Perception of the boundary between singleton and geminate plosives by Greek Cypriots: a sociophonetic perspective.

Katarzyna Alexander

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University of York

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Abstract

Standard Modern Greek (SMG) and Cypriot Greek (CG), two language varieties used by Greek Cypriots living in Cyprus, differ in their plosive inventories, as CG includes voiceless geminate plosives which are absent in SMG. Words containing geminate plosives may be divided into two groups; in one, replacing a geminate plosive with a singleton plosive changes the meaning of the word, whereas in the other group replacing a geminate with a singleton does not cause any change to the word's literal meaning. Matched-guise technique (MGT) tests carried out as a part of this study suggest that substituting a singleton plosive [t] with a geminate [t:ʰ] tends to alter the social characteristics attributed to the speaker uttering words containing the target sounds.

Forced-choice perceptual tests were carried out with Greek Cypriot listeners in three conditions, (1) in the presence of the Greek flag (symbolising the Greek culture and/or region), (2) in the presence of the Cypriot flag (symbolising the Cypriot culture and/or region), and (3) in the absence of the two flags. The results indicate that the perception of the boundary between singleton and geminate plosives tends to be affected by several variables such as the length of the plosive embedded in the test stimuli, the presence of the flags, the gender of the listeners and the way listeners produced singleton and geminate plosives themselves. Socio-economic background and cultural affiliation of the listeners, which were assumed to be indicators of the amount of exposure to singleton plosives in the discussed context, were also among the variables affecting the perception of the boundary.

The results of this study seem to add evidence to some of the assumptions of exemplar theory relating to the importance of amount of exposure to a sound category, the role of acoustic properties of stored exemplars, and processing of indexical information in speech perception. Also, the results of the study appear to suggest that factors such as listeners' linguistic insecurity or listeners' satisfaction with their social position might also have an effect on the way they process speech by increasing or decreasing their sensitivity to acoustic properties of sounds. It is suggested that the role of listeners' linguistic insecurity and the role of their satisfaction with social position in increasing and decreasing sensitivity to phonetic cues should be further investigated in future research and possibly incorporated into models of speech perception.

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National Football Team and a match including the Greek National Football Team. Which one would you choose to watch?

Author's declaration

I declare that this dissertation is my own work and none of its parts has been written in collaboration with others. None of the parts of this thesis has been submitted for any other academic degree.

1 Introduction

The present study aims to analyse, from a sociophonetic perspective, how Greek Cypriots perceive the boundary between voiceless singleton plosives and voiceless geminate plosives. It is assumed that the sociolinguistic situation in the Republic of Cyprus might have developed conditions in which the perception of the singleton/geminate contrast in voiceless plosives may involve more factors than the processing of only the acoustic features of perceived sounds. It is hypothesised here that the perception of the singleton/geminate boundary might be influenced by various social factors shaping Greek Cypriots' linguistic competence and their linguistic practices.

Greek Cypriots living in the Republic of Cyprus use Cypriot Greek (CG) for everyday communication and Standard Modern Greek (SMG) for communication in formal settings. The two varieties are reported to differ in phonetics, phonology, lexis and syntax (Newton 1972a; Arvaniti 2006). Various sources report that CG is not used in the same form by all people in all situations. It is suggested that there is a continuum of varieties approximating the form of SMG on various levels (Sophocleous 2006, 2009; Tsiplakou 2003, 2006; Karyolemou 2006).

Several studies have demonstrated that in places in which two languages or two language varieties are used, often by the same group of people, each of those languages or language varieties is evaluated in a certain way and different social characteristics are assigned to its users (Genesee & Holobow 1989; Hogg, Joyce & Abrams 1984; Lambert, Hodgson, Gardner & Fillenbaum 1960; Lambert, Anisfeld & Yeni-Komshian 1965; Ohama, Gotay, Pagano, Boles & Craven 2000; Wölck 1973; Woolard 1984; Woolard & Gahng 1990). Such tendencies can also be observed in the Cypriot context. Various studies reveal (Papapavlou 2004; Sophocleous 2006) that Greek Cypriots tend to hold different attitudes towards the two varieties of Greek. The evaluations of CG tend to indicate that the use of the variety is associated with social attractiveness, while the use of SMG is associated with competence and prestige (Papapavlou 2004; Sophocleous 2006).

As the differences between SMG and CG surface on phonetic, phonological, syntactic and lexical levels, it seems reasonable to suspect that some of the characteristic elements of CG are carriers of the social meanings associated with the language variety as a whole. The tendency among single sounds to carry social meanings has already been described by Campbell-Kibler (2006, 2008, 2009, 2011), Podesva (2004) and Eckert (2008). As an example, Campbell-Kibler (2006, 2008, 2009, 2011) analyses the social meanings of velar and alveolar variants of the suffix *-ing* in

American English, and her research results indicate that just the use of a sole instance of [ɪn] instead of [ɪŋ] influences listeners' social perception of a speaker. Further examples of such research could be the study by Podesva (2004, cited in Eckert 2008), who analyses the meanings of /t/ release in speech by a gay man, and the study by Eckert (2008), who provides an analysis of different meanings of /t/ release when used by schoolgirls, boys attending orthodox Jewish schools and by gay men.

It seems likely that voiceless aspirated geminate plosives, which exist in CG but not in SMG, could be potential carriers of social meanings. It needs to be noted that the words which include geminate plosives in CG can be divided into two groups. The first group comprises words for which a change from a geminate plosive to a singleton plosive results in a change in literal meaning of the words (Newton 1972a). Geminate plosives in such word context will be referred to as contrastive geminates from now on. The words in the other group do not change their literal meaning whether they are pronounced with a singleton or a geminate plosive. These geminates will be labelled as non-contrastive, whereas singletons appearing in the same word context will be referred to as non-contrastive singletons. It is hypothesised in this study that the use of non-contrastive geminate plosives may carry some social meanings. This assumption is made since geminate plosives are among the characteristic features of CG, the use of which entails assignment of certain social features to the speaker. In other words, geminate plosives are among the potential elements of the variety which are associated with the social features assigned to CG users. If that is the case, using a singleton or a geminate plosive could entail a change of social meaning communicated by the speaker.

According to exemplar theory (ET), which postulates bottom-up creation of categories (including sound categories), social information is stored in our memories together with linguistic information about sounds, and it is used in the processing of speech we are exposed to (Hintzman 1986; Johnson 1997a, 1997b, 2006, 2007; Nygaard 2005; Pierrehumbert 2001, 2003a, 2003b; Pisoni 1997). A number of studies have so far added evidence to the claim by presenting how different types of social information (or non-linguistic information) may influence perception of sounds. These include perceived age (Hay, Warren & Drager 2006b), gender (Clopper & Pisoni 2007; Strand & Johnson 1996; Strand 1999, 2000; Johnson 1990, 2006), social background (Hay et al. 2006b) or geographical background (Niedzielski 1999; Hay, Nolan & Drager 2006a; Hay and Drager 2010). It is hypothesised in this study that the potential social meanings associated with the use of non-contrastive geminate and singleton plosives might also affect Greek Cypriots' perception of the singleton/geminate plosive boundary.

Furthermore, the characteristics of the Cypriot sociolinguistic setting, in which Greek Cypriots develop their linguistic competence and practices, might have created an environment where factors other than non-linguistic information, which are considered by ET as important in the development of sound categories, could also have an influence on the way singleton and non-contrastive geminate plosives, or the boundary between the two, are perceived. These factors are the type and the amount of exposure to the occurrences of geminate and singleton plosives. It seems that the two factors might be playing an important role in the development of the two sound categories and in their perception, since, owing to the roles played by SMG and CG in Greek Cypriot society, the amount of exposure to SMG is likely to vary amongst Greek Cypriots depending on their social background.

It seems that the phonetic/phonological and sociolinguistic backgrounds could provide a convenient context for testing some assumptions set out by linguists working within the ET framework. For this reason, this thesis aims to investigate whether the way Greek Cypriots perceive the singleton/geminate plosive boundary could add evidence to assumptions, such as those pertaining to the role of social information or amount of exposure to a sound category in speech perception. For that reason, the study includes perceptual tests exploring which non-linguistic variables tend to affect the perception of the singleton/geminate boundary (in words with non-contrastive geminates) and how they do so. Furthermore, in order to confirm the supposition that the use of a non-contrastive geminate or a non-contrastive singleton plosive is likely to carry differing social information, the study also aims to establish whether and how Greek Cypriots evaluate the two variables socially. This is achieved by means of running matched-guise technique (MGT) tests comparing evaluations of singleton plosives and geminate plosives.

In addition to testing certain assumptions of ET, the thesis also focuses on contributing to existing knowledge on the perception of Greek Cypriot singleton and geminate plosives. Although several studies have been carried out in order to analyse perception and production of the sounds (Armosti 2010, 2012; Arvaniti 2001b; Arvaniti & Tserdanelis 2000; Tserdanelis & Arvaniti 2001; Botinis, Christofi, Themistocleous & Kyprianou 2004; Muller 2001; Christodoulou 2007), to the best of my knowledge, no study of CG voiceless plosives has explored the subject from a sociophonetic point of view. However, as the present state of research on speech perception implies, a full understanding of sound processing requires the incorporation of variables such as social information into the analysis.

Chapter 2 of this thesis provides a discussion of the sociolinguistic situation in the Republic of Cyprus and chapter 3 summarises up-to-date knowledge on phonetics and phonology of CG sound

inventory and on the perceptual and production features or issues of voiceless singleton and geminate plosives. Chapter 4 presents the assumptions of ET related to the subject of the present investigation. This description is followed by chapter 5 in which the research questions posed in this thesis are listed. Chapter 6 reports on and discusses a study of Greek Cypriots' attitudes towards the use of singleton and geminate plosives and its results, while chapter 7 describes a perceptual study testing several ET assumptions by investigating the influence of several variables on the perception of the singleton/geminate boundary. Chapter 8 includes a general discussion of results, a list of contributions to the knowledge on speech perception and the perception of CG singleton and geminate plosives and suggestions for further research.

2 Sociolinguistic issues in bidialectal Cyprus

In the Republic of Cyprus, SMG and Turkish are the two official languages. While Turkish remains as the language used for communication in the Turkish occupied territories in the north of the island, in the south of the island SMG is used in the public domain and CG is used in every day communication. Arvaniti (2006, 2010b) reports that the use of Turkish in the unoccupied part of the island is nominal. She explains that the language tends to be used in official documents, but not in all of them. She also brings to attention the fact that, in the 2001 census, 0.05% of respondents reported they are more fluent in Turkish than in any other language. Similarly to the non-occupied part of Cyprus where the inhabitants use CG and SMG (for more details on the use of the two varieties see section 2.1), in the occupied area, Turkish Cypriots are reported to use Cypriot Turkish dialect in everyday communication, and the form of Turkish which is used in Turkey (Standard Turkish) in the public domain (Kizilyürek & Gautier-Kizilyürek 2004). Since this thesis does not focus on language use in the Turkish-occupied area, as of now the term Cyprus will refer to the non-occupied part of the island, unless otherwise stated. This chapter discusses the way SMG and CG are used in CG (section 2.1), the attitudes towards the two varieties (section 2.2) and the relationship between identity and language use in Cyprus (section 2.3).

2.1 Standard Modern Greek and Cypriot Greek: the role of the varieties in the society

SMG, as the official language of the Republic of Cyprus, is reported to be the language used mainly in more formal domains, such as in education or the media. According to Arvaniti (1999a) CG, at the time of long isolation from Greece, was developing in its own direction that is different from the one in which SMG evolved. Therefore, CG is dissimilar to SMG to such a degree that it may sometimes be unintelligible to users of SMG from Greece. Arvaniti (1999a) also claims that the present increased exposure of Greek Cypriots to SMG does not seem to influence the shape of the phonetics and phonology of CG. Arvaniti (1999a) also states that CG is the sole language of everyday communication for Greek Cypriots, however, various descriptions of the linguistic situation in Cyprus indicate that the form of CG may vary depending on register (Karyolemou 2006; Sophocleous 2006, 2009; Tsiplakou 2006; Tsiplakou, Papapavlou, Pavlou & Katsoyannou 2006) or even geographical region (Newton 1972a). However, it needs to be stated that the study by Newton (1972a) was carried out before the Turkish invasion in Cyprus in 1974, after which Greek Cypriots living in the north part of the island were forced to move to the southern part of the island. It seems logical to assume that such a large movement of population could have affected the form of geographical variation of CG.

Although the linguistic situation in Cyprus is often described as diglossic (Newton 1972a), where SMG is the prestigious form used in a public domain while CG is the low form used in everyday communication in the private sphere, different linguists present various points of view on the existence and form of the diglossia. The differences between the descriptions of the linguistic situation appear to stem from the claim that Greek Cypriots do not realise SMG the same way mainland Greeks do. There seems to be a lack of agreement in the literature on whether Greek Cypriots tend to switch between CG and SMG, which differs in its form from the SMG used in Greece, or whether they tend to choose language forms from a dialectal continuum made of different approximations of SMG or from a register continuum.

Newton (1972a) states that Greek Cypriots tend to use SMG in formal situations and CG in everyday communication. He also states that CG comprises several regional varieties which may differ in lexis, syntax, phonetics/phonology and morphology. He also notes that CG has an urban, more standardised form and a rural form. Pavlou (1992, cited in Papapavlou and Pavlou 1998) states that, as well as CG and SMG, puristic Greek (katharevousa) is also used. Papapavlou (1997, cited in Pavlou and Papapavlou 1998: 213) supports the existence of diglossia and suggests that speakers switch between SMG and CG depending on the situation they find themselves in. Similarly, Arvaniti (2006, 2010b) describes Cyprus as a diglossic country where CG is the Low form, and SMG the High form. Yet, she maintains that since Greek Cypriots do not use SMG in the same form as mainland Greeks do, what can be presently observed is the formation of a new standard, Cypriot Standard Greek (CSG), which differs from SMG in its grammar, lexis, morphology, phonetics and phonology. This resonates with the statement by Yiakoumetti et al. (2005), who suggest that, as native speakers of CG, Greek Cypriots need to be taught SMG and, despite acquiring some SMG features, they tend to keep some of the features characteristic of CG (Yiakoumetti et al. 2005: 257).

Several reports pertaining to the use of SMG and CG in the public sphere seem to suggest that Greek Cypriots may not be consistent in their use of SMG in formal situations. As an example, Pavlou and Papapavlou (2004), who analysed teachers' attitudes towards the use of CG in the classroom, learned that teachers taking part in their study reported that the use of CG in class is acceptable when joking (71.3%), consoling a pupil (60%), and clarifying difficult concepts (70%). Moreover, 70% of the teachers said they used CG outside the classroom with their colleagues. These results resonate with Papapavlou's (2004) claim that SMG "remains academic and superficial for most Greek Cypriots who frequently feel pretentious and phony when using it" (Papapavlou 2004: 93). In a study which aimed to measure the frequency of dialect use at school,

Yiakoumetti, Papapavlou and Pavlou (2007) found that students use CG features in SMG when speaking or writing. The dialectal elements transferred to SMG tend to include phonological, lexical, morphological and syntactic features of CG. As regards the use of CG in the formal/public domain, Pavlou (2004) reports that unintentional use of CG also takes place in the Greek Cypriot electronic media. He claims that such examples of CG use take the form of code-switching and are the effect of speakers' limited ability to use SMG. As an example, on the radio or on TV, interviews with people, such as politicians, eyewitnesses or callers, may include code-switching. Results such as those by Pavlou and Papapavlou (2004) and Yiakoumetti et al. (2007) and Pavlou (2007) indicate that even though SMG tends to be reported as a language of the official domain, it is not the only variety used in formal settings, or, at least, it is not used in the form in which mainland Greeks use it. These results appear to add evidence to the claims put forward by Arvaniti (2006, 2010b).

Karyolemou (2006) draws attention to differences in the realisation of SMG by Greek Cypriots, claiming that "in reality, speakers do not use either the dialect or the standard, but combine features of the former with the features of the latter in a series of mixed varieties" (Karyolemou 2006: 1). Along these lines, research by Sophocleous (2006, 2009) suggests the existence of a dialectal continuum, with SMG at one extreme and Rural Greek Cypriot Dialect at the other. Moreover, Tsiplakou (2003) gives examples of how Greek Cypriots combine elements of SMG and CG subconsciously when involved in political, scientific and professional discussions. Nevertheless, according to Tsiplakou (2006), what we can observe in Cyprus is "classic diglossia in the Fergusonian sense, with Standard (Mainland) Greek as the superposed variety and a continuum of regional varieties and a metropolitan *koine* constituting the naturally acquired Cypriot Greek" (Tsiplakou 2006: 2345).

Tsiplakou et al. (2006) state that the variation within CG could be classified as a register continuum rather than a geographically defined dialect continuum. This suggestion is based on the tendency of CG speakers to be unable to enumerate any features of regional dialects despite being aware of their existence. Another piece of support for their claim is the tendency among young speakers to make use of hyperdialectalism. Tsiplakou et al. (2006) suggest that there are several registers present within CG which speakers tend to report while talking about CG. These include *vareta kipriaka* ('heavy Cypriot'), which is at one end of the continuum that is opposite to SMG, followed by *sosta/sistarismena kipriaka* ('correct/tidied-up Cypriot) and *evgenika kipriaka* ('polite Cypriot'), with *kalamaristika* ('pen-pusher speak'), or SMG, at the other end. Tsiplakou et al. (2006) note that SMG (or *kalamaristika*) tends to be perceived as a variety which does not

belong to the continuum. According to Tsiplakou et al. (2006), users of CG move along this continuum and make their choices of different linguistic features depending on factors such as the level of familiarity with the interlocutor and the subject of the conversation.

The present research is therefore not focused on deciding whether the situation could be labelled as a case of classic diglossia, rather this research seeks to draw attention to the suggested existence of various approximations to either SMG or CG which seems to be supported by a number of researchers (Karyolemou 2006; Sophocleous 2006, 2009; Tsiplakou 2003, 2006; Yiakoumetti et al. 2005).

It seems that treating the linguistic situation in Cyprus as either a classic case of diglossia or a dialectal continuum could influence the issue of [t]-[t:^{h}] boundary only to a small extent. As geminate plosives do not belong to the SMG sound set, they should be classified as (1) CG sounds if the linguistic situation were considered to be diglossic, or as (2) sounds which belong to a language variety (or a group of varieties) which is an approximation to SMG on a dialectal continuum. In case of the first scenario, it seems reasonable to believe that geminate plosives would be viewed as a complete alternative to singleton plosives and would be likely to carry all the social meanings of CG (see section 2.2). In the second scenario the possible meanings of geminate plosives would depend on the kind of variety on the continuum in which geminate plosives are likely to be used. The issue of social evaluations of singleton and geminate plosives was central to an evaluation study presented in chapter 6. The results of this study indicate that [t:^{h}] does not carry all the meanings attached to CG, and therefore it might be considered as an element of one of the intermediate varieties on a dialectal continuum.

2.2   Attitudes towards Standard Modern Greek and Cypriot Greek

According to both impressionistic accounts and systematic studies, which have employed, for example, attitudinal studies, Greek Cypriots evaluate SMG and CG differently. As an example, Tsiplakou (2006) says that "for the average Cypriot the dialect is 'heavy', 'peasant', 'in the process of becoming extinct', 'lacking a grammar', 'impoverished', 'rude' etc., whereas the Standard, which is pejoratively called 'pen-pusher-speak' in CG, is associated with education, modernity and social prestige" (Tsiplakou 2006: 2346). In the same way, Papapavlou (1998) claims that SMG speakers are considered to be more educated, attractive, ambitious, intelligent, interesting, modern, dependable, and pleasant, while the users of CG are believed to be more sincere, more humorous, kinder, and friendlier (Papapavlou 1998). This claim was based on the results of a matched-guise technique test carried out by Papapavlou (1998). The speakers whose voices were

used as guises in this study spoke CG as a native variety and were claimed to have mastered SMG to such a high level that their listeners could not detect they were not mainland Greeks. Their high level of mastery of SMG was due to the fact that they spent several years in Greece.

Furthermore, Sophocleous (2006), who divided CG into subvarieties and placed them on a continuum, analysed Greek Cypriots' attitudes towards the subvarieties using the MGT. The tests, which were carried out on a group of college students, produced results similar to those Papapavlou's study produced (Papapavlou 1998). Namely, as far as traits relating to competence are concerned, the speakers of Rural Greek Cypriot Dialect (Rural GCD; that is how Sophocleous refers to the basilect) received very low scores, yet they received higher evaluation on all attractiveness traits than SMG speakers. In contrast, SMG speakers scored the highest in all the groups on competence traits, although they received the lowest scores on attractiveness traits. The speakers of two intermediate subvarieties, Polished GCD and Modern GCD, obtained results that fell between those of SMG and Rural GCD speakers on all the above mentioned traits (Sophocleous 2006). Finally, attitudinal research by Pavlou (1997, cited in Pavlou & Papapavlou 1998: 216) implied that associations of kindergarten children with either SMG or CG seem to depend on their socio-economic background (Pavlou 1997, cited in Pavlou & Papapavlou 1998: 216). Such results indicate that the evaluations of CG not only differ on the basis of what subvariety is used by the speaker, but also on the basis of listener socio-economic background.

Attitudes towards CG have also been researched in the context of dialect use in education. Papapavlou and Pavlou's (2007) questionnaire study, which looked at primary school teachers' attitudes towards CG, showed great diversity in teachers' opinions on the status of the variety. Nearly half of the teachers that participated in the questionnaire did not consider CG an unsophisticated language; 17.6% of the respondents held the opposite view. Moreover 65.6% held that CG is a code that is adequate for communication, and 64.8% of the respondents agreed that CG is not less expressive than SMG. Yet, it has to be stressed that around one-third of the teachers were either unsure or disagreed with CG being adequate for communication and expressive.

Also, a related questionnaire study suggested that university students believed that CG has an inferior vocabulary range to SMG, yet it does not lack precision (Papapavlou 1998, cited in Papapavlou 2001). As far as teachers' views on language policy are concerned, slightly more than one-third of teachers (37.7%) were of the opinion that CG should be the language of instruction; 22.3% of the respondents were against the notion (Papapavlou & Pavlou 2007). A study of teacher classroom practices (Pavlou & Papapavlou 2004), based on a questionnaire administered to

teachers, suggested that 30.1% of teachers discourage pupils from using CG, 60.2% correct pupils' speaking CG, whereas 77.4% teachers correct pupils' writing. Moreover, when asked whether they paid attention to content or the code, 36.9% of teachers reported that they paid more attention to the code, 36.8% claimed they paid more attention to the content, while 26.3% were not sure. Additionally, 5.3% of teachers declared that they negatively assessed the performance of CG speakers.

Whereas most of the attitudinal research carried out on CG indicates how the variety (CG and SMG) or dialectal continuum is evaluated by listeners in general, it does not point out specifically which sounds, characteristic of the variety, are noticed and rated by the listener and how the ratings of various evaluated sounds differ from each other. The exception is research by Papapavlou (2001) which indicates that /ʃ/ tends to be rated lower than /dʒ/. Also, semi-structured interviews carried out by Alexander (2008a) might suggest that Greek Cypriot listeners are aware of the existence of geminate plosives in CG. When asked about differences between SMG and CG, the participants would list 'double Ps' and 'double Ts' as among other typically CG features. Nonetheless, it is difficult to ascertain if the informants were really referring to differences in the length of plosives while talking of 'double Ps' and 'double Ts'. It is worth noting though that, when asked to give examples of 'double sounds', the informants tended to give examples of words containing geminates and/or mimic geminate plosives putting a lot of emphasis on the length of plosives. That might indicate that the research participants were referring to geminate plosives. Nevertheless, to the best of my knowledge, currently it has not been experimentally tested whether the informants indeed refer to geminates while mentioning double Ps or double Ts.

Despite all the existing research, not all typically CG sounds, including geminate plosives, are described in detail with relation to the ratings they might receive from listeners, and therefore it is difficult to make claims pertaining to what features/sounds listeners react to when rating speakers.

2.3   Language and identity in the Republic of Cyprus

As argued by Pavlou and Papapavlou (1998), even though language appears to play a key role with Greek Cypriots in constructing identity, in fact, speakers' identities are shaped not only by language use, but also by other aspects of life such as moral values, political views and socioeconomic background. Thus, in order to grasp the way Greek Cypriots' identities are constructed, it is vital to understand the complexity of individual Greek Cypriots' social situations,

which is determined by the kind of relationship they have developed with Greece and Cyprus over the years, and the way language is related to this issue.

From the time they are born until they start formal education, Greek Cypriots are brought up exposed mostly to CG spoken by their families and peers, apart from some SMG to which they are exposed to mainly by means of radio or TV. The dialect (CG) is therefore their native language and is reported to be the code which, when used by group members, is said to evoke feelings of solidarity and equality among speakers (Karoulla-Vrikkis 1991). Thus, such a mind-set may be a foundation for the strengthening of national identity. Furthermore, speakers of CG tend to highlight the resemblance of CG to the ancient Greek language, which reportedly makes them feel proud of their language (Panayiotou 1996, cited in Pavlou and Papapavlou 1998).

Despite possibly feeling proud of the resemblance of CG to ancient Greek and the feelings of solidarity with other Greek Cypriots the use of CG may bring about, it is argued that Greek Cypriots are also inclined to be embarrassed by the variety, as they consider it a village dialect (Panayiotou 1996, cited in Pavlou and Papapavlou 1998). Such a stance may partially be a result of practices used in primary and secondary schools in Cyprus. In line with Papapavlou's (2004) account, teachers are claimed to discourage pupils from using the dialect in the classroom, as it is recommended that CG should not be used in the educational setting. Teachers are even reported to ridicule their students using dialectal features (Papapavlou 2004; Pavlou & Papapavlou 2004). It is also suggested that, due to such practices "often, children are made to feel, perhaps unintentionally, that their own natural way of speaking is wrong, inferior or impolite. As a result, they appear uneasy when using their native code and gradually come to believe that such a code should only be used by elderly Greek Cypriots living in rural areas (the so called *xorkades* 'peasants')" (Papapavlou 2004: 93). Such beliefs seem to be reflected in the results of some attitudinal studies, discussed in section 2.2, which suggest that CG is rated low on some traits, such as intelligence or modernity (e.g. Sophocleous 2006).

As well as being strongly attached to the culture and values of their own country, Greek Cypriots also seem to be culturally and historically bonded with mainland Greece. The bond may show itself in various ways. For instance, according to my observations, in addition to the Greek Cypriot Independence Day, Greek Cypriots celebrate the Greek Independence Day. Also, Greek flags seem to be almost always used together with Greek Cypriot flags. Furthermore, some Greek Cypriots tend to highlight that they are Greeks, just like the Greeks from the mainland. Greek Cypriots, who are regularly exposed to elements of Greek culture, through the radio and television, appear to follow Greek affairs and appreciate Greek popular culture. The relationship with mainland

Greece is also noticeable in the educational system and language policy of the country. According to Papapavlou (2004), SMG is taught in schools and is a national language in order to "deter the possibility of being cut-off from the 'motherland'" and to "maintain a national identity that is not much different from that in mainland Greece since the two places share common history, customs, culture and religion"(Papapavlou 2004: 92). Moreover, many of the textbooks that are used in Greek Cypriot schools were written and published by mainland Greeks, and were first introduced in the Greek educational system. Some students claim that, because of this fact, they find it difficult to study, as the language they study in is not their first language.

Yet, the status of SMG is said to be 'academic and superficial', as we saw above (Papapavlou 2004) since it is used almost exclusively in academic contexts. Its use in informal situations is viewed as 'pretentious and phony'. This argument could be supported by declarations of participants in research by Papapavlou (2004), who maintain that they code-switched to SMG when talking to a person who is educated or in authority. Such a state of affairs might imply a higher status of the code in contrast to the status of CG.

Another type of linguistic behaviour linked to the identity of Greek Cypriots is the frequent use of English words and expressions, which has been reported in several sources (Ioannou 1991; Karoulla-Vrikkis 1991; Panayiotou 1996). According to Ioannou (1991) and Karoulla-Vrikkis (1991), the common use of English phrases could signify that Greek Cypriots identify themselves with the western European culture. Karoulla-Vrikkis (1991) adds that besides demonstrating their pro-western-European identity, by using English phrases Greek Cypriots distance themselves from their Cypriot identity. Also, another explanation of the use of English phrases she offered is that some of the speakers might want to communicate to their interlocutor that they are educated.

It seems that, as a result of the history of their country, Greek Cypriots tend to have different levels of affiliation with Greece and Cyprus. Peristianis (2006) refers to results of a survey which facilitated establishing the proportions of different levels of affiliation with Greece or Cyprus within the Greek Cypriot society. In the survey the respondents were asked the following question: "As regards the issue of collective identity, which of the following best describes how you feel?" (Peristianis 2006: 107). The options given to the respondents were as follows: 'Cypriot', 'more Cypriot than Greek', 'equally Cypriot and Greek', 'more Greek than Cypriot' and 'Greek'. The survey results (see figure 2.1) suggest that reported identities vary from mainly Cypriot to mainly Greek with the greatest percentage of respondents (47%) identifying themselves as mainly Cypriot, 35% reporting to feel equally Cypriot and Greek and only 5% claiming to feel mainly Greek.

	Cypriot	More Cypriot than Greek	Equally Cypriot and Greek	More Greek than Cypriot	Greek
% of respondents	47	10	35	3	5
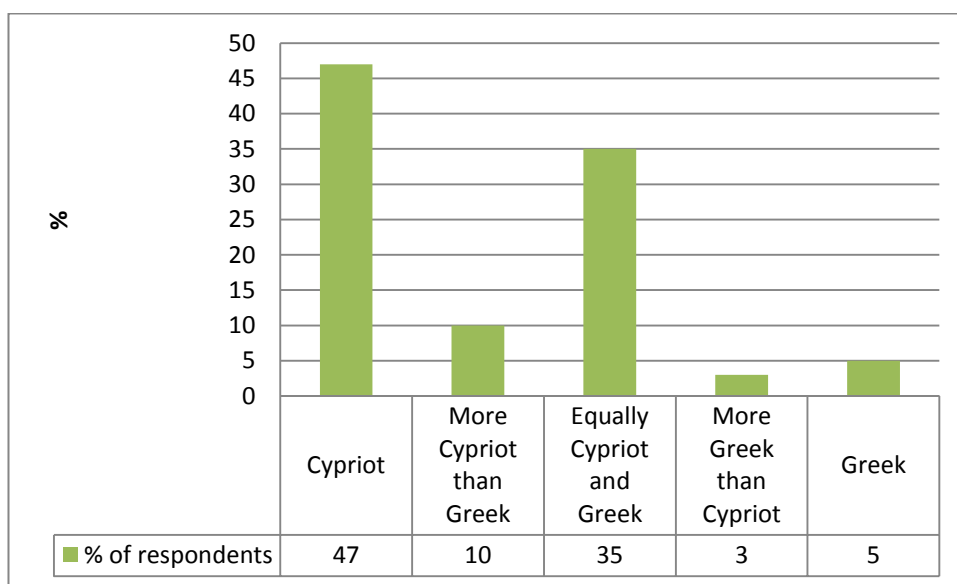
Figure 2.1 Identity reported by Greek Cypriots in a survey 'Understanding bicommunal perceptions and attitudes: A survey on political and national perceptions' (source: Peristianis 2006).

Peristianis (2006) notes that this wide range of identities is reflected in Cypriots' political loyalties, which may be divided into "loyalty to nation (hellenocentrism/ethnic nationalism) and loyalty to state (cyprocentrism/territorial-civic nationalism)" (Peristianis 2006: 105).

According to his descriptions, hellenocentrists feel that they are Greek and they are proud of Greek history and cultural heritage. In comparing Greece and Cyprus, they might play down the value of Cypriot history and cultural heritage. There seems to be a tendency among hellenocentrists to feel that Cyprus is Greek, and, in some cases, they may describe themselves as Greek Cypriots as opposed to Cypriots. Peristianis (2006) suggests that a consequence of hellenocentrists' Greece-oriented identities is their tendency to dissociate themselves from representatives of other ethnicities present in Cyprus and mainly from the Turks. He emphasises that Turkey tends to be viewed as "the complete opposite of Greece, the eternal enemy of the nation: lacking in history (…) and thus lacking in civilisation" (Peristianis 2006: 111). Yet, he notes that hellenocentrists tend to view Turkish Cypriots in a variety of ways, and that the level of their animosity towards Turkish Cypriots may vary from one person to another.

According to Peristianis' reports (2006), cyprocentrists tend to feel that they are Cypriots and they consider Greeks foreigners. They also tend to stress that Cyprus is a country independent of Greece and some of them distrust Greeks. As regards their attitude towards Turkish Cypriots,

cyprocentrists do not appear to be reluctant to work towards a solution of the Cyprus problem (the issue of the division of the island).

At this point, it needs to be noted that because CG is the native language of Greek Cypriots and SMG is the language used by mainland Greeks, Greek Cypriots' ideological affiliations may influence their language use and perceptions.

2.4 Conclusion

This chapter presented background information necessary for understanding the status and use of SMG and CG in the Republic of Cyprus. The chapter provided a brief overview of points of view on whether there is an example of classic diglossia or there is a dialectal continuum. It also provides an analysis of how the use of both varieties is evaluated by Greek Cypriots and a brief exploration of the relationship between Greek Cypriots' identities and the use of the two varieties. The attitudes towards the two varieties seem to indicate that it is likely that their users may evaluate some of the sounds which are characteristic of CG differently from their equivalents used in SMG. Such evaluation of sounds may mean that some of them could potentially carry some social meanings. Since geminate plosives are among those CG sounds which do not exist in SMG, it appears possible that they might carry some social meaning. This possibility will be investigated in a study to be discussed in chapter 6.

3 Plosives in SMG and CG

SMG and CG differ in their consonant inventories. Up to now, several studies have been devoted to the descriptions of differences between the consonants used in both varieties and to analyses of production and perception of CG and SMG consonants. Despite an increased interest in CG phonetics and phonology in the last two decades, it seems that a lot still needs to be discovered and understood about the phonetics and phonology of CG. Arvaniti (2010a) points out that even one of the most studied areas in CG phonetics and phonology – gemination – is not yet entirely understood.

This chapter presents a comparison of SMG and CG sound inventories (section 3.1). The comparison is followed by a brief discussion of the status of geminates in CG (section 3.2) and then by a review of production and perception studies of singleton and geminate plosives in CG (section 3.3). Section 3.4 discusses the issue of the representation of CG gemination in spelling.

3.1 Consonant inventories of SMG and CG: the differences

Table 3.1 presents a summary of the CG phonemic inventory. The summary was composed on the basis of accounts by Armosti (2010) and Arvaniti (2010a), which seem to be the most recent and up-to-date treatments of sound inventories of CG. Table 3.2 provides a summary of the SMG phonemic inventory prepared on the basis of information given in Arvaniti (1999b, 2007).

Arvaniti (2010a) and Armosti (2010) enumerate plosives (voiceless), affricates and fricatives, nasals, laterals, taps and trills as consonants belonging to the CG phonemic inventory. However, as indicated in table 3.1, there are some discrepancies regarding whether some of the sounds should be treated as phonemes or allophones.

Table 3.1 CG phonemic consonant inventory. Symbols printed in green are considered phonemes by Arvaniti (2010a) but not by Armosti (2010). The table does not include other CG sounds which are not a subject of dispute as to their allophonic status. (V-) – voiceless, (V+) – voiced.

	Bilabial		Labio-dental		Dental		Alveolar		Post-alveolar		Palatal		Velar	
	V-	V+	V-	V+	V-	V+	V-	V+	V-	V+	V-	V+	V-	V+
Plosive	p p:ʰ						t t:ʰ				c c:ʰ		k k:ʰ	
Fricative			f f:	v v:	θ θ:	ð	s s:	z z:	∫ ∫:	ʒ		j	x x:	ɣ
Affricate							ts		t∫ t∫:ʰ					
Nasal		m m:						n n:						
Tap								ɾ						
Trill								r						
Lateral approximant								l l:						

First of all, according to Armosti (2010) voiceless palatal plosives (singleton and geminate), voiced dental geminate fricatives, voiced singleton alveolar fricatives and palatal voiced fricatives should only have the status of allophones.

As far as voiceless palatal plosives are concerned, Armosti (2010) does not directly specify the reason for classifying them as allophones, but in one of his analyses of CG alternations he mentions [c] as one of the sounds that is derived from /j/. His classification could also be a result of the pattern that [c] and [cːʰ] appear only before front vowels /ɛ/ and /i/ which might make them be analysed as allophones of /k/ and /kːʰ/. This, however, is not indicated to be the reason for such a classification in his description of the GC sound system. Arvaniti's (2010a) categorisation of [c] and [cːʰ] as phonemes is not directly supported. The only argument that could explain her choice could be that she believes geminates should be treated as separate phonemes and not allophones of corresponding singletons as is postulated by Newton (1972a). However, this is a general statement by Arvaniti (2010a) regarding all geminates but not voiceless palatal plosives in particular. Also, she claims that palatal consonants are contrastive which might be another reason why she treats voiceless palatal plosives as phonemes. She does not provide any minimal pairs. What is interesting is that in her 1999a publication she classified [c] as an allophone of /k/ occurring before /ɛ/ and /i/.

