Say "pegged" again.

155 Say "trial" again.

Say "grab" again.

Say "dragged" again.

Say "looked" again.

Say "satchel" again.

160 Say "threaten" again.

Say "dreary" again.

Say "casual" again.

Say "licked" again.

Say "anywhere" again.

165 Say "everywhere" again.

Say "salt" again.

Say "phrase" again.

Say "wag" again.

Say "hairy" again.

170 Say "shrill" again.

Say "music" again.

Say "sprinkle" again.

Say "watt" again.

Say "tile" again.

175 Say "scramble" again.

Say "tweed" again.

Say "very" again.

Say "oval" again.

Say "bulb" again.

180 Say "strangle" again.

Say "plagued" again.

Say "attacked" again.

Say "twit" again.

Say "jury" again.

185 Say "locked" again.

Say "Twain" again. (As in the American writer Mark Twain)

Say "Harry" again.

Say "story" again.

Say "wire" again.

190 Say "awful" again.

Say "apple" again.

Say "bury" again.

Say "million" again.

Say "wear" again.

195 Say "poked" again.

Say "plugged" again.

Say "sorry" again.

Say "hurry" again.

Say "lie" again.

200 Say "bugle" again.

Say "wield" again.

Say "diary" again.

Say "seldom" again.

Say "twelve" again.

205 Say "quid" again.

Say "explode again.

Say "drool" again.

Subsidiary word list:

reader

redder

rather

rotten

roll

rule

Appendix 9 The phonetic transcription of the test words contained within the sentence list

	1. reader	2. bargain	3. twice	4 flowery
GF1	ɹidɪɹ	bɑ̈ɹgɪn	tw̥ʌɪs	flʲəʉɹe
GF2	ɹ̥idɪɹ̥	bɑ̈ɹgɪn	tʷw̥ʌɪs	flʲʌʉɾe
GF3	ɹidɪɹ	bɑ̈ɹgɪn	tw̥ʌɪs	flˠʌʉɾe
GF4	ɹidɪɾ	bɑ̈ɹgɪn	tɸˠʌɪs	flˠʌʉɾʉ
GF5	ɾidɪɹ	bɑ̈ɹgɪn	tɸˠʌɪs	flˠʌʉɾe
GM1	ɹidɪɹ	bɑ̈ɹgɪn	tɸʷw̥ʌɪs	flˠʌʉɾe
GM2	ɹidɪɹ	bɑ̈ɹgɪn	tɸʷʌɪs	flˠʌʉəɾe
GM3	ɹidɪɾ	bɑ̈ɹ̥gɪn	tɸˠʌɪs	flˠʌʉɾe
GM4	ɹidɪɹ	bɑ̈ɾgɪn	tʍʌɪs	flˠʌʉəɾe
EF1	ɹidəɹ	bɑ̈ɹgən	tw̥ʌɪs	flˠʌʉɹe
EF2	ɹidɪɹ	bɑ̈ɹgɪn	twʌɪs	fl̥ˠʌʉɹe
EF3	ɹ̥idɪɹ	bɑ̈ɹgɪn	tˢwʌɪs	f̥lˠʌʉɹe
EF4	ɹ̥idɪɹ	bɑ̈ɹgɪn	tw̥ʌɪs	f̥lˠʌʉɾe
EM1	ɻidɪɻ	bɑ̈ɻgɪn	tˢwʌɪs	flˠʌʉɪɹe
AF1	ɹidəɹ	bɑ̈ɹgən	tw̥ʌɪs	flˠʌʉɹ̥e
AM1	ɹ̥idɪɹ	bɑ̈ɹgɪn	tw̥ʌɪs	flˠʌʉɹɪ

	5 panel	6 farmer	7 open	8 ached
GF1	pʰɑ̈nlˠ	fɑ̈ɹməɹ	ʔɔ̈pʰɪn	ʔeʔk̚tʰ
GF2	pʰɑ̈nlˠ	fɑ̈ɹmɪɹ	ʔɔ̈pʰɪn	ʔeʔk̚ʰtʰ
GF3	pʰɑ̈nɪlˠ	fɑ̈ɹmɪɹ	ʔɔ̈pʰɪn	ʔeʔkˣtˢ
GF4	pʰɑ̈nɪlˠ	fɑ̈ɹmɪɾ	ʔɔ̈pʰɪn	ʔeʔk̚tʰ
GF5	pʰɑ̈nɪlˠ	fɑ̈ɹmɪɹ̥	ʔɔ̈pʰɪn	ʔeʔktˢʰ
GM1	pʰɑ̈nɪlˠ	fɑ̈ɹmɪɹ	ʔɔ̈pʰɪn	ʔeʔk̚ʰtˢʰ
GM2	pʰɑ̈nɪlˠ	fɑ̈ɹmɪɹ	ʔɔ̈pʰɪn	ʔeʔk̚t
GM3	pʰɑ̈nəlˠ	fɑ̈ɹmɪɹ	ʔɔ̈pʰɪn	ʔeʔk̚t
GM4	pʰɑ̈nɪlˠ	fɑ̈ɹmɪɹ	ʔɔ̈pɪn	ʔeʔk̚t
EF1	pɑ̈nəlˠ	fɑ̈ɹməɹ	ʔɔ̈pᶲən	ʔeʔk̚tˢ
EF2	pɑ̈nəlˠ	fɑ̈ɹməɹ	ʔəɔ̈pᵊn	ʔeʔk̚tˢ
EF3	pɑ̈nɪlˠ	fɑ̈ɹmɪɹ	ʔɔ̈pʰɪn	ʔeʔk̚t
EF4	pʰɑ̈nɪlˠ	fɑ̈ɹmɪɹ	ʔɔ̈pʰɪn	ʔeʔk̚ʰtʰ
EM1	pʰɑ̈nɪlˠ	fɑ̈ɻmɪɻ	ʔɔ̈pʰɪn	ʔeʔk̚tˢʰ
AF1	pʰanəɯ	fɑ̈ɹməɹ	ʔɔ̈pʰən	ʔeʔkt
AM1	pʰɑ̈nɪlˠ	fɑ̈ɹmɪɹ	ʔɔ̈pɪn	ʔeʔk̚ˣtˢ

	9 service	10 kettle	11 pecked	12 warning
GF1	sɚɹvɪs	kʰɛtˡɫˠ	pʰɛʔkt	wɔɹnɪŋ
GF2	sɛɹvɪs	kʰɛtˡɫˠ	pʰɛkˀt	wɔɻnɪŋ
GF3	sɛɹvɪs	kɛtˢɪlˠ	pʰɛʔktˢ	wɔɹnɪŋ
GF4	sɛɹvɪs	kɛtʰɪlˠ	pʰɛʔkt	wɔɹnɪŋ
GF5	sɛɹvɪs	kʰɛtˢʰɪlˠ	pʰɛʔktˢʰ	wɔɹnɪŋ
GM1	sɛɹvɪs	kʰɛtʰɪlˠ	pʰɛʔkʰtˢʰ	wɔɹnɪŋ
GM2	sɛɹvɪs	kɛtˡɫˠ	pʰɛʔˀt	wɔɹnɪŋ
GM3	sɛɹvɪs	kɛtɪlˠ	pʰɛʔˀkt	wɔɹnɪŋ
GM4	sɛɹvɪs	kɛtɪlˠ	pʰɛʔˀkˀt	wɔɹnɪŋ
EF1	səɹvɪs	kˠɛtˡɫˠ	pɛʔˀkt	wɔɹnɪː
EF2	səɹvɪs	kɛtˢəlˠ	pɛʔˀkˀt	wɔɹnɪŋ
EF3	sɛɹvɪs	kɛtˢəlˠ	pʰɛʔkˀt	wɔɹnɪŋ
EF4	sɛɹvɪs	kʰɛtɪɰ	pʰɛʔˀkʰtʰ	wɔɹnɪŋ
EM1	sɪɻvɪs	kɛtˡlˠ	pʰɛʔˀktˢʰ	wɔɻnɪŋ
AF1	sɜɻvɪs	kɛtˢʰɰ	pʰɛʔkt	wɔɹnɪŋ
AM1	sɜɹvɪs	kɛtˢɪlˠ	pʰɛʔkˣtˢ	wɔɹnɪŋ

	13 twang	14 horses	15 luck	16 twilight
GF1	tˢwaŋ	ɔɔɹsɪz	lʌkˀ	tˢwaelʌɪt
GF2	tɸˠwaŋ	ɔɔɹsɪz	lˠʌkˀ	twaelˠʌɪʔtˢ
GF3	tɸˠaŋ	ɔɔɹsɪz	lˠʌʔˀk	tɸˠaelˠʌɪʔ
GF4	tˢɸˠaŋ	ɔɔɹsɪz	lˠʌkˀ	tˢɸˠaelʌɪʔ
GF5	tɸˠaŋ	ɔɔɹsɪz	lˠʌʔˀkʰ	tmaelˠʌɪʔtˢ
GM1	tˢwaŋ	ɔɔɹsɪz	lˠʌʔˀkʰ	tˢwaelʌɪʔtˢʰ
GM2	tˢwaŋ	ɔɔɣsɪz	lˠʌkˀ	twʌɪlˠʌɪʔ
GM3	tˢwaŋ	ooɹsɪz	lˠʌk	tˢwaelˠʌɪt
GM4	tˢmaŋ	ɔɔɹsɪz	lˠʌkˀ	tɸˠaelˠʌɪʔ
EF1	twaŋ	ɔɔɹsɪz	lˠʌʔˀkˣ	tˢwaelˠʌɪʔ
EF2	twaŋ	ɔɔɹsɪz	lˠʌkˀ	twaelˠʌɪʔt
EF3	tˢwaŋ	ɔɔɹsɪz	lˠʌk	twaelˠʌɪt
EF4	twaŋ	ɔɔɹsɪz	lˠʌʔkʰ	twaelˠʌɪtˀ
EM1	tˢwaŋ	ɔɔɻsɪz	lˠʌʔkʰ	tˢwaelˠʌɪt
AF1	tˢwaŋ	ɔɔɹsɪz	lˠʌʔˀkˣ	tˢwaelˠʌɪʔt
AM1	tˢwaŋ	ɔɔɹsɪz	lˠʌʔˀkʰ	tˢwaelˠʌɪtˢ

	17 burden	18 loiter	19 pummel	20 whiter
GF1	bʌɹdɪ̃n	lˠɔetɹ̩	pʰʌ̃mlˠ	ʍʌɪtɪɹ
GF2	bʌɹdɪ̃n	lˠɜetʃʰɪɹ	pʰʌ̃mɪ̃lˠ	ʍʌɪtɪɹ
GF3	bəɹdɪ̃n	lˠɔetɪɹ	pʰʌ̃mɯ	ʍʌɪtɪɾ
GF4	bʌɹdɪ̃n	lˠɜetʃʰɪɹ	pʰʌ̃mə̃lˠ	ɸʌɪtɪɹ
GF5	bʌɹdɪ̃n	lˠɜetɪɹ	pʰʌ̃mə̃lˠ	ʍʌɪtɪɹ
GM1	bʌɹdⁿn	lˠɔetəɹ	pʰʌ̃mɪ̃lˠ	wʌɪtəɹ
GM2	bʌɹdə̃n	lˠɔeʔəɹ	pʌ̃mə̃lˠ	wʌɪʔəɹ
GM3	bʌɹdɪn	lˠɔetɪɾ	pʰʌmɪ̃lˠ	ɸˠʌɪtɪɹ
GM4	bʌɹdɪn	lˠɔetɪɹ	pʌ̃mɪ̃lˠ	wʌɪtɪɹ
EF1	bʌɹdⁿn̩	lˠɔetˢɪɹ	pʰʌ̃mə̃lˠ	ʍʌɪtˢəɹ
EF2	bʌɹdɪ̃n	lˠöetɪɹ	pʌ̃mɪ̃lˠ	ɸˠʌɪtˢəɹ
EF3	bɜ˞ːdɪ̃n	lˠɜẽtˢɪɹ	pʰʌ̃mɪlˠ	ɸˠʌɪtɪɾ
EF4	bʌɹdɪ̃n	lˠɔetɪɾ	pʰʌ̃mɪ̃lˠ	ɸˠʌɪtˢɪɾ
EM1	bɜ˞ɹdɪ̃n	lˠɔetˢʰɪɹ	pʌ̃mɪlˠ	wʌɪtˢɪɹ
AF1	bəɹdə̃n	lˠɔetəɹ	pʌmlˠ	ʍʌɪtəɹ
AM1	bɜɹdɪ̃n	lˠɔetˢɪɹ	pʰʌmɪlˠ	ʍʌɪtɪɹ

	21 betrothal	22 artist	23 whistle	24 marshes
GF1	bɪtiɹöðlˠ	ʔäɹtɪst	ʍɪsɪlˠ	mãɹʃɪz
GF2	bɪtiɹöðɪlˠ	ʔäɹtɪst	ʍɪsɪlˠ	mãɹʃɪz
GF3	bɪtiɹɔðɪlˠ	ʔäɹtʰɪst	ɸˠɪslˠ	mãɹʃɪtʃɪz
GF4	bətiɹɔðəlˠ	ʔäɹtɪst	ɸˠɪsɪlˠ	mãɹʃɪz
GF5	bətiɹɔθəlˠ	ʔäɹtɪst	ʍɪsəlˠ	mãɹʃɪz
GM1	bɪtiɹöðəlˠ	ʔäɹtɪs	wɪsəɯ	mãɹʃɪz
GM2	bɪtʰɹöðəlˠ	ʔäɹtɪst	wɪsəlˠ	mãɣʃɪz
GM3	bɪtʰɹöθlˠ	äɹtɪst	ɸˠɪsɪlˠ	mãɹʃɪz
GM4	bɪtɹöðəlˠ	ʔäɹtɪst	wɪsɪlˠ	mãɹʃɪz
EF1	bɪtɹɔθɯ	ʔäɹtˢɪst	ʍɪsɯ	mãɹʃɪz
EF2	bɪtɹoðəlˠ	ʔäɹtɪst	ɸˠɪsɯ	mãɹʃɪz
EF3	bɪtˢɹoðəlˠ	ʔäɹtˢɪst	ɸˠɪslˠ	mãɹʃɪz
EF4	bɪtɹoðɪlˠ	ʔäɹtɪst	ɸˠɪsəlˠ	mãɹʃɪz
EM1	bɪtɹɔθɪlˠ	ʔäɹtɪstˢ	wɪslˠ	mãɹʃɪz
AF1	bɪtɹoðlˠ	ʔäɹtɪst	ɸˠɪsɯ	mãɹʃɪz
AM1	bɪtɹɔθlˠ	ʔaɹtɪst	ʍɪslˠ	mãɹʃɪz

	25 buckle	26 raider	27 quid	28 surface
GF1	bʌkʰɫ	ɹedᶻɫ	kɪ̞ˠʷɪdᶻ	sɜɹfɪs
GF2	bʌkʰɫˠ	ɹedɪɹ	kʷɪd	sʌɹfɪs
GF3	bʌkʰɪlˠ	ɹedɪɾ	kʍɪd	sɜɹfɪs
GF4	bʌkʰəlˠ	ɾedɪɾ	kʍɪd	sʌɹfɪs
GF5	bʌkʰəlˠ	ɾedɪɹ	kɸˠɪd	sʌɹfɪs
GM1	bʌkʌlˠ	ɹedʌɹ	kʷɪd	sʌɹfɪs
GM2	bʌkᵊlˠ	ɹɪdɪɾ	kʷɪd	sʌɹfɪs
GM3	bʌkᵊlˠ	ɹedɪɹ	kʷɪd	sʌɹfɪs
GM4	bʌkˣʰəlˠ	ɹedɪɹ	kʷɪd	sʌɹfɪs
EF1	bʌklˠ	ɹedᵊəɹ	kʷɪdᶻʰ	səɹfəs
EF2	bʌklˠ	ɹedɹ	kʍɪd	sʌɹfəs
EF3	bʌkəlˠ	ɹedɪɹ	kʷɪdᶻ	sʌɹfɪs
EF4	bʌkəlˠ	ɹedəɹ	kᵉʷɪd	sʌɹfɪs
EM1	bʌkʰɪlˠ	ɫedɪɫ	kʷɪd	sɜɹfɪs
AF1	bʌkɫ	ɹedɪɹ	kᵉˠʷɪd	sɜɹfɪs
AM1	bʌkʰɪlˠ	ɹedɪɹ	kʍɪd	sʌɹfɪs

	29 twaddle	30 curler	31 Arthur	32 when
GF1	tʷɔdˡlʲ	kɚɫlʲəɹ	ʔaɹθəɹ	ʍɛn
GF2	tʷɔdˡlˠ	kɚɫlʲɪɫ	ʔäɹθəɹ	ʍɛn
GF3	tʍɔdˡlˠ	kʌɹlˠɪɾ	ʔäɹθɪɾ	ʍɛn
GF4	tɸˠɔdᵊlˠ	kʌɾlˠɪɾ	ʔäɹθɪɾ	ʍɛn
GF5	tʍɔdəlˠ	kʰʌɾlˠəɹ	ʔäɹθəɹ	ʍɛn
GM1	tɸˠʷɔdˡlˠ	kʌɹlˠʌɹ	ʔaɹθʌɹ	wɛn
GM2	twädˡlˠ	kʌɹlˠəɾ	ʔäɹθəɾ	wɛn
GM3	tʷɔdᵊlˠ	kʌɾlˠʌɹ	ʔäɹθəɹ	ʔʍɛn
GM4	tɸˠɔdᵊlˠ	kʌɹlˠʌɹ	ʔäɹθɪɹ	wɛn
EF1	tˢwɔdˡlˠ	kʌɹlˠʌɹ	ʔaɹθʌɹ	ʍɛ̃n
EF2	tʷɔdˡlˠ	kɚɹlˠɚɫ	ʔäɹθəɹ	ɸˠɛ̃n
EF3	tˢwɔdɪlˠ	kʌɫlˠəɹ	ʔaɹθɪɹ	ɸˠɛ̃n
EF4	tᵉˠwɔdəlˠ	kʌɹlˠəɹ	ʔäɹθɪɹ	ɸˠɛ̃n
EM1	twɔdˡlˠ	kʌɫlˠɪɫ	ʔaɫθɪɹ	wɛ̃n
AF1	tʷwɔdˡlˠ	kʌɹlˠʌɹ	ʔaɹθʌɹ	ɸˠɛ̃n
AM1	tʍɔdɪlˠ	kɜɹlˠɪɹ	ʔaɹθɪɹ	ʍɛ̃n

	33 urchin	34 odder	35 dwindle	36 here
GF1	ʔɚɻʔ̚tʃən	ɔ̃dɚɻ	dwɪndᵗlˠ	iiɻ
GF2	ʔʌɹʔ̚tʃɪn	ʔɔ̃dɪɹ	dwɪndᵊlˠ	iiɾ
GF3	ʔʌ̃ɹʔ̚tʃɪn	ʔɔ̃dɪɹ	dwɪndᴸlˠ	iiɹ
GF4	ʔʌɹʔ̚tʃɪn	ʔɔdɪɾ	dwɪndᵊlˠ	iiɹ
GF5	ʔʌɹʔ̚tʃɪn	ʔɔ̃dɪɹ̥	dwɪndᵊlˠ	iʊɹ
GM1	ʔʌɹʔ̚tʃɨn	ʔɔ̃dəɹ̥	dwɪndᴸlˠ	iʊɹ
GM2	ʔʌɹʔ̚tʃɪn	ɔ̃dɪɾ	dwɪndˡlˠ	iʊɹ
GM3	ʔʌɹʔ̚tʃɪn	ʔɔ̃dəɾ	dwɪndˡlˠ	iiɹ
GM4	ʔʌɹʔ̚tʃɪn	ʔɔ̃dəɹ	dwɪndᵊlˠ	iiɹ
EF1	ʔʌɹʔtʃɪn	ʔɔ̃dɹ	dwɪndlˠ	ʊiɹ
EF2	ʔɔɹʔ̚tʃɪn	ʔɔ̃dəɹ	dwɪndəlˠ	ʊʊᵊɹ
EF3	ʔʌ̃ɹʔ̚tʃən	ʔɔ̃dᶻɪɹ	dwɪndᴵlˠ	ʊʊɹ
EF4	ʔʌɻʔ̚tʃɪn	ʔɔ̃dəɹ	dwɪndəlˠ	ʊʊᴵɹ
EM1	ʔʌɻʔ̚tʃɪn	ʔɔ̃dᶻɪɹ	dwɪndˡlˠ	iʊᴵɻ
AF1	ʔʌ̃ɻtʃɪn	ʔɔ̃dɪɹ	dwɪndˡlˠ	iiᵊɹ
AM1	ʔɜɹʔ̚tʃɪn	ʔɔ̃dɪɹ	dwɪndᵊlˠ	iʊᴵɹ

	37 redder	38 loader	39 Welsh	40 squat
GF1	ɹɛ̃dɪɹ	lʊ̃dᶻɪɹ	wɛ̃ɰʃ	skᴱʷwɔ̃ʔtˢ
GF2	ɹɛ̃dɪɹ	tˠʊ̃dɪɹ	wɛ̃ɰʃ	skwɔ̃ʔtˢ
GF3	ɹɛ̃dɪɾ	lˠʊ̃dɪɾ	wɛ̃ɰʃ	skwɔ̃tˀ
GF4	ɹɛ̃dɪɾ	lˠʊ̃dɪɹʔ	wɛɰʃ	skwɔ̃ʔ̚t
GF5	ɹɛdɪɹ̥	lˠʊ̃dɪɹ	wɛ̃ɰʃ	skwɔ̃ʔ̚tˢʰ
GM1	ɹɛ̃dəɹ	lˠʊ̃dəɹ	wɛ̃ᴵɰʃ	skᴱʷwɔ̃ʔ̚tˢʰ
GM2	ɹɛdɪɹ	lˠʊ̃dɪɾ	wɛ̃ɰʃ	skwɔ̃ʔ
GM3	ɹɛ̃dɪɾ	lˠʊ̃dɪɾ	wɛ̃ɰʃ	skwɔ̃ʔ
GM4	ɹɛ̃dɪɹ	lˠʊdəɹ	wɛ̃ɰʃ	skwɔ̃ʔ̚t
EF1	ɹɛ̃dᶻɹ	lˠʊ̃dᶻəɹ	wɛ̃ɰʃ	skwɔ̃ʔ̚t
EF2	ɹɛdᶻəɹ	lˠʊ̃dᶻɹ	wɛ̃ɰʃ	skwɔ̃ʔ̚t
EF3	ɹɛ̃dᶻɪɹ	lˠʊ̃dᶻɪɹ	wɛ̃lˠʃ	skwɔ̃ʔ̚tˢ
EF4	ɹɛ̃dɪɹ	lˠʊ̃dɹʔ	wɛ̃ɰʃ	skᴱʷwɔ̃ʔ̚tʰ
EM1	ɹɛ̃dɪɻ	lˠʊ̃dɪɻ	wɛ̃ɰʃ	skwɔ̃ʔ̚tˢʰ
AF1	ɹɛ̃dɪɹ	lˠʊ̃dɪɹ	wɛ̃lˠʃ	skwɔ̃ʔ̚tˢ
AM1	ɹɛ̃dɪɹ	lˠʊ̃dɪɻ	wɛ̃ɰʃ	skwɔ̃tˢ

	41 Gwen	42 murky	43 urgent	44 queen
GF1	gwɛ̃n	mɜ˞ɹke	ʔɜ˞ɹdʒɪnt'	kɪʸĩn
GF2	gwɛ̃n	mʌ˞ɹke	ʔʌ˞ɹdʒɛ̃nʔt	kw̥ĩn
GF3	gwɛ̃n	məɹke	ʔəɹdʒɪ̃nʔ	kɪʸĩn
GF4	gwɛ̃n	mʌɹke	ʔʌɹdʒɪ̃nʔ	kɪʸĩn
GF5	gwɛ̃n	mʌɹke	ʔʌɹdʒɪ̃nʔtʰ	kɪʸĩn
GM1	gwɛ̃n	mʌɹke	ʔʌɹdʒɪ̃nʔtʰ	kɪʸĩn
GM2	gwɛ̃n	mʌɹke	ʔʌɹdʒɪ̃nʔ	kɪʸĩn
GM3	gwɛ̃n	mʌɹke	ʔʌɹdʒɪ̃nʔt	kw̥ĩn
GM4	gwɛ̃n	mʌɹke	ʔʌɹdʒə̃nʔ	kɪʸĩn
EF1	gwɛ̃n	mʌɹke	ʔʌɹdʒə̃nʔ	kw̥ĩn
EF2	gwɛ̃n	mʌɹke	ʔʌɹdʒə̃nʔt	kɪʸĩn
EF3	gwɛ̃n	mʌɹke	ʔʌɹdʒɪ̃nt	kɪʸĩn
EF4	gwɛ̃n	mʌɹke	ʔʌɹdʒɪ̃nʔtʰ	kɪʸĩn
EM1	gwɛ̃n	məɹki	ʔɪɹdʒɪ̃nʔt	kʸwĩn
AF1	gwɛ̃n	mʌɹki	ʔʌɹdʒə̃nt	kɪʸĩn
AM1	gwɛ̃n	mɜɹke	ʔɜɹdʒɪ̃nʔt	kmĩn