Armosti (2010) classifies voiced singleton alveolar fricatives as allophones of /s/ which occurs before voiced consonants such as /v/ in /ˈsvinnɔ/, *to close*, which is realised as [ˈzvinːɔ]. Arvaniti (2010a) does not explain the reason for her classification of the sound as a phoneme. Finally, singleton palatal voiced fricatives appear to be classified as an allophone [ʝ] since it is considered one of the realisations of /j/ (Armosti 2010). This pattern is mentioned in one of his discussions of CG sound alternations that affect /j/. Arvaniti (2010a) includes the symbol /j/ in a cell in her table where one would expect to see a voiced palatal fricative and she classifies that sound as a phoneme. It is not clear from the table text whether it is just a typographical error (which seems likely) or whether she meant that the underlying representation of [ʝː] is /j/. Also, in her earlier publication (1999a) she postulated that [ʝː] may be a realisation of /ɣ/ when it occurs before /ɛ/ and /i/, which makes it even more difficult to understand what her stance is on the status of palatal voiced fricatives.

Furthermore, in contrast to Arvanti's claims (2010a), Armosti (2010) suggests that there is only a geminate voiced post-alveolar fricative [ʒː] in CG and that it is an allophone of geminate alveolar fricatives as is in case of /mɛxɛˈzzjɐ/, *shops*, which may be realised as [mɛxɛˈʒːɐ]. Even though

Arvaniti (2010a) lists geminate post-alveolar fricatives as allophones, she also lists singleton post-alveolar fricatives which she classifies as phonemes. This classification is not supported with any discussion. Interestingly, her earlier article (1999a) shows that she treated the /zz/ and [ʒː] sounds in /mɛxɛˈzzjɐ/ and [mɛxɛˈʒːɐ] as singletons. However, analysis would only suggest that singleton post-alveolar fricatives can also be allophones and not phonemes.

Also, Armosti (2010) maintains that voiceless alveolar affricates, voiced alveolar fricative and voiced alveolar trills appear only as geminates and not singleton plosives in CG. Arvaniti (2010a) lists these three sounds as singleton phonemes in her table illustrating the phonemic system of CG. Also, her classification of singleton alveolar trills as phonemes seems to be based on a claim that they are contrastive, but she does not cite any minimal pairs. Instead, she refers to results of the study by Tserdanelis and Arvaniti (2001) which provided evidence of the existence of singleton alveolar trills (in words [ˈvɛɾɐ], *beat* imp., and [vɐˈrɐ], *he/she beats*; in the original study the words are transcribed with an alveolar tap [ɾ] and in Arvaniti 2010a with [r]). As regards voiceless alveolar affricates, Armosti (2010) provides an example of a word with a voiceless alveolar affricate (/pɐˈput͡sin/, *shoe*, realised as [pɐˈputsːʰin]). Nevertheless, neither Armosti (2010) nor Arvaniti (2010a) reveal the reasons for their classifications of voiceless alveolar affricates. Furthermore, Armosti (2010) supports his claim that voiced alveolar fricative phonemes appear only as geminates with an example of a word with the sound he gives /ˈpɛzzɔ/, *play*, which is realised as [ˈpɛzːɔ]. Arvaniti (2010a) classifies voiced alveolar geminate fricatives as allophones without providing support for her claim, whereas Newton (1972a) claims such geminates do not exist.

The status or even existence of /j/ in the CG phonemic inventory seems disputable. Although Newton (1972a) claims it belongs to the CG phonemic inventory, Arvaniti (2006a) argues that the sound does not exist in CG and that it is normally replaced by [i]. In his analysis /j/, Armosti brings up an issue of morphophonemic alternations such as the one that involves the vowel /i/ in the word /rɔˈlɔ.in/ (*clock)* which is realised as [rɔˈlɔ.in] in singular. The plural form of the word is /rɔˈlɔ.jɐ/ which surfaces as [rɔˈlɔ.ɟɐ] '*clocks*'. Armosti (2010) points out that he accepts the existence of /j/ even though it is never realised as [j], but it is helpful in the explanation of processes that result in surface forms such as [k], [c], [ɟ], [ɲ] and [ʄj].

In the literature on CG, there are also differences in accounts of places of articulation for /t/, /tːʰ/ and /n/. Earlier accounts (Newton 1972a; Arvaniti 1999a) suggest that these sounds are dental, whereas Armosti (2010, 2012) and Arvaniti (2010a) define them as alveolars. It is not clear on what grounds Arvaniti (1999a) and Newton (1972a) classify these Greek Cypriot consonants as

dental. It is likely that such descriptions are due to the impressionistic character of early studies of CG. Nonetheless, the electropalatography tests carried out by Armosti (2012) seem to indicate that the sounds are indeed alveolar, as are their geminate counterparts. Following this argument, it seems logical to assume that the prenasalised voiced plosives, which are allophones of alveolar voiceless plosives, should also be considered alveolar sounds.

Table 3.2 SMG phonemic consonant inventory (based on Arvaniti 2007).

	Bilabial	Labio-dental	Dental	Alveolar	Velar
Plosive	p b			t d	k g
Fricative		f v	θ ð	s z	x ɣ
Nasal	m			n	
Tap				ɾ	
Lateral approximant				l	

The consonant inventory of CG is not identical to that of SMG. Even a brief look at tables 3.1 and 3.2 can show that there are several differences between the phonemic consonant inventories of CG and SMG. One of the differences between the two varieties is the status of voiced plosives, which in CG are treated as voiced and prenasalised allophones of voiceless unaspirated plosives. In CG, plosives are voiced if they follow nasal consonants or /z/. Prenasalised plosives can be found in word-initial position, which happens rarely in SMG, and in word-medial position (Newton 1972a; Arvaniti 1999a, 2010a). According to Newton (1972a), a word-initial plosive may also be voiced if the word that stands before it ends in /n/. In contrast, in her descriptions of SMG inventory, Arvaniti (1999b, 2007) lists voiced plosives in SMG as separate phonemes, which she describes as prenasalised. However, she stresses that it is disputable whether the sounds should indeed be considered as separate phonemes or as sequences of homorganic nasal+voiceless plosive. As she reports, the first option is supported by Householder (1964) and the second by Newton (1972b). Newton (1972b) states that voiced plosives are only elements of homorganic clusters of nasals and plosives in which the nasal element assimilates to the place of articulation of the following plosive, whereas the plosive assimilates voicing.

Arvaniti (1999b) says that, with the exception of word-initial position, voiced plosives in SMG are prenasalised, particularly in formal speech. Prenasalisation of voiced plosives is also absent in consonant clusters in which the target plosive follows /l/ or /r/. Prenasalisation may be lost in fast speech and voiced plosives may be lenited in such contexts. Furthermore, she reports that prenasalisation is less frequent in speech by young users of the Athenian variety. A study of the use of word-medial prenasalisation by Athenian speakers by Arvaniti and Joseph (2000) revealed that speakers born after 1970 use a significantly lower number of prenasalised voiced plosives

than speakers who were born before 1954. Although it is claimed that prenasalisation does not occur word-initially in SMG (Arvaniti 1999b; Newton 1972b), the data collected by Arvaniti and Joseph (2000) from thirty Athenian speakers showed that 2.9% of 181 voiced, word-initial tokens were prenasalised. In a conversational style of speaking, it was mostly women who used word-initial prenasalisation, while, in a reading task, men and women produced a comparable percentage of prenasalised plosives.

The presence of geminate consonants is also one of the characteristics distinguishing CG from SMG, which comprises only singleton consonants. Geminates in CG appear word-initially and word-medially (intervocalically) and it is reported that they are not prenasalised (Arvaniti 1999a). Across languages, word-initial geminate plosives are reported to be less common than word-medial geminate plosives (Ladefoged & Maddieson 1996). Muller (2001) presents a survey of 29 languages that have word-initial geminates, 21 of which have voiceless geminate plosives. Six languages are reported to have word-initial voiceless geminate plosives with bilabial, alveolar, palatal and velar places of articulation. These include Cypriot Greek, Nhaheum, Woleaian, Lak, Luganda and Puluwat. Nine other languages are reported to have voiceless geminate plosives in other four places of articulation.

Words containing geminates, including geminate plosives, could be divided into two groups. One of the groups includes words in which substituting a geminate with a singleton changes the literal meaning of that word. Such pairs of words include ['pɛfti], *Thursday*, and ['pːʰɛfti], *s/he falls*, ['kɔtɐ], hen, and ['kɔtːʰɐ], *knock (imp.)*, ['fɐkɐ], *mouse trap*, ['fɐkːʰɐ], *hit (imp.)*, and [kɐ'kɐ], *bad (neut. pl.)*, and [kɐ'kːʰɐ], *poo*. Geminates appearing in such words are referred to as contrastive geminates in this thesis. The words included in the other group do not change their literal meaning if a geminate is substituted by a singleton. These words include *never*, which is pronounced as [pɔ'tɛ] (SMG) and [pɔ'tːʰɛ] (CG), *bone* pronounced as ['kɔkɐlɔ] (SMG) and ['kɔkːʰɐlɔ] and *granddad*, pronounced as [pɐ'pus] (SMG) and [pɐ'pːʰus] (CG). Geminates in such a word context are referred to as non-contrastive geminates in this thesis.

Armosti (2010) argues that sounds that do not undergo gemination are [ɱ] [ŋ] and [ɾ], which have the status of allophones and not phonemes. Namely, [ɱ] is a realisation of /m/ which stands before a labio-dental fricative, [ŋ] of a /n/ followed by a velar plosive and [ɾ̥] of /r/ before voiceless consonants.

According to Arvaniti (1999a, 2010), Newton (1972a) and Armosti (2010, 2012), geminates, except for those being present in word-initial and word-medial positions, may also be formed across

word boundaries. Post-lexical geminates are formed when word-final /n/ assimilates to sonorants or fricatives in word-initial position (Newton 1972a; Arvaniti 1999a). For example, in a phrase /nɐ tɔn ðɔ/, *to see him*, /n/ assimilates to /ð/ which, as a result, is realised as [ðː] in [nɐ tɔ ðːɔ] (Armosti 2010). Also, in /tɔn lɔɣɔn/, *the reason*, (acc.) /n/ assimilates to /l/. This assimilation results in the phrase being uttered as [tɔlːɔɣɔn] (Arvaniti 2010a). Arvaniti (1999a) notes that post-lexical geminates may also be formed by voiced fricatives. Armosti (2011) provides an example of such a postlexical geminate in the phrase *let it snow*, /ɐs xiɔˈnisi/ which may be realised as [ɐʃːɔˈnisi].

Apart from including lexical and post-lexical geminates in its inventory, CG is also reported to have post-lexical supergeminates. Even though it was argued that word-final /n/ is deleted if it is followed by a word starting with a geminate sound (see below) or a consonant cluster (Newton 1972a; Arvaniti 1999a; Muller 2002), Payne and Eftychiou (2006) report that the word-final /n/ is not completely elided and it is assimilated to the following geminates forming supergeminates. According to Armosti (2007), such a process takes place in the phrase /ˈen ipen ˈlːiɐ/ *they did not say 'a little'* which is pronounced as [ˈen ipe ˈlːˑiɐ]. However, he notes that post-lexical geminates and supergeminates "were not readily identified by the subjects" (Armosti 2007: 763) who took part in his study testing listeners' perceptions of differences between word-initial singleton consonants, word-initial lexical geminates, post-lexical geminates and post-lexical supergeminates. In his view, this result indicates that despite the existence of post-lexical geminates and supergeminates, the sounds may not be linguistically functional.

3.2 Phonological status of Cypriot geminates (including geminate plosives)

Arvaniti (1999a) draws attention to the difference in reported phonological status of geminates. As she notes, Newton (1972) claims they should be treated as homogeneous consonant clusters, whereas Charalambopoulos (1982) claims they should be treated as separate phonemes.

Newton (1972a) classifies geminates as clusters of identical consonants on the basis of several arguments. One of the arguments is that including geminate consonants as separate phonemes would nearly double the phonemic inventory of CG and other Dodecanese dialects which make use of geminate consonants that can be used in contrast with singleton consonants. Another argument was the claim that certain processes present in CG could not be explained if geminates were treated as monosegmental consonants. One such process could be the deletion of word-final /n/ appearing before words with word-initial geminates. The deletion of the word-final /n/ takes place when the sound is followed by a word starting in a geminate or a heterogeneous

consonant cluster. Such deletion does not take place if the word-final /n/ is followed by a monosegmental consonant. Yet, Armosti (2010) argues that classifying geminates as clusters of identical consonants would hinder the explanation of another phonological pattern followed by geminates. More precisely, Armosti (2010) and Arvaniti (2001a, 2010a) draw attention to the tendency of velar geminate fricatives and velar geminate plosives to undergo palatalisation the same way as their singleton counterparts do. Specifically, the whole sound changes its place of articulation to palatal if it is followed by front vowels /i/ and /ɛ/. If geminate sounds were phonologically clusters of homogeneous segments, only the second element of each cluster would be affected by the change. Armosti (2010) points out that neither of the two presented approaches to classification of CG geminates, that is classifying them as either clusters of homogeneous sounds or monosegmental consonants, can facilitate the explanation of all processes that are present in CG.

Muller (2002) provides another approach to classifying geminates by arguing that geminates should be considered separate phonemes and not clusters of identical sounds, and she draws attention to the fact that the only plosive+plosive clusters in CG, /pt/ and /pk/, are extremely rare and /pk/ can be found only in word-initial position. She claims that, since there are no such limitations on the use of geminate plosives, which are more frequent in CG, they should not be considered to be plosive+plosive clusters. However, Malikouti-Drachman (2003) criticised this approach, and suggested that clusters such as /pt/ and /pk/ should be viewed differently from clusters of homorganic plosives.

In order to further support the claim that geminates are not homorganic clusters, Arvaniti (2010a) also says that the duration of consonant clusters prone to larger variations in length depending on the speech context. She asserts that the production tests she carried out (Arvaniti 1999c, 2001b) indicate that the duration of CG geminates is altered in fast speech, but the alterations were not greater than those in singleton sounds. According to Arvaniti (2010a), this is another argument against classifying geminates as consonant clusters.

It seems that so far the most successful and the most recognised approach was proposed by Malikouti-Drachman (1987 cited in Arvaniti 2010a), who suggested analysing CG geminates as monosegmental consonants, which, due to their length, should be linked to two timing slots associated with one root when analysed from the perspective of CV theory. According to Arvaniti (2010a) the advantage of this approach is that it accounts for situations in which geminates behave like consonant clusters (for example when the word-final /n/ is deleted before geminates)

and for situations in which they behave like monosegmental consonants (for instance in case of palatalisation).

Since the classification of geminates as monosegmental sounds or clusters of homogeneous consonants is not the aim of the present research, I will not commit to any of the approaches presented here. The aim of this study is to identify variables which influence the perception of the boundary between geminate and singleton plosives and therefore it will treat geminate sounds as monosegmental sounds.

3.3 Acoustic and perceptual studies on voiceless plosives in CG

3.3.1 Production

In the case of plosives across various languages, closure duration is considered to be the main acoustic cue determining whether a plosive is a singleton or a geminate (Ladefoged & Maddieson 1998, Ham 2001). For instance, Henton, Ladefoged & Maddieson (1992) report that in languages such as Estonian and Italian it is the difference in closure duration and not burst or aspiration that creates contrast between singletons and geminates plosives. Yet, in CG increased VOT is also a cue for gemination. In a brief review of 24 languages that exhibit gemination in plosives, Ridouane (2010) lists 3 languages (Cypriot Greek, Turkish and Moroccan Arabic) which apart from longer CD have also longer VOT in their plosive geminates. In literature on CG, the classification of consonants into singletons and geminates has been made mainly on the basis of consonant duration including CD and VOT values (Arvaniti 2006, 2007, 2010; Armosti 2010; Newton 1972a), although Newton (1972a) also suggests that geminate obstruents are also characterised by tenseness. Since CG geminates are reported to differ from singleton plosives in the length of VOT and CD, several production studies have been carried out in order to investigate the values of the two variables in geminate plosives and to compare them to those of singleton plosives. Studies have also been carried out with the aim of determining the factors that influence the values of VOT and CD in geminate and singleton plosives in CG.

Research by Tserdanelis and Arvaniti (2001), who carried out production tests on four native speakers of CG, suggested that the CD of bilabial and alveolar geminate plosives is longer by circa 36% than the closure of their singleton counterparts. Although there was a similar tendency among velar plosives, the difference in length was difficult to establish due to the inadequate amount of data collected in this study. The problems with obtaining adequate data occurred because some speakers insisted that the target sounds in the test words chosen by the researchers are not pronounced with geminate sounds, as was assumed by Tserdanelis and

Arvaniti (2001), but with singleton sounds. Therefore, those speakers did not produce geminate plosives in those words which resulted in an insufficient number of velar geminates collected in the study. Similarly, the test results showed a difference between the length of VOT in singletons and geminates, but the difference here was much greater than the difference between CDs, as VOT for geminate plosives was reported to be longer by approximately 84%. The magnitude of difference in VOT for [k] and [k:^{h}] was not estimated due to the small sample of [k:^{h}]. The patterns relating to differences between the values of CD and VOT are corroborated by the results of the tests performed by Botinis et al. (2004), who show that the difference between the CD values of singleton and geminate plosives is smaller than between the VOT length of singletons and geminates.

Muller (2001) analysed the production of geminate plosives in word-initial and word-medial positions. The results showed that the overall average duration of VOT in geminates is three times longer than in singletons. She also observed that VOT is longer in word-initial than in word-medial position in singleton and geminate plosives. Statistical tests carried out as a part of that study also indicated that place of articulation does not significantly affect VOT duration, but the position of the target plosive in a word does. Additionally, place of articulation turns out to be significant in interaction with the word position of a plosive. The duration of the whole segment in word-medial position is also longer for geminates than for singletons.

The study by Christodoulou (2007) looked at word-initial and word-medial geminate plosives. The tests she carried out did not control for the effects of stress or word length. The tests showed that VOT is significantly longer in geminate plosives than in singleton plosives. The length of VOT and CD also vary across different places of articulation. On the basis of her results and on the basis of the argument that VOT is the only cue available to the listener in perception of word-initial geminates, Christodoulou (2007) concluded that VOT is a primary cue to gemination in CG.

Armosti (2012) researched production of plosives by means of electropalatography (EPG), which is a way of measuring the contact between the tongue and the palate with the use of a thin, acrylic palate with embedded electrodes. The artificial palate, the shape of which is adjusted to the shape of the tested speaker, is attached to the speaker's roof of the mouth. As the tongue of the speaker touches the artificial palate, the electrodes in the area of contact are activated and send the signal that there was contact through wires attached to them. The method facilitates detecting the place and duration of contact between the tongue and the palate (Harrington 2010).

In EPG tests carried out on a 23-year-old Greek Cypriot male, Armosti measured the seal duration (Sld) which he defined as "the period for which full closure of the stop was attained" (Armosti 2012: 123). The tests revealed that the Sld of plosives is influenced by factors such as gemination, word position and stress. Sld is longer in geminates than in singletons, in utterance-initial and in utterance medial-position. Also, geminates have longer Sld in stressed than in unstressed syllables. Despite the small scale of this study, these tests added evidence to the claim that geminate plosives have longer CD than singleton plosives, even in utterance initial position. This pattern could not be revealed by means of acoustic measurements of CD.

The tests also showed that, during the production of word-medial geminates, there is more contact between the articulators than during the production of word-medial singleton plosives. The area that Armosti (2012) expected to be the constriction area for the alveolar sounds was the first four rows of electrodes from at the front part of the palate. In the production of geminates, 10% more electrodes were activated. An opposite trend was observed in the production of word-initial plosives. Production of singletons involved 100% electrodes in the expected area, whereas, in the case of geminates, only 88% of expected electrodes were activated. This discrepancy was not statistically significant.

Production tests carried out on voiceless singleton and geminate plosives by Tserdanelis and Arvaniti (2001) revealed that the VOT of bilabial and alveolar geminate plosives is significantly longer in stressed syllables than in unstressed syllables, whereas the duration of VOT in singleton plosives does not differ significantly in stressed and unstressed syllables. Tserdanelis and Arvaniti (2001) note that the result obtained from the test on singleton plosives is in line with those observed by Fourakis (1986), who analysed voiceless singleton plosives in SMG. Tserdanelis and Arvaniti (2001) and Arvaniti and Tserdanelis (2000) also found that the lengths of vowels preceding singleton plosives tend to be longer than those of vowels preceding geminate plosives. They note that the difference is significant only for velar plosives.

Arvaniti (2001b) tested the influence of speaking rate on singleton plosives uttered by four Greeks and on geminate and singleton plosives uttered by four Greek Cypriots. The outcomes of an analysis of speaking rate on the target sounds revealed that increased speaking rate causes a reduction of CD in singleton plosives. Arvaniti (2001b) reported that Tukey HSD tests indicated that there is no significant difference in the length of CD in [p] uttered by Greeks in slow and fast speech. The tests showed that CD of singleton and geminate bilabial plosives produced by Greek Cypriots is significantly different. Tukey HSD tests showed that VOT in singleton [p] and [t] produced by Greeks and Greek Cypriots is not significantly affected by the changes in speaking

rate while speaking rate has an effect on VOT of geminate bilabial and alveolar plosives. In the same study, a comparison across varieties revealed that CD in SMG singleton plosives is shorter than in CG singleton and geminate plosives. CG geminate plosives also turn out to be significantly longer than CG singleton plosives. However, in fast speech, CD in singleton [p] uttered by Greeks and Greek Cypriots do not differ. As regards the effect of consonant type on VOT, it is significant in all cases. Moreover, VOT in singleton plosives does not differ for Greek and Greek Cypriot speakers and it is shorter than in geminate plosives in CG.

Another issue related to the production of geminate plosives is that Newton (1972a) claims that they are fortis sounds. Arvaniti (2001, 2010a) and Davy and Panayiotou (2003) maintain that the claim may be reinforced by the tendency for geminates not to undergo intervocalic lenition, which is a process affecting singleton plosives in CG. Arvaniti and Tserdanelis (2000) analysed several sound parameters which are reported to be features of fortis sounds, including root mean square (RMS) amplitude of VOT in the target consonant, differences in amplitudes between the first and the second harmonic of a vowel following a plosive, the duration of a vowel preceding the target plosive, and the acoustic properties of F1 and F2 of the vowel preceding the plosive.

In their investigation of possible fortis character of plosives, Arvaniti and Tserdanelis (2000) investigated RMS amplitude. RMS amplitude is a way of measuring the amplitude of a waveform, which is calculated by squaring each sample from a waveform window, calculating the mean of the squares and taking the square root of the calculated mean of squared samples (Johnson 2003). The tests by Arvaniti and Tserdanelis (2000), carried out on four native speakers of CG (two male, two female), revealed that, for alveolar and velar plosives, RMS amplitude is the same regardless of presence or absence of gemination and stress. This result is not true for bilabial plosives since, for one of the speakers, RMS amplitude was lower for geminate plosives than for singleton plosives.

Taking advantage of the evidence provided by Cho, Jun and Ladefoged (2000) that the degree of difference between the amplitudes of the first two harmonics in a vowel helps detecting whether a speaker produced modal voice (occurring after a lenis sound) or breathy voice (occurring after a fortis sound), Arvaniti and Tserdanelis (2000) investigated the values of the amplitudes of the two harmonics in vowels following singleton and geminate plosives in CG. The analysis of the differences between the amplitudes of the first two harmonics found in the initial 10 seconds of a vowel following the target plosive shows that the differences between the amplitudes of the two harmonics are affected by gemination of bilabial and alveolar plosives. The vowels following geminate bilabials and alveolars have a more breathy voice than do the vowels following bilabial

and alveolar singletons. As far as the results for velar plosives are concerned, the effect was observed in only one of the speakers. It was also concluded that the differences in phonation which were observed might be a result of aspiration of plosives instead of tenser properties of voice. The vowels preceding the singleton and geminate plosives do not significantly differ in their quantity and quality. The absence of clear and regular patterns made Arvaniti and Tserdanelis (2000) conclude that the values of RMS amplitude, differences between the first two harmonics of the following vowel and the differences in parameters of the vowels preceding plosives do not seem to be strong enough to support the claim that geminate plosives are fortis sounds. Arvaniti (2010a) states that the possibility of geminates being fortis sounds should not be rejected on the basis of these results. As she claims, the differences in parameters might be too subtle to be proven statistically.

Arvaniti (2010a) also cites the electropalatographic study by Eftychiou (2004, cited in Arvaniti 2010a), which, though not dealing with plosives, aimed to investigate whether geminate [lː] and [sː] have more extensive lingual contact than singletons do. Such increased lingual contact could be symptomatic of the fortis character of consonants. Yet, the study did not present conclusive results, as Eftychiou's (2004) study participant could deal with the artificial palate only for short periods of time. The results showed that geminate [lː] has greater lingual contact than its singleton counterpart, which seems to support the hypothesis of geminates being fortis consonants. At the same time there does not seem to be any significant difference in the amount of lingual contact between singleton [s] and geminate [sː].

The electropalatographic study of alveolar singleton and geminate plosives by Armosti (2012) revealed that there are some differences in the amount of lingual contact in production of singleton and geminate plosives. Specifically, the production of geminate plosives involves more extensive lingual contact. Such results might add evidence to the claim that geminate plosives in CG are fortis sounds.

Studies which were designed to explore the values of CD and VOT and the factors that affect these values in CG have so far looked at average durations of VOT and CD produced by all recorded speakers analysed as a group and not by each speaker, separately. However, another issue concerning the duration of geminate and singleton plosives is the variation in length across speakers. My previous study results (Alexander 2008b), which looked at how Greek Cypriot speakers produce voiced and voiceless plosives when using SMG and CG, suggested that there is variation in the length of VOT in singleton and geminate plosives produced by Greek Cypriots. A group of native speakers of CG was asked to read a list of (a) words containing singleton plosives

and (b) words containing plosives that would be pronounced as geminates when uttered in CG and as singletons when pronounced with a SMG accent. The study participants first read the test words using SMG and then using CG. The results showed that the target sounds from group (b) words were realised in a number of ways. For instance, when using SMG the subjects sometimes produced the sounds with long VOT (they did not manage to suppress aspiration) and sometimes with short VOT. In some cases the length of VOT was difficult to classify as typically geminate or singleton plosives. Also, the average length of aspiration differed across the speakers. Moreover, the length of VOT in group (b) plosives also fluctuated across speakers when the words were uttered in CG. Finally, the study also identified that (1) some variation was found in the VOT of (a) group sounds, and (2) the differences in VOT also seemed to depend on the speaker.

Variability in the length of plosives was also mentioned by Christodoulou (2007), who showed that the differences in VOT and CD duration between singleton and geminate plosives are statistically significant, but pointed out that there was some variability in the values of VOT and CD across speakers. Some speakers produced a very large difference between CD of singletons and geminates whereas some produced a very small difference. Such variability was also characteristic of VOT production.

Such variation in plosive duration suggests more focused research is required to help establish how the boundary between singleton and geminate plosives is perceived by listeners given that some values of plosive duration seem to be intermediate between what could clearly be called a geminate and a singleton plosive. A question arises concerning how listeners deal with the perception of sounds which are difficult to categorise on the basis of their phonetic properties only. Chapter 4 presents a linguistic theory which is believed to offer ways of approaching such problems, and chapter 7 presents a study which was designed to explore this issue.

The data collected in the studies presented above provided some evidence regarding the durational proportions of singleton to geminate plosives which may allow one to put CG geminates in the context of other languages with geminates. According to Ladefoged and Maddieson (1996), across languages geminate plosives tend to be from one and a half to three times longer in terms of closure duration values. As an example, Abramson (1987) specifies that Pattani Malay closure duration in geminate unaspirated plosives in word-initial position are slightly more than two times longer and in word-medial position more than three times longer than equivalent singletons. Measurements of closure duration in Bernese reveal that a voiceless singleton to geminate ratio tends to be 1:1.44 in word-medial and 1:1.40 in word-final position (Ham 2001). Khattab (2007), who analysed Lebanese Arabic geminates, found that in general

there was a 1:2.5 singleton to geminate ratio after a short vowel and a 1:2.09 ratio after a long vowel in a word-reading task. For plosives the ratios ranged from 1:1.63 for voiceless velars following long vowels to 1:2.48 for voiced bilabials following short vowels. In this study, the duration of plosives included CD and VOT. In spontaneous speech, the general ratio of singletons to geminates was 1:1.82 after short vowels. According to Kunnari, Nakai and Vihman (2001), in Finnish such ratios for singleton to geminate plosives in word-medial position are between 1:2.38 and 1:2.80 whereas in Japanese they are between 1:2.15 and 1:2.35. In this study the plosive duration included CD and VOT. Hassan (2002) reports Swedish and classical Arabic singleton to geminate ratios to be 1:1.34 and 1:1.73 respectively. In general, it is reported that CG geminate consonants are circa 1.5-2 times longer than singleton consonants (Arvaniti 2010). Table 3.3 summarises the differences between singletons and geminates reported in several acoustic studies on geminates. Tables 3.4 and 3.5 summarise values of singletons and geminates measured in several acoustic studies of gemination. In case of geminate plosives, the differences in duration encompass CD and VOT. For that reason, the values are listed separately in tables 3.3 and 3.4.

	Tserdanelis and Arvaniti (2001)	Armosti (2010)	Botinis et al. (2004)	Christodoulou (2007)	Muller (2001)
VOT	84%	247%	390%	270%	196%
CD	36%	56%	42%	60%	66%
Sonorants	47%				
Fricatives	24%				34%

Table 3.3 Differences between durations of singleton and geminate consonants. Dark-green shading – values for plosives and affricates together. Light-green shading – values for plosives only.

Differences in values of CD and VOT for singletons and geminates with different places of articulation appear to be well-separated in all studies mentioned in table 3.4. An analysis of values of singletons and geminates for each place of articulation separately shows that there could be some potential overlapping between categories reported in different studies. As an example, some of the mean CD values for geminates and singletons are very similar for alveolars and velars (the means provided by Muller (2001) and Arvaniti (2010) in both cases). Also, there seem to be only slight differences between some mean durations of singleton VOT and geminate VOT. There is only about a 10ms difference between bilabial VOTs reported by Muller (2001) and Arvaniti (2010), circa 15ms between alveolar VOTs provided by Muller and Arvaniti, and around 20ms between VOTs reported by Muller (2001) and Arvaniti (2010). However, it needs to be remembered that such potential overlapping might have been a result of differences in data collection employed by different researchers; examples of such differences include different

speech rate, stress effect, etc. Yet, the present data does not really allow generalisations to be made regarding where exactly the boundary is. Such apparent lack of separation might be a result of differences between studies. However, results of some studies mentioned earlier in this section (Christodoulou 2007, Alexander 2008b), indicate that there seems to be a certain degree of variation across speakers.

	Armosti 2010 6 speakers		Arvaniti 2010**** 4 speakers		Muller 2001 6 speakers			Christodoulou 2007 13 speakers		Botinis et al. 2004 10 speakers	
	CD	VOT*	CD	VOT**	CD***	VOT		CD	VOT	CD	VOT
						WI	WM				
[p]	72	15	70	10	85	39.9	23.3	80.4	14	76	13
[p:ʰ]	105	65	109	50	165	135.3	102.7	129	75	108	51
[t]	59	15	64	15	100	47.1	34.5	76.5	22		
[t:ʰ]	106	64	104	62	140	85.6	91.4	133.5	74		
[k]	59	25	61	32	80	44.4	29.9	78.5	29		
[k:ʰ]	95	70	82	63	135	123.2	109.5	115.4	91		
[c]	67	25									
[c:ʰ]	99	74									
[tʃ]	46	6	40	53							
[tʃ:ʰ]	72	22	66	94							

Table 3.4 Summary of mean VOT and CD values in singleton and geminate consonants analysed in several acoustic studies on CG (in ms). WI – word-initial, WM – word-medial, * - in affricates the value is for friction, ** - in Armosti (2010) in affricates instead of this value, time period measured from the end of frication until the beginning of vocal folds' vibration is included, *** - these are approximate values as the exact values were not given in the original figure, **** - Arvaniti (2010) reports these values to be based on data collected for Tserdanelis and Arvaniti (2001).

	Arvaniti 2010* 4 speakers		Muller 2001 6 speakers			
	Singleton in ms	Geminate in ms	Singleton in ms		Geminate in ms	
			WI	WM	WI	WM
[s]	134	166				
[ʃ]	116	159	177.2	134.2	221.1	195.1
[m]	81	125				
[n]	62	112				
[l]	67	123				
[r]	21	68				

Table 3.5 Summary of durations of singleton and geminate consonants analysed by Tserdanelis and Arvaniti (2001) and Muller (2001) in ms. * - Arvaniti (2010) reports these values to be based on data collected for Tserdanelis and Arvaniti (2001). WI – word-initial, WM – word medial

As far as the perceptual boundary is concerned, the results of the study by Armosti (2010), who analysed how a gradual increase in the length of CD and VOT influences perception of the boundary, show that percentages of tokens identified as geminates increased with the increase of CD and VOT values. It is not easy to identify where exactly the perceptual boundary is, because Armosti (2010) used combinations of different CD and VOT values in speech tokens. Furthermore, he used two different geminate-plosive continua which differed in the intensity of aspiration; in one of the continua VOT was generated from a VOT sample taken from a singleton plosive (higher aspiration intensity), whereas in the other one the VOT continuum was generated from a sample of a geminate plosive (lower aspiration intensity). In the two continua, the percentages of tokens classified as geminates were different; in the continuum with VOT generated from geminate plosive sample, tokens with shorter plosives were more likely to be classified as geminates. In that set of stimuli there was also a clearer boundary between geminates and singletons due to a sharp increase in the number of tokens labelled as geminates. More precisely, 80% of tokens with VOT of 50ms were labelled as geminates despite having only a 30ms CD. Tokens with longer CD and VOT were even more likely to be perceived as geminates. In the other continuum the increase was not so sharp; listeners labelled as geminates 59% of tokens with 70ms VOT and 60ms CD, 71% of tokens with 50ms VOT and 90ms CD, and 81% of tokens with 120ms CD and only 30ms VOT. Further increases in VOT and CD values caused a gradual increase in the percentage of tokens classified as geminates.

Figure 3.1 illustrates differences in length between non-contrastive singleton and geminate plosives in the word feta produced by the same speaker. These samples were recorded during a recording session which was carried out in order to gather material for production of stimuli used in a perceptual experiment which was a part of the present study (see section 7.1). What can be observed in the spectrogram and the waveform is that CD and VOT in the sample pronounced in CG are longer. A summary of factors other than gemination that influence VOT and CD values is presented in section 3.3.

To sum up, the body of research on GC plosives provides some information on their production. The studies mentioned in this section provide evidence on the differences in values of VOT and CD between geminates and singletons in CG. Some of the tests provided a comparison of the duration of VOT and CD in SMG and CG singleton plosives. The effect of word-context, stress, speech rate and place of articulation on the duration of geminate and singleton plosives uttered by Greek Cypriots have also been investigated. Small scale EPG tests provided some evidence regarding the duration and amount of alveolar contact in alveolar plosives in various contexts

(word and sentence context, stress). Several parameters have been analysed in order to verify that geminate plosives are fortis sounds; yet, not enough evidence has been found to support the hypothesis.
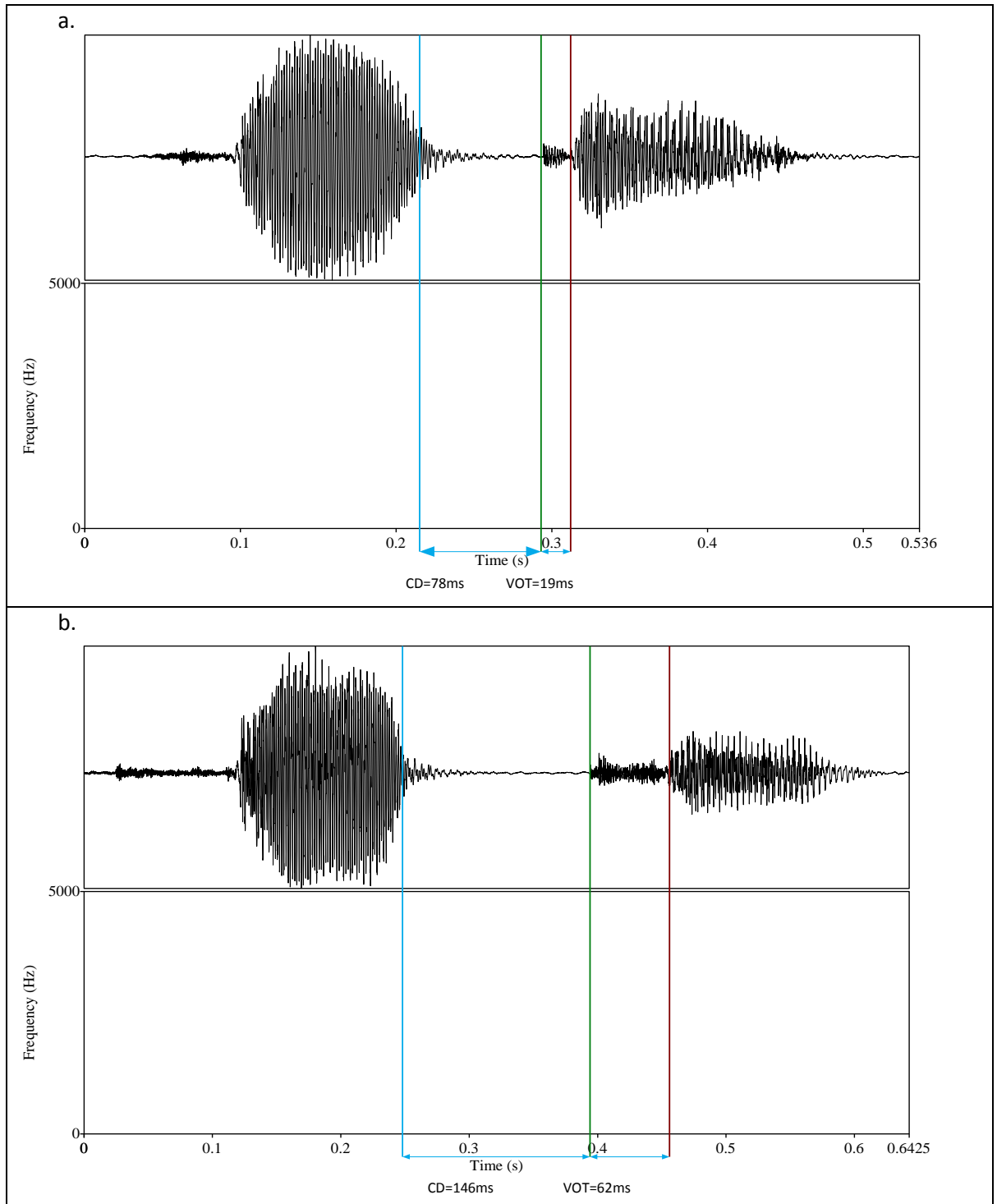
Figure 3.1 Spectrograms and waveforms of *feta* pronounced with a singleton (a) and with a geminate (b). Blue line – end of a vowel, green line – offset, brown line – onset of the vocal folds' vibration.