	45 saddler	46 rudder	47 ribbon	48 pure.
GF1	sädɪɹ	ɹʉdɪɹ	ɹɪbɪn	pjʉɹ
GF2	sädəɹ	ɹʉdəɹ	ɹɪbɪn	pjʉɹ
GF3	sädəɾ	ɹʉdəɾ	ɹɪbɪn	pçʉɹ
GF4	sädɪɾ	ɹʉdɪɾ	ɹɪbɪn	pçʉɾ
GF5	sädɪɹ	ɾʉdɪɹ	ɾɪbɪn	pçʉɹ
GM1	sädɪɹ	ɹʉdɪɹ	ɹɪbɪn	pjʉɪɹ
GM2	sädɪɾ	ɹʉdɪɾ	ɹɪbɪn	pjʉɹ
GM3	sädɪɾ	ɾʉdɪɾ	ɾɪbɪn	pjʉɹ
GM4	sädɪɹ	ɹʉdɪɹ	ɹɪbɪn	pjʉɹ
EF1	sädɹ	ɹʉdᶻɹ	ɹɪbɪn	pjʉɹ
EF2	sädᶻəɹ	ɹʉdᶻəɹ	ɹɪbɪn	pçjʉɹ
EF3	sädɪɹ	ɹʉdᶻɹ	ɹɪbɪn	pjʉɪɹ
EF4	sädɪɹ	ɹʉdɪɹ	ɹɪbɪn	pjʉɪɹ
EM1	sädɪɹ	ɹʉdɪɹ	ɹɪbɪn	pçjʉɪɹ
AF1	sädəɹ	ɹʉdɪɹ	ɹɪbɪn	pçjʉɹ
AM1	sädɪɹ	ɹʉdɪɹ	ɹɪbɪn	pjʉɪɹ

	49 where	50 joiner	51 rather	52 liver
GF1	weᶦɹ	dʒɔ̝ɛnəɹ	ɹäðɪɹ	lʲɪvɪɹ
GF2	ʍʷeᶦɹ	dʒɔ̝ɛnəɹ	ɹäðəɹ	lʲɪvəɹ
GF3	ɸˠeᶦɹ	dʒɔ̝ɛnəɹ	ɹäðəɹ	lˠɪvɪɾ
GF4	ɸˠɛ̝ɾ	dʒɔ̝ɛnəɹ	ɾäðɪɹ	lˠɪvɪɾ
GF5	ʍeᶦɹ	dʒɔ̝ɛnɪɹ̥	ɾäðɪɹ̥	lˠɪvɪɹ̥
GM1	weᶦɹ	dʒɔ̝ɛnɪɹ	ɹäðɪɹ̥	lˠɪvɪɹ
GM2	wɛ̝ɹ	dʒɔ̝ɛnɪɾ	ɹäðɪɾ	lʲɪvɪɾ
GM3	ʍeᶦɹ	dʒɔ̝ɛnɪɾ	ɹäðɪɾ	lˠɪvɪɾ
GM4	wɛᵊɹ	dʒɔ̝ɛnɪɹ	ɹäðɪɹ	lˠɪvɪɹ
EF1	ʍʷeɹ	dʒɔɛnɪɹ	ɹäðəɹ	lˠɪvɪɹ
EF2	ʍ. eɹ	dʒɔ̃ɛnɪɹ	ɹäðəɹ	lˠɪvɪɹ̊
EF3	ɸˠeɹ	dʒɔɛnɪɹ	ɹäðɪɹ	lˠɪvɪɹ
EF4	ɸˠɛᶦɹ	dʒɔɛnɪɹ	ɹäðɪɹ	lˠɪvɪɹ
EM1	wɛᶦɹ	dʒɔɛnɪɹ	ɹäðɪɹ	lʲɪvɪɹ
AF1	ɸˠeɹ	dʒɔɪnəɹ	ɹäðəɹ	lʲɪvəɹ
AM1	ʍeᶦɹ	dʒɔɛnɹ	ɹäðɪɹ	lʲɪvɪɹ

	53 err	54 quit	55 jar	56 dinner
GF1	ʔɛᵊɹ	kᶲʷɪtʾ	dʒäɹ	dɪ̃nɪɹ
GF2	ʔɛᶦɹ	kwɪʔt	dʒäɹ	dɪ̃nɪɹ
GF3	ʔɛᶦɹ	kɸˠɪʔtʰ	dʒäɹ	dɪ̃n̪ɪɹ
GF4	ʔɛɾ	kɸˠɪʔ	dʒäɹʔ	dɪ̃nɪɾ
GF5	ʔɛɹ̥	kʍɪʔtˢʰ	dʒäɾ	dɪ̃nɪɾ
GM1	ʔɛᶦɹ	kɸˠɪʔtˢʰ	dʒäɹ	dɪ̃nɪɹ
GM2	ʔɛɾ	kᶲʷwɪʔ	dʒäɹ	dɪ̃nɪɾ
GM3	ʔɛɹ	kʍɪʔt	dʒäɾ	dɪ̃n̪ɪɹ
GM4	ʔɛɹ	kʍɪtʾ	dʒäɹ̥	dɪ̃nɪɹ
EF1	ʔɛɹ	kʷwɪʔtˢ	dʒäɹ	dɪ̃n̪ɪɹ
EF2	ʔɛɹɹ	kʍɪʔtˢ	dʒäɹ	dɪ̃n̪ɪɹ
EF3	ʔɛɹ	kɸˠɪtˢ	dʒäɹ	dɪ̃nɪɹ
EF4	ʔɛᶦɹ	kɸˠɪtʾ	dʒäɹ	dɪ̃n̪ɪɹ
EM1	ʔɛᶦɹ	kɸˠɪʔt	dʒäɹ	dɪ̃nɪɹ
AF1	ʔɛɹ̊	kʍɪʔt	dʒäɹ	dɪ̃nɪɹ
AM1	ʔɛᶦɹ	kʍɪʔtˢ	dʒäɹ	dɪ̃nɪɹ

	57 Lather	58 rigged	59 well	60 tyre
GF1	lˠäθɪɹ	ɹɪg˺d	wɛlˠʔ	tˀäeᴵɹ
GF2	lǟðəɹ	ɹɪg˺d	wɛ̄lˠ	tʰäeᴵɹ
GF3	läðəɻ	ɹɪg˺d̥	wɛ̄lˠ	tʰäeᵊɻ
GF4	lˠaðəɻ	ɹɪg˺d̥	wɛ̄lˠ	tʰäeᵊɹ
GF5	lˠǟðɪɻ̥	ɻɪg˺d	wɛlˠ	tʰäeᵊɹ̥
GM1	lˠäðɪɹ	ɹɪg˺d̥	wɛɯ	tʰäeᴵɹ
GM2	lˠäðɪɻ	ɹɪg˺d̥	wɛlʳ	tʰäeᴵɹ
GM3	lˠäðɪɻ	ɹɪg˺d̥	wɛlˠ	tʰäeɪɻ
GM4	lʳäðɪɹ	ɹɪg˺d̥	wɛlˠ	tsʰäeᴵɹ
EF1	lˠaðɪɹ	ɹɪg˺d	wɛlˠ	tʰʌɪɹ
EF2	lˠaðɹ̩	ɹɪgd̥	wɛlʳ	täeᵊɹ
EF3	lˠäðɪɹ	ɹɪgd̥	wɛlˠ	tʰäeɹ
EF4	lˠäðᴵɹ	ɹɪg˺d̥	wɛ̄ɪlˠ	tʰäeᴵɹ
EM1	lˠäðɪɹ	ɹɪg˺dᶻ	wɛ̄ɪlˠ	täeᴵɹ
AF1	lʳäðəɹ	ɹɪgd̥	wɛ̄lˠ	tʌɪəɹ
AF2	lǟðɪɹ	ɹɪgd	wɛ̄lˠ	tʰʌɪəɹ

	61 pour	62 nor	63 choir	64 louder
GF1	po̞ᵊɹ	no̞ᵊɹ	kʷäeᵊɹ̥	lʲʌʉdɪɹ
GF2	pʰo̞ɹ	no̞ɹ	kwäeᵊɹ	lʲʌʉdəɹ
GF3	pʰoɹ	nɔɻ	kɪˠäeᵊɻ	lˠʌʉdəɹ
GF4	pʰoɻ	nɔɻ	kɪˠäeᵊɹ	lˠʌʉdᶻəɻ
GF5	pʰo̞ɹ̥	nɔɻ̥	kʍäeᵊɻ̥	lˠʌʉdəɹ̥
GM1	pʰoɪɹ	nɔɪɹ	kˣw̥äeɪɹ	lʳʌʉdəɹ
GM2	poɻ	nɔɻ	kˣw̥äeɪɻ	lˠʌʉdɪɹ
GM3	pʰoɻ	noɻ	kw̥äeɪɻ	lˠʌʉdɪɻ
GM4	pʰoᵊɹ̥	nɔɻ̥	kw̥äeɪɹ	lʳʌʉdɪɹ
EF1	pʰoɹ	nɔɹ	kw̥aeɹ	lˠʌʉd̥əɹ
EF2	poɹ	noɹ	kw̥äeɹ	lˠʌʉdɹ
EF3	pʰoɹ	nɔɹ	kw̥äeɹ	lˠʌʉdᶻɪɹ
EF4	pʰoɪɹ	nɔɹ	kw̥äeɪɹ	lˠʌʉdɪɹ
EM1	poɪɹ	noɹ	kw̥äeɪɹ	lʳʌʉdɪɹ
AF1	poᵊɹ	nɔɹ̥	kʍäeᵊɹ	lˠʌʉdəɹ
AM1	pʰoᵊɹ	nɔᵊɹ	kʍʌɪᵊɹ	lˠʌʉd̥ᶻɪɹ

	65 warm	66 fur	67 clean	68 whack
GF1	wɔɹ̃m	fɚɹ	kʰlʲĩn	wäʔk
GF2	wɔɹ̃m	fʌɹ	k̥lʲĩn	mäkʼ
GF3	wɔɹ̃m	fʌɹ	klˠĩn	wäʔk
GF4	wɔɹ̃m	fʌɹ	klˠĩn	mäk
GF5	wɔɾɪ̃m	fʌɾ	k̥lˠĩn	mäʔkʰ
GF1	wɔɹɪ̃m	fʌɹ	klˠĩn	waʔkʰˣ
GM2	wɔɹ̃m	fʌɾ	klˠĩn	wäk
GM3	wɔɹ̃m	fʌɾ	k̥lˠĩn	mäkʼ
GM4	wɔɾɪ̃m	fʌɹ	klˠĩn	wäkʼ
EF1	wɔɹm	fʌɹ	klʲin	ɸˠäɹk
EF2	woɹm	fəɹ	kʰlˠin	mäk
EF3	wɔɹm	fʌɹ	kʰlʲin	mäkʰ
EF4	wɔɹm	fʌɹ	kʰlʲin	ɸˠaʔk
EM1	wɔɹm	fʌɹ	kʰlʲin	wäkʼ
AF1	wɔɹm	fʌɹ	kʰlˠin	mäʔkʰ
AM1	wɔɹm	fʌɹ	kʰlˠin	maʔkʰ

	69 leather	70 never	71 rudder	72 Ethel
GF1	lˠɛðɪɹ	nɪ̃vɪɹ	ɹʌdɪɹ	ʔɛθlˠ
GF2	lʲɛðɪɹ	nɪ̃vɪɹ	ɹʌdɪɹ	ʔɛθɪlˠ
GF3	lˠɛðɪɾ	nɪ̃vɪɾ	ɹʌdɪɾ	ʔɛθɪlˠ
GF4	lˠɛðɪɹ	nɪ̃vɪɾ	ɹʌdɪɾ	ʔɛθəlˠ
GF5	lˠɛðɪɹ	nɪ̃vɪɹ	ɾʌdɪɹ	ʔɛθəlˠ
GM1	lˠɛðəɹ	nɪ̃vəɹ	ɹʌdəɹ	ʔɛθəlˠ
GM2	lˠɛðɪɾ	nɪ̃vɪɾ	ɹʌdɪɾ	ɛθlˠ
GM3	lˠɛðɪɾ	nɪ̃vɪɹ	ɹʌdɪɾ	ʔɛθəlˠ
GM4	lˠɛðɪɹ	nɪ̃vɪɹ	ɹʌdəɹ	ʔɛθəlˠ
EF1	lˠɛðəɹ	nɛ̃vəɹ	ɹʌdɪɹ	ʔɛθlˠ
EF2	lˠɛðɪɹ	nɪ̃vɪɹ	ɹʌdᶻɪɹ	ʔɛθɪlˠ
EF3	lˠɛðɪɹ	nɪ̃vɪɹ	ɹʌdɪɹ	ʔɛθɪlˠ
EF4	lˠɛðɪɹ	nɛ̃vɪɹ	ɹʌdɪɹ	ʔɛθɪlˠ
EM1	lˠɛðɪɹ	nɛ̃vɪɹ	ɹʌdɪɹ	ʔɛθɪlˠ
AF1	lˠɛðɪɹ	nɛ̃vəɹ	ɹʌdəɹ	ʔɛθɪlˠ
AM1	lˠɛðɪɹ	nɪ̃vɪɹ	ɹʌdɪɹ	ʔɛθɪlˠ