3.3.2 Perception

There have been a few studies analysing whether VOT or CD is the primary cue for the perception of gemination in CG. In several studies the speculations were based on production rather than perceptual tests. Thus, the analyses carried out by Christodoulou (2007), Botinis et al. (2004), and Arvaniti and Tserdanelis (2001) were based on production data. In contrast, Muller (2001) and Armosti (2010) made their assumptions on the basis of perceptual studies.

According to Christodoulou (2007), it is VOT that cues gemination in Cypriot Greek plosives, as it is the only cue available in the case of word-initial geminates. Yet, Arvaniti (2010a) points out that such justification might not be accurate, since there are languages (for example, Swiss German) with word-initial unaspirated geminate plosives, and in such languages the CD is the only cue for gemination in such sounds despite being inaudible in certain contexts.

Arvaniti and Tserdanelis (2000) and Muller (2001) offer the alternative view that CD is the primary cue, whereas VOT is the secondary cue. It is worth noting that Armosti (2010) argues that the study by Muller (2001) may not be entirely reliable because it was fundamentally flawed due to the fact that her perceptual stimuli differed in one more sound apart from the tested one. Yet another view as to what cues gemination of plosives is presented by Botinis et al. (2004), who argue that both CD and VOT are important cues.

Finally, Armosti (2010) carried out his perceptual tests using two sets of perceptual stimuli. The two sets differed in the intensity of the VOT namely an acoustic value proportional to the amplitude of a waveform which is perceived as loudness. More precisely, the intensity of VOT in one set was relatively higher than the intensity in the other set. The results of the tests suggested that, in the set that had lower intensity of VOT, CD tended to be a stronger cue. Yet, when VOT had relatively higher intensity, both cues (VOT and CD) were robust indicators of gemination. Such results imply that high intensity of aspiration is likely to increase the possibility of a plosive being perceived as a geminate (Armosti 2010). To the best of my knowledge, the study by Armosti (2010) has been the most detailed analysis of perception of plosive gemination that has been carried out so far. Nevertheless, despite giving a detailed account of acoustic variables involved in the perception of singleton/geminate boundary in CG, the study did not investigate non-linguistic cues which might potentially influence processing of the above-mentioned boundary.

3.4 Representation of CG gemination in spelling

CG is not a codified variety and has no standardised orthography (Themistocleous 2010; Arvaniti 1006a, 2006b). The majority of day-to-day writing in Cyprus is done in SMG except for some of the

current folkloristic literature, CG dictionaries and humorous/satirical texts. Pavlou (2004) reports that the use of CG in the press is rare and limited to single words or phrases in the dialect. If elements of CG are used in the press, it is done in order to give the writing a more informal style or when particular speakers using the dialect are cited.

Themistocleous (2010) notes that in general writers employ their own solutions in order to codify the CG sounds in a way that they reflect their Cypriot pronunciation. This problem also concerns representing geminate sounds which are not present in SMG. The issue is complicated as geminates used to exist in Ancient Greek when they were contrastive sounds, but survived only in some varieties of Greek, including CG (Themistocleous 2010; Themistocleous et al. 2012; Davy & Panayiotou 2003).

According to Themistoclous et al. (2012) many geminate sounds are still reflected in SMG orthography by means of double sequences of the symbols that reflect/stand for the geminates consonant, however, certain words which used to include geminates in SMG are now spelled as geminates. This situation is an outcome of a spelling reform which was introduced when Demotic Greek was established as the standard language in Greece. Themistocleous et al. (2012) draw attention to selectivity of choices made in the reform which eliminated representations of gemination in SMG, but not in all of the words.

As a result of the reform mentioned above, some words in SMG are still spelled with double symbols, such as ίππος (*horse*), καππάρι (*capers*) (the target symbols are in bold), however, these sounds are not realised as geminates in SMG ([ˈipɔs] and [kɐˈpɐri], respectively). Such sequences of identical symbols/letters may be realised as geminates in CG. Also, there are words which are pronounced with geminate sounds in CG, but do not have sequences of identical sounds in spelling in SMG. These are **π**έφτω (*fall*), ποτέ (*never*), κότα (*hen*) which in CG are realised as [ˈ**pːʰ**εftɔ], [pɔˈ**tːʰ**ε] and [ˈkɔ**tːʰ**ɐ] respectively.

According to Arvaniti (2006a), CG tends to use double letters in words in which SMG does not, but in which consonants are realised as geminates in CG such as πέ**νν**α, *pen* ([ˈpɛnːɐ]) in place of πέ**ν**α. Observations made by the author of this thesis suggest that such ways of reflecting CG pronunciation in spelling can be observed in restaurant menus around the island in words such as πί**ττ**α, φέ**ττ**α, instead of SMG πί**τ**α, φέ**τ**α are used. It is also the author's impression that blog writers and Facebook users who want to give their writing a less formal style use forms such as πο**ττ**έ and **ππ**έφτω instead of SMG ποτέ and **π**έφτω.

Themistocleous' (2010) research, which involved analysis of spelling/writing practices of Internet Relay Chat (IRC) users, revealed that when using the Roman alphabet, the writers tended to employ duplicated symbols representing the chosen geminate sounds.

The above discussion on spelling of geminate sounds shows that even though some of the CG geminates are represented in SMG orthography, not all of them are. Also, although CG users tend to find their ways of reflecting gemination in their writing, there are no standardised rules for CG spelling.

3.5 Conclusion

This chapter provided a review of the scarce research on plosives in CG and it showed the differences between the plosive inventory in SMG and CG. The acoustic features of CG singleton and geminate plosives indicate that the two types of sounds are continuous in nature which means that their length may be increased and decreased.

Several acoustic and perceptual studies of plosives and their acoustic features suggest that VOT and CD are robust cues for gemination, and that intensity of aspiration also plays a role in the perception of consonant length. The research on plosives also suggests that there is a certain level of variability in the duration of plosives and their components, VOT and CD, as the duration of both values tends to be influenced by factors like speech rate. Also, there seems to be evidence suggesting that there is a certain degree of variability across listeners.

It has also been brought to attention that geminate plosives may be divided into contrastive and non-contrastive ones. Considering that there seems to be a certain degree of variability in the duration of plosives across speakers and across the two varieties used in Cyprus, there is a possibility that speakers might also need to rely on cues other than acoustic ones in processing the geminate/singleton boundary when dealing with words that may include non-contrastive geminates or singletons.

The likelihood that non-linguistic cues are used in processing the geminate/singleton plosive boundary seems to be even stronger if one contemplates the possibility that the two variables may carry social information similarly to how the use of CG and SMG does (see chapter 2). This is especially likely due to the fact that the use of SMG, which does not have geminates in its inventory, and the use of CG, which has geminates, are reported to be associated with some characteristics attributed to the users of the varieties (Sophocleous 2006; Papapavlou 1998). Nevertheless, to the best of my knowledge, research on the social evaluation of singleton and geminate plosives in CG or on the use of non-linguistic cues in processing the singleton/geminate

plosive boundary has not been carried out yet. An analysis of social meaning attributed to the users of geminate plosives is a part of the present study and it is presented in chapter 6.

4   Exemplar theory

Exemplar-based approaches to perception, categorization and production have their roots in research on cognition carried out by researchers such as Semon (1923 cited in Johnson 2007: 27), Hintzman (1986) and Nosofsky (1986, 1988, 1991). The main feature of those approaches is that categories are built bottom-up on the basis of the experienced occurrences of those categories. According to exemplar-based approaches, categorization of experienced episodes is completed on the basis of similarity of the incoming, experienced item to the exemplars stored in a person's memory under a given category's label (Nosofsky 1986).

Linguists such as Goldinger (1996, 1997, 1998), Johnson (1997a, 1997b, 2006), Pisoni (1997), Jusczyk (1993), Anderson, Morgan and White (2003), Coleman (2002), Port (2007), Pierrehumbert (2001, 2003a, 2003b, 2006), Strand (1999, 2000), Hay and her collaborators (Hay et al. 2006b, Hay et al. 2006a, Hay and Drager 2010) and Bybee (2000, 2001, 2007), adopted the approach. Johnson (2007) points out that there is no single, uniform exemplar theory. Some of the many exemplar-based models suggested so far are MINERVA (suggested by Hinzman and applied in speech processing by Goldinger 1998), WRAPSA (Jusczyk 1993), PRIMIR (Werker & Curtin 2005), TRACE (McClelland & Elman 1986), or XMOD (Johnson 1997a). All the exemplar-based approaches to phonology assume that phonological categories and rules are built bottom-up on the basis of experienced phonetic details and that non-linguistic information is stored in memory alongside acoustic signal features. As several linguists (including Coleman 2002; Scobbie 2006; Pisoni 1997; Foulkes & Docherty 2006) have asserted, these basic assumptions of ET have the capacity to account for several language phenomena, which could not be explained through more traditional approaches to phonology, which assume solely abstract representations of language elements and speaker normalisation in speech perception. As an example, Coleman (2002) provides an analysis of several linguistic concepts (including phonemes, word frequency, syllable structure, feet, morae, sociolinguistic variation, evidence from perception and production studies) which seems to demonstrate that the representations of lexical items people store in their memories are phonetic and not phonological in nature and that those representations are based on the statistical input a listener receives.

Linguists have discussed and applied the basic assumptions of ET in different ways and in various areas of their discipline. The aim of adopting exemplar-based approaches in phonology has been to explain phenomena such as sound category formation, perception of speech, explaining frequency effects, and even production of sounds. The reason for the adoption of exemplar-based models was also to account for processes such as perception of variation and sound change.

In the remaining sections of this chapter I present an overview of the main assumptions of ET which are directly related to the aim and scope of the present study. These include aspects of speech perception, categorization of sounds and speech production. The overview is followed by a brief discussion of the relevance of the ET assumptions to the perception of the boundary between singleton and geminate plosives in CG.

4.1   Category formation and sound perception in ET framework

Exemplar theory assumes that sound categories are formed bottom-up, on the basis of previously experienced instances of sounds, which are kept in memory alongside non-linguistic information such as social information about the speaker. That is, experienced instances of sounds, words or word structures are remembered and the categories are created on the basis of statistical similarity and on the basis of similarity of non-linguistic information (Hintzman 1986; Johnson 1997a, 1997b, 2006, 2007; Nygaard 2005; Pierrehumbert 2001, 2003a, 2003b; Pisoni 1997). Even though it is assumed that listeners remember experienced sounds, the theory does not assume all of the experienced sounds are stored in listeners' memory. This issue is further addressed in section 4.1.1.

According to Johnson, "A perceptual category is defined as the set of all experienced instances of that category" (Johnson 1997a: 146). In line with this assumption "no abstract category prototypes are posited" (Johnson 1997a: 146). In other words, exemplar theory does not assume that speakers are born with abstract prototypes of sound categories. However, the theory does not exclude abstraction or generalisation over collected sets of exemplars belonging to one category. The exemplar-based model posited by Hintzman (1986), for instance, despite assuming that categories are built bottom-up, suggests that people tend to make generalisations over the perceived exemplars.

Johnson (1997a, 1997b, 2006, 2007) and Pierrehumbert (2001, 2003a) advocate an application of a category formation model which was initially proposed by Johnson (1997b) as a model of speech perception. The model assumes the existence of a phonetic map representing the phonetic space, whose dimensions are phonetic parameters which are significant in perception of a given category/percept. In line with this model, category nodes are placed at various locations on that map. The strength of category representation at certain position of the map is determined by a number and recency of exemplars stored at that position on the map. Pierrehumbert (2003a) highlights that this model predicts that categories with higher numbers of stored exemplars are likely to have more robust representations.

Johnson (1997b) notes that his model of auditory speech perception is similar to Nosofsky's model (1986), that is, the generalised context model (GCM). Johnson's model comprises three stages. During the first stage, the audio signal is transformed into a set of auditory spectra. During the second stage, the spectra are compared to those stored in memory and subsequently classified as the most similar ones. If the incoming spectra cannot be successfully matched to any of the stored ones, due to the lack of similarity, then the new incoming spectrum is added to a codebook and given its own number (all stored spectra have their numbers). If the spectrum of the new incoming signal is similar to any of the stored spectra, the similar stored spectrum changes its properties to become more like the new (incoming) spectrum. In the last stage, the incoming sequences of auditory spectra are matched with similar stored sequences. The stored sequences are placed on a phonetic map, also referred to as a covering map, and, if the incoming sequence is similar to any of those stored on the map, then the stored sequence, which is the most similar to the incoming one, gets updated. In a situation when there is no similar sequence stored on the map, the incoming sequence is saved on the map (Johnson 1997b).

Johnson's model of perception (1997b) also assumes that the stored spectra are gradually separated into segments (separate sounds) which are "based on auditory similarity and are position specific" (Johnson 1997b: 108). In line with his assumptions, "phonemes are defined in terms of subsets in the sets of exemplars which have time-aligned similarities in their auditory/perceptual representations" (Johnson 1997b: 108). Another element included in the model that Nosofsky (1986) proposes is the existence of attention weights which "control the degree to which the categorization process is sensitive to particular auditory properties" (Johnson 1997a: 149).

Jusczyk, who developed a similar perception model, WRAPSA (Jusczyk 1993), proposes an explanation of the way speech is perceived and stored in the memories of infants. Jusczyk (1993) claims that when an incoming signal is perceived, acoustic details are remembered. This is followed by the establishment of a weighting system which assigns levels of importance to particular elements of the remembered acoustic signal. The weights and levels of importance facilitate understanding of speech and they are assigned to various language elements on the basis of their statistical occurrences and capacity to indicate contrasts. Subsequently, words are singled out when the weighting system is in operation, and separate lexical items are stored and segregated in memory.

Goldinger (1997) assumes continuous updating and modification of categories, and he suggests that human memory is constantly updated with perceptual experiences characterised with

various parameters. Likewise, in her description of category development, Pierrehumbert (2003a) also stressed their incremental development, advocating that, as we are exposed to a language and its sounds, we store increasing numbers of exemplars of those sounds, and, in this way, sound categories become more robust in our memory. Pierrehumbert (2006) notes that the assumption regarding incremental development implies "the possibility of learning into adulthood" (Pierrehumbert 2006: 520); however, she mentions that this learning is most likely to be faster and more efficient in childhood than in adulthood.

Another issue closely related to category formation in the exemplar theory framework refers to storing non-linguistic/indexical information alongside the acoustic signal. Indexical information might include perceived background of the speaker, such as gender, age, social class or the geographical area the speaker comes from. Non-linguistic information might also relate to the context in which the speech act occurs. Storing of indexical information alongside acoustic signal information is argued for in work by Johnson (1997a, 1997b, 2005, 2006, 2007), Goldinger (1997) Pierrehumbert (2001, 2003a), Scobbie (2006), Pisoni (1997) and many others.

According to Foulkes and Docherty (2006), the link between both types of information is created automatically as the signal is stored in memory. In line with their suggestions, while storing incoming speech signal, "listeners map phonological patterning not only against the meaning of the word in question but also against other dimensions of that particular token such as the identity of the speaker" (Foulkes & Docherty 2006: 426).

The following sections (4.1.1 – 4.1.3) provide details regarding different aspects of category formation in the exemplar theory framework. These include the role of the amount and type of exposure and the effects of different types of non-linguistic information on speech processing.

4.1.1 The importance of the amount of exposure

Within the ET framework, the category's development is said to be dependent on the amount of exposure to occurrences of sounds that could be grouped in the same category, and the type of input. It is asserted that the more occurrences of a particular category of sound one is exposed to, the richer exemplar sets one possesses, which increases the likelihood of developing a strong sound category (Bybee 2000, 2001, 2006; Goldinger 1996, 1998; Pierrehumbert 2001, 2003a). Pierrehumbert (2003a) notes that, whereas an adequate amount of exposure to a sound category is likely to increase the category's robustness and its chances of lasting, an inadequate amount of exposure might hinder category development to such an extent that it could disappear or be

assimilated by another, neighbouring category. As regards the amount of exposure to a given category of sound, several studies seem to provide evidence of its importance.

The assumption that the amount of exposure to a sound category may determine the robustness of that category could be further supported by the claims made by Maye, Werker and Gerken (2002) about the way in which infants develop sound categories. Maye et al. (2002) claim that the reason why infants start demonstrating native-like categorisation of consonant sounds as they approach their first birthday, is that only when they are about ten months old have infants developed categories of those sounds fairly well. The level of development of those categories is claimed to be a result of the amount of exposure to the language. They also point out that the development of vowel sound categories in American English takes place earlier, as there are fewer vowels than consonants in American English. For instance, they claim that Standard American English has only ten vowels and twenty-four consonants. For that reason, vowel sounds are more often repeated (so they are more frequent). Anderson et al. (2003) also provided evidence for the basis of infants' development of sound categories. They looked into how infants' development of sound categories while learning English was affected by the amount of input. They tested perception of non-English sounds by two groups of infants learning English (6.5 months and 8.5 months). The results showed that the older infants were less successful at differentiating between non-English sounds than the younger ones. This difference between the two age groups was attributed to the assumption that the more children develop the target (native) language sound categories, the less likely they are to discriminate between non-native sounds despite being able to do that in the earlier stages of their lives. According to Anderson et al. (2003), these study outcomes imply that the amount of exposure is a significant factor in forming sound categories.

One of the studies which indicated that the amount of exposure to a pair of sounds may improve the ability to discriminate between them was a study of perception of retroflex and dental plosives in Hindi by native English speakers who had different amount of exposure to Hindi (Tees & Werker 1984). In that study listeners who had had five years of exposure to Hindi prior to the experiment performed better in discrimination tasks than listeners newly exposed to Hindi. This result suggested that the listeners who had prior exposure to the two classes of sounds might have had more robust representation of the two classes in their memories.

Studies of American dialect categorisation by naïve listeners revealed that listeners who travelled more or who had lived in several places dealt with the categorisation better than the other study participants. Clopper and Pisoni (2004, 2006) concluded that listeners who travelled more

outperformed other study participants as they had more exposure to different varieties of English and they had greater knowledge of places in which particular variables are used. Similar effects of exposure to other varieties were observed by Fridland, Bartlett and Kreuz (2004), who analysed listeners' ability to distinguish between vowels which had formant values characteristic of southern American accents and those that did not have those values. It was discovered that the listeners who had contact with speech communities that used the tested vowels were more accurate at making correct distinctions between the vowels they heard in the experiment.

Hay et al. (2006b) suggested that the potential amount of exposure to Australian speech affected perception of manipulated vowels by New Zealanders from higher social classes. Listeners in their experiment were asked to choose which vowel from an acoustically manipulated continuum would match another vowel which was produced by a speaker from New Zealand. The answer sheets the listeners were asked to use were labelled either 'Australia' or 'New Zealand'. Listeners with higher social backgrounds who were presented with the 'Australia' answer sheet tended to choose more Australian-like tokens from the continuum. Hay et al. (2006b) explained that as those listeners came from higher social backgrounds, they might have travelled to Australia more and developed their categories of Australian-like vowels.

It needs to be highlighted, though, that some of the studies cited in this section, especially the ones by Fridland et al. (2004), Clopper and Pisoni (2004, 2006) and Tees & Werker (1984) do not only indicate that it is the amount of exposure that influences/improves perception of various sound categories. These studies indicate that it is a combination of the amount of exposure and the type of exposure. The role of the type of exposure is discussed in detail in section 4.1.2.

Even though the hypothesis that the amount of exposure is important in category development seems to be supported by various pieces of evidence, the assumption that all occurrences of sounds are stored in memory has been declared unlikely by Pierrehumbert (2003a) and Johnson (1997a). It seems impossible that a person can remember every instance of sounds he/she has experienced. Johnson (1997a) notes that to account for this problem it seems necessary to refer to the sound perception and categorisation model posited by Kruschke (1992, cited in Johnson 1997a). In line with this model, exemplars of perceptual experiences are stored on an exemplar map, which symbolises the perceptual space in which exemplars are placed. In this multidimensional map, each dimension represents a given property of an incoming stimulus. In sound perception, the properties would be the sounds' acoustic characteristics, which play a significant role in its perception. Thus, the multidimensional exemplar map is a set of values of those acoustic characteristics. Similar to Nosofsky's perceptual model (1986), which Johnson

(1997a) adopted, Kruschke's model also assumes the existence of attention weights and association weights. The former determine the level of importance of a particular auditory property for the categorisation of a sound. The latter determines categorisation of given exemplars. According to Kruschke (1992), association weights and attention weights are learned and continually upgraded by listeners. New incoming exemplars tend to continuously modify the (acoustic) values of exemplars which have already been stored on the map instead of being stored on the exemplar map as separate units. Only those incoming exemplars which cannot be matched with any memorised ones are stored as separate exemplars. This way it seems possible that even though one's memory is exposed to continuously incoming stimuli, it is not being filled up with excess information. Pierrehumbert (2001, 2006) seems to support the idea that incoming experiences update the stored exemplars. However, she (2001) also suggests that some of the exemplars, especially those stored a long time ago, are likely to be forgotten.

An issue related to the importance of the amount of exposure is the frequency of certain lexical items or word structures in a language and how the frequent words and structures influence survival and/or emergence of sundry patterns (including sound or grammatical patterns) in languages. Frequency of words, sound patterns and grammatical patterns have also been reported to influence how they tend to be processed by listeners. Frequency effects have been a subject of multiple studies written within the framework of exemplar theory. However, as frequency effects are not the subject of this thesis, only a few examples of frequency studies are presented below.

As an example, a study of well-formedness of nonsense words clusters, by Hay, Pierrehumbert and Beckman (2003), aimed to test well-formedness of more frequent (such as /nt/) and less frequent (such as /nf/, /mθ/) nasal + obstruent clusters. Their study participants were asked to judge which of the non-existing words heard could be added to the English vocabulary. It was discovered that greater frequency increased a cluster's level of perceived well-formedness. Also, well-formedness turned out to be a gradient and not categorical property of consonant clusters.

Hay et al. (2003) draw attention to the role of frequency of language-specific phonotactic patterns in their perception. They refer to ample literature which gives evidence for the claim that more frequent language-specific phonotactic patterns are perceived differently to less frequent ones. Pierrehumbert (2003b) notes that such frequency effects can be observed on several levels, including morphological structure of words, word-level phonotactic structures and phonetic categories. Pierrehumbert (2006) explains the emergence of such patterns as follows:

Frequent categories are advantaged in speech perception because speech perception involves competition amongst alternative classifications of the same physical stimulus. This competition plays out in exemplar theory through the cumulative force of the exemplars in the similarity neighbourhood of the stimulus (Pierrehumbert 2006: 524).

Thus, the exemplar sets of more frequent categories are more robust, and such categories (e.g. words) are processed faster, even in difficult conditions.

Bybee (2006) also discusses the importance of frequency and claims that the frequency with which certain word sequences appear in the language has an effect on the way they are stored in memory. High frequency usage leads to development of collocations and grammatical structures. As she explains, "frequency strengthens the memory representations of words or phrases, making them easier to access whole and thus less likely to be subject to analogical reformation" (Bybee 2006: 715). This reinforcement of structures may be behind the development of phenomena such as the irregular forms of verbs or phonetic reduction of phrases.

Experiments carried out by Nycz (2013), suggest that, in acquisition of a new category which is present in a language variety not native to the listeners, the acoustic features of the new category are acquired faster in high-frequency words than in low-frequency lexical items.

4.1.2 The separation of sound categories

As far as the type of input is concerned, a body of research suggests that developed categories may or may not be well separated, depending on what types of exemplars of sounds one has been exposed to. More precisely, the separation of categories is likely to be determined by the magnitude of the differences between exemplars that belong to two different categories (Pierrehumbert 2001, 2003a, 2003b; Maye et al. 2002; Maye and Gerken 2000).

Separation of categories plays a role in classification of perceived sounds. In line with ET, the process of sound/exemplar classification is believed to involve comparison of the incoming exemplar to those already stored in memory. Specifically, upon exposure to a new stimulus, instances of sounds (exemplars) stored in memory are activated to a different level depending on how similar they are to the new stimulus. Johnson (1997a) suggests that the similarity of the phonetic signal could be calculated on the basis of a formula posited by Nosofsky (1986). Using this formula, calculation of similarity of two sounds would involve (1) Euclidian distance between values of particular auditory properties of both sounds, (2) attention weights of a property, which estimate the level of sensitivity to the sound property, and (3) a sensitivity constant, the role of

which is to lessen the influence of distant exemplars (Johnson 1997a: 147-148). The level of excitation of each exemplar depends not only on its phonetic detail, but also on if and how the extralinguistic information stored with it matches that of the new incoming signal (Goldinger 1997; Johnson 1997a, 1997b, 2005, 2006, 2007). As this section focuses on the importance of the type of phonetic signal that influences perception, the role of non-linguistic (indexical) information in perception is further discussed in section 4.1.3.

It is crucial that the categories are well-separated from each other, especially when categories which are potentially similar to each other are both supposed to survive without being assimilated to a neighbouring category. In a case when categories are not well-separated, one of them may be assimilated by the stronger one, or the two categories may merge. Pierrehumbert notes that "learning the phonetic patterns of a language involves learning probability distributions over the parametric phonetic space" (Pierrehumbert 2003a: 127). She suggests that developing sound categories involves storing exemplars of sounds with various acoustic properties and categorising them on the basis of similarity and quantity. Thus, categories are potentially well-separated if a substantial number of exemplars with similar acoustic properties are stored for each of the categories. In other words, the distribution of the exemplars of sounds in the phonetic space needs to be such that there is a relatively high density of exemplars in the phonetic space of those given categories, but there should be low density of exemplars in between the phonetic spaces of those categories.

Pierrehumbert (2003a) points out that research by Maye et al. (2002) and Maye and Gerken (2000) add evidence to the assumption that the way sound categories are separated from each other in one's memory is likely to depend on the amount of exposure and the type of sounds (acoustic properties of sounds) that a person experiences. Maye et al. (2002), who researched how different types of exposure to a voiced-voiceless plosive continuum may affect a child's development of the sound categories, found out that exposure to a bimodal frequency distribution allows children to develop better separated sound categories than exposure to unimodal frequency distribution.

The ET assumptions regarding the type of input and category separation have been reported to be applicable in understanding situations in which listeners are exposed to substantial variation in acoustic signal (within one sound category or in similar categories) such as in mergers or splits of sound categories. Nycz (2013) points out that differences between realisations of two categories may range from a substantial one to one that is not noticeable to the speaker/hearer. If two categories are similar to each other to a degree that the speakers/hearers do not hear the

difference, increased exposure to exemplars classified as one of the categories but with slightly different acoustic parameters may shift the category in a way that it will diverge from the other, similar, category.

To show an example of such a contrast acquisition, Nycz (2013) discusses the acquisition of the *cot-caught* contrast by Canadian speakers living in the New York area. The Canadian speakers Nycz (2013) included in her study managed to acquire the *cot-caught* contrast to a certain extent despite being exposed to the two sound categories as mature speakers. Yet, the production of the two target categories by the study participants was not identical to the production of the same sounds by native New York area residents. Also, Nycz (2013) reported an overlap between the two categories. This incomplete split of a category could be an outcome of a gradual change in build-up of exemplars of words containing the *caught* vowel.

Even though evidence such as that presented above seems to indicate that exemplars of a sound category are stored in the same general phonetic space, this issue is more complex. Foulkes (2010) draws attention to the tendency among male, female and young speakers to produce certain phonetic categories differently, which leads to a situation in which the same sound category has different phonetic parameters. As an example, Foulkes (2010) and Foulkes and Hay (in press) point out that due to biological differences in their vocal tracts, men, women and children tend to produce the corresponding sounds with different f0 values. This implies that male, female and child exemplars of corresponding categories occupy different phonetic spaces. Such use of different phonetic spaces carries indexical information. As regards developing the association between f0 values and the sex of the speaker, Foulkes (2010) and Foulkes and Hay (in press) notice that existing evidence presented in literature on processing of indexical information by infants suggests that young children who have started discriminating between individual voices might be forming more general categories of talkers such as males and females. These generalisations are made as the listeners get more and more exposure to language produced by an increasing number of speakers. Sound categories produced by male and female speakers may also occupy different phonetic spaces due to other phonetic, but non-biologically-conditioned, parameters/features. These include differences in formant values between male and female speakers which cannot be attributed to biological factors. Such differences seem to be socially-conditioned and their association with indexical meaning appears to develop later than the ability to discriminate between male and female voices.

The possibility of a category to occupy different phonetic spaces indicates that linguistic and indexical information may not be stored completely separately, and that some indexical

information is carried by phonetic parameters of sounds. However, Foulkes (2010) emphasises that it is still not very clear how exactly both types of information are stored, processed and accessed.

4.1.3 Indexical information

In line with ET, occurrences of sounds are remembered with indexical information, which in modular approaches to phonology would be considered "noise" (Semon 1923, as cited in Johnson 2007: 27; Goldinger 1997; Johnson 1997a, 1997b, 2006, 2005, 2007; Pierrehumbert 2003a; Scobbie 2006; Pisoni 1997). At the time of speech processing, listeners are believed to make use of the stored indexical information. Johnson (2007) refers to the process of non-linguistic information activation as the exemplar resonance mechanism. He speculates that this mechanism "permits activation to spread through a set of exemplars via non-phonetic properties" (Johnson 2007: 36). Thus, the two mechanisms, calculation of similarity and exemplar resonance mechanism, facilitate classification of an incoming signal on the basis of its phonetic and non-phonetic features. According to Johnson (2007), "similarity of between exemplars on their non-phonetic aspects changes the phonetic response of the system" (Johnson 2007: 36).

Scobbie (2006) notes that, thanks to this assumption, ET has the potential to account for successful communication between speakers with incompatible sound systems. As he reports it, one of the differences between most English accents and Shetlandic is that in most English accents voiced plosives are characterised by short lag VOT, whereas voiceless plosives have long lag VOT. However, Scobbie (2006) claims that the variety of English spoken by native Shetlanders has voiced plosives with negative VOT values, while voiceless plosives have short lag VOT. Thus, Shetlandic voiceless plosives are pronounced the way voiced plosives are in other English varieties, and therefore Scobbie (2006) refers to these two systems as incompatible. To address this issue he analyses the VOT values of speakers brought up and living in the Shetland Islands. The speakers were divided into three groups depending on where their parents were from: Scotland (but not Shetland), England or Shetland. The measurements of VOT in voiced and voiceless plosives indicated that there was a lot of variation in the VOT values across the speakers, and, as predicted, some speakers produced voiced plosives with short lag VOT values, whereas others produced voiceless plosives with short lag VOT. These results made Scobbie (2006) suggest that there could be some other information, apart from the phonetic signal, which would help speakers of that community differentiate between two phonemes, even though they tend to be realised in the same way. He suggests that the information is indexical in nature, and concludes that such results could be explained by means of exemplar approaches, which assume that

perception of sounds includes processing both phonetic and indexical cues. He also suggests that, in order to explore similar linguistic situations, more studies should include data collected from speakers of vernacular varieties of languages. Such data is more likely to incorporate what Scobbie (2006) refers to as 'unwanted variation', that is, variation across individual subjects. Research looking into this sort of data has the potential to explore "the underlying uniformities of the speakers' linguistic systems" (Scobbie 2006: 387)

Non-linguistic information stored in listeners' memories may include speakers' (perceived) age (Hay et al. 2006b), gender (Clopper & Pisoni 2007; Strand & Johnson 1996; Strand 1999, 2000; Johnson 1990, 2006), social background (Hay et al. 2006) or geographical background (Niedzielski 1999; Hay et al. 2006a; Hay and Drager 2010). Some studies report that listeners tend to store the quality of voice of the speakers (Mullennix, Pisoni & Martin 1989; Mullennix & Pisoni 1990). The influence of non-linguistic information on speech perception has already been documented in several studies.

Outcomes of some studies indicate that listeners tend to store and/or use information such as speakers' quality of voice. Mullennix et al. (1989) exposed one group of listeners to lists of words read by more than one speaker and another group of speakers to a list of words read by only one speaker. Listeners from both groups were asked to name the words the speakers uttered. The listeners who were exposed to more than one speaker tended to make more mistakes than the listeners who were exposed to a list read by one speaker. Furthermore, listeners exposed to multiple speakers named the heard words more slowly than their counterparts. It was concluded that the listeners exposed to multiple speakers took more time and found the task more challenging because they had to process indexical information relating to different voices. A study carried out by Mullennix and Pisoni (1990) showed that when listeners were exposed to speech by more than one speaker who differed in gender, they needed more time to process acoustic information. Such results indicate that, when processing speech, listeners pay attention to the characteristics of the acoustic signal of the heard sounds and to social information about the speakers they hear.

Similar results were achieved by Goldinger (1996, 1997, 1998), who reports that listeners who were asked to repeat the words they had heard were more successful when they were exposed to a list of words read by one speaker than when they heard a list of words read by various speakers. Such patterns might imply that while listening to several different speakers, listeners need to exert more effort as they process more indexical information (such as the quality of voice), as compared to a listener who is exposed to only one speaker. This might mean that when listeners

need to compare an incoming signal to stored exemplars of speech, they compared not only the acoustic information of stored and incoming samples of speech, but also the non-phonetic information that accompanies the phonetic signal. In a study aiming at analysing how being familiar with a voice of a speaker influences a listener's ability to perceived words, Nygaard, Sommers and Pisoni (1994) observed that familiarity with speakers' voices enhanced listeners' perceptual performance. This result shows yet another example of a tendency which suggests that processing social information about a speaker might be a part of speech perception.

Docherty and Foulkes (2000) analysed the production of pre-pausal /t/ in Tyneside English and found that there was a substantial degree of use of pre-aspirated /t/ which tends to be used by young, working-class women. They point out that children have the ability to pick up such phonetic detail even though its use does not change the meaning of utterances but only has social meaning. From their point of view, this ability on the part of children is yet another argument for exemplar-based models of perception (Docherty & Foulkes 2000). This behaviour on the part of the children in the study implies that, apart from just paying attention to the acoustic signal that affects the literal meaning of speech, they also tend to be sensitive to the types of acoustic detail that is likely to carry social information.

A study on perception of gender by Foulkes, Docherty, Khattab and Yaeger-Dror (2010) established that gender-specific realisations of /p, t, k/ characteristic of people in the Tyneside area facilitate discrimination between male and female voices for listeners who are familiar with the Tyneside realisations of /p, t, k/. Listeners who were not familiar with the Tyneside variety made more errors in tasks in which they had to classify children's voices as male or female voices. The study seems to support the assumptions that (1) categories are built bottom-up as the listeners who had previous exposure to the categories they heard in the experiment were more successful in their judgements, and (2) that social information is stored with the acoustic signal as the listeners associated particular realisations of the target sounds with one gender or the other. This study appears to suggest that the type of exposure one receives influences the person's perception.

Perceived gender of a speaker is one of the social variables that have been reported to influence perception of an acoustic signal in several studies. For instance, Johnson (1990) observed that the perceived gender of the speaker influenced the way listeners in a vowel categorisation task perceived the vowels that were played to them. In a study by Strand (2000), a group of listeners was asked to listen to a speaker and then to repeat the words they heard. The words they heard were uttered by speakers with stereotypical and non-stereotypical male and female voices. The

level of stereotypicality of voices had been earlier established by means of multi-dimensional scaling of perceptual test results combined with tests that analysed reaction times in gender classification of heard voices. It was observed that when repeating after speakers with non-stereotypical male or female voices, the study participants had longer reaction times than when repeating after stereotypical male or female voices. The results suggest that listeners have different expectations of speakers from either gender. Furthermore, in situations in which it is not so easy to classify a voice as being either male or female, processing of sounds with such voices may be more difficult and take more time as a result.