	73. quaint	74. sour	75 roll	76 blinked
GF1	kweɪnt	sʌʉɪɹ	ɹoʊ	blʲɪŋkʼt
GF2	kweɪntˀ	sʌʉəɹ	ɹoɫˠ	blˠɪŋʔkʰ
GF3	kʍeɪnt	sʌʉəɾ	ɹoʊ	blˠɪŋʔt
GF4	kʍeɪnʔtʰ	sʌʉəɾ	ɹoɫˠ	blˠɪŋʔt
GF5	kʍeɪnʔtˢʰ	sʌʉəɹ	ɹoɫˠ	blˠɪŋʔkʼt
GM1	kɸˠeɪnʔtˢʰ	sʌʉəɹ	ɾoɫˠ	blˠɪŋʔkʰtˢʰ
GM2	kweɪnʔ	sʌʉɪɾ	ɹoʊ	blˠɪŋkʼtˢʰ
GM3	kʍeɪnʔtˢʰ	sʌʉɪɾ	ɹoɫˠ	blˠɪŋʔtˢʰ
GM4	kʍʷeɪntˀ	sʌʉəɹ	ɹoɫˠ	blˠɪŋʔkʼtˢʰ
EF1	kwẽnʔ	sʌʉ əɹ	ɹoɫˠ	blˠɪŋʔkʼt
EF2	kweɪnʔtˢ	sʌʉɹ	ɹoʊ	blˠɪŋʔktˢ
EF3	kweɪnʔtˢ	sʌʉɪɹ	ɹoɫˠ	blʲɪŋʔkʼt
EF4	kweɪnʔtʰ	sʌʉɪɹ	ɹoʊ	blˠɪŋʔkt
EM1	kʍeɪnʔtˢ	sʌʉɪɹ	ɹoʊ	blˠɪŋʔt
AF1	kwẽnʔtˢ	sʌʉəɹ	ɹoɫˠ	blˠɪŋktˢ
AM1	kʍeɪntˀ	sʌʉɪɹ	ɹoɫˠ	blˠɪŋktˢ
			ɹoɫˠ	blˠɪŋkʼtˢʰ

	77. humour	78. warn	79 glutton	80 plucked
GF1	çʲʉmɪɹ	wɔəɹn	glʲʌtⁿn̩	plʲʌʔkʼtˢʰ
GF2	çʉməɹ	wɔəɹn	glˠʌtˢn̩	plˠʌʔtʰ
GF3	çʉmɪɾ	wɔɪɹn	glˠʌʔn̩	pʰlˠʌʔt
GF4	çjʉməɹ	wɔɹn	glˠʌtən	pʰlˠʌʔkʼt
GF5	çjʉmɪɹ	wɔɾɪn	glˠʌtən	pʰlˠʌʔkʰtˢʰ
GF1	çəmɪɹ	wɔɪɹn	glˠʌtˢən	plˠʌʔkʰtʰ
GM2	çʉmɪɹ	wɔəɹn	glˠʌʔn̩	plˠʌʔt
GM3	çʉmɪɹ	wɔɹn	glˠʌlɪn	plˠʌʔt
GM4	çʉmɪɹ	wɔəɹn	glˠʌtɪn	plˠʌʔkʼt
EF1	jʉmɪɹ	wɔɹn	glˠʌtⁿn̩	plˠʌʔkʼtˢ
EF2	çjʉmɪɹ	wɔɹn	glˠʌʔn̩	plˠʌʔkʼtˢ
EF3	çjʉmɪɹ	wɔɹn	gʰlˠʌtˢɪn	pʰlˠʌʔkʼtˢ
EF4	çjʉmɪɹ	wɔɪɹn	glˠʌʔn̩	pʰlˠʌʔkt
EM1	çjʉmɪɹ	wɔɾɹn	glˠʌtˢɪn	pʰlˠʌʔktˢʰ
AF1	çjʉməɹ	wɔɹn	glˠʌtˢn̩	pʰlˠʌʔkt
AM1	çjʉmɪɹ	wɔəɹn	glˠʌtⁿn̩	pʰlˠʌktˢʰ

	81. hurt	82. Laser	83. quack	84. question
GF1	ʌ̃ʌ̃ɹʔ̚t	lˠɛ̈zɪɹ	kwaʔ̚k	kʷɛʃt̠ʃɪn
GF2	ʌ̥ʌ̃ɻʔ̚tˢ	lʲɛ̈zəɹ	kw̥äʔ̚k	kwɛʃtʃɪ̠n
GF3	ə̥əɹʔ̚t	lɛ̈zɪɾ	kɸˠa kʾ	kwɛ̠ttʃɪn
GF4	ʌ̥ʌɪ̠t	lˠɛ̈zɪɾ	kɸˠäʔ̚kʰ	kɸˠɛ̠ʃtʃɪn
GF5	ʌ̥ʌɹʔ̚tˢʰ	lˠɛ̈zɪɾ̥	kʍäʔ̚kʷ	kʷɛ̈ʃtʃɪn
GM1	ʌ̥ʌɹʔ̚tʰ	lˠɛ̈zɪ̠ɹ	kwäʔkʰ	kɸˠɛ̠ʃtʃɪ̠n
GM2	ʌ̥ʌɹʔ	lɛ̈zɪɹ	kʍä k	kwɛ̈ʃt̠ʃɪn
GM3	ʌ̥ʌɹʔ̚t	lˠɛ̈zɪɾ	kʍäʔ̚k	kʍɛ̈ʃtʃn̩
GM4	ʌ̥ʌɹʔ̚t	lˠɛ̈zɪɹ	kʍäʔ̚k	kʍɛʃːən
EF1	ʌ̥ʌɹʔ̚t	lˠɛ̈zɪɹ	kw̥äʔ̚k	kw̥ɛʃt̠ʃɪn
EF2	ʌ̥ʌɹʔ̚t	lˠɛ̈zəɹ	kw̥äk	kw̥ɛstʃɪn
EF3	ʌ̥ʌɹt	lˠɛ̈zɪɹ	kɸˠäʔk̚t	kw̥ɛstʃɪn
EF4	ʌ̥ʌ̃ɻʔ̚tˢʰ	lʲɛ̈zɪɹ	kw̥aʔ̚k	kɸˠɛ̈ʃt̠ʃɪn
EM1	ʌ̥ʌ̃ɻʔ̚tˢʰ	lˠɛ̈zɪɻ	kwäʔkʰ	kw̥ɛstʃɪn
AF1	ʌ̥ʌɹʔ̚tˢ	lˠɛ̈zəɹ	kᶲˠwäʔ̚k	kw̥ɛʃːɪn
AM1	ʌ̥ʌɹt	lˠɛ̈zɪɹ	kʍäk	kw̥ɛʃtʃɪn

	85. Tudor	86. absurd	87. quite	88. leopard
GF1	tʃʉ̈dɪɹ	ʌbsʌ̃ɹd	kw̥ʌɪʔ̚t	lʲɛpʰəɹd
GF2	tʃʉ̈dɪɹ	ʌbsʌɹd	kwʌɪt̚	lʲɛpəɹd
GF3	tʃʉ̈dɪɾ	ʌbsʌɹd	kᶲˠwäɛ̈əʔ	lˠɛpɪɹd
GF4	tʃʉ̈dɪɾ	ʌbsʌɹd	kʍʌɪt	lˠɛpʰɪɹd
GF5	tʃʉ̈dɪɹ	ʌbzʌɹd	kʍʌɪt̚	lˠɛpʰɪɹd
GM1	tʃʉ̈dɪɹ̥	ʌbsʌɹd	kw̥ʌɪʔ̚tʰ	lˠɛpʌɹd
GM2	tʃʉ̈dɪɾ	ʌbsʌɹd	kw̥ʌɪʔ	lˠɛpʌɹd
GM3	tʃʉ̈dɪɾ	ʌbsʌɹd	kʍʌɪʔ̚tʰ	lˠɛpʰəɹd
GM4	tʃʉ̈dɪɹ	əbsʌɹd	kʍʌɪʔ̚t	lˠɛpəɹd
EF1	tʃʉdɪɹ	ʌbsʌɹd	kwʌɪʔ̚t	lˠɛpəɹd
EF2	tʃʏ̈dəɹ	ʌbsʌɹd	kwʌɪʔ̚tˢ	lˠɛpəɹd
EF3	tʃʉ̈dɪɹ	ʌbsʌ̃ɹd	kɸˠʌɪtˢ	lˠɛpɪɹd
EF4	tʃʉ̈dɪɪ̠	ʌbsʌɹd	kᶲˠwʌɪt̚	lˠɛpɪɹd
EM1	tʃʉdɪɹ	ʌbzəɹd̥ᶻ	kɸˠʌɪʔ̚tˢʰ	lˠɛpɪɹdᶻ
AF1	tʃʉdɪɹ	əbsəɹd	kᶲˠwʌɪʔ̚t	lˠɛpʰəɹd
AM1	tʃʉdɪɹ̥	ʌb̥sʌɹd	kʍʌɪtˢʰ	lˠɛpʼɪɹd

	89. church	90. weeds	91. odour	92. quote
GF1	tʃɝɹʔ̚tʃ	widz	odəɹ	kw̥ot̚
GF2	tʃʌɹʔ̚tʃ	widz	ʔodɪɹ	kwoʔ̚tʰ
GF3	tʃəɹʔ̚tʃ	widz	ʔodɪɹ	kʍoʔ
GF4	tʃʌɹʔ̚tʃ	widz	ʔodɪɾ	kʍoʔ̚t
GF5	tʃʌɹʔ̚tʃ	widz	ʔodɪɾ̥	kʍoʔ̚tˢʰ
GM1	tʃʌɹʔ̚tʃ	wiːdz	ʔodɪɹ	kɸoʔ̚tˢʰ
GM2	tʃʌɹʔ̚tʃ	wiːdz	ʔodɪɾ	kwoʔ
GM3	tʃɝɹʔ̚tʃ	wiːdz	ʔodɪɾ̥	kʍot
GM4	tʃʌɹʔ̚tʃ	wiːdz	ʔodɪɹ	kʍoʔ̚t
EF1	tʃɪɹʔ̚tʃ	widz̥	ʔodᶻɪɹ	kw̥oʔ̚tˢ
EF2	tʃəɹʔ̚tʃ	widz̥	ʔodᶻəɹ	kw̥oʔ̚tˢ
EF3	tʃɝɹʔ̚tʃ	widz	ʔodɪɹ	kɸotˢ
EF4	tʃʌɹʔ̚tʃ	wiːdz	ʔodəɹ	kᶲw̥ot
EM1	tʃɝɹʔ̚tʃ	wiːdz	ʔodɪɹ	kʍoʔ̚tˢʰ
AF1	tʃɪɹʔtʃ	widz	ʔodəɹ	kwoʔ̚tˢ
AM1	tʃɪ̈ɹʔ̚tʃ	widz	ʔodəɹ	kʍotˢ

	93. park	94. rotten	95. harp	96. quarrel
GF1	pʰäɹk̚	ɹɔtʰn̩	ḁäɹʔ̚pʰ	kw̥ɔɹəɰ
GF2	pʰäɹk̚	ɹɔtˢɪn	ḁäɹʔ̚p	kwɔɹəlˠ
GF3	pʰäɹk̚	ɹɔtˢɪn	ḁäɹp̚	kɸɔɾ̥ɪlˠ
GF4	pʰäɹk	ɹɔtɪn	ḁäɹp	kʍɔɾɪlˠ
GF5	pʰäɹʔ̚kˣʰ	ɾ̥ɔtɪn	ḁäɹʔ̚pʰ	kʍɔɾɪlˠ
GM1	pʰäɹʔ̚kʰ	ɹɔt̥ən	ḁäɹʔpʰ	kɸɔɹəlˠ
GM2	pʰäɹk	ɹɔʔɪn	ḁäɹp	kwɔɾ̥əlˠ
GM3	pʰäɹ̥k	ɹɔʔn̩	ḁäɹpʰ	kᶲwɔɹɪlˠ
GM4	pʰäɹʔ̚k	ɹɔtˢɪn	ḁäɹʔ̚p	kʍɔɾɪlˠ
EF1	pʰäɹʔ̚k	ɹɔtʰn̩	ḁäɹʔ̚p	kwɔɹəlˠ
EF2	pʰäɹk	ɹɔtʰn̩	ḁäɹp	kw̥ɔɹəlˠ
EF3	pʰäɹk	ɹɔtˢɪn	ḁäɹp	kwɔɹəlˠ
EF4	pʰäɹk̚	ɹɔʔn	ḁäɹp	kw̥ɔɹɪlˠ
EM1	päɹʔkʰ	ɹɔtˢʰɪn	ḁäɹp	kᶲw̥ɔɾɪlˠ
AF1	pʰäɹʔ̚k	ɹɔtˢən	ḁäɹʔp	kʍɔɹɪɰ
AM1	pʰäɹkʰ	ɹɔʔn̩	ḁäɹp	kʍɔɹɪlˠ

	97. slammed	98. Kerb	99. what	100. child
GF1	sˠlʲämd	kɛ̆ˀɹb	wɔ̝t̚	tʃʌ̝i̝ɰd
GF2	s̥lˠämd̥	kɛ̆ɹb	ʍɔ̝ʔ̚tʰ	tʃʌ̝i̝ɰd
GF3	s̥tämd	kəɹb	ʍɔ̝ɪ̝tʰ	tʃʌ̝i̝ɰd
GF4	s̝lämd̥	kəɹb	ʍɔ̝ɪ̚t	tʃʌ̝i̝ɰd
GF5	sˠlämɪ̚tˢ	kɛ̆ɹb	ʍɔ̝ɪ̚tˢʰ	tʃʌ̝i̝ɰd
GM1	sˠlʲämd	kɛ̆ɹb	wɔ̝ɪ̚tˢʰ	tʃʌ̝i̝ɪɰd
GM2	slˠämd	kʌ̝ɹb	wɔ̝ɪ	tʃʌ̝ɪɰd
GM3	slˠämd	kɛ̆ɾb	ʍɔ̝ɪ	tʃʌ̝i̝ɰd
GM4	slˠämd	kɛ̆ɹb̥	wɔ̝ɪ̚tʰ	tʃʌ̝i̝ɪld
EF1	slˠämd	kɛɹb	ɸˠɔɪt	tʃäɛ̆ɰd
EF2	s̥lˠämd̥	kɚɹb	ɸˠɔt̪ˢ	tʃäɛ̆ɰd
EF3	s̥lˠämd	kɛ̆ɹb	ʍɔt	tʃʌ̝i̝ɰd
EF4	slˠämd	kɜɹb	ɸˠɔt̚	tʃʌ̝ɯɰd
EM1	slˠämd̥ə̥	kʌɹb	wɔɪ̚tˢʰ	tʃäɛ̆ɪlˠd
AF1	s̥lʲä̃md	kɜ̆ɻb	mət	tʃäɛ̆ɪld
AM1	s̥l̥ˠämd	kɜɹb	ʍɔɪ̚tˢ	tʃʌ̝ɛɰd

	101 Vlad	102 serve	103 lever	104 flag
GF1	vlʲäd	sɛ̆ˀɹv	lʲi̝vɪɹ	flʲäg
GF2	vlˠäd	səɹv	lʲi̝vɪɹ	flˠäg
GF3	v̥lˠäd	səɹv	li̝vɪɾ	flˠäg
GF4	vlˠäd	sɛ̆ɹv	li̝vɪɾ̥	f̥lˠäg
GF5	v̥lˠäd	sɛ̆ɹv	lˠi̝vɪɹ̥	f̥lˠäg
GM1	v̥lˠäd	sɛ̆ɹv̥	lˠi̝vɪɹ	flˠäg̊
GM2	vlˠäd	sɛ̆ɹv	lˠi̝vɪɾ̥	flˠäg
GM3	vlˠäd	sɛ̆ɹv	lˠi̝vɪɾ	flˠäg̊
GM4	vläd	sɛ̆ɹv̥	lˠɛ̆vɪɹ	flʲäg
EF1	vlˠäd	sɚɹv	lˠi̝vɪɹ	flˠäg
EF2	ɣlˠäd	sɪ̆ɹv	lˠi̝vɹ̩	f̥lˠäg
EF3	vlˠäd	sɛ̆ɹv	lʲi̝vɪɹ	f̥lˠäg
EF4	vlˠäd	sɛ̆ɹv	lʲi̝vɪɹ	f̥lˠäg
EM1	v̥lˠäd	sɚɹv	lʲi̝vɪɻ	f̥lˠäg
AF1	vlˠäd	sɜ̆ɹv	lˠi̝vəɹ	flˠäg
AM1	vlˠäd	səɹv	lˠi̝vɪɹ	flˠäg

	105. surf	106 rider	107 veil	108 yeild
GF1	sʌɹf	ɹʌidɪɹ	veɪlˠ	jiɪlˠd
GF2	sʌɹf	ɹʌidɪɹ	veɪlˠ	jiɰd
GF3	səɹf	ɹʌidɪɾ	veɪlˠ	jiɰd
GF4	səɹf	ɾʌidɪɾ	veɪlˠ	jiɰd
GF5	səɹf	ɾʌidəɹ	veᵊlˠ	jiɰd
GM1	sʌɹf	ɹʌidɪɹ	veᵊlˠ	jiɰd
GM2	sʌɹf	ɹʌidɪɾ	velˠ	jiɰd
GM3	sʌɹf	ɹʌidɪɾ	veɪlˠ	jiɪlˠd
GM4	sʌɹf	ɹʌidɪɹ	veɪlˠ	jiɪlˠd
EF1	sʌɹf	ɹʌidɪɹ	veɪlˠ	jiɪlˠd
EF2	sʌɹf	ɹʌidᶻɪɹ	veilˠ	jiɰd
EF3	sʌɹf	ɹʌidɪɹ	veɪlˠ	djiɰd
EF4	sɪɹf	ɹʌidɪɹ	veɪlˠ	jiɰd
EM1	sʌɹf	ɹʌidɪɹ	veɪlˠ	jiɪlˠd
AF1	sʌɹf	ɹʌidəɹ	velˠ	jiəlˠd
AM1	səɹf	ɹʌedɪɹ	veɪlˠ	jiɰd

	109 serve	110 split	111. milk	112 fodder.
GF1	sɛᵊɹv	splʲɪt'	mɪɰk'	fɔdɪɹ
GF2	səɹv	splˠɪt'	mɪɰk	fɔdɪɹ
GF3	səɹv	splˠɪʔ	mɪɰk	fɔdɪɾ
GF4	səɹv	splˠɪʔ	mɪɰk	fɔdɪɾ
GF5	sɛɹv	splˠɪʔ'tˢʰ	mɪɰʔ'kʰ	fɔdɪɹ
GM1	sɛɹv̥	splˠɪʔtʰ	mɪɰk	fɔdəɹ
GM2	sɛɹv	splˠəʔ	mɪɰʔ'k	fɔdɪɾ
GM3	sɛɹv	splˠɪʔ	mɪɰk	fɔdɪɾ
GM4	sɛɹv̥	splˠɪʔ't	mɪɰk	fɔdɪɹ
EF1	sɜɹv	spʰlˠɪʔ'tˢ	mɪɰk	fɔdᶻəɹ
EF2	sɛɹv	spʰlˠɪt	mɪɰk	fɔdᶻɪɹ
EF3	sɛɹv	splʲɪt	mɪɰk	fɔdɪɹ
EF4	sɛɹv	splˠɪʔ't	mɪɰk	fɔdᶻɪɹ
EM1	sɚɹv	splˠɪʔ'tˢʰ	mɪɰʔ'kʰ	fɔdɪɹ
AF1	sɜɹv	splˠɪʔ'tˢʰ	mɪlˠʔk	fɔdəɹ
AM1	səɹv	splˠɪt'	mɪɰk	fɔdᶻɪɹ

	113. rise	114. pal	115. howl	116. earth
GF1	ɹäez	pʰä lˠ	ʌ̊ʌ ʊ̈ ɪ lˠ	ʔɪɹθ
GF2	ɹäez	pʰä lˠ	ʌ̥ʌ ʊ̈ lˠ	ʔɛ̄ɪɹθ
GF3	ɹäez	pʰä lˠ	ʌ̥ʌ ʊ̈ lˠ	ʔɛɪɹθ
GF4	ɾ̥äez	pʰä lˠ	ʌʌ ʊ̈ lˠ	ʔɛɪɹθ
GF5	ɾäez	pʰɪ̈ lˠ	ʌ̥ʌ ʊ̈ lˠ	ʔɜɪɹθ
GM1	ʔɹäez	pʰä lˠ	ʌ̥ʌ ʊ̈ə lˠ	ʔɛɪɹθ
GM2	ɹäez	pʰä lˠ	ʌ̥ʌ ʊ̈ lˠ	ʔɛɹθ
GM3	ʎäez	pʰä lˠ	ʌ̥ʌ ʊ̈ə lˠ	ʔɛ̄ɹθ
GM4	ɹäez	pʰä lˠ	ʌ̥ʌ ʊ̈ə lˠ	ʔɛ̄ɹθ
EF1	ɹäez	pʰäɰ	ʌ̥ʌ ʊ̈ ɰ	ʔɛɹθ
EF2	ɹäez	pä lˠ	ʌ̥ʌ ʊ̈ə lˠ	ʔʌɹθ
EF3	ɹäez	pʰä lˠ	ʌ̥ʌ ʊ̈ lʲ	ʔɛɹθ
EF4	ɹäez	päɰ	ʌ̥ʌ ʊ̈ə lˠ	ʔɛ̈ɹθ
EM1	ɹäez	pʰä lˠ	ʌ̥ʌ ʊ̈ə lˠ	ʔɚɹθ
AF1	ɹ̝äez	pʰä lˠ	ʌ̥ʌ ʊ̈ l	ʔəɹθ
AM1	ɹ̝äez̥	pʰä lˠ	ʌ̥ ʌ̈ ʊ̈ə lˠ	ʔəɹθ

	117. gulp	118. skliff	119. lacks	120. rags
GF1	gʌɰpʾ	sk̥lʲɪf	lʲäʔks	ɹägz̥
GF2	gʌɰpʾ	sk̥lˠɪf	lˠäks	ɹägz
GF3	gʌɰp	sk̥lˠɪf	lˠäʔks	ɹägz
GF4	gʌɯʔp	sklˠɪf	lˠäʔks	ɹ̝ägz
GF5	gʌlˠʔpʰ	sklˠɪf	lˠäʔks	ɾägz
GM1	gʌʔlˠp	sk̥lˠɪf	lˠäʔks	ɹägz
GM2	gʌlˠp	sklˠɪf	lˠäʔks	ɹägz
GM3	gʌˠlˠpʰ	sk̥lˠɪf	lˠäʔks	ɹägz
GM4	gʌɰʔp	sklˠɪf	lˠaʔks	ɹägz
EF1	gʌɰpʰ	skʰlˠɪf	lˠäɹks	ɹägz̥
EF2	gʌɰp	skʰlˠɪf	lˠäʔks	ɹägz
EF3	gʌɰp	skʰlˠɪf	lˠäʔks	ɹägz
EF4	gʌlˠp	sklˠɪf	lˠäʔks	ɹ̝ägz
EM1	gʌˠlˠpʰ	skʰlˠɪf	lˠäʔks	ɹägz
AF1	gʌɰpʰ	sklˠɪf	lˠäɹʔks	ɹägz
AM1	gʌɰp	sklˠɪf	lʲäks	ɹägz

	121 curse	122 dull	123 film	124 whoa
GF1	kʌɹs	dʌlˠ	fɪlˠm	wo
GF2	kʌɹs	dʌlˠ	fɪɯm	wo
GF3	kəɹs	dʌlˠ	fɪɯm	wo
GF4	kʌɹs	dʌlˠ	fɪlˠm	wo
GF5	kʌɹs	dʌlˠ	fɪlˠəm	wo
GM1	kʌɹs	dʌlˠ	fɪɯm	ɪˠä
GM2	kʌɹs	dʌlˠ	fɪɯm	wo
GM3	kʌɹs	dʌl	fɪˠlˠm	mo
GM4	kʌɹs	dʌlˠ	fɪlˠəm	wo
EF1	kʌɹs	dʌlˠ	fɪɯm	wo
EF2	kʌɹs	dʌlˠ	fɪɯm	wo
EF3	kʌɹs	dʌlˠ	fɪɯm	wo
EF4	kʌɹs	dʌlˠ	fɪɯm	wo
EM1	kʰʌɹs	dʌlˠ	fɪɯm	wo
AF1	kəɹs	dʌlˠ	fɪlˠm	wo
AM1	kɜɹs	dʌlˠ	fɪlˠm	wo