Some studies on how the speaker's perceived gender influences those who listen to it involved exposing listeners to videos with male and female voice/face mismatches. In one of such experiments, Schwippert and Benoit (1997) had their study participants wear goggles during the test and then exposed them to videos of a female speaker whose voice was dubbed with (1) acoustically degraded (by means of white noise) recordings of a male speaker and (2) her own acoustically degraded voice, and acoustically-degraded audio stimuli by the same two speakers. The listeners were also exposed to the same video recordings without audio signal. Half of the study participants were familiar with the female speaker. The study participants were asked to indicate on an answer sheets the vowels they heard. The outcomes of the experiment showed that the study participants performed better when exposed to the visual stimulus. Some listeners perceived the face of the speaker as a male face. In case of such study participants, listening to male recordings and looking at what they perceived as a male face improved their perception of the recordings they had heard. This indicated that availability of social information may affect perception of sounds.

Knowing that the values of F3 and F4 in /s/ differ for men and women, Strand and Johnson (1996) exposed a group of participants to audio-visual recordings of male and female speakers producing the words 'sod' and 'shod'. In some of the stimuli, the faces in video recordings were dubbed with non-prototypical voices of speakers of the opposite sex. Also, in the recordings the F3 and F4 values were manipulated in a way that different samples of 'shod' and 'sod' had different values of the formants. The values of formants could be put on a nine-point scale. Strand and Johnson (1996) report the differences in frequency values between each step on a scale to be equal Bark units. They used bandwidths equal to 10% formal frequency value for production of the continuum. The study participants, who were asked to classify the heard words as 'shod' or 'sod', turned out to be influenced by the type of faces they saw in the film. The results showed that the stimuli which had intermediate F3 and F4 values between /s/ and /ʃ/ were more likely to be

perceived as 'sod' when the participants saw a male face in the video. Such behaviour seems consistent with the production patterns followed by male speakers who tend to produce lower formant frequencies when producing /s/.

A similar study, in which female faces were dubbed with male voices and vice versa, was also carried out by Johnson, Strand and D'Imperio (1999), who tested how the perceived gender of a speaker could affect the perception of /ʊ/ and /ʌ/ boundary. Johnson et al. (1999) exposed their subjects to a series of videos with speakers, whose voices differed in levels of gender stereotypicality, who produced samples of speech with manipulated formant values in /ʊ/ and /ʌ/. The listeners were asked to indicate whether each of the heard stimuli was *hood* or *hud*. Johnson et al. (1999) observed that exposing their study participants to male and female faces shifted the /ʊ/ - /ʌ/ boundary, which, according to them, signified that the listeners had different expectations of male and female speakers.

The perceptual patterns in all the studies on the influence of perceived gender of the speaker which I presented above suggest that information about gender is remembered together with acoustic signal and tends to be used during speech processing by listeners.

Experiments carried out by Hay et al. (2006b) involved playing samples of speech and simultaneously showing pictures of a person, whom the listeners believed to be the speaker they were listening to, in different guises. The aim of the guises was to give the impression that the speakers were of certain age and came from different social classes. The study outcomes revealed that the perception of sounds may also depend on the perceived age and social class of a speaker.

Results of some experiments revealed that placing a regional label on an answer sheet or exposing listeners to objects symbolising a geographical area may also affect speech perception. For instance, Niedzielski (1999), who carried out perceptual experiments involving listeners matching synthesised vowel samples, divided her subjects (listeners), who were from Detroit, into two groups. Members of one of the groups received answer sheets with a 'Detroit' label, whereas members of the other group received answer sheets labelled 'Canadian'. As Niedzielski (1999) observed, the way the listeners matched the synthesised samples depended on which group the listeners belonged to, that is, since Detroiters tend to believe that they speak Standard English they were inclined to choose a sample of a standard vowel as the best match if they belonged to the group which was told the speaker was a Detroiter. On the other hand, the listeners who were asked to use the answer sheets labelled 'Canadian' tended to choose the synthesised sample which sounded more Canadian.

Hay et al. (2006a) also placed regional labels on answer sheets which their study participants used when matching synthesised vowels to those heard in recordings of New Zealanders' natural speech. One set of the answer sheets had the label 'Australia' printed on them, and the other set had a label 'New Zealand'. The outcome revealed that the listeners chose more Australian-like speech samples when exposed to the 'Australia' label on the answer sheet. Interviews with the study participants revealed that the listeners were aware of the fact that, during the perceptual experiment, they were listening to a New Zealander. Hay et al. (2006a) concluded that even though the listeners did not believe they had been listening to Australians, the presence of the 'Australian' label on the answer sheet caused the activation of the 'Australia' notion stored in speech exemplars at the time of processing the incoming sound signal.

In order to add evidence to the claim that the presence of a symbol representing a geographical area may activate the information stored in sound exemplars and referring to the area, Hay and Drager (2010) exposed their study participants to stuffed kiwi and kangaroo toys. The former toys were supposed to symbolise New Zealand and the latter Australia. The results of the experiment further support the claim that an item symbolising a culture or place may also activate a concept linked to that culture or area which is stored along acoustic information of the sound.

The effects of context in which the speech act takes place were also reported in some studies. Hay et al. (2006b) report that the experimenter's language variety may also impact the study participant's perception of sounds. Hay and Drager (2010) claim such patterns indicate that "dialect information is stored in the mind and is indexed to other tokens in the dialect" (Hay and Drager 2010: 870).

Perception of heard sounds is also likely to be affected by the context of an utterance. For example, results of experiments carried out by Borsky, Tuller and Shapiro (1998) indicate that perception of voicing in a VOT continuum between /k/ and /g/ by American listeners depended on the content of the carrier phrase in which the target words, *goat* and *coat*, were placed. The words containing the target sounds, in which the duration of VOT was manipulated acoustically, were built into carrier phrases some of which were *goat*-biased and some of which were *coat*-biased. It was found that the listeners' interpretation of the target sound depended on the length of VOT in the stimuli and on whether the context of the carrier phrase was biased towards *goat* or *coat*. This result adds evidence to the claim that, while processing speech, listeners also tend to rely on cues other than acoustic signal.

4.2 Speech production in the ET framework

Pierrehumbert (2001) proposed supplementing the ET model of perception, suggested by Johnson (1997a), in a way that it also explains production. In line with Pierrehumbert's (2001) suggestions, the first step to be taken in production would be choosing the desired label on a phonetic map. The choice of a particular exemplar may be affected by social or stylistic factors. At the point of choosing the preferred label, exemplars stored under that label are activated and the properties of the target item are determined on the basis of average features of the activated exemplars. Consequently, the target item is produced with what Pierrehumbert (2001) refers to as noise. That noise could, as an example, be an effect of the motor gestures produced by the speaker. These assumptions regarding speech production seem to suggest (1) that production depends on the type of sounds/categories to which speakers were earlier exposed and which they stored in their memory and (2) that in certain sociolinguistic/social situations speakers may choose different options which are available in their memory.

Pierrehumbert (2003a) also notes that extending the perception model to the production/perception one facilitates the analysis of what she refers to as perception-production loop. The perception-production loop is a phenomenon in which the feedback one receives from one's speech community and one's own speech affects the development of categories stored in the memory of a speaker.

In order to illustrate the process, Pierrehumbert (2003a) describes the ways in which an initial, three-category system might develop in the memory of a person functioning in a uniform speech community. She claims that, if the developing categories are well-separated in comparison to the within-class variability or noise and they have an adequately distinct mode, they will all successfully develop and none of them will be taken over by any neighbouring category. Yet, if the categories are crowded in comparison to the variability or noise and one of them comprises a lower number of exemplars, then such an underdeveloped category is likely to be incorporated by either of the two stronger categories or by both of them. Pierrehumbert (2003a) provides examples of situations in which one of such developing categories has been absorbed by the neighbouring ones. One of them is the /ɛ/, which in Stockholm Swedish has been displaced by /æ/ and /ɪ/ which occupy the F2 dimension that initially was occupied by /ɛ/.

Pierrehumbert (2006) notices that the frequency of categories does not need to have the same effect on production as it has on perception. Despite having exposure to various language varieties, native speakers may not have equal amount of opportunities to produce these other

varieties. The acoustic values in the production of those varieties by these inexperienced speakers may diverge from the intended ones.

4.3 Exemplar theory and the singleton/geminate boundary in Cypriot Greek

The way non-contrastive singleton and non-contrastive geminate plosives are used by Greek Cypriots could potentially involve certain processes that could be described by means of ET. It seems that due to this sociolinguistic setting, the perception of the boundary between singleton and geminate plosives could be a suitable area for testing the applicability of some of the ET assumptions.

In Greek Cypriot society, non-contrastive singleton and non-contrastive geminate plosives are used depending on the social context in which speakers find themselves. Because singleton plosives are an element of the SMG inventory, whereas geminate plosives are a part of a CG sound set, the former tend to be used in formal situations and the latter in informal settings. Moreover, as the use of SMG and CG tends to be associated with different sets of social characteristics (see chapter 2), the use of singleton and geminate plosives could also be associated with various sociolinguistic meanings (see chapter 6), and, according to the assumptions of ET, these meanings could potentially be saved with acoustic signal of exemplars stored in the memories of Greek Cypriots. In line with ET, such information might be used during speech processing by Greek Cypriot listeners.

As some tests suggest (Alexander 2008b; see chapter 3) the values of VOT and CD produced by Greek Cypriots using SMG tend to vary across speakers; in some cases the length of a plosive does not seem to clearly indicate whether the sound is a geminate or a singleton plosive. This may mean that an average Greek Cypriot person may be exposed to different values of plosives. This situation appears to be similar, but not identical, to that presented by Scobbie (2006), and it appears that listeners might need some additional, possibly indexical cues which would aid them in processing the message.

Furthermore, since, in Cyprus, SMG and CG are used interchangeably, and SMG is a variety associated with formal speech, it seems likely that the amount of exposure of various Greek Cypriots to SMG may vary depending on their social background. Therefore, listeners' uneven exposure to singleton plosives, according to ET, may affect their representation of singleton plosive categories. For that reason, differences in the level of development of the non-contrastive singleton plosive category may have an influence on listeners' perception and even production of these sounds.

Predictions of how several ET assumptions could apply in the perception of the boundary between singleton/geminate plosives by Greek Cypriots are presented in chapter 5 which outlines all research questions posed in the present study.

5   Research questions

In the discussion on dialectal variation in chapter four we saw that in some settings a speech sound may have different acoustic properties depending on which section of society, or which country, speakers come from. It was also demonstrated that the perceptions of such sounds may depend not only on the acoustic features of heard sounds but on other factors too. These factors may include indexical information about a speaker (e.g. gender, age, perceived social background, etc.) or presence of indexical information suggesting the cultural background a speaker might come from (e.g. stuffed toys associated with New Zealand or Australia, a label on an answer sheet suggesting the background of the speaker). Such perception patterns are consistent with the assumption of ET that when categories of sound are developed, indexical information tends to be stored in our memories along with acoustic features of sounds.

Since in Cyprus language use is reported to depend on the context of the conversation (e.g. formal vs. informal situations) and the background of the speakers (e.g. listeners from urban areas and listeners from rural areas), perceptual patterns observed in other places with dialectal variation, such as that pertaining to the influence of indexical information on perception, might potentially exist in Cyprus too. One of the linguistic features that could potentially be a subject of perception that involved processing indexical information along with acoustic features of a sound is the gemination (or non-gemination) of voiceless plosives, since the use of singleton and geminate voiceless plosives depends on the variety a speaker chooses to use. The geminate and singleton voiceless plosives are reported to differ in the length of VOT and CD. Even though several production studies indicate that the two sounds seem to be well-separated in terms of VOT and CD values, there is evidence that suggests the differences between VOT and/or CD values for singletons and geminates are very small (Christodoulou 2007). It is still not clear where exactly the perceptual boundary between the two sounds is. Yet, perceptual studies carried out so far facilitated establishing that the perception of the boundary seems to depend on the values of CD, VOT and the intensity of aspiration.

It should be reiterated at this point that this study is concerned with non-contrastive singleton and non-contrastive geminate plosives. The decision to focus on non-contrastive items only was dictated by the reasoning that including contrastive items would involve including CG words which, as elements of the variety, are potentially subject to social evaluation. In such a scenario it would not be clear whether while processing the stimuli, listeners would be using only the acoustical cues of plosives or also the social information attached to the lexical items with the target plosives.

Literature on sound perception in the framework of ET suggests that the acoustic signal may not be the only information used by listeners when processing sounds. It proposes that the perception of sounds may depend on, among other things, the frequency of words or phrases that include the target sound (Bybee 2000, 2001; Pierrehumbert 2001, 2003a), the amount of exposure to a given sound (Johnson 1997a; Pierrehumbert 2001, 2003a), the acoustic values of the sounds listeners are exposed to (Johnson 1997a; Pierrehumbert 2001, 2003a) and the indexical information stored together with acoustic signal of the sound (Niedzielski 1999; Hay and Drager 2010; Hay et al. 2006a).

Taking into consideration some of the reported linguistic practices in Cyprus, it is likely that factors such as (1) amount of exposure to non-contrastive geminate and non-contrastive singleton plosives, (2) the values of acoustic features of the sounds stored in listeners' memories, and (3) indexical information stored together with information on the acoustic signal, may have an influence on how one perceives the singleton/geminate boundary in plosives.

The issue of the amount of exposure to voiceless geminate and singleton plosives is related to the role of the two types of sounds in speech and the contexts in which speakers (choose to) use singletons or geminates. Non-contrastive singletons can be heard only in some situations (that is, in more formal speech); therefore Greek Cypriots are likely to be exposed to [t:ʰ] in every-day conversations and to [t] in more formal settings. It is hypothesised here that the amount of formal situations Greek Cypriots find themselves in, the more exposure they are likely to receive to [t]. In keeping with ET, the greater one's exposure to [t], the better developed that sound category might be in one's memory. It needs to be remembered that different Greek Cypriots may follow different linguistic practices which could be defined by background. It might be possible that those with a higher socioeconomic background and those who are more affiliated with Greece than with Cyprus could have more exposure to non-contrastive singleton plosives.

Some of my previously collected data on the production of VOT and CD by Greek Cypriots in CG and SMG suggest that geminate and singleton plosives might be realised differently (i.e. have different durations) by different speakers. This situation might suggest that the values of VOT and CD in both categories of sounds (geminates and singletons) may vary across speakers. As claimed by Pierrehumbert (2001, 2003a), when speaking, speakers choose the realisations of categories on the basis of exemplars of those categories of sounds stored in their memories and depending on the speech style the speakers would like to employ. Should Pierrehumbert's (2001, 2003a) claim be correct, it is expected that the pronunciations of sounds might be reflections of the values of sound categories stored in their brains. In other words, the perception of the boundary

between singleton and geminate plosives might depend on listeners' representations of those sounds in their memories.

The sociolinguistic situation in Cyprus suggests that the use of singleton plosives is associated with formal speech and, since it is an element of SMG which is spoken in Greece, it might also be associated with speech by Greeks from the Mainland. In contrast, the use of geminate plosives tends to be associated with informal speech and, since it is one of the characteristic elements of CG, it might also be associated with the speech of Greek Cypriots. Taking this relationship between sounds and their associations into account, and considering earlier accounts of how language stereotypes might influence perception of sounds (Hay et al. 2006a; Hay and Drager 2010; Niedzielski 1999), it might be expected that the presence of items symbolising Greek or Greek Cypriot culture might influence listeners' perception of the boundary between the two sounds. Such a pattern would add further evidence to the assumption that listeners store indexical information together with acoustic features of sounds in exemplars of those sounds.

In order to establish whether the ET assumptions pertaining to the way sounds are perceived apply in the perception of the singleton/geminate boundary in words in which the change from singleton to geminate (and vice versa) does not change their meaning, the following questions were asked:

1 How do listeners perceive the boundary between singleton unaspirated and geminate aspirated voiceless plosives?

Because it is supposed that Greek Cypriots who are more affiliated with Greek culture may have an increased amount of exposure to SMG and hence larger sets of exemplars of singleton plosives in the relevant lexical items, we need to investigate whether listeners' perception of the singleton/geminate boundary may be influenced by their degree of affiliation with Greece or Cyprus. To address this, the following question is posed:

1a Is perception of the boundary between singleton unaspirated and geminate aspirated voiceless plosives affected by the listener's affiliation?

The hypothesis that socioeconomic background may also be linked to a person's amount of exposure to SMG and therefore to [t] in the relevant word contexts resulted in the formulation of question 1b.

1b Is perception of the boundary between singleton unaspirated and geminate aspirated voiceless plosives affected by the listener's socio-economic background?

In line with the claims that the sounds that are produced by speakers could be a reflection of the categories of sounds they have shaped in their memories, this study aims to explain whether the quality of sounds memorised by listeners could affect the way the listeners perceive the discussed boundary. Hence, question 1c was asked:

1c Does perception of the boundary between singleton unaspirated and geminate aspirated voiceless plosives depend on the listener's production of the sounds?

Since earlier research indicates that even mere exposure to an element associated with a speech community may shift the perception of a boundary between two sounds, It is sought to explain whether the perception of the singleton/geminate boundary may also be affected by exposure of a listener to an element associated with one of the cultures/regions (Greek or Greek Cypriot). For that reason, question 1d was asked:

1d Does exposure to a concept associated with a region influence the perception of the boundary between singleton unaspirated and geminate aspirated plosives?

Several hypotheses were made regarding the possible answers to questions 1a, 1b, and 1c, or, in other words, the likely influence the level of affiliation with Greece or Cyprus, socioeconomic background and the values of plosives produced by the listeners would have.

Hypotheses were made regarding how values of CD and VOT produced by Greek Cypriot listeners could possibly influence their perception of the boundary. Following the reasoning that (1) the way listeners produce plosives is a reflection of the shape of categories of those sounds in their memory, and (2) listeners, when processing sounds, try to match the heard stimulus to the closest equivalent exemplar of a sound stored in their memory, the following hypotheses were put forward:

Hypothesis I: The longer geminate plosives a person produces, the longer plosives that person will need to hear to classify them as a geminate plosive.

Hypothesis Ia: The longer VOT in geminate plosives one produces the longer VOT one will need to hear to classify the consonant as a geminate plosive.

Hypothesis Ib: The longer CD in geminate plosives one produces the longer CD one will need to hear to classify them as a geminate plosive.

Hypothesis II: The longer singleton plosives a person produces, the longer plosives that person will still perceive as singleton plosives.

Hypothesis IIa: The longer VOT in singleton plosives a person produces, the longer the VOT that person will perceive as belonging to singleton plosives.

Hypothesis IIb: The longer CD in singleton plosives a person produces, the longer CD that person will perceive as belonging to singleton plosives.

Regarding the influence of the level of affiliation with Greece or Cyprus, it was assumed that the level of listeners' affiliation with Greece or Cyprus could be linked to their likely amount of exposure to non-contrastive singleton plosives. More precisely, it was presumed that the more one is affiliated with Greece, the more one gets involved in activities in which one would receive exposure to SMG and to non-contrastive singleton plosives. An increased exposure to non-contrastive singleton plosives may result in a well-developed category of [t] in the mentioned word context. It seems reasonable to assume that the listeners who have well developed [t] categories in such word contexts are likely to be sensitive to small increases in the length of CD and VOT and to be less likely to label those slightly longer plosives as singleton than other listeners (more Cyprus oriented) would be. Hence, the hypothesis III was formed:

Hypothesis III: The more one is affiliated with Greece and its culture, the more likely that person is to notice small increases in VOT and CD of plosives and to perceive such plosives as geminates.

In this study, while calculating the socio-economic index, information that was taken into consideration included the profession of the listener and of his/her parents, the listener's educational background and financial situation. For that reason, it may be claimed that the higher socio-economic index a person has the more likely he/she is to have (1) high (quality) education, (2) well-educated parents or parents performing relatively high-status jobs, and/or (3) a good financial situation. Thus, it seems likely that listeners with high(er) socio-economic indexes may have greater exposure to SMG singleton plosives as a result of having parents who are likely to use more prestigious forms more often when speaking, enough money to travel abroad and to Greece and enough money to get their children educated in more prestigious schools. Such listeners could be expected to find themselves in more professional situations in which SMG is likely to be used and may have studied and lived in urban areas where SMG singletons, or singletons in the relevant word context, are more likely to be used than they are in rural areas. The more of these conditions are true for a given listener, the more likely he/she appears to have well-developed categories of SMG singleton plosives or singleton plosives in the relevant words. Having such robust categories of singleton plosives may lead listeners to have greater sensitivity

to increases in values of CD and VOT in plosives. This way of reasoning resulted in generating hypothesis IV:

Hypothesis IV: The higher a person's socioeconomic background, the more likely he or she is to label plosives with only slightly increased values of CD and VOT as geminate plosives.

Due to the fact that in Armosti's study (2010) the odds of plosives being classified by listeners as geminates rose with the increase of the length of those plosives, hypotheses were also made regarding the way listeners would label the plosives in the present research.

Hypothesis V: The longer the plosive a listener hears, the more likely that listener will be to label that plosive as a geminate.

Hypothesis Va: The longer the VOT a listener hears, the more likely that listener will be to classify the plosive containing that VOT as a geminate.

Hypothesis Vb: The longer the CD a listener hears, the more likely that listener will be to classify the plosive containing that CD as a geminate.

Singleton plosives were divided in two groups in this study, that is non-contrastive and contrastive singleton plosives. It was expected that the values of the former might be different from the latter as a result of speakers' limited ability to completely suppress gemination in the words in which singletons appeared. For this reason, the influence of both types of singleton plosives was analysed.

From the literature presented in the previous chapters, it can be deduced that the sociolinguistic situation in the Republic of Cyprus may have created the conditions for several sounds and other elements of language to become carriers of social information. As geminate plosives are one of the characteristic features of CG, it seems fair to expect that they and their SMG equivalents, singleton plosives, might be assigned some social meaning. Since social information is claimed to be stored in memory together with information on acoustic features of speech sounds, such indexical information might potentially be used in the perception of the boundary between singleton and geminate plosives, provided that any information of this type is assigned to geminate plosives.

In order to establish whether there is any social meaning attached to geminate plosives as suggested earlier in this chapter, the following research questions were posed:

2 How are geminate voiceless plosives evaluated by Greek Cypriots?

2a What social meanings are associated with geminate voiceless plosives by Greek Cypriot listeners?

Two studies were carried out with the aim of answering the research questions presented in this chapter. In order to answer questions 1, 1a, 1b, 1c and 1d a perceptual study involving two forced-choice perception tasks was carried out. The study established which variables influence the perception of the singleton/geminate boundary. To answer questions 2 and 2a, an attitudinal study using the MGT was carried out. The study was designed to reveal what social meanings are carried by singleton and geminate plosives. The attitudinal study and its results are presented in chapter 6 and the perceptual study and its outcomes are presented in chapter 7.

6   Social evaluation study

The aim of the study discussed in this chapter is to explain whether and, if so, how geminate plosives are evaluated by Greek Cypriot listeners. As I have already mentioned in chapter 2, it is possible for a sound to carry some social meaning. The goal of the study is to define the social meaning of [t:ʰ].
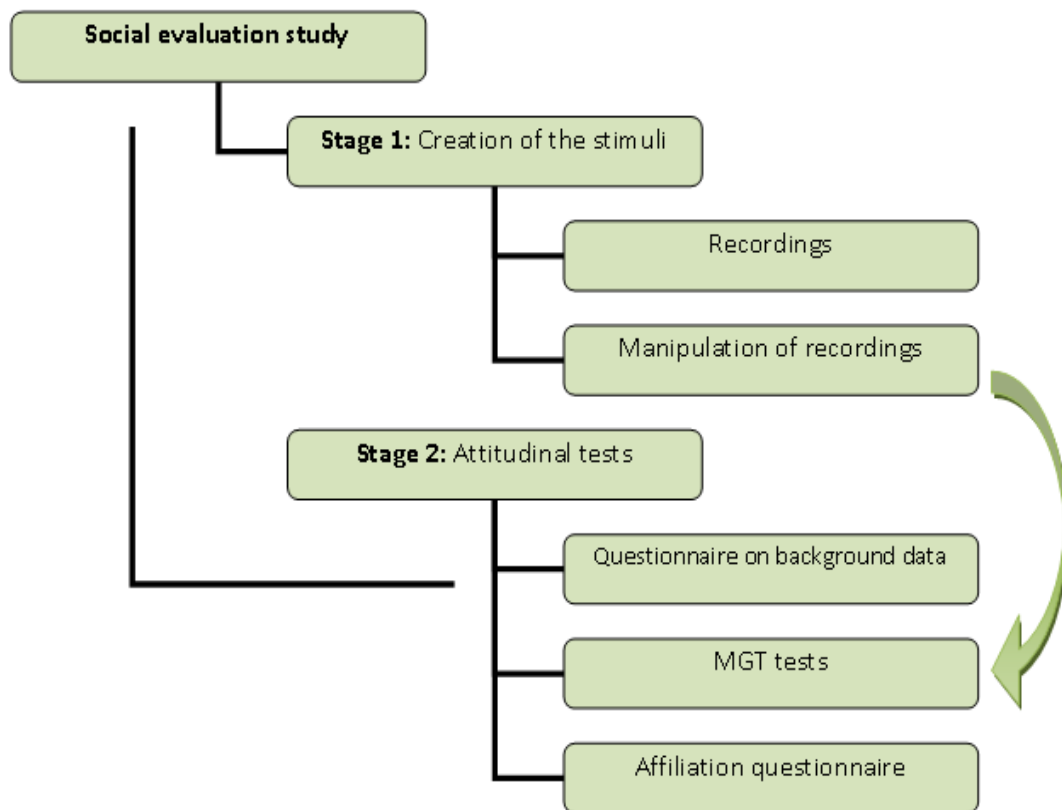
Figure 6.1 General overview of the social evaluation study**.**

The social evaluation study was carried out in two main stages (see figure 6.1). First, speech samples from Greek Cypriot speakers were collected in order to create stimuli that could be acoustically manipulated for further attitudinal tests. The second stage comprised three main parts, that is: (a) the collection of background information and information on the socio-economic background of the judges; (b) the elicitation of data on judges' attitudes towards the target sounds; (c) the collection of data aimed to establish the judges' level of affiliation with Greek and/or Cypriot culture. The information mentioned in points (a) and (c) was gathered by means of two short questionnaires (see Appendices 2 and 4). It was collected in order to facilitate a better understanding of the extent to which the social background of listeners may affect evaluation of [t:ʰ]. The data on listeners' attitudes towards the target sounds (point b) were elicited by means of the matched-guise technique (MGT).

To date, the only published study of attitudes towards Greek Cypriot variety using the MGT, developed by Lambert in 1960s (Lambert 1967), has been carried out by Sophocleous (2006) and Papapavlou (1998). In her research, Sophocleous (2006) placed four different subvarieties on a dialectal continuum with SMG as one extreme and Rural Greek Cypriot Dialect as the other extreme, and then collected data on attitudes towards speakers of the four subvarieties. Whereas the features tested in Sophocleous' study included phonetic/phonological, lexical, grammatical and stylistic features, the goal of the present study was to investigate Greek Cypriot speakers' attitudes towards one element of Greek Cypriot, namely gemination of plosives. In order to analyse Greek Cypriot speakers' attitudes towards gemination of plosives I decided to use the MGT, exposing judges to a pair of sentences read by several speakers in SMG. Both of the sentences were identical with the exception that only one of them contained a geminate plosive [t:^{h}]. The choice and preparation of the stimuli is described in the following sections.

6.1 Stage 1: collection of data for the social evaluation test stimuli

When making decisions about the kind and amount of data to be collected for this stage of the study, it was necessary to make sure that the tests were not too strenuous for the study participants. In order to make sure that the task was not too demanding and that it would not take the participants too much time to complete, it was decided to limit the number of recordings by testing only one place of articulation. Hence, palatal geminates were excluded due to their acoustic properties, that is, it was observed in my previous experiments that the offset of palatal plosives tends to be followed by aspiration which is often characterised by significantly higher intensity than aspiration in other Cypriot plosives. It should be noted that Armosti (2010) reported that the degree of intensity in plosives helps to distinguish geminate from singleton plosives in Cypriot Greek. Because it is not clear how this additional acoustic feature might influence the perception of the sounds, it was decided that palatals should be excluded. Furthermore, velar and palatal plosives were not tested due to the scarcity of lexical items with velar and palatal geminates (especially in word-initial position). Finally, when choosing between bilabial and alveolar plosives it was decided to follow the reasoning of Armosti (2010) who, in his research, chose to test alveolar plosives since this place of articulation is "an intermediate point between the extremes of the labial and velar place" (Armosti 2010: 120). These recordings and those used for synthesis of perceptual stimuli in the perceptual study (see chapter 7) were recorded in the same session.

6.1.1 The test word

The test word which was chosen for this experiment was a lexical item which exists in SMG and could be pronounced with a geminate plosive in CG. Replacing a geminate plosive with a singleton plosive in this word does not cause a change in the literal meaning of the word. There are two reasons why this decision was made. First, the subjects were asked to read sentences containing the test word in SMG and in CG. It was assumed that if lexical items that exist only in Cypriot lexicon had been included in the reading task, the study participants might have been confused as the task would have required them to read Cypriot words and use SMG at the same time. Secondly, even if a typically Cypriot word were pronounced with a singleton voiceless plosive, it could still carry some social meaning and could skew the data, that is, even if the speaker had read the sentence with SMG, he/she might not have been evaluated as an SMG speaker due to the use of a Cypriot lexical item. For these reasons, the test comprised a target word which exists in both varieties, πίτα (*pie*), which is pronounced [ˈpita] in SMG and [ˈpit:ʰa] in CG. The word will be spelled as *pita* from now on. In order to prevent a situation in which it is not clear whether judges in the experiment evaluate the speakers on the basis of (1) the plosive included in a target word or (2) the target word and the duration of the plosive in the word, it was decided that only one target word would be used in the tests. Such a solution facilitated the limitation of external factors influencing the judges' choices.

6.1.2 The sentences

The target item was built into a carrier sentence so that it was not obvious to the listeners what element was being tested. Also, this procedure was meant to make the listening appear more natural and less 'suspect'. The sentence (see table 6.1) was designed in such a way that its meaning would not lead listeners to draw any conclusions about the speakers' background such as educational background, profession or place of residence. When read in SMG, the phrase was expected to be free of sounds clearly marked as CG. When read using CG, however, the speakers were likely to use two CG sounds, that is, they might insert [n] at the end of some words, or use [ˈmniɐ] instead of [ˈmiɐ]. Indeed, some of the speakers used the two CG features. The phrase pronounced in CG was not played to the judges, but was used as a source of CG geminates which would later on be extracted and inserted into the same sentences but read in SMG.

It is likely that some of the phonological features present in the carrier phrases read in SMG, such as intonation patterns, might have suggested/revealed that the speakers were Greek Cypriots, and not Greeks, but making the judges believe that the speakers were Greeks was not the aim of

the study. Even if the judges could identify that the speakers were Greek Cypriots, it was believed that it would not affect the results of the study. The reason for that is that the judges heard exactly the same carrier phrase read by each speaker in SMG in each guise. The only difference between each guise was that the word *pita* (the one with a geminate [t:ʰ]) was copied and pasted from a phrase read in CG into a phrase read in SMG (see section 6.1.4 for the description of the preparation of the stimuli). Since the only difference between the two sentences in both guises was the presence or absence of a geminate plosive, it is believed that if the subjects evaluated each sentences in pairs produced by the same speaker differently, the differences in evaluation were most likely to be due to the difference in the characteristics of the target sound.

Table 6.1 The carrier phrase with the target sound (the target sound is in bold).

Η Έλενα είδε μια καλή πί**τα**.
/ i ˈɛlɛnɐ ˈiðɛ ˈmiɐ kɐˈli ˈpi**tːʰ**ɐ/
Elena   saw   a   good   pie.

All subjects read the same sentences to make sure that, in the listening test, different evaluations of various stimuli would be a result of their different pronunciations, and not the subject-matter of the recordings. One of the female subjects read the sentence used as a trial/presentation slides/sentences. This is why there were four female speakers and three male speakers in this experiment.

6.1.3 The speakers

Seven subjects read the sentences which later on served as stimuli in the MGT tests (four female, three male). The average age of all speakers was twenty. The average age for female subjects was 18.66, whereas for the male subjects it was 22.00. All of the subjects were students at the University of Nicosia. Only one of them lived in a rural area (F5). During the experiment, no reference was made to the background of the speakers. In the instructions (and the consent form) the listeners were asked to make judgments about several speakers who were supposed to use different ways of speaking.

6.1.4 Preparation of the listening stimuli

Each speaker was asked to read the target sentence twenty times, first ten times in SMG and then ten times in CG. In order to minimise hesitations, the study participants had been given the chance to practise the sentences before they were recorded.

After the sentences had been recorded, VOT and CD were measured, using Praat (Boersma & Weenink 2011). In [t] and [t:ʰ] CD was measured from the end of the second formant of the preceding vowel up to the release of the plosive (as in Cole, Hansook Choi, Kim & Hasegawa-Johnson 2003), while VOT was measured from the release of the plosive to the beginning of the vibration of the vocal folds (Lisker & Abramson 1964) (see figure 6.2). The duration of the whole plosive was measured from the end of the second formant of the preceding vowel to the beginning of vocal fold vibration of the following vowel. The sentences were then classified into two groups. Group 1 comprised sentences read in SMG with singleton plosives, while group 2 included sentences read in SMG, but with the word containing the target word *pita* copied and pasted from an identical phrase but read in CG where the target sound was realised as a geminate. This was done with the intention of producing sentences that would give the impression that the speaker was attempting to use SMG but failed to suppress gemination. The method was based on the one used by Campbell-Kibler (2006) who substituted (ing) endings with (in) endings in order to test whether and how the use of (in) in English is evaluated by the listeners. It was assumed that pasting samples of *pita* produced with a geminate into a carrier phrase produced in SMG without the use of salient CG features would not create any conflict as Cypriots are reported to have a tendency to unintentionally use CG features when speaking in SMG (Pavlou 2004).

The acoustic manipulation of the stimuli, which was done using Praat, was carried out according to the following procedure. To replace a word containing a singleton plosive with a word pronounced with a geminate plosive, a word with a geminate plosive in a Greek Cypriot recording by subject X was identified. The word was selected by placing one cursor at the end of a closure of the first plosive ([p]) (right before the offset of [p], or right before the red line in Figure 6.2) and the other cursor at the end of the word. The selected word was then pasted into the position of the corresponding word from an SMG recording (group 1) by the same subject. The original word in the SMG recording was deleted.
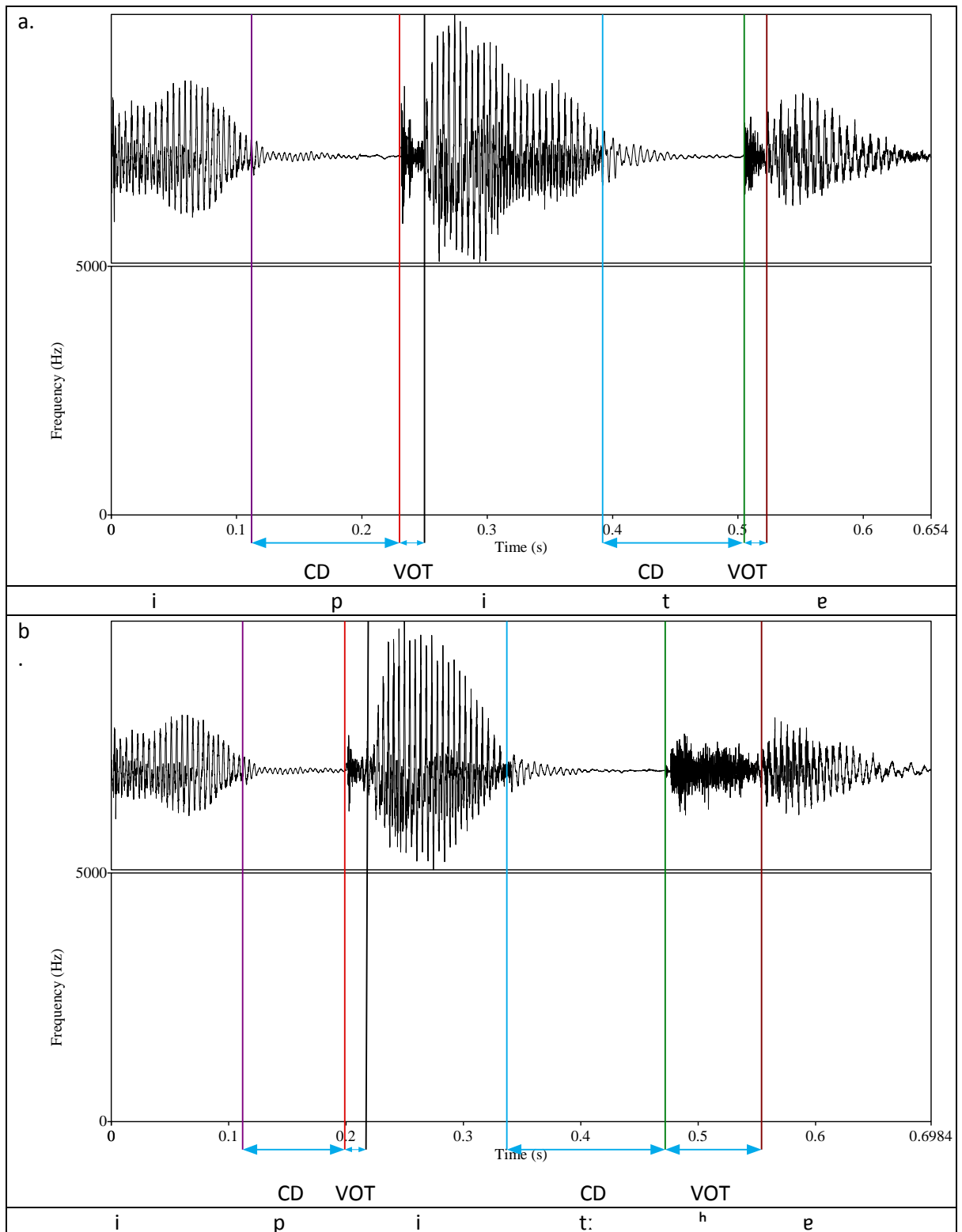
Figure 6.2 Segmentation of *pita*. a. pronounced with [t], b. pronounced with [t:ʰ], purple line – the end of [i] in the preceding word *καλή* ('good' [kɐˈli]), red line – the offset of VOT in [p], black line – the onset of [i], blue line – start of CD in [t] and [t:ʰ], green line – the offset of VOT in [t] and [t:ʰ], brown line – the onset of [ɐ].

Table 6.2 Order of samples in the MGT test. S = singleton plosive ([t]), G = geminate plosive ([t:ʰ]).

Sentence number	1	2	3	4	5	6	7	8	9	10	11	12	13
Speaker	F5	M3	F6	M2	F4	F8	F6	M4	M2	F8	F4	M4	M3
Plosive	S	S	G	G	S	G	S	G	S	S	G	S	G

The procedure was repeated several times so that pairs of sentences, one with and one without a geminate plosive, were produced using recordings of all the speakers. A list of thirteen sentences selected from these pairs was prepared for the evaluation task (stage 2). The list of sentences was arranged in such a way that no sentence was followed by a sentence read by the same speaker (see table 6.2). Sentence 1 was only a trial slide. The results for this speaker were not included in the analysis.

In this experiment only not manipulated samples of plosives were used. When choosing samples of target sounds for this experiment, it was sought to include samples of words with plosives that would differ in their overall duration. Hence, the ratios of overall singleton plosive durations to geminate plosive durations in this study ranged from 1:1.49 to 1:2.17 (see table 6.3). These ratios correspond to the values of differences reported by Arvaniti (2010), who stated that geminates tend to be from 1.5 to 2 times longer than singletons. Samples of singleton plosives were taken from utterances produced in SMG, whereas samples of geminate plosives were taken from utterances produced in CG. The number of available samples was limited and some samples of *pita* could not be used due to their quality. For instance, in some cases, the vowel following the target plosive was produced without voicing, which made it impossible to measure the VOT of the plosive. For these two reasons it was not possible to find enough samples in which there would be large differences in the values of CDs of geminates and plosives. This is why the differences in values of CD in the samples by F4, M3 and M4 were not large, and there was hardly any difference between CDs in F8. The differences between all VOTs ranged from 35ms for M3 to 64ms for M4. It needs to be remembered that these were unmodified samples of plosives and similar, small, differences in the values of CD and VOT have been reported earlier by Christodoulou (2007). Her analysis of mean VOT and CD in minimal pairs and near-minimal pairs of singleton and geminate plosives across study participants indicated that some listeners produced smaller differences in CD and VOT values. Some of the mean CD differences for individual speakers were as small as 20ms. In fact, there were seven cases of mean differences between 20 and 29ms in that study. As far as VOT is concerned, the smallest difference between individual speaker means was 8ms. Since the scope of this study was to establish whether geminate and singleton plosives are subject

to different social evaluations, and not to establish if and where the exact boundary is between the non-contrastive singletons and geminates, it was felt that the chosen samples, which had significant differences in overall plosive durations, were adequate for establishing the potential differences in social evaluations.

Table 6.3 Values of length of CD, VOT and the whole plosive (PLOS) in Standard Modern Greek (SMG) and Cypriot Greek (CG) of all [t:ʰ] speech samples used in the MGT test.

	CD (SMG) in ms	CD (CG) in ms	VOT (SMG) in ms	VOT (CG) in ms	PLOS (SMG) in ms	PLOS (CG) in ms	RATIO PLOS (SMG) : PLOS (CG)
F4	107	133	20	80	127	213	1 : 1.68
F6	73	132	24	68	97	200	1 : 2.17
F8	102	104	22	81	124	185	1 : 1.49
M2	94	141	25	82	119	223	1 : 1.87
M3	91	120	25	60	116	180	1 : 1.55
M4	110	146	18	82	128	228	1 : 1.78

6.2 Stage 2: attitudinal study

This step of the study incorporated three parts (see figure 6.1). To begin with, since one of the objectives of this study was to scrutinise how a listener's socio-economic background influences his/her evaluation of geminate plosives, each of the subjects taking part in the matched-guise study were asked to fill in a questionnaire aiming at establishing their socio-economic background. After that, the stimuli were listened to by each of the listeners, who were asked to evaluate each sentence on the basis of several traits. This allowed inferences to be made about the listeners' attitudes towards the gemination of plosives in Greek Cypriot.

In addition, with the intention of establishing their level of affiliation with Greek and Greek Cypriot culture, the participants were asked to fill in an identity questionnaire. As it is vital for the reader to understand how background data was collected in order to understand the social background of the study participants, the methods used for collection of data used to calculate the socio-economic index and the identity score are discussed first.

6.2.1 Background data

After being informed about the nature of the study and their right to withdraw, the study participants were presented with a questionnaire (in Greek) aimed to collect data pertaining to their socioeconomic background (see Appendix 1). It was decided that the collection of

background data should be the first part of the study, as it could a serve as an ice-breaker before the attitudinal tests.

Apart from standard questions about background (such as gender, age, etc.), the questionnaire contained questions which were supposed to establish the socio-economic background of the listeners. The questions were inspired by those utilised in the calculation of the six-component socioeconomic index by Trudgill which he had used in his Norwich study in order to assign his study participants to appropriate social classes (Trudgill 1974, cited in Chambers 2003: 51). In Cyprus, which does not have a clearly defined class system in the form the UK society does, a person's social standing seems to be determined by his/her financial situation, place of residence (rural versus urban), job held and level of attained education. These factors determining the social position of Cypriots appear to correspond to those factors which were included in the socio-economic index as calculated by Trudgill, that is, occupation, income, education, locality and housing. Nevertheless, the data collected in the present study had to be adjusted to fit the Greek Cypriot context. The adjustments are discussed further in this section.

The questions which were designed to calculate the socio-economic index for the present participants were those from five to seven and from nine to twelve in Appendix 1. There are five components relating to the subjects' education, occupation, housing, location and the education of the subject's parents. The five components could be grouped into two categories, that is, (1) social position (education, occupation, parents' occupation) and (2) economic status (housing, location). The scores were assigned for particular items (see Appendix 2) in a way that gave equal weighting to categories (1) and (2), so that priority was not given to either the social or the economic status of any person.

Points for locality were not assigned on the basis of the exact area a person resided in (as was done by Trudgill), but on the basis of whether their area was an urban or a rural area (more precisely whether the person resides in a city centre, city outskirts, village or in a place away from cities or villages). This decision was taken because the value and prestige of properties seems to be linked to whether they are placed in rural or urban areas. As far as housing is concerned, the age of the occupied property was not taken into consideration, but rather the number of bedrooms and the type of property. The types of properties ranged from flats to detached houses. It was decided that information on the types of occupied houses (terraced, semi-detached and detached) would be recorded as the prestige and prices of properties tend to be linked to their types in Cyprus, for instance, terraced houses (which are not numerous) tend to be

smaller and cheaper than semi-detached or detached houses. Such houses might also appear to be less impressive than detached or semi-detached ones even if newly built.

Information on the income was not collected as it was expected that the majority of the participants would be students who might not be aware of the amount of their parents' income. It was expected that the information on their housing would be an indicator of their economic situation. Also, assigning scores to various occupations was carried out as follows. When all questionnaires had been collected, the occupations entered by the subjects were listed and presented to a group of Greek Cypriots who placed each of these jobs on a scale from one to five. The overall scores for each subject were then calculated. Following Trudgill's (1974) practice, if a participant was a student or was unemployed, the score for his/her parents' occupation was entered as his/her occupation. If a subject did not work (student or unemployed) and was married, his/her score for occupation was his/her spouse's score. Finally, when calculating scores for parents' occupation, if both parents worked, their scores were added and divided by two. If one parent worked, that parent's score was used to calculate the index.

In the present study, unlike in the study by Trudgill (1974), the participants were not assigned to any classes. The answers to the questions were allocated points and finally an index was assigned to each participant. The resulting scores were used in various statistical tests.

6.2.2 Affiliation questionnaire

Upon completing the matched-guise task (see section 6.2.4), each participant was asked to fill in a short questionnaire (see Appendix 4) which elicited data pertaining to their degree of affiliation with Greek and/or Greek Cypriot culture. The questionnaire was based on Llamas' (2007) identification questionnaire used for the collection of data on subjects' regional affiliation. Nevertheless, as the aims of the present study differed slightly from those of Llamas, the way the questions were asked was changed slightly. In Llamas' (2007) study, the questions were aimed to establish how affiliated her subjects felt with their area. Thus, the questions focused on the way they rated their area, people living there and the language they used. The present study attempts to establish whether the subjects affiliate more with Greece or with Cyprus. To achieve this, the questions were designed in a way that participants had to choose between corresponding Greek and Greek Cypriot elements of culture, everyday life, etc.

The questionnaire comprised 8 multiple choice questions all of which asked the respondent to indicate a choice they would make in a given situation. Answers were placed on a scale on one end of which option (a) would suggest strong preference for a Greek element of culture, while on

the other end of the scale option (f) would imply strong preference for a Greek Cypriot element of culture. Option (b) signified a moderate preference for a Greek element of culture, while option (e) stood for a moderate preference for Greek Cypriot culture. Option (d) implied a neutral attitude, i.e. the respondent indicated that he/she would not choose one culture over another. Option (c) (no opinion) was an alternative which supposedly could be chosen by someone who was not interested in the subject mentioned in the question, for instance a respondent who was asked which football match he/she would choose to watch might not be interested in football at all.

Each of the options was assigned a points on the scale from 0 to 5 (a=1, b=2, d= 3, e= 4, f= 5, c= 0). When calculating the identity score (ID score), points for chosen options to all answers were added up and divided by the number of responses excluding those for which the participant chose option (c).

The reason why the questionnaire was administered after taking the MGT test is that some of them might have given the participants the idea that the study was about evaluating CG versus SMG speech, which should be avoided. The questionnaire was administered in Greek.

6.2.3 The study participants (listeners/judges)

36 participants took part in the study (seventeen male, nineteen female). They were mostly students at the University of Nicosia, and their average age was 23.13, with a range of eighteen to thirty-eight. The youngest participant was eighteen, the oldest thirty-seven. It is worth noting that the average age of male participants (23.88) was higher than that of females (22.47); this was mainly due to that fact that most male Greek Cypriot students start university education after completing their two-year long military service. Thus, one of the male study participants was thirty-seven, while the oldest female was thirty-three.

The average socioeconomic index was 20.89, with a range from fifteen to twenty-four. It was difficult to divide the subjects into any groups that would have clearly differed in the socio-economic index, as the values of the index did not cluster in any obvious way (see figure 6.3).

With regard to the identity score (ID), the possible range was from one (maximally Greek affiliation) to five (maximally Greek Cypriot affiliation). The values calculated for the study participants ranged from 1.00 to 4.25 and the average was 3.12. According to figure 6.4, the majority of listeners (63.8%) had an ID score between 3.00 and 3.99. This means that even though the sample included Greece-oriented and Cyprus-oriented listeners, the majority of listeners were more oriented to Cyprus than to Greece. Therefore, it was difficult to divide the listeners clearly

into those who were more affiliated with Greek or Cypriot culture, as many of them seemed to be somewhere in-between.
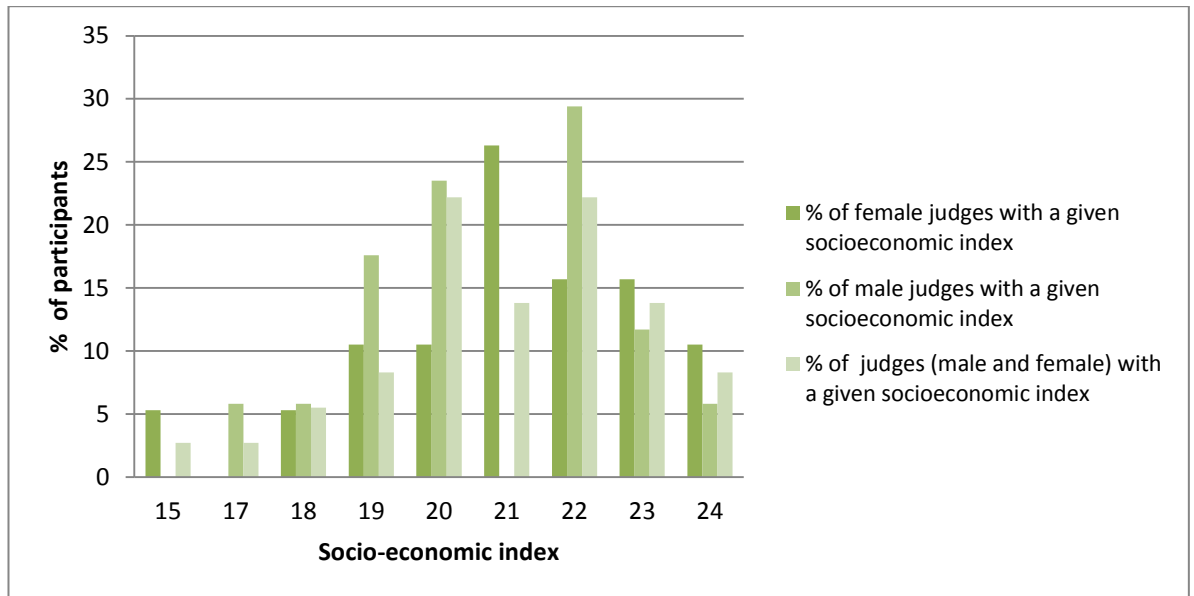
Figure 6.3 Distribution of socio-economic index across the judges in the evaluation study. Vertical axis – percentage of participants; horizontal axis – socio economic index (15 was the lowest socio-economic background reported by the study participants; 24 was the highest socio-economic background reported by the study participants).
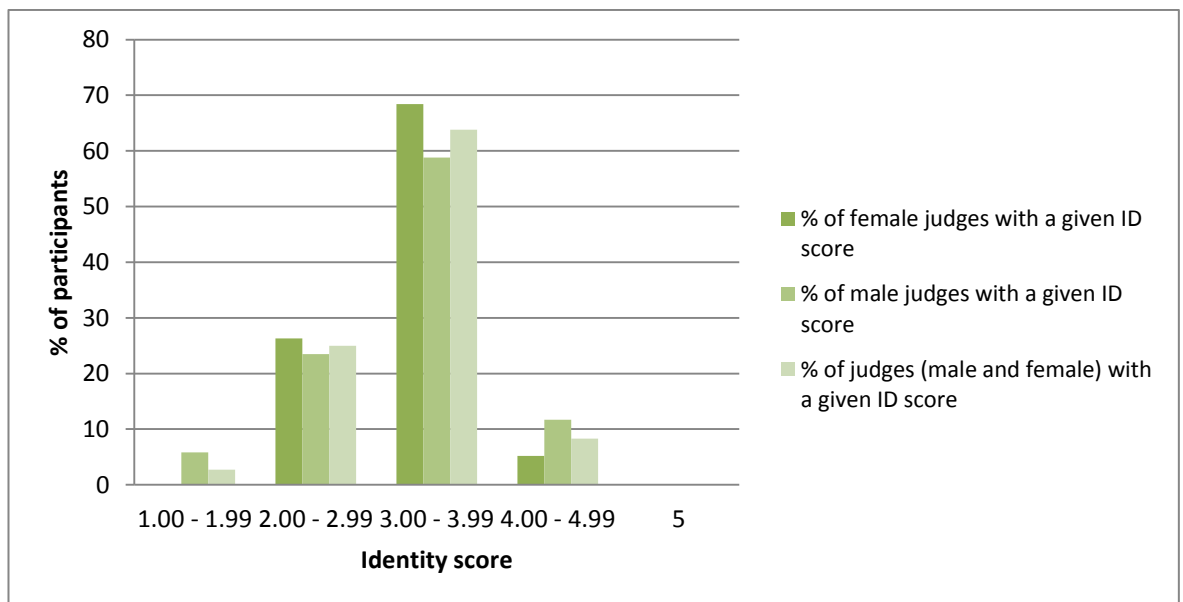
Figure 6.4 Distribution of ID scores across the judges in the evaluation study**.** Vertical axis – percentage of participants; horizontal axis – ID score (1.00 – affiliated with Greece; 5.00 affiliated with Cyprus).

6.2.4 The experiment: matched-guise tests

After filling in the questionnaire, the study participants were asked to listen to and to evaluate the speakers from the recordings. All the three stages (completion of the background sheet and the affiliation questionnaire and the matched-guise test) took place in the office of the researcher, which is a quiet place.

The listeners were asked to sit in a chair behind the researcher's desk while the researcher was sitting opposite the listener. During the MGT test the listeners listened to the recordings through earphones. In the experiment, each of the stimuli was attached to a different slide in a Power Point slide show. In order to hear a recording, a listener had to click an icon in the screen/Power Point slide (see Appendix 9). The listeners were instructed to use a mouse to play each recording and to press an arrow on a keyboard to change a slide. The order in which the target sentence read by each speaker was played is presented in table 6.2 in section 6.1.4. Each stimulus had a corresponding answer sheet (see a sample in Appendix 3) with 5-point Likert scale answers. The study participants were allowed to listen to each recording several times, and they were instructed to answer the questions right after each stimulus was played.

The decision to grant the listeners unlimited number of times they could hear each stimulus was taken as the listeners had to judge each speaker on eleven traits and it was feared that the listeners might feel the need to hear some of the samples when making judgements on the traits that were at the end of the list. However, it should be highlighted that such procedure might have been a reason for unequal exposure to stimuli across the listeners, and therefore some of them might have been more confident about their choices. However, as the procedure was supposed to give them the opportunity to listen to the stimuli as many times as they felt necessary, it was believed that each of them would listen to the recordings so many times that they would feel confident enough about their choices.

Once the following stimulus was played, the subject was not allowed to listen to the previous recording or change the answers in the previous answer sheet. As the researcher was sitting opposite the listener, she could observe whether the listeners were playing the recordings or changing the Power Point slides.

Each speaker was evaluated on eleven pairs of traits which are listed in Appendix 3. However, it needs to be noted that one of the pairs of traits, namely 'lives in a village' and 'does not live in a village' was not included in the pilot of the study which involved seven judges. However, the answers of those seven judges were still used in statistical data analyses as the researcher

considered them valuable data regarding the evaluation of speakers on all the remaining traits. At the same time, even though the 'lives in a village' trait was not used with seven out of thirty-six listeners, the results for this trait appeared to be among the most robust ones (see section 6.4).

To summarise, each of the thirty-six judges had to evaluate six tokens with singleton plosives and six tokens with geminate plosives. This gives 216 evaluations of singleton plosives and 216 evaluations of geminate plosives. Also, as only twenty-nine listeners judged each speaker on the 'lives in a village' trait, singleton plosives were evaluated on that trait one hundred and seventy-four times. The same was true for geminate plosives. All the other ten pairs of traits were used with thirty-six judges. Therefore, both singleton and geminate plosives were evaluated on each of those ten traits two hundred and sixteen times.

6.3 Ethical considerations

At all stages of this research each study participant was asked to sign a consent form (Appendix 5 Appendix 6 and Appendix 8) prior to completing the required task. In accordance with the BAAL (1994) recommendations for good practice in research, the contents of the consent form familiarised the participants with the aim of the study and their right to withdraw at any point in the experiment as well as their right to remain anonymous.

The researcher was granted ethical approval to carry out these tests by Lancaster University Research Ethics Committee.

6.4 Results

In the MGT tests the total number of evaluation cases was 4478. Table 6.4 summarises the percentages of different ratings on each of the traits given to the played tokens.

The t-test and the Mann-Whitney test were used in order to find out whether there was any significant difference between the means calculated from evaluation points given to [t] and [t:[h]] for each trait. Results of the t-test (table 6.5) as well as the Mann-Whitney test (table 6.6) suggest that there is a significant difference in the way [t:[h]] and [t] are rated, with the former rated more highly on both the 'casual' and 'lives in a village' traits. Such results are in line with other accounts of attitudes towards CG and SMG (Sophocleous 2006; Papapavlou 1998) which suggest that SMG tends to be rated higher on prestige traits whereas CG tends to be evaluated better on social attractiveness related traits.

Table 6.4 Percentages of ratings given by the judges to sentences with [t] and [t:^{h}]. N – number of rated tokens, 5 – sentence rated as having the characteristic given in the left column, 1 - sentence rated as having the characteristic given in the right column, 4, 3, 2 – intermediate ratings between 5 and 1.

	N	Target sound	5	4	3	2	1	
Intelligent	216	[t]	10.6	44.0	28.7	13.9	2.8	Unintelligent
	215	[t:^{h}]	11.6	38.1	34.0	13.5	2.8	
Ambitious	216	[t]	13.0	36.6	25.5	18.5	6.0	Unambitious
	215	[t:^{h}]	15.3	30.7	28.8	19.1	6.5	
Educated	216	[t]	15.3	41.7	32.4	8.3	2.3	Uneducated
	215	[t:^{h}]	10.2	40.9	34.4	12.6	1.9	
Hardworking	216	[t]	9.3	37.0	36.6	11.6	5.6	Lazy
	215	[t:^{h}]	10.2	33.0	35.8	16.3	4.7	
Confident	216	[t]	21.3	24.5	25.5	19.0	9.7	Unconfident
	215	[t:^{h}]	22.8	21.9	27.4	18.1	9.8	
Sincere	216	[t]	14.4	37.5	33.8	13.0	1.4	Insincere
	215	[t:^{h}]	22.8	37.2	26.0	11.6	2.3	
Friendly	216	[t]	13.0	31.0	41.2	12.0	2.8	Unfriendly
	215	[t:^{h}]	15.0	36.9	27.6	15.9	4.7	
Humorous	216	[t]	3.7	10.6	37.0	27.8	20.8	Humourless
	215	[t:^{h}]	5.6	16.3	30.7	29.3	18.1	
Casual	216	[t]	13.9	20.4	32.4	22.2	11.1	Formal
	215	[t:^{h}]	15.8	28.4	38.1	14.0	3.7	
Speaks like me	216	[t]	5.1	12.5	23.1	24.5	34.7	Does not speak like me
	215	[t:^{h}]	4.7	17.2	24.2	26.5	27.4	
Lives in a village	168	[t]	4.2	10.1	32.1	29.8	23.8	Does not live in a village
	168	[t:^{h}]	20.2	30.4	25.0	10.7	13.7	

Furthermore, these two tests yield results which were close to being significant for two other traits. The p value for 'sincere' was equal to .099 according to the t-test and .054 according to the Mann-Whitney test, which is only slightly higher than the .05 threshold. In both cases the use of [t:^{h}] was more likely to be associated with being sincere than the use of [t] would be. Similarly, for the 'educated' trait, p was .079 in the t-test and .100 in the Mann-Whitney test, and the mean values in the t-test as well as mean rank values in the Mann-Whitney test indicates that [t:^{h}] might be associated less with being educated.

Table 6.5 T-tests results testing the differences in means of scores assigned to [t:^{h}] and [t] on various traits.

Trait	[t]mean	[t:^{h}] mean	Mean difference	Significance (2-tailed)
Lives in a village	2.41	3.33	-.917	.000
Casual	3.04	3.39	-.351	.001
Educated	3.60	3.44	.155	.079
Sincere	3.51	3.66	-.157	.099
Speaks like me	2.29	2.45	-.168	.148
Humorous	2.49	2.62	-.128	.222
Hardworking	3.33	3.28	.056	.560
Intelligent	3.47	3.42	.050	.591
Friendly	3.40	3.41	-.017	.863
Ambitious	3.31	3.30	.014	.895
Confident	3.29	3.30	-.013	.913

Table 6.6 Mann-Whitney results indicating significant differences in scores assigned to [t:^{h}] and [t].

Trait	Mean rank [t]	Mean rank [t:^{h}]	Significance
Lives in a village	133.96	203.04	0.000
Casual	197.81	234.27	0.002
Sincere	205.00	227.06	0.054
Educated	225.29	206.67	0.100
Speaks like me	207.09	224.95	0.124
Humorous	209.64	222.39	0.270
Hardworking	219.72	212.26	0.514
Friendly	212.04	218.99	0.544
Intelligent	219.05	212.94	0.591
Ambitious	217.00	215.00	0.863
Confident	215.53	216.47	0.936

While analysing the implications of p values obtained in these two tests, it is worth considering which results should be expected to be more reliable. Since The Mann-Whitney test is a non-parametric test, it is more likely to give more reliable results in situations when the tests are run on small samples (Brase & Brase 2003). The results discussed here were taken from 36 listeners each of whom heard each target sound ([t] or [t:^{h}]) 6 times. That means that each sound ([t] or [t:^{h}]) was rated 216 times on each of the traits excluding 'lives in a village'. This is because the first 7 listeners did not have this option in the answer sheet. The trait was not probed in the pilot study and was included only later. The disadvantage of using Mann-Whitney test is the power of the

test as, according to Brase and Brase (2003), nonparametric tests are not as sensitive as parametric tests and "tend to result in acceptance of the null hypothesis more often than they should" (Brase & Brase 2003: 713).

Even though the p value is greater than .05 for traits 'sincere' and 'educated', the results still seem to indicate tendencies which were described by previous attitudinal studies on CG. Such similarity between the present results and the results of previous studies might indicate an inclination to evaluate the use of [t:ʰ] as being more sincere and the use of [t] as being more educated. It may be that that these tendencies would be more robust on a greater sample of listeners, or with a sample of listeners with slightly different socioeconomic background – though of course we cannot tell.

Interestingly, the results of the tests are significant only for some of the traits. In contrast, other attitudinal studies, which investigated evaluation of the dialect as a whole, including several features instead of analysing each separately, pointed towards CG being evaluated differently from SMG on a greater number of traits (Sopholeous 2006; Papapavlou 1998). Since the use of [t:ʰ] did not turn out to be evaluated differently from the use of [t] on all traits, it might be inferred that not all elements of the dialect contribute to its evaluation in the same/equal way. Such a propensity would be in line with the claim by Armosti that the use of [t:ʰ] is not stigmatised (personal communication; 22 April 2011).

It is worth mentioning at this point that informal conversations carried out with study participants upon completing their tasks revealed some weaknesses of the method used. Several subjects noticed that some speakers were the same people, although the listeners were not convinced of this. Yet, it is likely that even if they recognized any of the voices, they had no opportunity to go back to any of the completed answer sheets to change or check their previous answers as (a) they were instructed not to, and (b) the researcher was present in the room throughout the experiment and paid attention to what the participants were doing without being intrusive. The only way the participants could adjust the answers was by remembering the first set of scores they had assigned – which seems very unlikely.

An interesting comment from a study participant was that some speakers seemed more self-confident because they spoke a bit louder (FE3). Such reported perceptions might indicate that some samples might have been rated differently due to the factor 'loudness', but it should be remembered that even if some speakers sounded more confident than others owing to their

loudness, they spoke with the same loudness in both guises, hence if geminates were rated differently from singletons, they would have been rated differently anyway.

In order to exclude the possibility that there are no significant differences between evaluation marks due to (a) different performances by various speakers, and/or (b) different lengths of plosives and their components, Mann-Whitney U tests were carried out in order to analyse differences in the evaluation of singleton and geminate plosives produced by each speaker separately. It was decided that Mann-Whitney U test would be more appropriate, as comparison of evaluation marks for each speaker and each trait separately involves working with very small samples. Table 6.7 summarises details of traits on which [t] and [t:ʰ] were evaluated differently for every speaker as analysed separately.

The Mann-Whitney U Test results (see table 6.7) showed several significant results (in most of which $p < .05$) indicating differences in rating the two target sounds. Thus, the difference in rating was significant (mostly $p < .05$ level) for traits such as 'lives in a village', 'speaks like me', 'confident', 'casual', 'educated', and 'humorous'. The values of mean ranks for all significant results for 'lives in a village' show that the use of [t:ʰ] is inclined to be interpreted by the listeners as speech of village residents. This result is in line with the result of the tests carried out on the data gathered from all speakers in this study. Moreover, whenever the difference in how [t:ʰ] and [t] were rated on the 'casual' trait was significant, the values of mean ranks suggested that the use of [t:ʰ] appeared to be more casual to the listeners than [t] did. Also, M3 seemed to be more humorous to the listeners when using [t:ʰ]. However, when using [t], F8 was more likely to be described as educated than when using [t:ʰ]. To sum up, the results for 'lives in a village', 'casual', 'humorous' and 'educated' were in line with previous accounts of attitudes towards CG provided by Sophocleous (2006) and Papapavlou (1998).

Interestingly, for 'speaks like me' F6 had higher mean ranks for geminates, whereas M2 received higher ranks for singletons. It is hypothesised here that the difference could be linked to the fact that the two speakers represented different genders. That is, for some reason the listeners might identify themselves more with a female user of geminates than with a male user of singletons. The reason for this tendency remains unclear, and it needs to be remembered that such a result might stem from a small sample and might not be replicated in a similar study. The fact that the number of male and female judges was almost the same (nineteen females and seventeen males) suggests that it is unlikely that listeners identified themselves more with a female speaker using such a variant because the sample included more female judges.

Table 6.7 Details of traits on which [t] and [t:ʰ] were rated differently for each speaker separately (significant results).

speaker	Trait	Mean rank [t]	Mean rank [t:ʰ]	Significance
M3	Humorous	30.21	41.96	.012
F6	Speaks like me	30.00	43.00	.006
F6	Confident	31.46	41.54	.034
F6	Casual	30.47	42.53	.011
F6	Lives in a village	23.43	33.57	.017
M2	Lives in a village	20.18	36.82	.000
M2	Speaks like me	40.46	32.54	.050
M2	Ambitious	40.69	22.31	.065
F4	Lives in a village	22.36	34.64	.004
F8	Lives in a village	21.82	35.18	.002
F8	Casual	32.12	40.86	.069
F8	Educated	40.78	22.22	.038
M4	Lives in a village	23.18	33.82	.012
M4	Casual	30.89	42.11	.018

Finally, there was a tendency to label F6 as more confident when she was using a geminate. This result is not in line with the general claim that generally CG is rated higher than SMG on social competence related traits (Sophocleous 2006; Papapavlou 1998). In order to interpret this result it is worth remembering that the overall results (see table 6.5) do not give a robust indication that [t:ʰ] and [t] are rated significantly differently on most of the tested competence-related traits except for 'educated', and the p for 'educated' was higher than .050 in both statistical tests (the t-test and Mann-Whitney test), so the significance of the difference between ratings assigned to this trait is disputable. Such a state of affairs might indicate that the meaning carried by the use of [t:ʰ] may not be competence related. In contrast, the tendency to describe F6 as sounding more confident when she uses [t:ʰ] might denote an understanding that such a person is thought to be confident enough to speak her mother tongue instead of switching to another variety which might be considered more prestigious just to sound more credible. It might be understood that a person who does not feel the need to use a prestigious variety believes more in his/her own value and does not need to pretend to be someone else.

Table 6.8 Details of traits on which [t] and [t:ʰ] were rated differently by particular listeners.

Listener	Trait	Mean rank [t]	Mean rank [t:ʰ]	Significance (2-tailed)
Me19	Lives in a village	3.58	9.42	.002
Me23	Lives in a village	3.50	9.50	.002
Fe14	Lives in a village	3.50	9.50	.002
Fe7	Lives in a village	3.58	9.42	.002
Me5	Lives in a village	3.92	9.08	.009
Me18	Lives in a village	3.83	9.17	.009
Me26	Lives in a village	4.25	8.75	.026
Me22	Lives in a village	4.42	8.58	.041
Fe6	Lives in a village	4.33	8.67	.041
Me27	Casual	3.50	9.50	.002
Fe15	Casual	4.42	8.58	.041
Me18	Casual	3.83	9.17	.009
Fe4	Casual	9.00	4.00	.015
Me19	Casual	4.08	8.92	.015
Fe23	Casual	4.50	8.50	.065
Me22	Friendly	8.75	4.25	.026
Me23	Friendly	4.42	8.58	.041
Me20	Humorous	8.58	4.42	.041
Fe24	Speaks like me	4.17	8.83	.026
Fe7	Educated	8.67	4.33	.041

Another result for which p was greater than .050 but was close to the .050 threshold was that for 'ambitious' (p = .065). The difference between [t:ʰ] and [t] for this trait indicated that M2 was rated higher when using [t] than when using [t:ʰ] which corresponded with previous attitudinal studies (Sophocleous 2006; Papapavlou 1998).

In order to investigate how individual listeners evaluated the two target sounds and to check whether the data were not skewed by the answers of one or two judges who might have evaluated the sounds idiosyncratically, evaluation marks for [t] and [t:ʰ] assigned by each judge separately were calculated and the significance of the differences between them was analysed by means of the Mann-Whitney U Test. Once more, there were significant results (see table 6.8) suggesting that the use of [t:ʰ] tends to be associated with a possible rural background of speakers and was likely to be classified as casual speech. One of the listeners for whom the differences in evaluations were significant (FE4) appeared to describe the use of [t] as more casual than the use of [t:ʰ].Also, scores assigned by FE7 suggest that she rated users of [t] as more educated than users of [t:ʰ]. These results resonate with general accounts of attitudes towards CG (Sophocleous 2006; Papapavlou 1998).

The test also revealed several significant results for the traits 'friendly' and 'humorous'. However, some of them were contradicting others: ME22 was inclined to label [t] users as more friendly, whereas ME23 was more likely to consider [t:ʰ] users as friendly. The tendencies displayed by ME23 are in agreement with previous general descriptions of attitudes toward CG (Sophocleous 2006; Papapavlou 1998). The available information on the background of the two judges does not seem to provide any indication of what could be the source of these discrepancies in the evaluation of [t] and [t:ʰ]. The values of the socioeconomic index (ME22=20, ME23=20) and ID score (ME22=3.5, ME23=3.3) are very similar for both judges. ME22 is a resident of a rural area, while ME23 comes from a city, but it appears to be difficult to explain why a person from a village would find the use of [t] more friendly than the use of [t:ʰ].

As regards the evaluations given on the 'humorous' trait, ME20 seemed to associate the use of [t] with being more humorous than the use of [t:ʰ]. This result, however, does not resonate with previous accounts of attitudes towards SMG and CG (Sophocleous 2006; Papapavlou 1998).

The results showing how judges evaluated [t:ʰ] and [t] on the 'casual' and 'lives in a village' traits were also used to find out whether the evaluation of geminate voiceless plosives depends on listeners' affiliation and socio-economic background. More precisely, logistic regression was used in order to establish if listeners' socio-economic background and/or their level of affiliation with Greece or Cyprus may have had any influence on whether they evaluated [t:ʰ] and [t] differently on the 'casual' and 'lives in a village' traits.

For that purpose, the 'y' (dependent) variable was significance of differences in evaluation score means, which was dichotomous ('significant' or 'not significant'; dummy variables 0 and 1 were used), while the 'x' values (independent variables) were the ID score (described in section 6.2.2) and socio-economic index (discussed in section 6.2.1). However, the results of the statistical test revealed that the model was not significant (sig. =0.619, df. = 2, Chi-square =0.958). The socio-economic index and ID scores turned out not to have significant effects on whether there was a significant difference in evaluation of [t:ʰ] and [t] on the two traits (sig. = 0.332 for socio-economic index, sig. = 0.589 for the ID score). The lack of significance of the model might, however, have been caused by a small sample on which the tests were carried out.

6.5 Discussion

The results of the study seem to indicate that Greek Cypriots are aware of the fact that geminate plosives are a part of the CG sound inventory. It was previously indicated by Alexander (2008a) that in interviews Greek Cypriot informants tended to mention 'double Ts' when listing typical

Greek Cypriot features. This was treated by Alexander (2008a) as a basis for the deduction that Greek Cypriots are conscious of the existence of geminate plosives in CG. The outcomes of the present study appear to further underpin this claim. Since the informants in this study rated the use of [t] and [t:^{h}] differently on several traits, it may be assumed that they perceive the difference between [t] and [t:^{h}].

The following section provides a discussion on the kind of meanings that are carried by the use of [t:^{h}] and those meanings that according to the results of the present study did not appear to be attached to [t:^{h}]. The discussion is followed by an analysis of the status of [t:^{h}] in terms of the orders of indexicality model suggested by Silverstein (2003) to arrive at the conclusion that [t:^{h}] is not only linked to several meanings, but it is also likely to be associated with CG as a dialect.