	125 loops	126 cudgel	127 why	128 spider
GF1	lʲʏʔps	kʌdʒɪlˠ	wäe	spaedɪɹ
GF2	lˠʉʔps	kʌdʒɪlˠ	mäe	spʌidɪɹ
GF3	lˠʉʔps	kʌdʒɪlˠ	mäe	späedɪɾ
GF4	lˠʉʔps	kʌdʒɪlˠ	mäe	spaedɪɾ
GF5	lˠʉʔps	kʌdʒəlˠ	mäe	späedɪɾ
GM1	lˠʉʔpˢʰ	kʌdʒəlˠ	wäe	späedɪɹ
GM2	lˠʉʔps	kʌdʒəlˠ	wäe	späedɪɾ
GM3	lˠʉʔps	kʌdʒʌlˠ	mäe	spaedɪɾ
GM4	lˠʉʔps	kʌdʒəlˠ	wäe	spaedɪɹ
EF1	lˠʉps	kʌdʒɪɯ	ɪˠae	spaedɪɹ
EF2	lʲʏps	kʌdʒɪɯ	ɪae	spaedᶻɪɹ
EF3	lˠʉps	kʌdʒɪlˠ	ɪˠae	späedɪɹ
EF4	lʲʉʔps	kʌdʒɪɯ	ɪˠae	späedᶻɪɹ
EM1	lˠʉʔps	kʌdʒɪlˠ	ɪˠae	späedəɹ
AF1	lˠʉʔps	kʌdʒəlˠ	wae	spʌedɪɹ
AF2	lˠʉʔps	kʰʌdʒɪlˠ	mäe	späedəɹ

	129. nowhere	130 urge	131 dial	132 fetch
GF1	nowẽɪɹ	ʔɪɹdʒ	däẽɪlʲ	fɛʔtʃ
GF2	noɪ̈ɤẽɪɹ	ʔʌɹdʒ	däɪɪlˠ	fɛʔtʃ
GF3	nowẽɪɾ	ʔəɹdʒ	däeɪlˠ	fɛʔtʃ
GF4	nomɛɾ	ʔʌɹdʒ	däejɪlˠ	fɛʔtʃ
GF5	nomẽɪɹ	ʔʌɹdʒ	däejɪlˠ	fɛʔtʃ
GM1	nowẽɪɹ	ʔʌɹdʒ	däeʌlˠ	fɛʔtʃ
GM2	nowẽɾ	ʔʌɹdʒ	däeʌlˠ	fɛʔtʃ
GM3	nomẽɪɾ	ʌɹdʒ	däeəlˠ	fɛʔʃ
GM4	nowẽɪɹ	ʔʌɹdʒ	däejɪlˠ	fɛʔtʃ
EF1	nomẽɹ	ʔəɹdʒ	däeəɰ	fɛʔtʃ
EF2	nomẽəɹ	ʔʌɹdʒ	däeəlˠ	fɛʔtʃ
EF3	nomẽɪɹ	ʔʌɹdʒ	däelˠ	fɛʔtʃ
EF4	nomẽɪɹ	ʔʌɻdʒ	däeəlˠ	fɛʔtʃ
EM1	nomẽɪɹ	ʔʌɹdʒ	däẽɪlˠ	fɛʔtʃ
AF1	nowẽɹ	ʔɜɹdʒ	däeəlˠ	fɛʔtʃ
AM1	nowɜɹ	ʔʌɹdʒ	däeəlˠ	fɛtʃ

	133 lots	134 kiln	135 marsh	136 rowdy
GF1	lʲɔʔts	kɪlˠn	mäɹʃ	ɹʌʉdẽ
GF2	lˠɔʔs	kɪlˠn	mäɹʃ	ʊʌʉdẽ
GF3	lˠɔʔs	kɪlˠn	mäɹʃ	ɹʌʉdẽ
GF4	lˠɔʔs	kɪlˠn	mäɹʃ	ɹʌʉdẽ
GF5	lˠɔʔs	kɪlˠən	mäɹʃ	ɾʌʉdẽ
GM1	lˠɔʔs	kɪɰn	mäɹʃ	ɹʌʉdẽ
GM2	lˠɔʔs	kɪlˠn	mäɹʃ	ɾʌʉdẽ
GM3	lˠɔʔs	kɪlˠn	mäɹʃ	ɹʌʉdẽ
GM4	lˠɔʔs	kɪlˠn	mäɹʔtʃ	ɹʌʉdẽ
EF1	lˠɔʔs	kɪɰn	mäɹʃ	ɹʌʉdẽ
EF2	lˠɔʔs	kɪɰn	mäɹʃ	ɹʌʉdẽ
EF3	lˠɔʔs	kɪlˠn	mäɹʃ	ɹʌʉdẽ
EF4	lˠɔʔʔts	kɪɰn	mäɹʃ	ɹʌɑdẽ
EM1	lˠɔʔʔts	kɪlˠn	mäɹʃ	ɹʌʉdẽ
AF1	lˠɔʔs	kɪln	mäɹʃ	ɹʌʉdẽ
AM1	lˠɔʔs	kʰɪlˠn	mäɹʃ	ɹʌʉdɪ

	137 filch	138 health	139 globes	140 somewhere
GF1	fɪlˠʔ˺tʃ	ɛ̃ɛ̃lˠθ	glʲobz̥	sʌmweɪɹ
GF2	fɪɰʔ˺tʃ	ɛ̃ɛɰθ	glˠoʊbz	sʌmwɪɹ
GF3	fɪɰʔ˺tʃ	ɛ̃ɛɰθ	glˠoʊbz̥	sʌmweɪɹ
GF4	fɪlˠʔ˺tʃ	ɛ̃ɛ̃ɰθ	glˠoʊbz	sʌmmeəɹ
GF5	fɪlˠʔ˺tʃ	ɛ̃ɛɰθ	glˠoʊbz	sʌmweɪɹ
GM1	fɪɰʔʃ	ɛ̃ɛɰθ	glˠoʊbz	sʌmweɪɹ
GM2	fəˠlˠʔ˺tʃ	ɛ̃ɛlˠθ	glˠoʊbz	sʌmweɪɾ
GM3	fɪˠlˠʔ˺tʃ	ɛ̃ɛˠɫθ	glˠoʊbz	sʌmweəɾ
GM4	fɪˠlˠʔ˺tʃ	ɛ̃ɛɰθ	glˠoʊbz	sʌmweɪɹ
EF1	fɪɰʔʃ	ɛ̃ɛɰθ	glˠobz̥	sʌmɪˠeəɹ
EF2	fɪlˠʔ˺tʃ	ɛ̃ɛɰθ	glˠobz	sʌmweəɹ
EF3	fɪˠlˠʔ˺tʃ	ɛ̃ɛɰθ	glˠobz	sʌmmeɪɹ
EF4	fɪɰʔ˺tʃ	ɛ̃ɛlˠθ	glʲobz	sʌmweɪɹ
EM1	fɪlˠʔ˺tʃ	ɛ̃ɛlˠθ	glˠobz	sʌmweɪɹ
AF1	fɪlˠʔ˺tʃ	ɛ̃ɛɰθ	glˠobz̥	sʌmweəɹ
AM1	fɪɰtʃ	ɛ̃ɛəlˠθ	glˠobz̥	sʌmwɪɹ

	141 bulge	142 royal	143 leaked	144 prestige
GM1	bʌɰdʒ	ɹɔ̃ejɪlˠ	lʲiːʔ˺k˺t	pɹɛstiːʒ
GF2	bʌɰdʒ	ɹɔ̃ejəlˠ	lʲiːʔ˺kt	pɹɛstiːdʒ
GF3	bʌɰdʒ	ɹɔ̃ejɪlˠ	lˠiːʔ˺k˺t	pɹɛstiːdʒ
GF4	bʌlˠdʒ	ɹɔ̃ejəlˠ	lˠiːʔ˺k˺t	pɹɛstiːʒ
GF5	bʌˠlˠdʒ̊	ɾɔ̃ejəlˠ	lˠiːʔ˺kʰtˢʰ	pɾɪstiːdʒ
GM1	bʌɰdʒ̊	ɹɔ̃eəlˠ	lˠiːkt	pɹɪstiʒ
GM2	bʌˠlˠdʒ̊	ɹɔ̃eʌlˠ	lˠiːʔ˺k˺t	pɾɪstiːdʒ
GM3	bʌˠlˠdʒ	ɹɔ̃eʌlˠ	lˠiːʔ˺t	pɾɛstiːʒ
GM4	bʌlˠdʒ	ɹɔ̃ejəlˠ	lˠiːʔ˺k˺t	pɹɛstiːdʒ
EF1	bʌɰdʒ	ɹɔ̃eɪlˠ	lˠiʔkt	pɹɛstiʒ
EF2	bʌlˠdʒ	ɹɔ̃elˠ	lˠiʔkt	pɹɛstiɡ
EF3	bʌɰdʒ	ɹɔ̃ejɪlˠ	lˠiʔk˺tˢ	pɹɛstidʒ
EF4	bʌɰdʒ	ɹɔ̃eɪlˠ	lʲiʔ˺ktˢʰ	pɾɛstiʒ
EM1	bʌlˠdʒ	ɹɔ̃eɪlˠ	lʲiʔkt	pɹɛstiɡ
AF1	bʌˠlˠdʒ	ɹɔ̃eəlˠ	lˠiʔ˺kt	pɹɛstiɡ
AM1	bʌˠlˠdʒ	ɹɔ̃eɪlˠ	lˠiʔktˢʰ	pɹɛstiɡ

	145 cares	146 boil	147 wheel	148 brave
GF1	keɪɹz	bɔəɪlˠ	ʍɪilˠ	bɹev
GF2	keɪɹz	bɔəɪlˠ	ʍɪilˠ	bɹev
GF3	keɪɹz	bɔeəlˠ	milˠ	bɾev
GF4	keəɹs	bɔeəlˠ	milˠ	bɾev
GF5	keəɹz	bɔeəlˠ	milˠ	bɾev
GM1	keɪɹs	bɔiɪlˠ	wiəlˠ	bɹev
GM2	keɪɹz	bɔeəlˠ	wilˠ	bɾev
GM3	keɪɹz	bɔeɪlˠ	milˠ	bɾev
GM4	keɹz	bɔeəlˠ	wilˠ	bɾev
EF1	keəɹz	bɔeɯ	ʍilˠ	bɾev
EF2	keɪɹz	bɔelˠ	milˠ	bɹeɣ
EF3	keəɹz	bɔɛlˠ	ʍilˠ	bɹev
EF4	keɪɹz	bɔeɪlˠ	ʍilˠ	bɹev
EM1	keɪɹs	bɔɪɪˠlˠ	miɪlˠ	bɹev
AF1	keɪɹs	bɔeɪlˠ	milˠ	bɹev
AM1	keɹz	bɔeɪlˠ	milˠ	bɾev
				bɾev

	149 somewhat	150 liked	151 muzzle	152 crawl
GF1	sʌmwəɪʔtʰ	lˠaiɪʔkʔt	mʌzlˠ	kɹɔlˠ
GF2	sʌmwət	lˠʌiɪʔkt	mʌzlˠ	kɹɔlˠ
GF3	sʌmməɪʔt	lˠʌiɪʔt	mʌzɪlˠ	kɹɔlˠ
GF4	sʌmwəɪʔt	lˠʌiʔt	mʌzɪlˠ	kɹɔlˠ
GF5	sʌmməɪʔtʃʰ	lˠʌiɪkt	mʌzəlˠ	kɾɔlˠ
GM1	sʌmwətʃʰ	lʌikt	mʌzəlˠ	kɹɔəlˠ
GM2	sʌmwəɪ	lˠʌikʔt	mʌzəlˠ	kɾɔlˠ
GM3	sʌmwəɪ	lˠʌiɪʔt	mʌzəlˠ	kɾɔlˠ
GM4	sʌmwəɪʔt	lˠʌiɪʔkʔt	mʌzəlˠ	kɹɔlˠ
EF1	sʌmwɔɪ	lˠʌiɪʔkt	mʌzɯ	kɹɔlˠ
EF2	sʌmwɔɪ	lˠʌit	mʌzɪlˠ	kɹɔlˠ
EF3	sʌmʍɔts	lˠʌikʔts	mʌzɪlˠ	kɹɔlˠ
EF4	sʌmʍɔɪtʰ	lˠʌiɪktʰ	mʌzɪlˠ	kɾɔlˠ
EM1	sʌmwɔɪt	lˠʌiɪʔktʃʰ	mʌzɪlˠ	kɹɔlˠ
AF1	sʌmwətʔ	lˠʌiɪʔkt	mʌzəlˠ	kɹɔlˠ
AM1	sʌmwɪɪʔtʃʰ	lˠʌikt	mʌzɪlˠ	kɹɔlˠ