6.5.1 The social meaning(s) of [t:^{h}]

The outcomes of this study were also instrumental in addressing question 2a, that is, *what are the social meanings associated with geminate voiceless plosives by Greek Cypriot listeners?* The results of the statistical tests run on feedback from all listeners (judges) on the speech of all speakers suggest that the study participants were likely to describe a [t:^{h}] user as someone who came from a village, spoke casually and was less educated than people who do not use [t:^{h}]. These results seemed to be in line with other descriptions of listeners' attitudes towards CG (Karyolemou 2006; Panayiotou 1996 cited in Pavlou and Papapavlou 1998; Papapavlou 1998; Papapavlou & Sophocleous 2009; Pavlou 1997 cited in Pavlou & Papapavlou 1998; Sophocleous 2005; Tsiplakou 2006; Yiakoumetti et al. 2005), in which it is maintained that CG is assigned less prestige but is associated with social attractiveness. Thus, similarly to the tendencies in listeners' attitudes towards CG as a whole, [t:^{h}], an element characteristic of a non-standard variety, was rated higher on the 'casual' trait but lower on the 'educated' trait.

For instance, it has been suggested that SMG speakers are likely to be perceived as more educated than CG speakers in several papers (Papapavlou 1998; Papapavlou & Sophocleous 2009; Sophocleous 2006; Tsiplakou 2006). Furthermore, it is worth reiterating the point that several studies seemed to suggest that Cypriot Greek speakers are inclined to use various blends of CG features depending on the situation (Karyolemou 2006; Tsiplakou 2006; Tsiplakou et al. 2006). Thus, the more formal the situation the closer to SMG the variety of speech would be. The rating of [t:^{h}] on the 'casual' trait is consistent with the above accounts of differences of formality of speech.

Finally, as far as the 'lives in a village' trait is concerned, the results of the present study also resonate with previous accounts of beliefs regarding CG. The listeners in the present study tended to associate the use of [t:ʰ] more with village speech than with urban speech. Likewise, Panayiotou (1996 cited in Pavlou and Papapavlou 1998) claims that Greek Cypriots have a propensity for feeling ashamed of their speech as they consider it to be a 'village dialect', whereas Tsiplakou (2006) and Papapavlou and Sophocleous (2009) note that CG is often described as 'peasant' speech. Even so, [t:ʰ] is used in Nicosia and in other Greek Cypriot cities. In fact, informal conversations carried out by the researcher indicate that the word *pita,* which is the target word in this study, and the word *φέτα ('feta, a kind of cheese'*; pronounced as [ˈfeta] in SMG and as [ˈfe t:ʰa] in CG), which is the target word in two more experiments described later in this thesis (see chapter 7), are both widely pronounced by Greek Cypriots (in urban and rural areas) with a [t:ʰ] not [t]. During informal conversations which took place before and/or after the experiments in the present study, some of the informants even suggested that *pita* and *feta* are pronounced with [t] only by Mainland Greeks. Why then would the judges associate the use of [t:ʰ] with being from a village?

The data collected in this study is not sufficient to answer this question; however, such a situation may be an upshot of certain stereotypes alive in the Cypriot society regarding CG as a whole. Interviews carried out with University of Nicosia students, similarly to the subjects in this study, by Papapavlou and Sophocleous (2009) imply that CG speech comprising basilectal features was also described as speech of villagers of low social background. Probed about the reasons why the informants felt ashamed to use CG in public, the study participants suggested that it was a feature of Cypriot mentality to judge and criticise users of CG. In this case CG meant the basilectal form of CG. Papapavlou and Sophocleous (2009) hint that such views may be promoted by society in general. As they put it, "...society encourages young speakers such as these participants to associate GCD [Greek Cypriot dialect] with village life and people who are less educated as them" (2009: 10). The Greek Cypriot educational system might be taking an active part in perpetuating such stereotypes. For instance, one of the participants of Papapavlou and Sophocleous' (2009) study mentioned that his/her fellow students at a primary school were ridiculed by the teacher for using CG in class. This is not the only claim of this sort in literature on attitudes towards CG as mocking users of CG by their teachers had been earlier reported by Papapavlou (2004). Even though the publication (Papapavlou & Sophocleous 2009) does not include information relating to whether [t:ʰ] was one of the basilectal elements included in the recording that was used as a prompt in the interviews, it is understood here that there is a certain likelihood that such stereotypes might concern [t:ʰ] too.

Research carried out in other communities also implies that listeners use regional stereotypes regarding the use of certain speech elements when making assumptions about speakers' background. For instance, research by Yozenawa Morris (2010) indicates that even though vowel devoicing is present in the speech of Tokyo and Kinki residents, the feature is associated with Tokyo speech but not with the Kinki accent. Experiments carried out by Yozenawa Morris (2010) revealed that listeners from Tokyo and Kinki tended to classify samples of speech by Tokyo and Kinki speakers producing vowel devoicing as Tokyo speech, whereas speech by Tokyo and Kinki speakers not producing vowel devoicing as Kinki or non-Tokyo accent. It appears likely that when making judgements about speakers' background the listeners in the present study relied on a local stereotype.

Thus, it may be reasonable to assume that even though [t:^{h}] is widely used in urban areas in Cyprus, the social meanings it tends to carry is that its users are villagers.

6.5.2 The significance of insignificant results

The insignificant results of this study appear to be as important as the significant ones. No significant difference in rating was found for the 'intelligent' trait whereas the significance of differences in rating on 'sincere' might be viewed as disputable due to the p value being .099 in the t-test and .054 in the Mann-Whitney test. This result is not in line with other accounts of attitudes towards the variety, as Papapavlou (1998) and Sophocleous (2006) suggest that the use of SMG is associated with intelligence and CG with sincerity. Such a state of affairs might imply that not all features of the variety contribute to the overall perception/image of it in an equal way. It appears that although the use of the variety carries some sets of meanings, the different elements that the variety comprises might carry only some of the meanings. Evidence presented by Papapavlou (2001) might reinforce such claims. That is, according to Papapavlou (2001) /dʒ/ in CG is likely to be evaluated higher than /ʃ/. Furthermore, it seems reasonable that not all features/elements of a variety carry all the same meanings, if the existence of a dialect continuum is to be assumed (Sophocleous 2006; Karyolemou 2006; Tsiplakou 2006; Tsiplakou et al. 2006). If speakers are to move along the dialectal continuum in order to project different levels of formality and different social messages in their speech, then different speech elements used by them are likely to carry different meanings, including different levels of formality.

Also, no significant difference in rating was found for traits such as 'ambitious', 'hardworking', 'sincere', confident' 'friendly', 'humorous' and 'speaks like me' in tests carried out on the data collected from all listeners evaluating all speakers. Yet, in the case of the above-mentioned traits,

significant differences in evaluations were found when testing significance of differences for each listener or each speaker separately. Thus, when analysing evaluations of each speaker separately, significant results were obtained for differences in evaluation on 'humorous' (M3), 'speaks like me' (F6, M2), 'confident' (F6), 'ambitious' (M2) and 'educated' (F8). When analysing evaluations by each listener separately, significant results were found for differences in ratings on the following traits: 'friendly' (ME2, ME22), 'humorous' (ME20), 'speaks like me' (FE24) and 'educated' (FE7). Such results might signify that the use of [t:ʰ] could possibly carry some other, secondary, meanings apart from those suggested by the results of tests carried out on the whole sample, but the other meanings might not be as robust.

6.5.3 [t:ʰ] and orders of indexicality

Apart from showing that listeners are aware of the difference between [t] and [t:ʰ], the overall results of this test help to establish the status of [t:ʰ] with respect to the Labovian classification of dialectal variables into *indicators*, *markers* and *stereotypes* (Labov 1971) and Silverstein's orders of indexicality model (Silverstein 2003) which explain the way different linguistic variables are perceived. The two divisions are very often considered as equivalent (Johnstone, Andrus & Danielson 2006; Johnstone and Kiesling 2008; Johnstone 2010; Silverstein 2003).

According to the Labovian classification, *indicators* "show a regular distribution over socioeconomic, ethnic, or age groups, but are used by each individual in more or less the same way in any context" (Labov 1971: 192). Similarly, if a linguistic variable bears an n-th indexical order (or the first indexical order), it is used by a whole specified socio-demographic group, and it is only noticeable by individuals who are not a part of this group (Silverstein 2003). Labov's *markers* "not only show social distribution, but also stylistic differentiation" (Labov 1971: 193) and in a similar manner Silverstein's (2003) model assumes that a variable acquires the n-th + 1 indexical order (the second indexical order) if individuals using this variable imbue it with social meaning. Such social meaning might for instance refer to the formality or correctness of an utterance. A variable imbued with an-th+ 1 indexical order may be further charged with additional meaning(s) linked to another ideology, and hence gain a higher indexical order, which is glossed as (n+1) + 1-th order by Johnstone (2012) and Johnstone and Kiesling (2008) (third, etc., indexical order). A variable bearing a higher indexical order, such as the third indexical order, is comparable to Labovian *stereotypes* which not only are used in altering styles but are also a subject of overt comments (Labov 1971: 200).

Figure 6.5 depicts orders of indexicality for and social meanings of [t:ʰ]. The inner circle denotes first-order indexicality, the in-between circle represents second-order indexical meaning, and the outer circle stands for third order indexical meaning(s). The fact that [t:ʰ] is a feature used across Cyprus (Armosti 2010; Arvaniti 1999a, 2006; Newton 1972) would constitute the first order of indexicality. To the best of my knowledge, there is no empirical research establishing whether some Greek Cypriots are unaware of the existence of the sound or whether some Cypriots have difficulty distinguishing between [t:ʰ] and [t]. The statistical tests on the data coming from the present research, however, indicate that some of the judges did not rate the use of [t:ʰ] and [t] significantly differently on any of the tested traits. This might imply that some of the judges did not attach any of the tested meanings to the use of [t:ʰ], but it does not exclude the possiblility that for these judges [t:ʰ] carries some other social meanings that were not tested in this study.
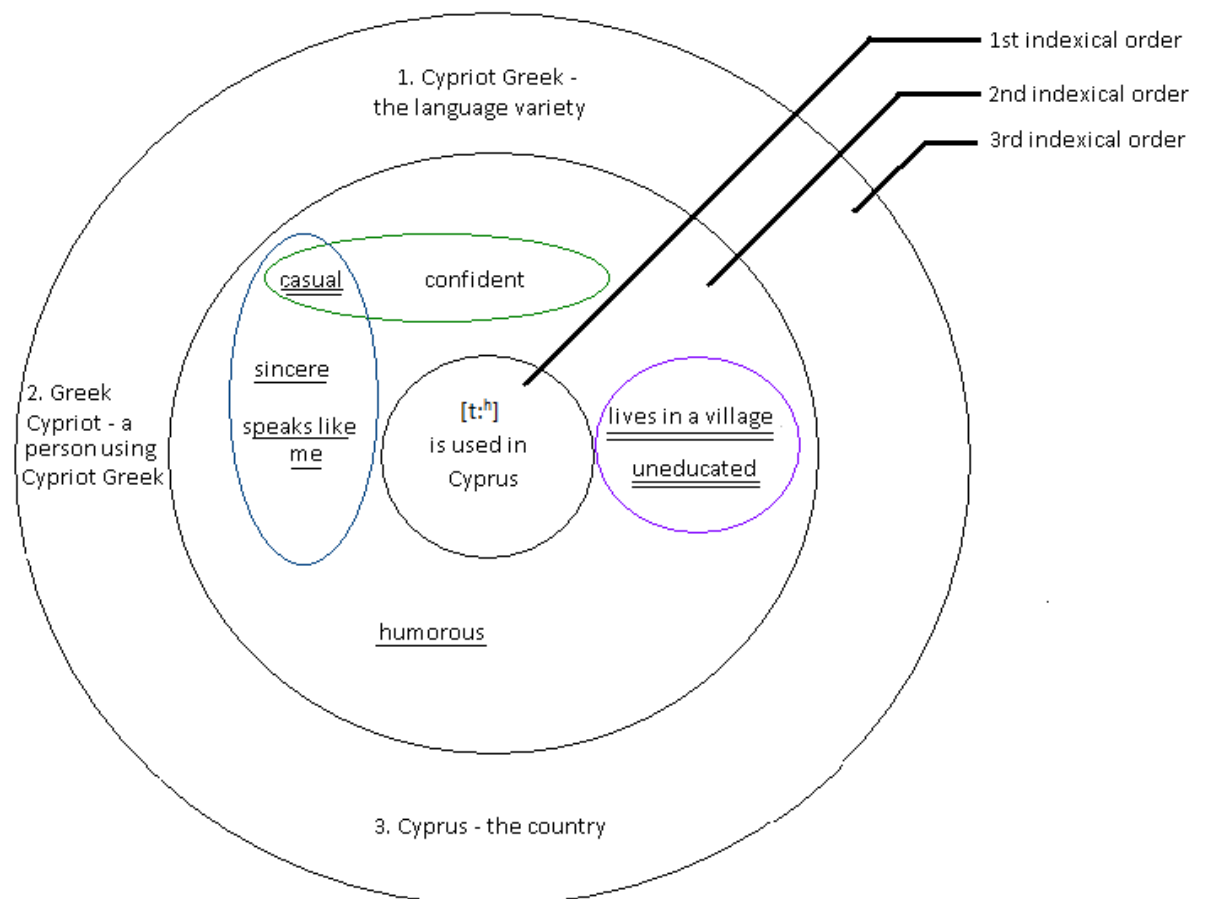
Figure 6.5 Three orders of indexicality for [t:ʰ]. The inner circle – first-order meaning; the in-between circle – second-order meanings; the outer circle – third-order meanings. The blue, purple and green lines group traits which are related to each other. Single underlining – high social attractiveness. Double undelining – low prestige.

As pointed out by Johnstone and Kiesling (2008), a variable may be the first order index for a given person depending on the kind of exposure to the variable and its possible alternatives that the person has had. In their study on Pittsburgese, they provide examples of a study participant, Esther, who did not differentiate between diphthongal and monophthongal /aw/ allegedly due to her sociolinguistic background, that is, she was unlikely to have had considerable exposure to diphthongal /aw/. Another participant in the same study, Lydia, turned out to distinguish between the two sounds, but not to associate the use of either of them with any indexical meaning. It is also reasonable to assume that there may be a group of Greek Cypriots, especially among the older generations, who might not be able to tell the difference between [t:^{h}] and [t], or at least are not likely to associate the use of [t:^{h}] with any particular group of people.

It is possible to claim that [t:^{h}] constitutes a second-order index since the present study reveals that [t:^{h}] indexes several social meanings. By rating samples of speech containing [t:^{h}] and [t], the research subjects indicated that they link the presence of [t:^{h}] in speech with certain social characteristics, which are listed in the in-between circle of the figure 6.5. The results could be compared to those of Johnstone and Kiesling (2008) who concluded that /aw/ in Pittsburghese functons as a second-order index. In order to support their argument Johnstone and Kiesling (2008) report that their subject, Dennis C., labelled the use of /aw/ as rural speech, whereas another subject, Dennis G., not only expressed his attitudes towards the use of the sound, but also some of them seemed to contradict each other. Such labelling practices revealed by Jonhnstone and Kiesling (2008) and in the present study are an example of attributing linguistic features with meaning associated with and rooted in ideologies functioning/existing in a given socio-demographic group believed by Silverstein (2003) to be the main feature of second-order indexes.

The meanings that sounds may carry appear not to be permanent and such meanings seem to depend on the speaker, listener and context (Eckert 2008; Johnstone & Kiesling 2008; Johnstone 2010; Silverstein 2003; Podesva 2004). According to Eckert (2008: 464), sounds/linguistic variables have indexical fields which allow speakers to make choices on how to use the sounds in order to project the desired meaning contingent on the circumstances. The projected meaning might then not only communicate that a speaker belongs to a local group, but the meaning also might manifest loyalty to a certain set of values. Eckert (2008) illustrates the idea of indexical fields using the results obtained by Campbell-Kibler (2006) and provides the reader with an image (Fig 6.5) which illustrates the system of meanings carried by [ɪn] and [ɪŋ] in the speech of Americans.
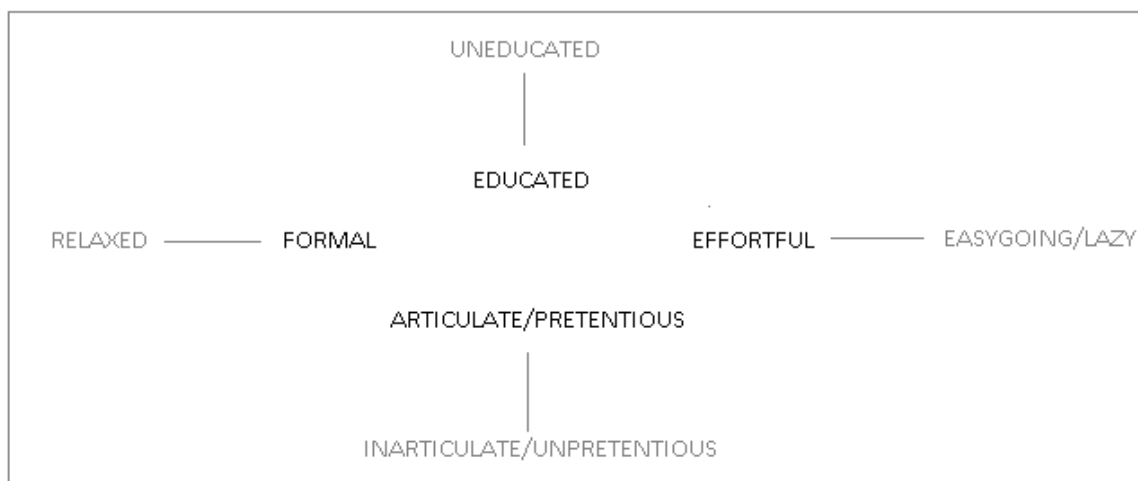
Figure 6.6 (ing) indexical field suggested by Campbell-Kibler (2006) (after Eckert 2008).

The centred meanings (*educated*, *effortful*, *articulate/effortless* and *formal*) are those potentially carried by the use of [ɪŋ], whereas the outer meanings (*uneducated*, *relaxed*, *inarticulate*, *unpretentious* and *easygoing/lazy*) are those which are likely to be associated with [ɪn]. As Eckert (2008) emphasises, it is not obvious that the use of one of the variants ([ɪn] or [ɪŋ]) may project all the meanings at the same time. Instead, the way the use of a given variable is perceived is likely to depend on the situation in which the variable is used and on the listener. Thus, a given variable might project one or a combination of several potential meanings (Eckert 2008).

As the results of the present study propose that [tːʰ] could carry several meanings, it seems reasonable to expect that the meanings also form an indexical field. An illustration of a potential lexical field for [tːʰ] in CG is presented in figure 6.7.

The meanings enclosed in the inner, grey, circle are those which had significant results of statistical tests carried out on the whole sample (all speakers and all listeners). The meanings which are printed in black had $p < 0.05$ in both statistical tests, whereas those printed in grey had p slightly higher than 0.05 in one of the tests and therefore they should be treated as potential meanings only. For each of the pairs, the element in a pair which is closer to the centre of the circle represents the meaning associated with [tːʰ] whereas the more peripheral one corresponds to the meaning of [t]. The outer, white, part of the circle includes the meanings which turned out to be significant either in statistical tests carried out for particular speakers (the underlined adjectives) or in statistical tests carried out for each listener separately (adjectives without underlining). Just as in the case of meanings in the grey circle, the meanings in the white circle which are closer to the centre are associated with [tːʰ], whereas those close to the edge are linked to [t].
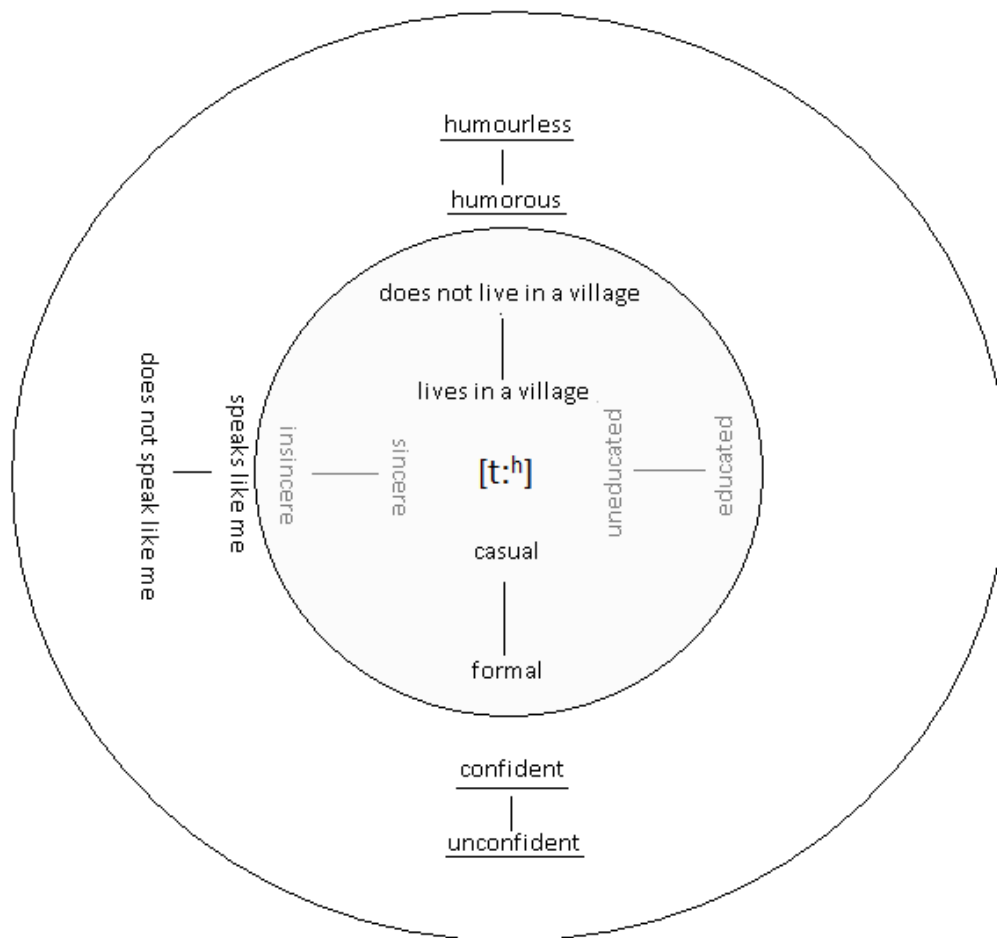
Figure 6.7 Indexical field for [t:ʰ] in CG. Inner circle – traits with statistically significant differences in rating by all listeners (black print - p <0.05 in both statistical tests; grey print – p slightly higher than 0.05); outer circle – traits with statistically significant ratings either across listeners (not underlined) or across speakers (underlined).

It should be noted that the results of the study did not indicate that the use of either of the sounds ([t:ʰ] or [t]) makes a speaker sound either confident or unconfident, either sincere or insincere, either educated or uneducated and so on. The results suggested that the use of a sound was evaluated as more educated/confident/insincere/etc. than the other. Therefore, even though figure 6.7 comprises adjectives which are antonyms, their meanings should not be interpreted as definite but in a gradient way. For instance, if a speaker uses [t:ʰ], he/she would be likely to be referred to as more sincere than the user of [t] instead of being labelled as just sincere.

Also, it is understood here that just as it is widely assumed (Eckert 2008; Johnstone & Kiesling 2008; Johnstone 2010; Silverstein 2003; Podesva 2004), the meanings carried by [t:ʰ] or [t] may vary depending on the situation in which the sounds are used and who the listeners are. In line with this claim, the speakers are likely to choose between the use of [t] and [t:ʰ] depending on what social/background message they would like to project be it consciously or not. Such an

assumption seems to resonate with previous accounts of the use of SMG and CG which suggest that the choice of certain SMG and CG features is based on the circumstances (Karyolemou 2006; Papapavlou 2004; Tsiplakou 2006; Tsiplakou et al. 2006). As an example, Papapavlou (2004) claims that whereas the use of SMG may be viewed as an appropriate choice in formal conversations and public talks, in casual settings it may be considered 'pretentious and phony' (Papapavlou 2004: 93).

It seems that the assumption that a social meaning of a variable may change depending on the context (Eckert 2008; Johnstone & Kiesling 2008; Johnstone 2010; Silverstein 2003; Podesva 2004) may be helpful in providing a better explanation why, even though [t:ʰ] tends to be used all over Cyprus, it tends to be associated with village speech. Earlier in section 6.5.1 it was suggested that such perceptions might be due to existing social stereotypes. Since it is claimed that a variable is likely to change its social meaning depending on the context in which it appears, it might be possible that [t:ʰ] is not always perceived as an element of village speech; the association of [t:ʰ] with village background might be triggered by certain circumstances and/or listeners' background. Such an explanation could also be seen as reasonable as the statistical tests revealed that not every listener judges the use of [t] and [t:ʰ] differently on 'lives in a village' trait. Also, the judges who did rate the two sounds significantly differently on this trait did not seem to give extreme ratings to either sound (i.e. either one or five), which might have indicated that they were hesitant about the suitability/accuracy of their answers.

It is the case, however, that the nature of the data does not permit one to speculate as to which circumstances might influence the meaning, or combination of meanings, which is likely to be attached to [t:ʰ]. Neither do they permit speculation about how those circumstances could affect the perception of [t:ʰ].

When proposing the existence of indexical fields, Eckert (2008) suggests that meanings associated with variables are likely to be linked to social ideologies. For instance, she gives the example of /t/ release in America, and she draws attention to links between several meanings associated with /t/ release, viz. 'nerdy', 'Orthodox', 'gay' and 'British'. At first sight, it might seem that there is no connection between these three meanings. However, Eckert (2008) suggests that each meaning is related to some ideology. Thus, the speech of 'nerdy' girls and Jewish Orthodox boys attending orthodox Jewish schools is seen as 'clear' which may further be associated with 'care'. Further to that, drawing on the context in which the particular case of /t/ release was used by a gay person, she claims that it was interpreted by Podesva (2004 cited in in Eckert 2008: 468) that the use of /t/ release made the gay speaker sound 'prissy'. Additionally, the use of /t/ release is labelled as

sounding British, which may be further extended to 'cultured', 'refined' and 'articulate' in line with the existing American stereotypes of the British asserted by Eckert (2008). The ideologies , 'clear speech', 'prissy', 'cultured', 'refined' and 'articulate' may further be linked to 'hyperarticulation', which in turn may be associated with 'education' and 'power'. The existence of such secondary meanings implies that /t/ release may also function as a third-order index.

Likewise, a careful analysis of the potential meanings of [t] and [t:ʰ] presented in figure 6.5 allows one to see connections between some of them and connections to general beliefs regarding CG. Accordingly, being sincere and casual might be related to the understanding that the use of CG is more natural as this is the local and therefore native way of speaking for Greek Cypriots. It might be understood that if a speaker uses [t], which is a variant of SMG, he or she may be thought to be affected and false. Such a speaker might be perceived as trying to distance himself/herself from other members of the same speech community. By extension, the meanings 'speaks like me' and 'does not speak like me' may also be related to the idea of being a member of a speech community. Here the community could be understood in two ways. On the one hand, 'speaks like me' could mean 'speaks like a typical Greek Cypriot' as opposed to 'speaks like a Greek' as, generally, gemination of voiceless plosives is a feature used by Greek Cypriots in everyday conversations. Nonetheless, since the results of statistical tests on the whole sample indicate that 'lives in a village' is one of the possible meanings of [t:ʰ], there is an option that 'speaks like me' could be interpreted as 'speaks like a person from a village'. Such an option does not, however, seem to be very likely as the majority of the judges in the experiment were from Nicosia or other Cypriot towns. However, this study does not allow for an in-depth analysis of this issue, and therefore further study is needed to explain this problem.

Also, it is worth remembering the overall results of interviews carried out by Papapavlou and Sophocleous (2009), which hinted that users of a basilectal form of CG are perceived as villagers with low social background and lacking education. Such a point of view permits one to draw links between 'lives in a village/does not live in a village' meanings and 'educated/uneducated'.

It is also possible to observe some further links between formality and other meanings, that is, 'confident/unconfident'. The meanings 'confident/unconfident' could imply that it is perceived that the person who feels unconfident might resort to using [t] as a more formal way of expression to compensate the feeling of insecurity. Thus, there could be a relationship between confidence (or its lack) and level of formality.

These connections are marked with blue, green and purple lines in figure 6.5. Also, some of the ascribed characteristics, those with single underlining, imply social attractiveness, while the traits with double underlining connote low level of prestige. The reason for development of opposing meanings of the same sound might be the assumption that the use of [t:ʰ] could be more appropriate in one situation than in another. Such a hypothesis appears to be in line with reported linguistic practices in Cyprus, where the choice of language variety depends on the context of the conversation.

The range of meanings which could potentially be carried by [t:ʰ] gives the impression that it reflects the general beliefs about CG (see section 2.2). The existing literature reports that CG tends to be described as: (1) a village dialect (Panagiotou 1996 referred to in Pavlou & Papapavlou 1998); (2) a dialect which is 'peasant', 'heavy', 'rude', 'impoverished' and 'lacking grammar' (Tsiplakou 2006); (3) a dialect that is used only by people of 'lower background' (Papapavlou & Sophocleous 2009). These beliefs are often contrasted with those related to the status of SMG, involving education and modernity. As [t:ʰ] could potentially carry meanings such as 'lives in a village', 'uneducated' and 'casual', then by extension, the [t:ʰ] usage might be identified with all these negative perceptions of CG or even Greek Cypriots as members of the speech community.

A similar logic might be applied to linking more positive meanings associated with [t:ʰ]. It is claimed that the use of CG evokes feelings of solidarity and is likely to strengthen national identity (Karoulla-Vrikkis 1991). Meanings such as 'sincere' and 'speaks like me' appear to be related to notions such as solidarity or national identity. Hence, the presence of [t:ʰ] in speech may be associated with belonging to the CG-speaking community. Furthermore, the overarching social meaning(s) of [t:ʰ] could be extended to (1) the language variety 'Cypriot Greek'; (2) 'Greek Cypriot', a person using the variety; or even (3) the country 'Cyprus'. Just as in the case of extension of meaning of /t/ release (Eckert 2008), these secondary meanings may suggest that [t:ʰ] could bear third-order indexicality, however, such a possibility was not directly tested in this study. However, this assumption could be supported by the earlier reported interviews (Alexander 2008a) which revealed that when asked to enumerate differences between SMG and CG study participants mentioned geminate plosives.

Johnstone and Kiesling (2008) present similar findings regarding orders of indexicality of /aw/ in Pittsburghese. In contrast with other study participants discussed by Johnstone and Kiesling (2008), Jason E. was not only able to tell the difference between monophthongal and diphthongal /aw/, but he could also link the use of the monophthongal type to Pittsburghese. His ability to distinguish between the sounds and to label the use of monophthongal /aw/ as Pittsburghese was

attributed to the array of accents he was exposed to while growing up and to the exposure to various accounts of Pittsburghese presented in the media.

It is conceivable that the judges in the present study had a similar linguistic background to the one of Jason E. in a way that although they were slightly older than Jason E. they had grown up in a society where their native dialect was not the only language variety to which they had had exposure. SMG can be heard on the radio and TV and it is taught at schools. Yiakoumetti et al. (2005) report on a language awareness programme which was carried out in several schools across Cyprus and focused on teaching children about differences between SMG and CG (including phonological ones) with the aim of improving their SMG skills. As the children taking part in the programme received formal instruction regarding the differences between the two varieties (it is not specified if instructions were made regarding geminate plosives), they were equipped with a tool to make overt comments the subject. Moreover, according to my impressionistic observations, the use of 'double' consonants is a subject to overt comments. All of these issues may further support the claim of third-order indexicality of [t:^{h}].

Finally, going back to the overarching meanings of [t:^{h}], it remains to be added that, in words such as *pita*, [t] is also likely to be a carrier of a social meaning. Since the sound is an alternative to the use of [t:^{h}], and the use of [t] in words such as *pita* is a characteristic of SMG, which is used in Greece, the use of the sound might be carrying meanings such as (1) the language 'Greek', (2) 'Greek', a person from Greece, or even (3) the country 'Greece'.

6.6 Conclusion

Despite the small sample size (thirty-six judges), the results indicate that listeners are aware of the existence of [t:^{h}] in CG and that they tend to ascribe some social meaning to the use of geminates. Furthermore, it was possible to establish that, according to the classification by Labov (1971), the variable is at least at the level of a *marker* and could potentially be classified as a *stereotype*, and further research is required to confirm such claims. Also, the results of the study helped the researcher to sketch a potential indexical field for [t:^{h}] and to speculate on the latent ideologies lying behind the indexical field. The ideology behind the indexical field seems to imply that the use of [t:^{h}] could be associated not only with meaning such as 'lives in a village', 'casual', etc., but also with notions approximating 'Cypriot Greek', 'Greek Cypriot', or even 'Cyprus'. It might also be assumed that the use of [t] could potentially carry meanings such as 'Greek' or 'Greece'.

However, as [t:ʰ] carries several potential meanings, having only the data coming from this study, it is difficult to ascertain precisely the way the listeners interpret them depending on the situation. Neither is it possible to fully understand how the speakers make their choices, whether conscious or not, to project the desired meaning onto the listeners.

According to Eckert (under review) the study of meaning could be applied in variation studies looking into how/if "social information is completely integrated with grammatical information" (Eckert under review). Having established the potential of [t:ʰ] to carry the meanings 'Cypriot Greek', 'Greek Cypriot', or 'Cyprus', it is felt reasonable to conclude that the results of this study stand as a basis for further experiments aimed to establish whether information related to the notion 'Cypriot' could be stored in speakers' memory together with acoustic features of [t:ʰ] in order to serve as one of the perceptual cues of the sound. A study aimed to discover whether the above-mentioned notion might be stored in speakers' memory as part the exemplar of [t:ʰ] is presented in chapter 7.

7   Perceptual study of the [t]-[t:ʰ] boundary

In the study described in this chapter, we will seek to establish whether three particular assumptions of exemplar theory could be applied in the context of perception of the singleton/geminate boundary by Greek Cypriot speakers. The three assumptions under scrutiny are: (1) that categories are built bottom-up on the basis of statistical similarity; (2) that categories are continuously updated as listeners are exposed to exemplars of sounds belonging to those categories; (3) that indexical information is stored in our memory alongside the information on acoustic features of the sounds.

Verification of the applicability of the three exemplar theory assumptions mentioned above was carried out by determining whether the following three factors could have an influence on the perception of the singleton/geminate boundary. The three factors were: (1) the likely amount of exposure to SMG; (2) the way the study participants produce CD and VOT in various contexts; (3) the presence of a visual cue associated with Greek or Greek Cypriot culture. The possible amount of exposure of the study participants to SMG (Standard Modern Greek) was estimated on the basis of the participants' level of affiliation with Greece and Cyprus and their socioeconomic background. The way the study participants produce CD and VOT was considered a reflection of the values of CD and VOT which the participants stored in their memory as a result of the exposure they had had to CG and SMG. The influence of an item associated with either Greek or Greek Cypriot culture was tested by exposing study participants to either the Greek or to the Greek Cypriot flag. This was done to ascertain whether the concepts 'Cypriot' or 'Greek' could be stored with an acoustic signal as a part of the exemplars of [t:ʰ] and [t].

The data collection facilitated an investigation of the influence of additional variables on the perception of the singleton/geminate boundary. These variables include gender and the place of residence (rural versus urban) of the listeners. It was believed that since men and women are reported to differ in their perception and production of sounds (Eckert 1989; Labov 1990; Hay et al. 2006a; Hay and Drager 2010; Nygaard and Queen 2000; Namy, Nygaard & Sauerteig 2002; Yozenawa Morris 2010), using data on the gender of the listeners might benefit the study and give a deeper understanding of factors influencing perception of the sound boundary. It was also understood that information on whether listeners come from rural or urban areas might also potentially reflect their amount of exposure to [t:ʰ] and [t].
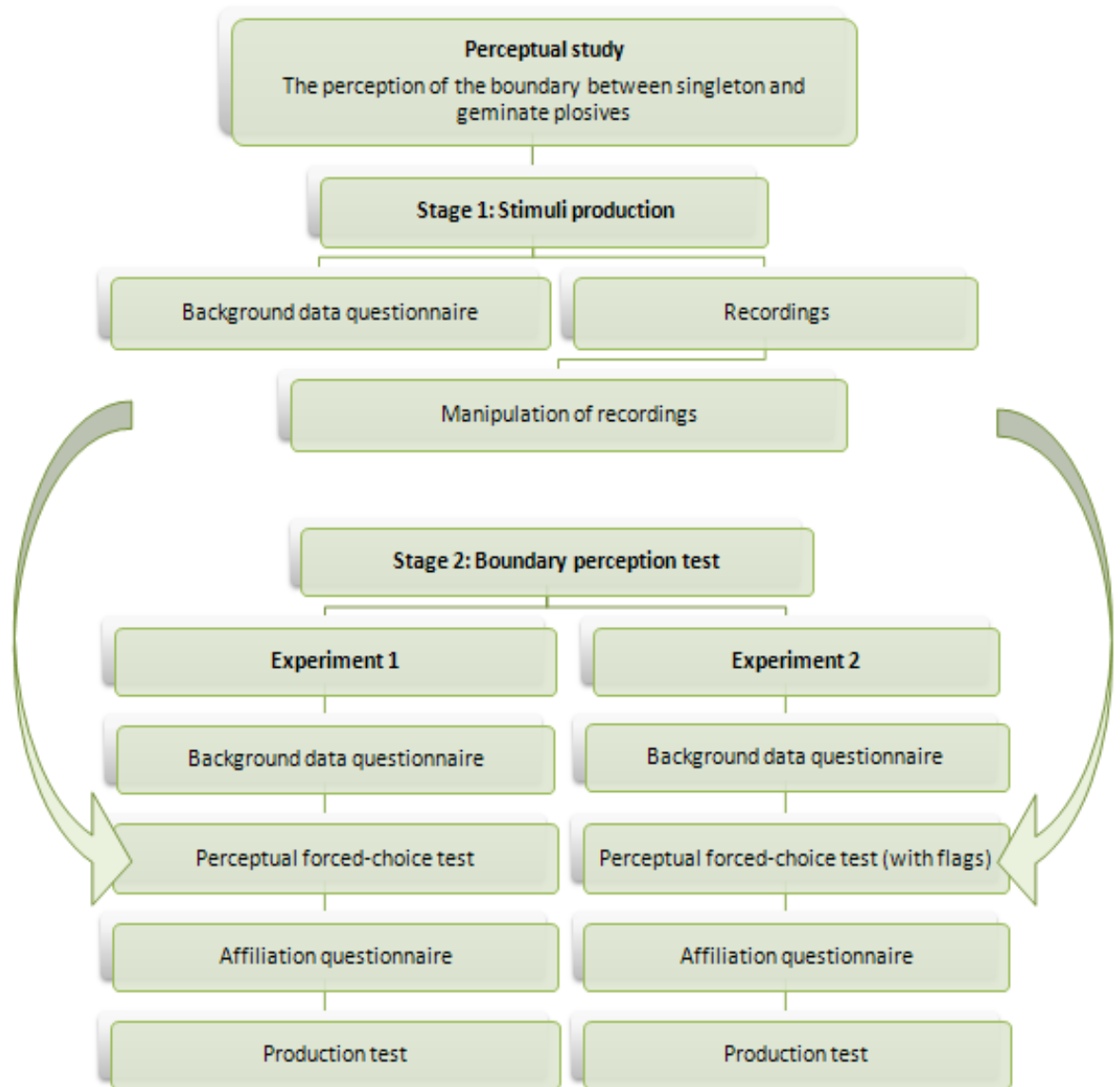
Figure 7.1 General overview of the study on the perception of the boundary between singletons and geminate plosives.

The study comprised one production experiment and two perceptual experiments (see figure 7.1). The production experiment was carried out in order to record audio material needed for the creation of perceptual stimuli which were later used in the two perceptual experiments. The first of the perceptual experiments was intended to reveal if and how the length of CD and VOT influence perception of [t] and [tːʰ]. The study also sought to test whether other factors, such as social affiliation, socioeconomic background and gender of the listener, may influence perception of the [t] - [tːʰ] continuum. The goal of the second perceptual experiment was to analyse if and how exposure to a concept associated with a region affects the perception of the singleton/geminate boundary. Furthermore, an explanation was provided regarding whether the

influence of exposure to a concept associated with a region depends on other factors, such as social affiliation, socioeconomic background and gender of the listener.

In both perceptual experiments, perception of the singleton-geminate boundary was tested by means of forced-choice listening tasks in which listeners were asked to classify plosives of various durations as geminates or singletons. The main difference between the two experiments was that in the second experiment the study participants were exposed to either the Greek or the Greek Cypriot flag. As data pertaining to social affiliation and socioeconomic background of the listeners were needed for this study, questionnaires on background data and group affiliation were administered with both perceptual tests (see Appendix 1 and Appendix 4). Finally, as one of the aims of the study was to establish the relationship between production of singleton/geminate plosives and the perception of the boundary between those sounds, the study participants taking part in the perceptual study (experiments 1 and 2) were additionally asked to take part in production tests too.

A similar study has been carried out by Armosti (2010); however, Armosti analysed the perception of a geminate/singleton continuum between words which were minimal pairs. Thus, in his study he looked at how VOT and CD values of plosives heard changed the meaning of the word being tested. In the present study, however, whether a sound was perceived as a singleton or a geminate could not have caused a change of the meaning of the word; yet, it was expected that it would cause the listener to believe that the speaker used either SMG or CG when pronouncing each of the target word samples. A choice to use SMG or CG might potentially make a listener attribute various characteristics to the speaker. In line with the results of the study presented in chapter 6, depending on how the sound is perceived, as a singleton or as a geminate, the sound may carry or not carry the meaning 'Cypriot' or 'Cyprus'. Thus, the tests described in this chapter give an insight into whether and how VOT and CD length may influence the perception of social meaning. The other difference between how the two studies analysed the geminate/singleton boundary was that in the present study it was investigated how the following three factors influenced the perception of the singleton/geminate boundary: (1) social background of the listener; (2) their production of the target sound; (3) the presence of an item symbolising Greek or Greek Cypriot culture. The inclusion of such variables might allow a better understanding of boundary perception and might add a more sociophonetic context to the research on perception of the boundary which was not addressed in Armosti (2010). Investigating the perception of the boundary from a sociophonetic point of view is in line with exemplar theory, which assumes the

importance of indexical cues in the development of sound categories and a bottom-up development of those categories.

The chapter is structured as follows. First, the steps involved in the production of the stimuli for the perceptual tests are described (section 7.1). The description is followed by an explanation of the methods used in the perceptual tests (section 7.2), a detailed account of the results of experiment 1 (section 7.3), a discussion of the results of experiment 2 (section 7.4) and a discussion of the results of statistical tests carried out on pooled data collected in experiments 1 and 2 (section 7.5). Section 7.6 presents a general discussion of all results included in chapter 7. The chapter ends in a general summary and discussion of the most important outcomes of the study (section 7.7).

7.1 Production of the perceptual stimuli

The data collected for the purpose of stimuli production for this study were recorded during the same recording session in which audio material was recorded for the social evaluation study (see section 6.1). The material needed for the social evaluation study was recorded first, and then the recordings of material used in the present study followed.

As indicated in figure 7.1, first, the study participants were asked to fill in a short questionnaire on their socio-economic background (see Appendix 1). Subsequently, the study participants were recorded reading lists of words and phrases using CG and SMG. The speech samples were analysed and manipulated acoustically in order to create stimuli for the perceptual tests (the procedures pertaining to data manipulation are described in section 7.1.5).

Audio data were collected from several speakers, for two reasons. First, they were collected in order to establish the average minimum and maximum values of VOT and CD of [t] and [t:ʰ] across the speaker sample. These values were later helpful in establishing minimum and maximum values of VOT and CD of the audio stimuli used in the perceptual tests. Second, having a range of recordings of various speakers helped in the choice of a convenient sample of the target word which could later be manipulated acoustically in order to produce the singleton /geminate continuum.

7.1.1 The test words

As the words were supposed to be read with SMG and CG pronunciations, lexical items existing in both varieties were included. This decision had been taken in order not to confuse the participants by asking them to read Cypriot words and use SMG at the same time. At this stage,

two of the recorded words were the target word. One of them, φέτα (*feta,* a kind of cheese; it will be spelled as *feta* from now on), was a word which is pronounced with [tːʰ] in CG (['fetːʰa]) and as [t] in SMG (['feta]). The recordings of this word were used in order to establish the average length of the plosive for every recorded speaker using it when speaking SMG and CG, and as material for production of the perceptual test stimuli. The second word, βάτα ('cotton', 'wadding'; it will be spelled as *vata* from now on), which is pronounced as ['vata] in both accents, was recorded to establish the average length of a regular singleton [t] as used by Greek Cypriots. The averages were then compared to those of the singleton [t] pronounced in the word *feta*. They were also used when establishing the minimum VOT and CD length in perceptual stimuli. The decision to compare both types of singleton plosives was taken since my previous production tests suggested that not all speakers of CG are able to suppress gemination. These results resonate with similar claims by Arvaniti (2006) and Armosti (personal communication). If the samples of singleton plosives had been collected only by recording geminate words uttered in SMG, not enough data might have been collected in order to: (1) establish the exact values of CD and VOT of singletons by all participants; (2) produce desired range of stimuli for the perceptual tests; and (3) decide about the values of CD and VOT of the steps on the singleton-geminate continuum.

Table 7.1 The test words and the target sounds (in bold).

	Word-medial
Singletons in SMG, geminates in CG	φέτα (*feta*, a kind of cheese) ['fe**t**a] in SMG ; ['fe**tː**ʰa] in CG
Singletons in SMG and CG	βάτα ('cotton', 'wadding') ['va**t**a]

When recorded, the words were not read by the study participants as parts of sentences, but as separate words in a list. The reason for this preference was that, in order to limit the number of potential cues, it was decided that in the perceptual tests only isolated words would be played. It was decided that the stimuli would sound more natural, and therefore less suspect, if they were not extracted from sentences but recorded and played as isolated words. It should be highlighted that just as in the case of the target word containing a geminate plosive, the plosive in the word containing singleton was followed by the vowel /a/.

There were several reasons behind the decision to choose *vata* and *feta* as the production test words. One of the reasons for using these two words was linked to the choices made regarding

the test words used in the perceptual study. It was decided that only one word, *feta*, would be used in perceptual tests. The word was chosen for perceptual tests because it does not include any other CG features and includes a non-contrastive geminate when pronounced in CG. The reason for choosing another test word was that it was felt necessary to compare the values of singleton plosives in *feta* to non-contrastive singleton plosives. It was believed that the two words should be structurally as similar as possible. Therefore, both were two-syllable words with the target plosives in intervocalic and stressed position and the onsets of both syllables were also structurally similar.

Another reason for choosing only two words was dictated by the need to adjust the length of the task in a way to keep it manageable and not too time-consuming for the study participants. It needs to be remembered that except for reading the list of words and the sentences (the speakers also recorded the material for the MGT test), they also were asked to fill out the questionnaires on their socio-economic background (section 6.2.1) and their affiliation (section 6.2.2). As regards the reading task, it included reading one sentence (see section 6.1.2) twenty times, that is, ten times in SMG and ten times in CG and reading a list of six words (see Appendix 10). Each of the words was repeated ten times on the list in a random order. The words were read ten times in order to facilitate calculation of mean values of CD and VOT for each speaker. The list was read first in SMG and then in CG. As far as the other words on the list are concerned, two of them included typically CG sounds when pronounced in CG, namely [ʃ] and [tʃ], and they were included in order to distract the readers' attention from the target words. Also, one of the remaining words had [t:ʰ] in word initial position in CG, and another one included [t] in word initial position in both accents. Each of those four words was repeated ten times on the list as well.

7.1.2 The speakers

The two sets of audio data were collected from thirteen subjects (eight female, five male), each of whom recorded all the words/phrases during one recording session. Data from two subjects could not be analysed due to a failure of the recording equipment. The average age of the speakers was twenty-one. The average age for female subjects was 20.6, whereas the average age of male subjects was 21.6.

The speakers were recruited from students attending various programmes and courses at the University of Nicosia. In order to recruit study participants, the researcher asked her colleagues to distribute an invitation to take part in an experiment among students attending the courses. The

students read the invitation that contained a general description of the experiment and those who were interested in volunteering were asked to leave their name and contact number. The students were informed that participation would be voluntary and that participation in the experiment would not have any influence on their course grades.

7.1.3 The recordings: procedure

Every participant was given the opportunity to see the word list (see Appendix 10) and do one trial reading prior to the recording. The aim of the trial reading was to prevent situations in which the subjects may have felt unsure and therefore could have hesitated or could have made mistakes during the recording session, which in turn might have negatively influenced the quality of the recording and/or might have decreased the number of tokens of target words.

As regards procedure, first, each study participant was instructed to read each set of words (see Appendix 10) ten times using SMG, and then ten times using CG. When instructed how to read the sentences, the participants were not directly asked to use SMG or Cypriot. Instead, they were asked to speak as if they were talking in a formal situation (e.g. the way they speak in front of a teacher in a classroom), or in an informal situation (e.g. as if they were having a conversation with their friends or family). The first reason for this procedure was that research on attitudes towards Cypriot shows that it is SMG users who are considered more intelligent, ambitious and educated than Cypriot users by university students (University of Cyprus) whose attitudes were investigated by means of MGT (Papapavlou 1998). Similarly, research by Sophocleous (2006) maintains that Intercollege[1] students evaluated speakers of the rural variety of Cypriot very low on the feature 'speaks like me' in a matched-guise experiment. Taking these attitudes into consideration it is conceivable that asking the participants to speak Cypriot, and thus possibly implying that they are speakers of the low status variety, might offend some of them. Moreover, although Newton (1972a) used the term Cypriot to refer to the rural as well as urban varieties, and this is how the term is usually used in literature, Cypriots tend to associate the term with rural speech (Sophocleous 2006). Therefore, it is possible that if the participants had been instructed to speak Cypriot, they might have tried to imitate the rural varieties that normally they may not use at all, instead of speaking what is actually their native language. Yet, if participants who were asked to speak *the way they talk to their friends/family* wanted to confirm that the researcher meant Cypriot, a positive answer was given in order not to confuse them. Similarly, if participants who were asked to speak the way they would *talk to their teacher* wanted to confirm that they were

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[1] In 2006 Intercollege was an institution of tertiary education in Cyprus which in 2007 received university status and subsequently changed its name to the University of Nicosia.

asked to use SMG, a positive answer was given. I had employed this method of instruction in my previous studies, and the study participants did not show any signs of confusion.

The two target words were read as a part of a list of words (see Appendix 10) in which one could also find words which are normally pronounced differently in SMG and CG. Inclusion of other words in a list was dictated by the need to distract study participants' attention from the target words. The subjects were asked to read randomised lists of words in such a way that there was always a short pause after each item. The recordings were made in a sound-treated booth at the University of Nicosia.

7.1.4   Analysis of the spoken data

The data collected in the recordings described in section 7.1.3 were subsequently analysed acoustically by means of Praat (Boersma & Weenink 2011). The analysis focused on (1) CD, (2) VOT and (3) the duration of the whole plosive. CD and VOT were measured the same way as described in section 6.1.4.

Mean values of VOT, CD and duration of the whole plosive were calculated for each subject separately, and for all subjects together. The reason why means were calculated for each subject separately was that my previous research results indicated that the realisation of plosives may vary across speakers. Comparison of mean values of singleton plosives included in the word *vata*, and singleton plosives included in *feta*, helped to establish if the subjects managed to suppress gemination in *feta* when using SMG. Also, the analysis of the above mentioned values for geminate and singleton plosives helped to resolve the minimum and the maximum values of CD and VOT in plosives included in the singleton-geminate continuum used in the perceptual tests. This method was earlier used by Armosti (2010) who made his decision on the range of CD and VOT values in his stimuli on the basis of the values he obtained in his acoustic study of VOT and CD in CG (Armosti 2010). In the present study, the participants who took part in the production tests produced wider ranges of VOT and CD than those in Armosti's study; therefore, the range of CD and VOT in the present study was wider than in the study by Armosti (2010). Further information regarding the values of VOT and CD in the perceptual test stimuli is presented in section 7.1.5.

	F1	F3	F4	F5	F6	F7	F8	M2	M3	M4	M5
CD ['feta]	128	99	99	88	84	119	110	134	120	118	92
VOT ['feta]	14	18	20	22	22	30	23	40	17	23	27
CD+VOT ['feta]	142	117	120	110	107	148	133	174	137	141	119
CD ['fet:ha]	164	103	133	129	131	130	131	165	120	159	157
VOT ['fet:ha]	46	30	74	71	68	83	64	79	43	76	37
CD+VOT ['fet:ha]	209	133	207	200	199	212	195	244	163	235	194
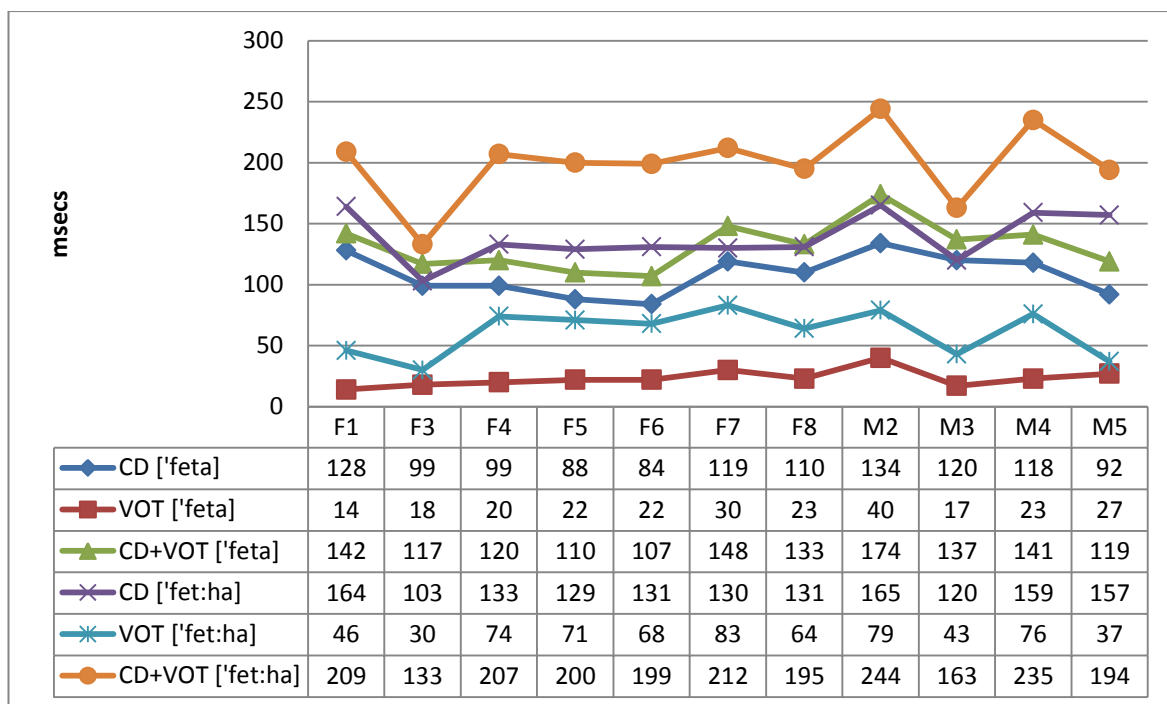
Figure 7.2 Length of CD, VOT and the whole plosive (CD+VOT) in the word *feta* pronounced with a singleton [t] (in SMG) and a geminate [t:ʰ] (in CG) plosive by the research participants. All values are in milliseconds.

The data presented in figures 7.2 and 7.3 show how the duration of alveolar plosives can be different for different speakers. Data on [t] and [t:ʰ] (see figure 7.2) pronounced as a part of the word *feta* suggest that VOT mean values for [t] and [t:ʰ] were not very different from each other when pronounced by M5 and F3, even though the [t:ʰ] values were slightly higher for [t:ʰ] in both cases. Interestingly, F3 also produced similar CD values for geminates and singletons; however, the CD of [t] and [t:ʰ] produced by M5 were different.

Also, the mean total length of the geminate plosives produced by F3 was shorter than the mean total length of singleton plosives produced by F7, M2 and M3, which might have been caused by the fact that singletons and plosives pronounced by F3 had a similar length. Furthermore, the mean total duration of the singleton plosive uttered by M2 was longer than the mean total duration of the geminate plosive by M3. Yet, although the mean CDs pronounced by M3 in [t] and [t:ʰ]were almost the same, the VOT of [t] and [t:ʰ]of the same speaker was different.

Such results imply that even though in some cases the discrepancies in the length of different components of plosives might have been caused by differences in speech tempo, some differences are likely to be caused by individual ways of pronouncing these sounds. For example, overall, M3 produced shorter geminate plosives than the singleton plosives M2 produced yet, even if the speech tempo influenced the total length of geminate plosives produced by M3, the

total duration was also influenced by the value of CD of the M3 geminate plosives which was nearly identical to the values of M3 singleton plosives. Likewise, F3 produced geminate plosives shorter than singleton plosives uttered by some of the other subjects. In fact, her geminate plosives were hardly any longer than her singleton plosives.

	F1	F3	F4	F5	F6	F7	F8	M2	M3	M4	M5
CD ['vata]	104	76	97	76	86	93	93	104	115	101	88
VOT ['vata]	13	13	24	19	18	31	19	35	18	27	24
CD+VOT ['vata]	118	88	121	96	104	124	112	139	133	127	113
CD ['feta]	128	99	99	88	84	119	110	134	120	118	92
VOT ['feta]	14	18	20	22	22	30	23	40	17	23	27
CD+VOT ['feta]	142	117	120	110	107	148	133	174	137	141	119
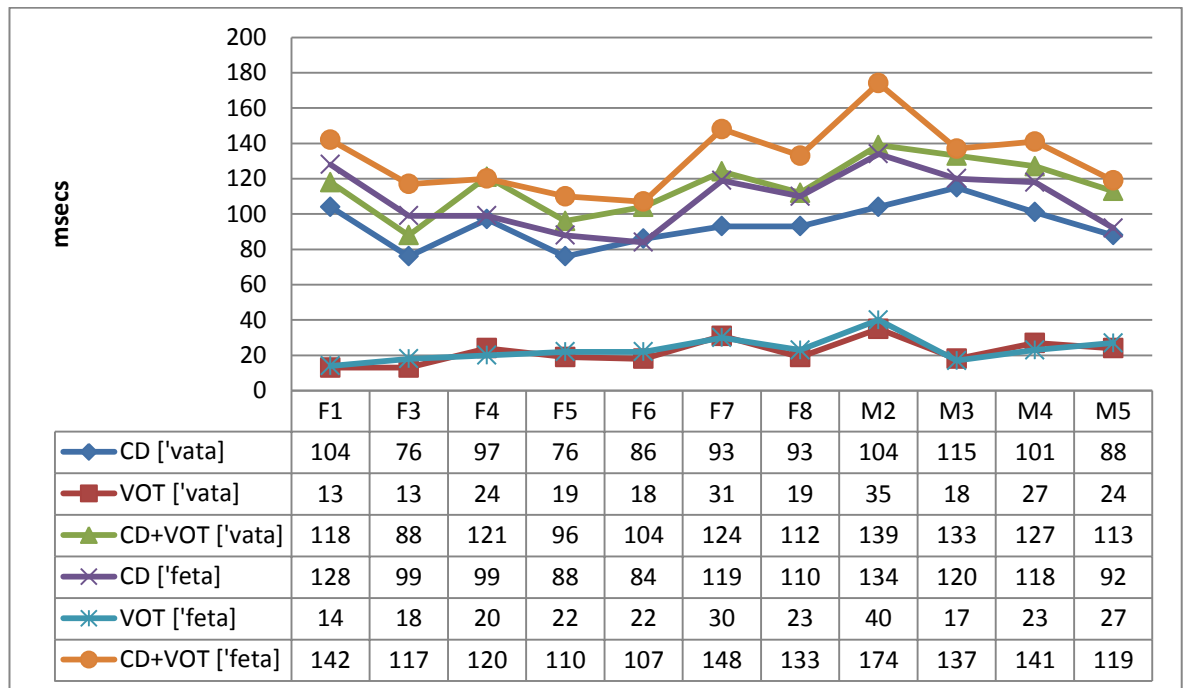
Figure 7.3 Length of CD, VOT and the whole plosive (CD+VOT) in the words *vata* and *feta* pronounced with singleton [t] plosives by the research participants using SMG. All values are in milliseconds.

Furthermore, some interesting observations were made when comparing singleton plosives in *vata* which is not pronounced with a geminate in either SMG or CG, and singleton plosives in *feta* which is pronounced with a geminate in CG and a singleton in SMG: the mean VOT values appeared to be approximately the same in [t] coming from both lexical items, whereas the mean CD values appeared to be slightly longer in [t] embedded in *feta* than in *vata* (see figure 7.3) with the exception of four subjects (M5, M3, F6 and F4).

The pooled mean values of plosives in *feta* and *vata* pronounced in SMG were compared by means of a t-test. The results of that test suggested that the differences in CD and the length of the whole plosive were statistically significant. The difference in VOT values in [t] in the two lexical items was not statistically significant. Such results might imply that even though when using SMG, Greek Cypriots tend to reduce the length of plosives in lexical items in which plosives are normally pronounced as geminates in CG, some of them may not reduce the length of CD to the duration of a true singleton plosive such as in *vata*. Also, it seems that the problem concerns CD but not VOT.

These observations influenced the way the stimuli for the two perceptual studies were synthesised. That is, the minimum length of CD in the synthesised speech samples was based on the minimum CD of [t] found in *vata* and not *feta* as it is likely that even though some speakers in this study reduced the length of plosives when using SMG, they did not completely suppress gemination in the *feta* plosive and, therefore, the CD they produced might have been different than it would be in a regular singleton [t] such as those in *vata*. As the CD in the [t] present in *feta* seems to be slightly longer, it was not clear how it could be perceived. Therefore, in order to make sure that singletons are as 'singleton-like' as possible in the perceptual study, the values of true singletons such as those in *vata* were taken into consideration when the decision about the length of particular sections of plosives were manipulated (see section 7.1.5 for details).

7.1.5   Preparation of the listening stimuli

In order to test the perception of the boundary between [t] and [t:ʰ] the subjects in the perceptual tasks had to be exposed to a series of sounds with various lengths of CD and VOT. For this reason, it was necessary to generate a series of words with plosives of different CD and VOT values. All acoustically manipulated plosives with different lengths of CD and VOT were generated from a single sample of the word *feta* which had been originally pronounced with a singleton plosive by the subject M3. The decision to use only one word was taken to ensure that no other cues from neighbouring vowels were used by the listeners to label the stimuli as geminates. The reason why all continua were generated using only one sample of *feta* was that such a practice is likely to help to control the effects of speed on various sound cues. The original VOT of the word sample was 17ms and the original CD was 117ms.

The acoustic manipulation of the length of the stimulus plosive was based on the one employed by Armosti (2010). As the aim of the manipulations was to produce a series of plosives with various combinations of different VOT and CD values (see table 7.4), the CD of a plosive taken from a single sample of *feta* was extended in such a way that a series of plosives with a range of CD lengths varying from 60ms to 180ms in five 30ms steps was created. Furthermore, the VOT duration was manipulated in a manner similar to the way different values of CD were manipulated acoustically; that is, a series of plosives with different VOT values (10ms, 30ms, 50ms, 70ms, 90ms and 110ms) was created. In order to do that, the whole of the VOT in the base word was replaced with the VOT which was extracted from one instance of *feta* pronounced in CG by the same subject. The length of the pasted VOT was reduced or increased in order to produce a VOT continuum from 10ms to 110ms with 20ms steps. Following the practice of Armosti (2010), the burst was not subject to any manipulations. The decision not to use a VOT portion from a

singleton plosive was taken after pilot manipulations revealed that continua manipulated from VOT coming from singleton plosives had very high intensity and therefore sounded very unnatural when they were extended to create geminate like VOTs.

Table 7.2 Pooled results for the mean length of CD, VOT and the whole plosive (VOT+CD) in the word *feta* pronounced using SMG and CG (all values given in milliseconds).

	Mean	Min.	Max.
CD (SMG)	107.5	70	159
CD (CG)	137	92	202
VOT (SMG)	22.93	11	57
VOT (CG)	59.47	18	124
VOT+CD (SMG)	130.35	90	202
VOT+CD (CG)	196.86	112	296

The values in the continua were based on the values of CD, VOT and the whole plosive produced by the subjects when uttering *feta* and *vata* (see table 7.2 and 7.3). Hence, as the shortest CD for a singleton plosive was 70ms in *feta* and 48ms in *vata* it was decided that the shortest CD value of the perceptual stimuli would be as close to the shortest true singleton CD (48ms) as possible. However, since 50ms CD seemed to sound unnatural, which was confirmed by a native speaker of CG, it was decided that the shortest CD value would be 60ms. It is likely that the 50ms VOT sounded unnatural because of the length of the vowels surrounding it. It is likely that the length of the shortest CD in a singleton plosive (48ms) was a result of the rate at which the sound was pronounced. Furthermore, even though the longest CD for a geminate plosive (in *feta*) was 202ms, it was decided that the longest CD value would be only 180ms, as values longer than that seemed to make the plosive sound unnatural. This effect also might have been due to the length of the surrounding vowels. Nevertheless, as the longest true singleton (in *vata*; 138ms) was much shorter than 180ms, and the mean CD of true singleton plosives was 94.06ms, it was decided that the difference was large enough.

Since Armosti's research (2010) on CG plosives suggested that singleton and geminate plosives also differ with respect to the intensity of aspiration, the VOT continuum was synthesised from a VOT portion coming from only one instance of *feta* in order to ensure that the intensity of VOT in all resulting samples was the same.

Table 7.3 Pooled results for the mean length of CD, VOT and the whole plosive (VOT+CD) in the word *vata* (all values given in milliseconds).

	Mean	Min.	Max.
CD	94	48	138
VOT	22	4	120
VOT+CD	116	64	230

Table 7.4 Combinations of VOT and CD values and the duration of whole generated plosives (the latter in the shaded slots).

	10ms (VOT)	30ms (VOT)	50ms (VOT)	70ms (VOT)	90ms (VOT)	110ms (VOT)
60ms (CD)	70ms	90ms	110ms	130ms	150ms	170ms
90ms (CD)	100ms	120ms	140ms	160ms	180ms	200ms
120ms (CD)	130ms	150ms	170ms	190ms	210ms	230ms
150ms (CD)	160ms	180ms	200ms	220ms	240ms	260ms
180ms (CD)	190ms	210ms	230ms	250ms	270ms	290ms

Table 7.5 The values of intensity of synthesised samples of VOT before normalisation.

VOT (ms)	Before normalisation (in dB)
10	47
30	46
50	45
70	45
90	44
110	44

After all the samples had been created, the mean intensity of VOT in every sample was measured and, as there were still differences in values between samples (see table 7.5), the intensity of each VOT sample was normalised using Praat. In order to manipulate intensity, VOT was isolated from every word sample and manipulated by means of 'Manipulate > Scale intensity' function in Praat.

In every sample of manipulated VOT the 'New average intensity', which had to be entered in Praat at the time of manipulation, was equal to 45dB. As a result of the normalisation of the intensity of VOT, the intensity of each VOT portion was measured, and it was verified that it was equal to 45dB in each stimulus. 45dB seemed an appropriate intermediate value to choose, since the intensity values of synthesised VOT samples ranged from 47dB to 44. It was felt that if the value had been closer to 44dB, it would have been too low and therefore too unnatural in stimuli with 10ms or 30ms VOT, and if the value had been closer to 47dB, it would have been too high and too unnatural for the stimuli with 90ms or 110ms VOT. After the manipulation was carried out, each portion of VOT was pasted back into its respective word and the intensity was measured again.

To sum up, samples of *feta* with sixteen combinations of different VOT and CD values in word-medial position were created.

7.2   Methods used in perceptual tests

The data collected in this part of the study were meant to answer a series of questions pertaining to the factors influencing the perception of the boundary between singleton and geminate plosives. Therefore, as the potential influence of several factors needed to be analysed, a number of data collection techniques had to be employed at this stage. Accordingly, apart from a perceptual test, a background data questionnaire, affiliation questionnaire and a production test were administered to subjects taking part in this stage of the study. Since one of the questions asked in this study was whether perception of the singleton-geminate boundary is influenced by the exposure of the listeners to a concept associated with Greek or Greek Cypriot culture, the data of the study were collected in two very similar perceptual experiments. The two experiments, which are described in section 7.2.2 in detail, differed in only one element: in experiment 1 the listeners were not exposed to any element associated with any of the two cultures, whereas in experiment 2 the listeners were divided into two groups. Listeners belonging to one of the groups were exposed to the Greek flag, while listeners from the other group were exposed to the Greek Cypriot flag.

7.2.1   The study participants (listeners)

Most listeners were recruited the same way as the speakers were (see section 7.1.2). Since the researcher could collect data only from volunteers, it was not possible to ensure that the sample included an equal number of participants with a certain ID score or SOCIO index. The way the ID score and SOCIO index were calculated is presented in sections 6.6.2 and 6.6.1 respectively.

Getting an equal number of listeners from rural and urban areas was also highly problematic, and as a result, the majority of participants were from urban areas. Several listeners were encouraged to take part in the study by the researcher's acquaintances or by other study participants.

Table 7.6 Demographics of listeners taking part in experiment 1.

	All listeners	Female listeners	Male listeners
Age (mean)	21.80	20.72	22.88
ID score (mean)	3.27	3.4	3.1
SOCIO (mean)	21.3	21.6	21

The participants in experiment 1 of this study were thirty-six students at the University of Nicosia (eighteen male, eighteen female). Three participants, who were recruited by the researcher's acquaintances and other study participants, were not University of Nicosia students. The average age was 21.8 years old (min eighteen and max thirty). The average age for female participants was 20.7, whereas for male participants it was 22.9 years old. Their socio-economic background indexes ranged from sixteen to twenty-five (average 21.3). The average socio-economic index for male listeners (21.0) was slightly lower than for female listeners (21.6). The Mann-Whitney U test and the t-test revealed that the difference between those two averages was not statistically significant. The minimum ID score was 1.43 whereas the maximum was 4.625 (average 3.27). The average ID for women (3.4) was slightly higher than the mean ID for men (3.1), making female listeners more Cyprus-affiliated on average. Results of the t-test and the Mann-Whitney U test suggest that the difference was not statistically significant. Seven of participants came from a rural background and twenty-nine were from urban localities.

As can be seen from figures 7.4 and 7.5, the listeners who took part in experiment 1 had a wide range of SOCIO indexes and fairly well-spread ID scores. Although in the case of ID score the majority of listeners appeared to have their ID scores in the range between 3.00 and 3.99, it seems that the fact that there were several cases of Greece-oriented listeners and that there were a few for whom the ID was higher than 4.00, allowed the ID score to be treated as a continuous independent variable in this study. Treating ID as a continuous variable instead of a binary one facilitated an analysis of how different degrees in affiliation with both cultures (Greek and Cypriot) affected the perception of the geminate-singleton boundary.
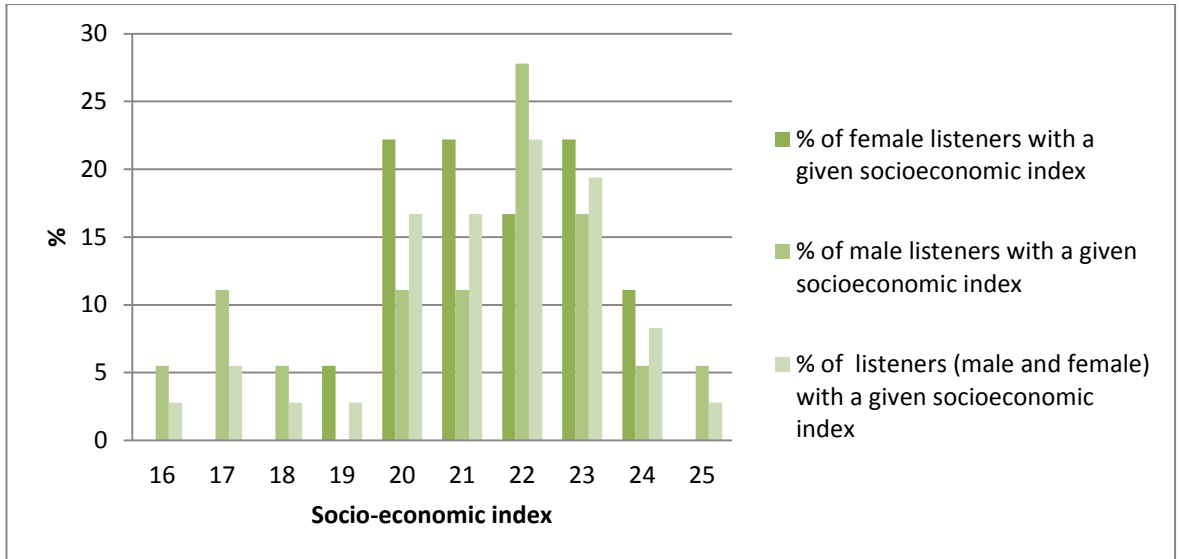
Figure 7.4 Distribution of socio-economic index across the listeners in experiment 1. 16 was the lowest socio-economic background reported by the study participants, 25 was the highest socio-economic background reported by the study participants.
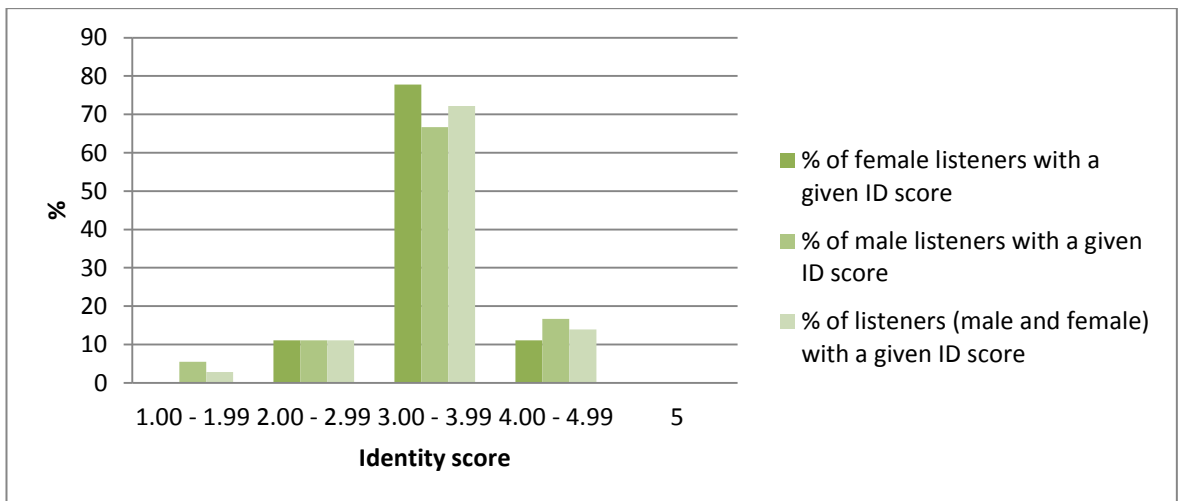
Figure 7.5 Distribution of identity score across the listeners in experiment 1 (1.00 – affiliated with Greece; 5.00 affiliated with Cyprus).