	153. Brechin	154. pegged	155. trial	156. grab
GF1	bɹɪ̈x ɪn	pʰɛ̈g̚d	tɹ̥aɛ̈ɪ lˠ	gɹäb
GF2	bɾɪ̈x ɪn	pʰɛ̈g̊d̥	tɹ̥aɛ̈ɪ lˠ	gɹab
GF3	bɹ̝ɪ̈x ɪn	pʰɛ̈g̊d̥	tɹ̝aɛ̈ɪ lˠ	gɾ̝äb
GF4	bɾɛ̈x ɪn	pʰɛ̈g̚d̥	tɹ̝̂äɛ̈ə lˠ	gɾäb
GF5	bɾɪ̈x ɪn	pʰɛ̈g d̥	tɹ̝aɛ̈ə lˠ	gɾäb
GM1	b̥ɹ̝ɪ̈x ɪn	pʰɛ̈g d	tɹ̥aɛ̈ə lˠ	gɹäb
GM2	bɾɪ̈k ɪn	pʰɛ̈g̚d̥	tɹ̥aɛ̈ə lˠ	gɾab
GM3	bɾɪ̈x ɪn	pʰɛ̈g̚d	tɹ̥aɛ̈ə lˠ	gɾab
GM4	bɾɪ̈k ɪn	pɛ̈g̚d	tɹ̥äɛ̈ə lˠ	gɹab
EF1	bɹɪ̈x ɪn	pʰɛ̈g̊d̥	tɹ̝ʌ̈ɪ̈ lˠ	gɹab
EF2	bɹ̝ɪ̈k ɪn	pʰɛ̈g̚d	tɹ̝aɛɪ lˠ	gɹab̚d
EF3	bɹ̝ɪ̈x ɪn	pʰɛg̚d	tɹ̝äɛ lˠ	gɹäb̚d̥
EF4	bɾɪ̈x ɪn	pʰɛ̈gd̥	tɹäɛɪ lˠ	gɾäb
EM1	bɹɪ̈x ɪn	pʰɛ̈g̚d	tɹäɛɪ lˠ	gɹäb
AF1	bɹɪ̈x ɪn	pʰɛg̚d̥	tˢɹ̥aɛ̈ə lˠ	gɹäb
AM1	bɾɪ̈x ɪn	pʰɛ̈gd	tɹ̥ʌ̈əɪ lˠ	gɹ̝äb

	157. dragged	158. locked	159. satchel	160. threaten
GF1	dɹ̝äg̚d	lʲ ʉ̈ʔ̚kˀtˢ	säʔ̚tʃɪ lˠ	θɾɛ̈ tɪn
GF2	dɹ̝äg̚d̥	lˠ ʉ̈ʔ̚ktˢʰ	säʔtʃɪ lˠ	θɾɛ̈ tɪn
GF3	dɹ̝äg̚d̥	lˠ ʉ̈ʔ̚ʔ	säʔ̚tʃɪ lˠ	θɾɛ̈ʔn̩
GF4	dɹ̝äg̚d̥	lˠ ʉ̈kˀtˀ	säʔ̚tʃə lˠ	θɾɛ̈tɪn
GF5	dɾäg̊d̥	lˠ ʉ̈ʔ̚kʰtˢʰ	säʔ̚tʃə lˠ	θɾɛ̈ tɪn
GM1	dɹ̝äg̊d̥	lˠ ʉ̈ʔ̚kʰtˢʰ	säʔ̚tʃə lˠ	θɹ̥ɛ̈ʔn̩
GM2	dɾäg̊d̥	lˠ ʉ̈ʔ̚t	säʔ̚tʃə lˠ	θɾɛ̈ʔn̩
GM3	dɾäg̚d	lˠ ʉ̈ʔ̚kˀt	säʔ̚tʃə lˠ	θɾɛ̈ʔn̩
GM4	dɹäg̚d	lˠ ʉ̈ʔ̚k̚t	säʔ̚ʃə lˠ	θɹɛ̈tɪn
EF1	dɹ̝äg̚d	lˠ ʉ̈ʔ̚kt	säʔ̚tʃɪ lˠ	θɹɛʔn̩
EF2	dɹ̝äg̚d	lˠ ʉ̈ʔ̚kt	säʔ̚tʃɪ lˠ	θɹ̥ɛʔn̩
EF3	dɹ̝äg̚d	lˠ ʉ̈ʔ̚k̚tˢ	säʔ̚tʃɪ lˠ	θɹ̝ɛtˢɪn
EF4	dɹ̝äg̊d̥	lʲ ʉ̈ʔ̚ktʰ	säʔ̚tʃɪ lˠ	θɾɛʔn̩
EM1	dɹ̝äg̊d̥	lˠ ʉ̈ʔ̚ktˢʰ	säʔ̚tʃɪ lˠ	θɹ̝ɛtɪn
AF1	dɹäg̚d	lˠ ʉ̈ʔ̚kt	säʔ̚tʃɪ lˠ	θɹ̥ɛ tɪn
AM1	dɹ̝äg̚d	lˠ ʉ̈ʔ̚kt	säʔ̚tʃɪ lˠ	θɹ̝ɛʔn̩

	161. dreary	162. casual	163. licked	164. anywhere
GF1	dɹiɹi	kæʒɪlˠ	lʲɪʔkt^sh	ɛnɛwɪɹ
GF2	dɹiɹi	kæʒɪlˠ	lˠɪʔkt	ɛnɪweɪɹ
GF3	dɾiɾe	kæʒɪlˠ	lˠɪʔt	ɛnɪweɪɾ
GF4	dɹiɾe	kæʒəlˠ	lˠɪʔkt	ɛnɛmeəɹ
GF5	dɾiɾe	kæʒəlˠ	lˠɪʔkt	ɛnɛmeəɾ
GM1	dɹiɹe	kæʒəlˠ	lˠɪʔktʰ	ʔɛnɛweəɹ
GM2	dɾiɹe	kæʒəlˠ	lˠɪʔkt	ʔɛnɛweəɹ
GM3	dɾiɾe	kæʒəlˠ	lˠɪʔkt	ʔɛnɛmeɪɹ
GM4	dɹiɹe	kæʒəlˠ	lˠɪʔkt	ʔɛnɛwɛɪɹ
EF1	dɹiɹe	kæʒʌlˠ	lˠɪʔkt^s	ʔɛnɛɸeɹ
EF2	dɹiɹe	kæʒɪɰ	lˠɪʔkt	ʔɛnɛweɪɹ
EF3	dɹiɹe	kæʒɪlˠ	lˠɪʔkt	ʔɛnɛɸˠeɹ
EF4	dɹiɾe	kæʒɪlˠ	lˠɪʔktʰ	ʔɛnɛɸˠeɪɹ
EM1	dɹiɹe	kæʒɪlˠ	lˠɪʔkt^s	ʔɛnɛweɪɹ
AF1	dɹiɹe	kæʒɪlˠ	lɪʔkt^sh	ʔɛnɛweɪɹ
AM1	dɹiɹe	kɑʒɪlˠ	lˠɪkt	ʔɛniwɪɹ

	165. everywhere	166. salt	167. phrase	168. wag
GF1	ɪvɹɛweɹ	sɔlˠʔt	fɹez	wæg
GF2	ɪvɹɪweɪɹ	sɔɰt^s	fɹez	wæg
GF3	ɪvɾɛweɪɾ	sɔɰʔ	fɾez	wæg
GF4	ɪvɾɛmeəɹ	sɔɰʔt	fɾez	wæg
GF5	ɪvɾɛmeəɹ	sɔɰ	fɾez	wæg
GM1	ɪvɹɛweəɹ	sɔɰtʰ	fɹez	wæg
GM2	ɪvɾɛwɛɹ	sɔɰʔ	fɾez	wæg
GM3	ʔɪvɾɛweɪɹ	sɔɰʔ	fɾez	wæg
GM4	ɪvɾɛwɛɪɹ	sɔlˠt	fɾez	wæg
EF1	ʔɛvɹeɸeɹ	sɔɰt	fɹez	wæg
EF2	ʔɛvɹeɸeɪɹ	sɔɰt^s	fɹez	wæg
EF3	ʔɛvɹɛmɛɹ	sɔɰt^s	fɹez	wæg
EF4	ʔɛvɹɪɸˠeɪɹ	sɔɰʔt^s	fɹez	wæg
EM1	ʔɪvɹɛweɪɹ	sɔɰʔt^sh	fɹez	wæg
AF1	ʔɛvɹɛweɪɹ	sɔɰt	fɹez	wæg
AM1	ʔɪvɹiwɪɹ	sɔlˠʔt^sh	fɹez	wæg

	169. hairy	170. shrill	171. music	172 sprinkle
GF1	ɛeɹɛ	ʃɹɪlˠ	mjʉzɪk̚	spɹɪŋkɰ
GM2	ɛeɹe	ʃɹɪlˠ	mjʉzɪk̚	spɹɪŋkʌlˠ
GF3	ɛeɾe	ʃɹɪlˠ	mjʉzɪkʰ	spɹɪŋkl̩ˠ
GF4	ɛeɾe	ʃɹɪlˠ	mjʉzɪkʰ	spɹɪŋkəlˠ
GF5	ɛeɾe	ʃɾɪlˠ	mjʉzɪk̚	spɾɪŋkəlˠ
GM1	ɛeɾe	ʃɹɪlˠ	mjʉzɪk̚	spɹɪŋkəlˠ
GM2	ɛeɾe	ʃɹɪlˠ	mjʉzɪʔ	spɹɪŋkɰ
GM3	eeɾe	ʃɹɪlˠ	mjʉzɪk	spɾɪŋkɪlˠ
GM4	ɛɛɾeɹ	ʃɹɪlˠ	mjʉzɪʔk	spɹɪŋkᵊlˠ
EF1	eeɹe	ʃɹɪlˠ	mjʉzɪʔk	spɹɪŋkəlˠ
EF2	ɛeɹe	ʃɹɪlˠ	mjʉzɪʔ̚k	spɹɪŋkɪlˠ
EF3	ɛeɹe	ʃɹɪlˠ	mjʉzɪʔk	spɹɪŋkɪɰ
EF4	ɛeɾe	ʃɹɪlˠ	mjʉzɪk̚	spɹɪŋkəlˠ
EM1	ɛeɹe	ʃɹɪlˠ	mjʉzɪʔ̚k	spɹɪŋkɪlˠ
AF1	ɛeɹe	ʃɹɪlˠ	mjʉzɪk	spɹɪŋkɪlˠ
AM1	ɛeɹe	ʃɹɪlˠ	mjʉzɪʔ̚kʰ	spɹɪŋkɰ

	173 watt	174. tile	175 scramble	176 tweed
GF1	wɔt̚	tʰäeɪlˠ	skɹämbl̩ˠ	tɸˠid
GF2	wɔʔ̚t	tʌilˠ	skɹämbl̩ˠ	tɸˠid
GF3	wɔʔ	tʰäelˠ	skɾämbl̩ˠ	tɸˠid
GF4	wɔʔt	tʰʌiᵊlˠ	skɾämbl̩ˠ	tɸˠid
GF5	wɔʔ̚tˢ	tʰʌiᵊlˠ	skɾämbᵊlˠ	tɸid
GM1	wɔʔ̚tˢʰ	tʌitlˠ	skɹämbl̩ˠ	tɸˠid
GM2	wɔʔ	tʌiɰ	skɹämbl̩ˠ	tʍid
GM3	wɔʔ	tʌiɪlˠ	skɾämbl̩ˠ	tɸˠid
GM4	wɔt̚	tʌiᵊlˠ	skɾämbl̩ˠ	tʍid
EF1	wɔʔt	tˢʌilˠ	skɹämbl̩ˠ	tw̥id
EF2	wɔt	tʰʌilˠ	skɹämbl̩ˠ	tɸˠid
EF3	wɔʔ̚tˢ	tʰʌilˠ	skɹämbɪlˠ	tˢɸˠid
EF4	wɔt̚	tʰʌiɪlˠ	skɾämbəlˠ	tw̥id
EM1	wɔʔ̚t	tʰäeɪlˠ	skɹämbl̩ˠ	tˢwid
AF1	wɔʔt	tʰäelˠ	skɹämbl̩ˠ	tʍid
AM1	wɔʔ̚t	tʰʌiɪlˠ	skɹämbl̩ˠ	twid

	177. very	178 oral	179. bulb	180. strangle
GF1	vɛɹe	ʔovlˠ	bʌɰb	stɹäŋglˠ
GF2	vɛɾe	ʔovɪlˠ	bʌɰb	stɹäŋgɰ
GF3	vɛɾe	ʔovəlˠ	bʌlˠb	stɹäŋglˠ
GF4	vɛɾe	ʔovəlˠ	bʌlˠb	stɹäŋgᵊlˠ
GF5	vɛɾe	ʔovəlˠ	bʌɰb	stɾäŋgᵊlˠ
GM1	vɛɾe	ʔovlˠ	bʌlˠb	stɹendʒ
GM2	vɛɾe	ʔovlˠ	bʌɰb	stɹäŋgɰ
GM3	vɛɾe	ʔovlˠ	bʌˠlˠb	stɾäŋglˠ
GM4	vɛɾe	ʔovᵊlˠ	bʌˠlˠb	stɹaŋglˠ
EF1	vɛɹe	ovlˠ	bʌɰb	stɹäŋglˠ
EF2	vɛɹe	ʔovᵊlˠ	bʌlˠb	stɹäŋgᵊlˠ
EF3	vɛɹe	ʔovlˠ	bʌlˠb	stɹäŋglˠ
EF4	vɛɾe	ʔovəlˠ	bʌɰb	stɾäŋglˠ
EM1	vɛɹe	ʔovlˠ	bʌlˠb₀ʰ	stɹäŋglˠ
AF1	vɛɾe	ʔovəlˠ	bʌlˠb	stɹäŋglˠ
AM1	vɛɹiᵀ	ʔovɪlˠ	bʌlˠb	stɹäŋglˠ

	181 plagued	182 attacked	183 twit	184 jury
GF1	plˠeg̚d	ʔʌtäʔ̚k̚t	tɸɪʔ̚tˢʰ	dʒʉɹe
GF2	plˠeg̚d	ʌtäʔkt	tɸˠɪtʼ	dʒʉɾe
GF3	plˠeg̚d	ʌtäʔ̚kt	tɸˠɪtʰ	dʒʉɾe
GF4	plˠegd	ʌtäʔkt	tɸˠɪʔ̚t	dʒʉɾe
GF5	pʰlˠegd	ʌtʰäʔ̚kʰtˢʰ	tɰɪʔ̚tˢʰ	dʒʉɹe
GM1	pʰlˠeg̚d	ʌtäʔ̚kʰtˢʰ	tɸˠɪʔ̚tˢʰ	dʒʉɾe
GM2	plˠegd	ʌtäʔt	twɪʔ	dʒʉɹe
GM3	pʰlˠeg̚d	ʌtʰäʔ̚k̚t	tɰɪʔ	dʒʉɾe
GM4	plˠeg̚d	ʌtäʔ̚k̚t	tɸˠɪtʼ	dʒʉɾe
EF1	plˠeg̚d	ətäʔ̚k̚t	twɪʔ̚t	dʒʉɹe
EF2	plˠeg̚d	ətäʔ̚ktˢ	twɪʔ̚tˢ	dʒʉɹe
EF3	plˠegd	ətäʔkt	twɪtˢ	dʒʉɹe
EF4	pʰlˠegd	ətäʔkʰtʰ	twɪtʼ	dʒʉɾe
EM1	pʰlˠegdˢ	ɪtäʔkˣtˢ	twɪʔ̚tˢʰ	dʒʉɹiᵀ
AF1	pʰlˠe.gd	ətäktˢʰ	tɰɪʔ̚tˢʰ	dʒʉɹe
AM1	pʰlˠegd	ɪtäkt	tɰɪʔ̚tʰ	dʒʉɹiᵀ

	185. locked	186. Tw[illegible]n	187. Harry	188. story
GF1	lʲɔ̄kˣtʰ	tɸˠeᴵn	ə̄ä ɹē	stō ɹe
GF2	lˠɔ̄ʔktˢʰ	tɸ ēᴵn	ə̥ a ɾ iᵀ	stōɾe
GF3	lˠɔ̄ʔ˺k˺t	tɸˠēn	ə̥ ä ɾ̥ ē	stōɾ̥e
GF4	lˠɔ̄ʔ˺k tʰ	tɸˠēn	ə̥ a ɾē	stōɾe
GF5	lˠɔ̄ʔ˺k tʰ	tˢw̥ēᴵn	ə̥ ä ɾē	stōɾ̥e
GM1	lˠɔ̄ʔ˺k˺t	tɸˠēn	a a ɾ̥ē	stōɹe
GM2	lˠɔ̄ʔ˺t	tw̥ēn	ə̥ ä ɾ̥e	stōɾe
GM3	lˠɔ̄ʔ˺k˺t	tɸˠēn	ə̥ a ɾē	stōɾe
GM4	lˠɔ̄ʔ˺tˢ	tɸˠēn	ə̥ ä ɾe	stōɾ̥e
EF1	lˠɔ̄ʔk˺t	tw̥ēn	ä ä ɹē	stōɹe
EF2	lˠɔʔk˺t	tw̥ēn	ə̈ ä ɹe	stōɹe
EF3	lˠɔʔ˺ktˢ	tɸˠwē'n	ə̈ ä ɹē	stōɹe
EF4	lˠɔʔ˺ktˢʰ	tɸˠw̥eᴵn	ä ə̈ ɾē	stōɾe
EM1	lˠɔʔkʰtˢʰ	tˢwe'n	ə̥ a ɹ ē	stōɹe
AF1	lˠɔk˺t	tw̥ēn	ə̥ ä ɹe	stōɾe
AM1	lˠɔk˺t	tw̥ēn	ə̥ ä ɹ iᵀ	stōɾ iᵀ

	189. wire	190. awful	191. apple	192. bury
GF1	wäēᴵɹ	ʔɔ̄fɪlˠ	ʔāplˠ	bʌ̄ɹē
GF2	wäēᴵɹ	ʔɔ̄fɪlˠ	ʔäpl̩ˠ	bʌ̄ɾɪᵀ
GF3	wäēᴵɹ	ʔɔ̄fl̩ˠ	ʔäpl̩ˠ	bʌ̄ɾē
GF4	wäēᵊɾ	ʔɔ̄flˠ	ʔäpl̩ˠ	bʌ̄ɾē
GF5	wäēᵊɹ	ʔɔ̄flˠ	ʔäpʰl̩ˠ	bəɹē
GM1	wäēᵊɹ	ʔɔ̄fl̩ˠ	ʔäpl̩ˠ	bʌ̄ɾē
GM2	wäēᵊɾ̥	ʔɔ̄fᵊlˠ	ʔäpʰᵊlˠ	bəɾē
GM3	wäēᵊɹ	ʔɔ̄fᵊlˠ	ʔäpᵊlˠ	bɪɾe
GM4	wäēᵊɹ	ʔɔ̄fᵊlˠ	ʔäpʰl̩ˠ	bɪɾē
EF1	wäēᵊɹ	ɔ̄flˠ	ʔäpl̩ˠ	bʌ̄ɹe
EF2	wäēɹ	ʔɔ̄flˠ	ʔäpl̩ˠ	bɛ̄ɹe
EF3	wäēɹ	ʔɔ̄fl̩ˠ	ʔäpl̩ˠ	bʌɹe
EF4	wäējɪɹ	ʔɔ̄fl̩ˠ	ʔäpl̩ˠ	bʌɾe
EM1	wäēɪɹ	ʔɔ̄fl̩ˠ	ʔäpl̩ˠ	bɪɹe
AF1	wʌ̄ɪᵊɹ	ʔɔ̄fəlˠ	ʔäpəlˠ	bʌɹe
AM1	wʌ̄ɪᵊɹ	ʔɔ̄fᵊlˠ	ʔäpʰɪlˠ	bʌɹe

	193 million	194 wear	195 poked	196 plugged
GF1	mɪɯjɪn	weɪɹ	pʰõɪʔkʼtˢʰ	pʰlʌgd
GF2	mɪlˠjɪn	weɪɹ	pʰõɪʔkʼt	pʰlˠʌgd
GF3	mɪɯjɪn	weɪɹ	pʰõɪʔkʼt	pʰlˠʌgʼd
GF4	mɪɯjɪn	weəɪ	pʰõɪʔkʼt	pʰlˠʌgʼd
GF5	mɪlˠjɪn	weəɪ	pʰõɪʔkt	pʰlˠʌgd
GM1	mɪɯjɪn	weəɹ	pʰõɪʔktˢʰ	pʰlˠʌgd
GM2	mɪɯjʌn	we əɹ	põɪʔtˢʰ	pʰlˠʌgd
GM3	məɯjʌn	wɛɪɹ	pʰõɪʔkʼt	plˠʌgʼd
GM4	məɯjɪn	wɛɪɹ	pʰõɪʔkʼtˢ	plˠʌgʼd
EF1	mɪɯjɪn	weəɹ	põɪʔkʼtˢ	pʰlˠʌgd
EF2	mɪɯjɪn	weəɹ	pʰõɪʔkt	pʰlˠʌgʼd
EF3	mɪɯjɪn	weɪɹ	põɪʔktˢ	pʰlˠʌgʼd
EF4	mɪɯjɪn	weɪɹ	pʰõɪʔktʰ	pʰlˠʌgd
EM1	mɪlʲjɪn	weɪɹ	pʰõɪʔktˢʰ	pʰlˠʌgd
AF1	mɪlˠjɪn	weəɹ	pʰõɪʔkt	pʰlˠʌgd
AM1	mɪɯjɪn	weɪɹ	pʰõɪʔkt	pʰlˠʌgd

	197 sorry	198 hurry	199 lie	200 bugle
GF1	sɔɹe	ʌ̥ʌɹe	lˠäe	bjʉglˠ
GF2	sɔɹe	ʌ̥ʌɹe	lʲäe	bjʉgɪlˠ
GF3	sɔɾe	ʌ̥ʌɾɛ	lˠäe	bjʉgɪlˠ
GF4	sɔɾe	ʌ̥ʌɾe	lˠäe	bjʉgəlˠ
GF5	sɔɾe	ʌ̥ʌɾe	lˠäe	bjʉgəlˠ
GM1	sɔɾe	ʌ̥ʌɾe	lˠäe	bjʉgəlˠ
GM2	sɔɾe	ʌʌɾe	lˠäe	bjʉgʌlˠ
GM3	sɔɾe	ʌ̥ʌɾe	lˠäe	bjʉgɪlˠ
GM4	sɔɾe	ʌ̥ʌɾe	lˠäe	bjʉgəlˠ
EF1	sɔɹe	ʌ̥ʌɹe	lˠäe	bjʉgəlˠ
EF2	sɔɹe	ʌ̥ʌɹe	lˠäe	bjʉgəlˠ
EF3	sɔɹe	ʌ̥ʌɹɛ	lˠäe	bˢjʉgɪlˠ
EF4	sɔɾe	ʌ̥ʌɾe	lˠäe	bjʉglˠ
EM1	sɔɹi	ʌ̥ʌɹe	lˠäe	bjjʉglˠ
AF1	sɔɹe	ʌ̥ʌɹe	lˠäe	bjjʉgɪlˠ
AM1	sɔɾi	ʌ̥ʌɾi	lˠäi	bjʉgɪlˠ

	201 wield	202 diary	203 seldom	204 twelve
GF1	wiᵊlˠd	däɛɹɛ	sɛ lˠdɪm	tɪˠɛɰv
GF2	wiɰd	däɛɪɾɛ	sɛ ɰdɪm	tɪˠɛɰv
GF3	wiɰd	däɛᴵɾɛ	sɛɰdɪm	tᴵʳwɛɰv
GF4	wiɰd	däɛᵊɾɛ	sɛɰdɪm	tw̥ɛɰv
GF5	wiɰd	däɛɾɛ	sɛɰdɪm	tw̥ɛɰv
GM1	wiˠlˠd	däɛɾɛ	sɛɰdɪm	tw̥ɛɰv
GM2	wi^lˠd	däɛɾɛ	sɛᵊlˠdᵊm	tˢw̥ɛɰv
GM3	wiᵊlˠd	däɛəɾɛ	sɛˠlˠdɪm	tw̥ɛɰv
GM4	wiəˠlˠd	däɛᵊɹɛ	sɛɰdəm	twɛlˠv
EF1	wiɰd	däɛəɹɛ	sɛɰdəm	twɛɰv
EF2	wiˠlˠd	däɛᵊɹɛ	sɛɰdəm	twɛɰv
EF3	wiɰd	däɛɹɛ	sɛˠlˠdəm	tw̥ɛɰv
EF4	wiɰd	däɛɾɛ	sɛɰdɪm	tw̥ɛɰv
EM1	wiɰd	däɛɹɛ	sɛlˠdəm	tɪˠɛɰv
AF1	wiᵊlˠd	däɛɾɛ	sɛlˠdɪm	twɛɰv
AM1	wɪlˠd	dʌiɹi	sɛɰdɪm	tw̥ɛɰv

	205 drool	206 explode
GF1	dɹʉlˠ	ɪɪksplʲod
GF2	dɹʉlˠ	ɪɪksplˠod
GF3	dɹʉlˠ	ɪɪksplˠod
GF4	dɹʉlˠ	ʔɪɪksplˠod
GF5	dᵊɾʉlˠ	ʔɪɪksplˠod
GM1	dɾʉlˠ	ɪɪkspʰlˠod
GM2	dɾʉlˠ	ɪɪksplˠod
GM3	dɾʉlˠ	ɪɪksplˠod
GM4	dɾʉlˠ	ʔɪɪksplˠod
EF1	dɹʉɰ	əʔɪkspʰlˠod
EF2	dɹʉlˠ	ʔəʔɪkspʰlˠod
EF3	dɹʉlˠ	ʔəʔɪksplˠod
EF4	dɹʉlˠ	ʔɛksplˠod
EM1	dɹʉlˠ	ʔɪɪksplˠod
AF1	dɹʉlˠ	ʔɪʔɪksplˠod
AM1	dɹʉlˠ	ʔɪɪsplˠod

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