Since in experiment 2 the listeners were divided into two groups, the social background (demographics) of these two groups is discussed separately in this section. Even though the way the study participants were recruited hindered recruiting individuals with the desired socio-economic background and affiliation, some study participant selection was used at the time the experiment with flags (experiment 2) was carried out. Also, since some of the participants who took part in experiment 2 had taken part in either the evaluation study and/or in experiment 1, their ID score and SOCIO index had already been calculated, which facilitated decisions regarding which flag each of them had to be exposed to in order to have a fairly similar sample of participants in terms of SOCIO index and ID score in both conditions (with the Greek and with the

Cypriot flag). This procedure helped to complete two samples with similar average ID score and SOCIO index (see table 7.7) although the values of SOCIO index seems to be slightly lower in the group exposed to the Cypriot flag.

In order to verify whether the difference between the average ID score for all listeners in each group was statistically significant, a t-test and a Mann-Whitney U test were carried out. In the t-test the p was equal to .011 and in Mann-Whitney U test it was .022. Additionally, figures 7.8 and 7.9 illustrate what the percentages were of listeners with various ID scores in both groups. Even though the ID score of the majority of listeners fell into the range between 3.00 and 3.99, in both groups there were several listeners who had different ID scores (beyond the 3.00-3.99 range). Thus, just as in the case of experiment 1, in experiment 2 the ID score may be treated as a continuous variable.

The difference between male and female speakers' SOCIO was found not to be statistically significant according to a t-test and Mann-Whitney U test. The summary of the spread of SOCIO in both groups presented in figures 7.6 and 7.7 show that there was enough variety in the values of SOCIO so that the values could be treated as continuous independent variables in statistical tests.

Finally, listeners exposed to the Greek Cypriot flag were on the whole older than listeners exposed to the Greek flag. Also, within both groups male listeners were older than the female ones.

Table 7.7 Demographics of listeners taking part in experiment 2.

		ID score (average)	SOCIO (average)	Age (average)
Listeners exposed to the Greek flag	Female listeners	3.46	21.6	20.6
	Male listeners	2.74	21.5	22.42
	All listeners	3.17	21.55	21.35
Listeners exposed to the Cypriot flag	Female listeners	3.43	20.8	23.2
	Male listeners	2.77	20	24.4
	All listeners	3.12	20.45	23.57
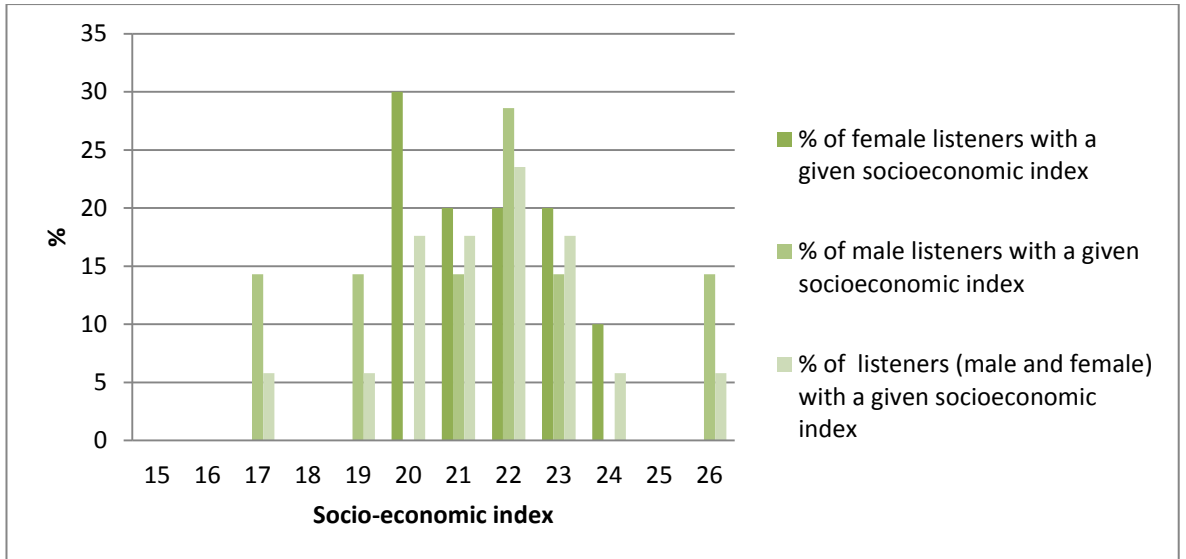
Figure 7.6 Distribution of socio-economic index across the listeners exposed to the Greek flag in experiment 2. 17 was the lowest socio-economic background reported by the study participants; 26 was the highest socio-economic background reported by the study participants.
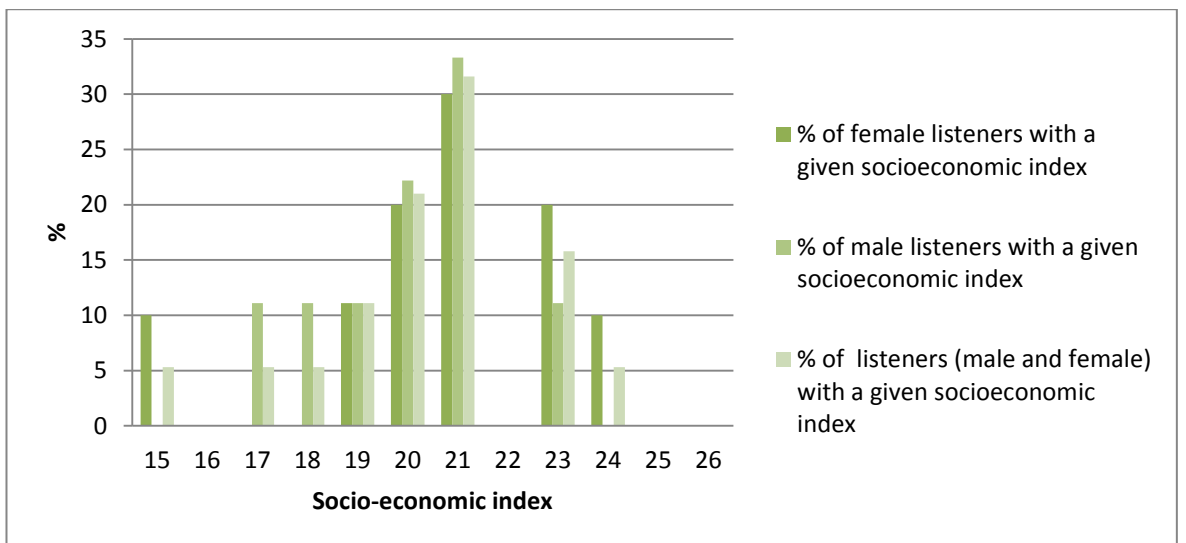
Figure 7.7 Distribution of socio-economic index across the listeners exposed to the Greek Cypriot flag in experiment 2. 15 was the lowest socio-economic background reported by the study participants; 24 was the highest socio-economic background reported by the study participants.
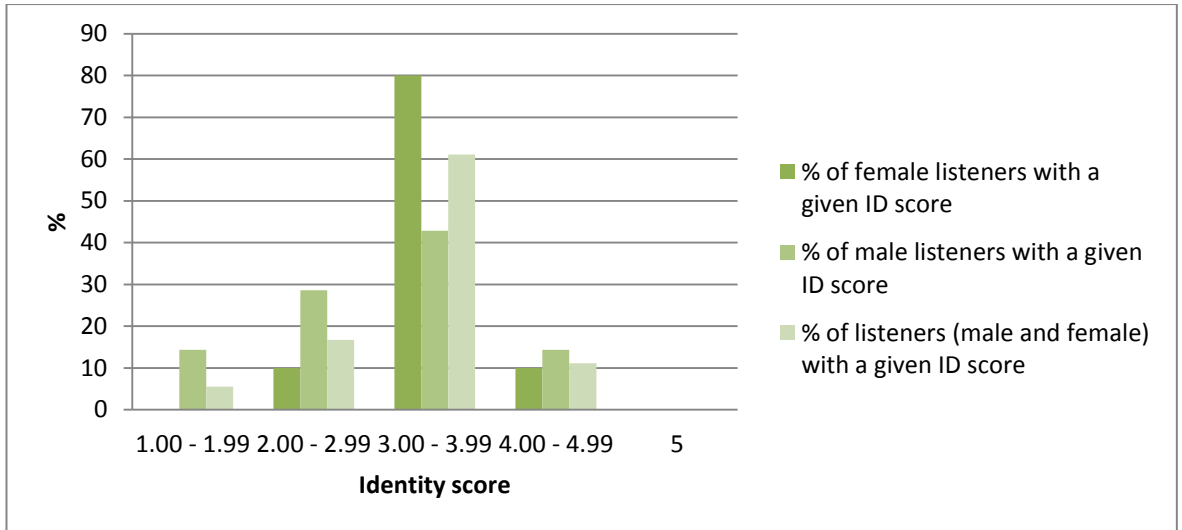
Figure 7.8 Distribution of identity score across the listeners exposed to the Greek flag in experiment 2 (1.00 – affiliated with Greece; 5.00 affiliated with Cyprus).
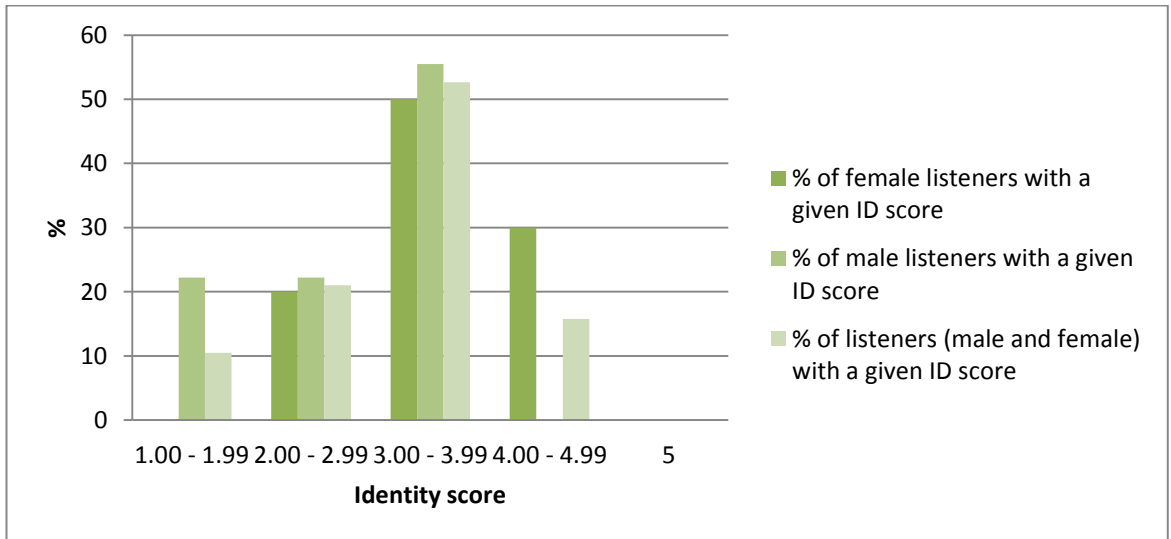
Figure 7.9 Distribution of identity score across the listeners exposed to the Greek Cypriot flag in experiment 2 (1.00 – affiliated with Greece; 5.00 affiliated with Cyprus).

Unfortunately, it was extremely difficult to collect data from two groups of speakers with more similar ages and values of SOCIO index and ID score due to the method that was employed to recruit the listeners. As only volunteers took part in both experiments, it was not possible to choose participants with a desired SOCIO index or ID score as the data necessary for calculation of both figures was collected in the same meeting during which the perceptual test was administered.

7.2.2 Perceptual experiments 1 and 2: the procedure

At the beginning, the subjects were asked to fill in a background data questionnaire (see Appendix 1), which was previously described in section 6.6.1. Collection of the background data was decided to be the first part of the study as it could a serve as an ice breaker before the perceptual tests.

The listeners were asked to take part in a forced choice task in which for each speech sample they heard they were asked to specify whether it contained a singleton or a geminate plosive. More specifically, any time they heard a sample of speech (the word *feta*), they were asked to indicate whether they heard T or TT. Such a method seemed sensible as previous research and observations suggest that Greek Cypriots are aware of the existence of geminate plosives in their speech and they frequently refer to them as 'double sounds' or, for instance, 'double Ps', 'double Ts', etc. (Alexander 2008a).

The experiment was designed and run using a Praat script that facilitated playing a sequence of previously prepared stimuli and recording the way listeners labelled those sounds. The experiment was administered using a laptop computer with plugged headphones. At the beginning of the experiment the participants were presented with a short introduction to the experiment displayed on the computer screen (see Appendix 11). After getting acquainted with the instructions, the participants were asked to click the screen to start the test. Upon hearing a speech sample, a study participant had to press one of two rectangles visible in the computer screen (Appendix 11). One of these rectangles was labelled 'φέτα', the other 'φέττα', as 'φέττα' is another spelling of 'φέτα' which is widely used in Cyprus. After clicking the chosen answer there was 1.8s silence and then another token was played to the listener. All the thirty previously-prepared tokens (see Table 7.4 section 7.1.5) were presented randomly, each of them four times to each listener, which means that every listener had to categorise 120 tokens. In this way, in experiment 1, 4320 tokens were categorised altogether whereas in experiment 2 the listeners classified 4320 tokens in total. There were three short breaks every thirty tokens.

Upon completing the perceptual test, each participant was asked to fill in a short questionnaire (see Appendix 4) which elicited data pertaining to their degree of affiliation with Greek and/or Greek Cypriot culture. The questionnaire is described in section 6.6.2.

7.2.3 Reading task: the procedure

After completing the affiliation questionnaire, each subject was recorded while reading the list of words mentioned in section 7.1.1. The procedure employed during this recording session was the same as the one described in section 7.1.3. The only difference, however, would be the equipment used to record the study participants: as the samples were not going to be used in perceptual tests, the recordings were not made in a sound-treated booth. The values of VOT and CD in *feta* and *vata* recorded in this experiment were used as independent variables in logistic regression models described further in sections 7.4, 7.5 and 7.6.

7.2.4 Ethical issues

Each of the study participants was presented with an information sheet and asked to sign the consent form (see Appendix 7 and Appendix 8) before taking part in the experiment. The study participants were informed of what the experiment would involve, their anonymity, and the right to withdraw at any stage of the experiment. The consent form and information sheet, as is the case with all the other materials used in the experiments, were written in Greek. The study was approved by the Lancaster University Ethics Committee in September 2011.

7.2.5 Normalisation of CD and VOT values

While making the recordings described in section 7.2.3, the study participants tended to read the lists of words at different speeds. The speed of reading not only differed from speaker to speaker, but some of study participants read more slowly when using SMG and faster when using CG. Since Arvaniti (2001b) and Botinis et al. (2004) have reported that the pace of speech may influence the value of CD and VOT, attempts were made to reduce the possible effect of speech rate on the values of CD and VOT. For this reason, the following way of data normalisation was employed.

The method for normalisation of consonant length value was inspired by the option to modify the length of recordings by means of Praat. The normalisation could be carried out by (1) acoustic manipulation of a recording or by (2) calculations. In this study the second method was used.

The method aimed to choose the same section in each occurrence of [feta] and [fet:ʰa] and to multiply its length in a way that in the end, each of the chosen samples of the chosen section had exactly the same length, that is, as if all the occurrences of the word ([ˈfeta] and [ˈfet:ʰa]) were pronounced with exactly the same speed. The final length of the chosen section of [ˈfeta] was different from the final duration of the chosen section of [ˈfet:ʰa].

First of all, a choice had to be made as to which section of the word had to undergo the manipulation of its duration. It was decided that the desired portion of each word would be [et(:^{h})], measured from the onset of [e] to the onset of [a]; where the onset of each of the vowels was counted from the beginning of the vibration of vocal folds. There were two reasons for this decision. First, although the recordings were made in a fairly quiet room, there was still some background noise in many of the recordings, which made it extremely difficult to identify the beginning of [f] in some of the samples. Also, as the list of words which was read by the study subjects had fifteen lines, it was observed that if the target word was at the end of the line, its final vowel may have been devoiced, slightly shortened or elided.

Knowing the individual length of (1) [et(:^{h})] in every instance of [feta] and [fet:^{h}a] and (2) the average lengths of [et(:^{h})] in all instances of [feta] and [fet:^{h}a] pronounced by all perceptual study participants allowed the calculation of the degree to which every individual sample of [et] or [et:^{h}] was longer or shorter than the average [et] or [et:^{h}] respectively. This degree of difference in length was calculated using the following formula (1):

(1) **A = (XXxETx100)/AET**

where A is the degree of difference in length between an individual token of [et(:^{h})] and the group average length of [et(:^{h})] expressed in percentages, AET is the average length of [et] or [et:^{h}] for all perceptual study participants, and XXxET is an 'x' instance of [et/] or [et:^{h}] uttered by speaker XX. Note that if 'A' is calculated for a target word uttered in SMG, XXxET will be the average length of [et] for all perceptual study participants and XXxET will be an 'x' instance of [et] or uttered by speaker XX. If 'A' is calculated for a word uttered in CG, XXxET will be the average length of [et:^{h}] for all perceptual study participants and XXxET will be an 'x' instance of [et:^{h}] or uttered by speaker XX. Thus we could even refer to A$_{SMG}$ and A$_{CG}$.

It is assumed here that, for example, if A=115 (i.e. XXxET is 15% longer than AET), then the word containing XXxET would need to be evenly reduced in length by 15% for XXxET to be equal to AET. It is also assumed that in such a situation the VOT and CD of the [t(:^{h})] which is a part of XXxET would both therefore be reduced by 15%. Following this logic, it is possible to normalise the length of VOT embedded in XXxET by means of formula (2):

(2) **XXxVOT1 = (XXxVOTx100)/A**

where XXxVOT is an 'x' instance of VOT uttered by an XX speaker and XXxVOT1 is the length of normalised VOT uttered by an XX speaker in an x token of [fet(:^{h})a].

In the same manner, CD embedded in XXxET can be calculated using formula 3:

(3) **XXxCD1= (XXxCDx100)/A**

where XXxCD is an 'x' instance of CD uttered by an XX speaker and XXxCD1 is the length of normalised VOT uttered by and XX speaker in an x sample of [fet(:^{h})a].

As a result, it was possible to calculate the mean length of normalised VOT and CD for each speaker and accent separately. The mean values were then used in statistical tests.

Using the three formulas described above, the VOT and CD values were normalised for each speaker and accent separately in order to establish whether they influence the way listeners perceive the singleton/geminate boundary.

7.3   Perceptual experiments 1 and 2: method of data analysis

In order to ascertain what variables are likely to influence the perception of plosive length by the listeners, logistic regression tests were run on the data collected in experiment 1, experiment 2 and experiments 1 and 2 combined. Logistic regression permits one to establish if it is possible to predict dependent variables, which are dichotomous variables, on the basis of independent variables (predictors) which may be continuous or dichotomous (Brace, Kemp & Snelgar 2006; Brase & Brase 2003; Field 2000). Logistic regression tests allow one to build a statistical model and establish its strength, that is, specify the extent to which independent variables (predictors) included in the model may predict the values of the dependent variables in the model (Brase & Brase 2003; Field 2000).

The tests were run by means of the SPSS statistical package. A series of different models were generated as attempts were made to explain what independent variables were significant predictors in various conditions for instance by gender, by place of residence (rural versus urban), by affiliation (Cyprus-oriented versus Greece-oriented).

The dependent variables were listeners' responses to the speech samples heard in perceptual tests, which were either 'tt' (i.e. [t:^{h}]) or 't' ([t]). Independent variables were place of residence (RES), ID score (ID), socio-economic index (SOCIO) and gender of each listener (GEN). Values of CD and VOT of the speech samples played in the experiment were also entered as independent variables; however, in several models instead of using these values, the length of the whole plosive (PLOS) included in the stimuli was entered. This was done to investigate whether the listeners relied more on the length of the whole plosive as a perceptual cue or on CD and VOT separately. As one of the aims of this research was to see whether the way listeners pronounce [t]

and [tːʰ] influenced their perception, the length of VOT and CD produced by the listeners were also treated as independent variables. For this reason, three types of VOT and CD were taken into consideration. These were (1) VOT and CD produced when the listeners uttered *feta* using CG (these will be referred to as CYCD and CYVOT respectively from now on); (2) VOT and CD produced when the listeners uttered *feta* using SMG (GRVOT and GRCD respectively); (3) VOT and CD produced when the listeners uttered *vata* in SMG (VTVOT and VTCD respectively). The (2) and (3) values both were supposed to be values of singleton [t]. Nevertheless, it was suspected that when the participants pronounced *feta* in SMG they might not have been able to successfully avoid using gemination and might have pronounced [t] differently than they would normally pronounce [t] in other words which are pronounced only with a [t] in both accents. For that reason it was decided that the VTCD and VTVOT values would also be included in the analysis. In models in which GRVOT and GRCD were entered, VTCD and VTVOT were not included in the analysis, whereas in models in which VTCD and VTVOT were independent variables, GRVOT and GRCD were not entered. Such a decision was taken in order to avoid colinearity. In fact, when all the four values were entered at the same time, two of them (GRCD and GRVOT or VTCD and VTVOT) were not included in the model by the statistical software. Additionally, in some models the values of the whole plosives instead of the values of VOT and CD produced by the listeners were entered. Thus in some models instead of GRVOT and GRCD, GRPLOS was used, CYPLOS replaced CYVOT and CYCD, and VTPLOS was entered in place of VTCD and VTVOT. In models with GRPLOS, VTPLOS was not entered and vice versa. All the values of CD and VOT were normalised; also, all the values of the whole plosives were normalised as described in section 7.2.5. All the models in which VTVOT, VTCD and VTPLOS were entered instead of GRVOT, GRCD and GRPLOS have the '(vt)' label appearing next to the name of the model.

To fit each model, all desired independent variables were initially entered into the model. Upon obtaining the results, each of the variables that did not have statistical significance (that is, its p was higher than .05) was successively removed from the model up to a point when a statistically significant model with only statistically significant independent variables was obtained.

Logistic regression models were fitted to three data sets. These include data from (1) experiment 1, (2) experiment 2 and (3) experiments 1 and 2 combined. There were several reasons for the inclusion of the three sets and the presentation of multiple models fitted to all the sets of data.

First of all, since the presence of the two flags is a dichotomous variable in experiment 2 (if one was present then the other was absent), then any time the results of logistic regression models fitted to data from experiment 2 indicated that one flag affected the listeners in a certain way, the

same results suggested that the other flag had the opposite effect. In such a situation it was unclear whether indeed both flags affected the listeners, and if not, which of the flags really did have an impact on perception, and which result was only an outcome of the binary character of the variable. In order to establish which of the two flags affected perception of the boundary, several logistic regression models were fitted to combined data from experiments 1 and 2. This solution introduced another condition, that is, NO FLAG, and therefore, guaranteed that if the presence of any of the flag turned out to be a significant predictor, it was not a result of a dichotomous character of the variable.

Also, fitting logistic regression models to combined data from both experiments turned out to be useful in the analysis of trends followed by groups of listeners which were underrepresented. These groups comprise Greece-oriented listeners (experiment 1 – five participants, experiment 2 - ten participants) and village listeners (experiment 1 - seven participants, experiment 2 - eight participants). Even though it was not one of the primary goals of this research, since relevant data were available, I sought to explain whether trends in perception differ between Greece- and Cyprus-oriented listeners and listeners from rural and urban areas. Even though these analyses yielded some very interesting results (see sections 7.4.2, 7.5.3, 7.4.4 and 7.5.5), the low number of village and Greece-oriented listeners made some of them appear less reliable. Using the pooled data from both experiments facilitated obtaining slightly more reliable data. Even though the weakness of this approach could be that in the combined data set some of the listeners were exposed to flags and some were not, the analysis of such data (and the scarce data from two separate experiments 1 and 2) produced some interesting results which give an indication of which issues concerning perception of the boundary seem to need further exploration (see section 8.2.4).

Including some of the multiple models in the data analysis provided additional evidence supporting one of the final and most important conclusions in this thesis. The evidence was obtained from models fitted to data from village residents from both experiments combined and was used to support the argument that listeners' linguistic security could influence their sound perception (see section 7.7.3 and 8.2.4).

Fitting various models to the combined data set also revealed that some of the independent variables entered into logistic regression models affected listeners in the three data sets and their subsets in various ways which were not always consistent. Some examples could be the way ID score affected the perception by female listeners (sections 7.4.3, 7.5.4 and 7.6.2) or how SOCIO index affected urban listeners (sections 7.4.4, 7.5.5 and 7.6.4) from the three different data sets.

It was felt that it was necessary to report all of the outcomes, regardless of whether they were predictable or not, in order to provide the reader with the whole set of observed patterns. It was also perceived that not revealing the data could be a case of unethical conduct.

Sections 7.4 and 7.5 demonstrate detailed results of logistic regression test on experiment 1 and experiment 2 respectively. A thorough presentation of logistic regression models fitted to pooled data from experiments 1 and 2 is included in section 7.6. A general summary and discussion of the most important findings from the three data sets are presented in section 7.7.

7.4   Experiment 1: results and discussion

7.4.1   Overall results

In the experiment thirty-six listeners categorised 120 tokens each, which amounted to the total of 4320 categorised tokens. Each of the thirty tokens was evaluated 144 times. As can be seen from the table 7.8, 39.5% of the played tokens were classified as singletons, whereas 60.5% were classified as geminates. Table 7.9 summarises the way tokens with different CD and VOT values were evaluated. It can be observed that, in general, the percentage of tokens classified as geminates rose with the values of CD and VOT. Additionally, ratios of tokens categorised as singletons and geminates by each listener are presented in Appendix 12.

Table 7.8 Number and percentage of tokens labelled as singletons and geminates in experiment 1.

Tokens labelled as [t]	Tokens labelled as [t:^{h}]	Total
1705	2615	4320
39.5%	60.5%	100%

Table 7.9 Percentages of tokens with different VOT and CD values perceived as geminates in experiment 1. The values are given in percentages. N = 144 per token.

VOT CD	10ms	30ms	50ms	70ms	90ms	110ms
60ms	2.8	2.1	29.2	69.4	84.0	84.7
90ms	2.1	6.9	41.7	84.7	97.2	95.8
120ms	0.7	9.7	78.5	95.1	96.5	100
150ms	4.2	22.2	86.8	97.9	97.9	96.5
180ms	4.2	36.8	93.1	98.6	98.6	97.9

Table 7.10 summarises models 1af – 1bv which were fitted to all data collected in experiment 1. According to the Omnibus test, which establishes the effectiveness of a regression model, all of these models significantly predicted the listeners' responses. Models 1av and 1bv are equivalents of models 1af and 2bf with the only difference that the former were fitted with values of singleton plosives that came from *vata*, whereas the latter were fitted with values obtained from *feta*. The sign '/' signifies that a given variable turned out not to be a statistically significant predictor. The sign is used to indicate the lack of statistical significance in all models presented in this chapter.

Table 7.10 Models fitted to all data collected in experiment 1.

Model		1af	1bf	1av (vt)	1bv (vt)
N		4200	4200	4200	4200
Omnibus tests	Chi Square	3211.09	3210.74	3217.66	3210.99
	Df	4	5	6	5
	Sig.	.000	.000	.000	.000
% of correctly predicted responses	[t]	87.0	87.2	87.3	86.5
	[t:ʰ]	91.5	91.5	91.4	91.0
	Total	89.7	89.8	89.8	89.2
% of variance predicted in responses (Cox & Snall R Square - Nagelkerke R Square)		53.4-72.3	53.4 -72.3	53.5 – 72.4	53.4 – 72.3
Significance of the independent variables					
Entered variables	VOT	.000 +	.000 +	.000 +	.000 +
	CD	.000 +	.000 +	.000 +	.000 +
	ID	/	/	.018 -	/
	RES	/	.006 +	.001+	.001+
	GRCD	.002 -	/	/	/
	CYCD	.016 -	/	.000 -	/
	VTCD	/	/	.030 +	/
	GRPLOS	/	.048 -	/	/
	CYPLOS	/	.008 -	/	.000 -
	VTPLOS	/	/	/	.041+

Model 1af can predict correctly 89.9% of listeners' overall responses and accounts for 53.4% - 72.3% of variance in responses as indicated by Cox & Snall R Square and Nagelkerke R Square statistics[2]. Model 1bf predicts 89.7% overall responses and accounts for 53.4% -72.2% of variance

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[2] In logistic regression, Cox & Snall R Square and Nagelkerke R Square values are reported instead of R[2] which cannot be computed in logistic regression.

in listeners' responses. It seems that even though 1af GRCD and CYCD and 1bf GRPLOS and CYPLOS turned out to be significant, the model in which values of VOT and CD produced by the listeners were entered instead of values of the whole plosives uttered by the same participants turned out to be more successful in predicting listeners' responses. The same could be observed in models 1av and 1bv.

As described in table 7.10, only some of the entered independent variables turned out to have a significant effect on the responses. VOT and CD were significant predictors in all four models (p<.0005), and the B coefficient values[3], which were positive, indicated that the longer the VOT and CD in the stimulus, the more likely the listeners were to classify the stimulus as a geminate. This result is in line with those reported by Armosti (2010) who stated that in his study an increase in the values of VOT and CD increased the likelihood of a plosive to be perceived as a geminate plosive.

Only some of the values of parts of plosives produced by the listeners influenced their perception of the boundary, and only some of the values had an influence, which was in line with previously made hypotheses (hypotheses I and II) regarding the way the values would influence the perception of the boundary.

According to the B coefficient values, the way in which VTCD, GRCD and CYCD influenced the results in models 1af – 1bv (table 7.10) was not the same. The positive value of B coefficients in VTCD indicates that as the values of VTCD grew, the chances of a stimulus to be labelled as a geminate rose too. The way that the VTCD values influenced the listeners' responses did not support the researcher's initial hypothesis (hypothesis II) about the way the values of VTCD would influence the way listeners perceive the boundary. However, as predicted, an increase in values of GRCD and CYCD meant a drop in the likelihood that a stimulus is perceived as a geminate. This trend is demonstrated by the positive value of the relevant B coefficients. GRPLOS, VTPLOS and CYPLOS were also significant, but the p value was higher for GRPLOS and VTPLOS than for CYPLOS, which might indicate weaker significance of the influence of GRPOLS and VTPLOS on the way

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[3] The value of B coefficient (positive or negative) is provided for each tested independent variable; if the coefficient has a positive value, the increase in the value of the independent variable will increase the odds of the expected result and vice versa. For example, in this study a positive coefficient computed for VOT and CD values indicates that the increase in values of the variables increases the odds of a token being perceived as a geminate. The value of B coefficient (positive or negative) for each independent variable is given right after the p value in each table presenting logistic regression models by means of '+' and '-' signs. In the remaining parts of this thesis the labels 'B coefficient (values)' and '(positive/negative) B statistic' will refer to the positive or negative sign of B coefficient.

listeners perceived the stimuli. Increase in the length of GRPLOS and CYPLOS reduced the likelihood of plosives being heard as geminates. These results were in line with the previously made predictions. Similarly to the results for VTCD, the B coefficient for VTPLOS did not support the hypotheses about the influence of singleton plosives produced by the listeners on their perception of the singleton/geminate boundary.

The discrepancy between the results for GRCD and VTCD as well as GRPLOS and VTPLOS appears intriguing. Such a difference in results might suggest that perception does not only depend on the length of [t] and its components (CD and VOT), but also on the lexical item in which the [t] is embedded. Here, the result was more predictable and more significant in case of the values of CD in a lexical item which would normally be produced as a geminate and as a singleton only when a speaker attempts to use SMG. It might also be inferred that there could be two types of [t] produced by Cypriots; those which are always produced as singletons and those that are produced as singletons when speakers use SMG. In fact, a t-test and a Mann-Whitney U test comparing the mean length of normalised plosives pronounced in *vata* and *feta* (using SMG) indicated that the mean length of [t] produced in *vata* was statistically shorter than the mean duration of [t] embedded in *feta* pronounced (p <.0005 in t-test and Mann-Whitney U test comparing CD mean values; p < .0005 in t-test and p=.001 in Mann-Whitney U test comparing VOT values). Also, standard deviations were higher for GRCD and GRVOT than for VTCD and VTVOT, which might suggest that the speakers may have lacked control over the length of CD and VOT they produced when attempting to suppress gemination in *feta*.

VOT values produced by the listeners in all the three contexts did not turn out to be significant in any of the models presented in table 7.10. Such an outcome might indicate that VOT is not as important an acoustic cue for the listeners as CD appears to be. Such a result might be supported by earlier claims by Arvaniti and Tserdanelis (2000). Yet, results presented later in this chapter, which refer to the influence VOT and CD produced by the listeners have on their perception, do not always seem to support this claim.

A positive value of B coefficient in RES means that residents of urban areas were more likely to classify heard sounds as geminates than residents of villages did. A negative B statistic stands for the opposite trend. This is true for all B coefficient values for RES in chapter 7. RES was not significant only in model 1af in this set, but in the remaining three models being a resident of urban areas increased the likelihood of perceiving the stimuli as geminates. This result seems to suggest that people from urban areas are more sensitive to small increases of the length of CD and VOT of plosives. Such sensitivity might have been developed through greater exposure to

what is referred to as standard speech, and it appears logical to assume that living in a town or a city offers listeners the opportunity to find themselves in official situations that require the use of, and involves the exposure to, the more formal variety of speech more frequently than would happen if the study participants lived in a village.

The result pertaining to the difference in which city and village citizens perceive the singleton-geminate boundary also appears to be linked to one of the results of the evaluation study discussed in chapter 6. This is that one of the outcomes of the study suggested that the use of geminate plosives is associated with rural background. Even though it is reported (Arvaniti 2006) that [t:ʰ] is used all over Cyprus, it might be possible that in villages it is used more frequently. Therefore, it would be logical to suspect that the listeners in this experiment who reside in rural areas were exposed to singletons in words with non-contrastive geminates less than study participants from towns/cities.

Table 7.11 Models fitted to all data collected in experiment 1

Model		1cf	1df	1cv (vt)	1dv (vt)
N		4200	4200	4200	4200
Omnibus tests	Chi Square	1830.89	1828.28	1828.43	1828.28
	Df	3	3	3	3
	Sig.	.000	.000	.000	.000
% of correctly predicted responses	[t]	68.4	68.7	68.5	68.7
	[t:ʰ]	83.8	83.7	83.5	83.7
	Total	77.6	77.7	77.5	77.7
% of variance predicted in responses (Cox & Snall R Square - Nagelkerke R Square)		35.3 – 47.8	35.3 – 47.7	35.3 – 47.4	35.5 – 47.7
Significance of the independent variables					
Entered variables	PLOS	.000 +	.000 +	.000 +	.000 +
	RES	/	.012 +	.055 +	.012 +
	GRCD	.013 -	/	/	/
	CYCD	.058 -	/	.002 -	/
	GRPLOS	/	/	/	/
	CYPLOS	/	.003 -	/	.003 -
	VTPLOS	/	/	/	/

The ID score was a significant predictor only in 1av. Its B coefficient, which was negative, implied that the more a listener was affiliated with Cyprus, the less likely he/she was to label the stimuli as a geminate. This result resonates with hypothesis III and might mean that for Greece-oriented

listeners, plosives (and their components) need to be shorter to be called singletons than to other listeners who are more affiliated with Cyprus.

Models 1cf – 1dv (see table 7.11) were fitted with the value of duration of the whole plosive included in each stimulus instead of being fitted with VOT and CD values separately. These models, however, were not as strong as models 1af – 1bv since they could correctly predict only lower percentages of listeners' responses, namely between 77.5% and 77.7%. As a comparison, models 1af – 1bv correctly predicted between 89.2% and 89.8% of responses. Such results may be interpreted in a way that the duration of the whole plosive built in the stimuli helps to predict listeners' responses (or perception of the length of the plosive) less precisely than the durations of CD and VOT when analysed separately. This could mean that when processing the speech signal, listeners tend to analyse the two components (CD and VOT) separately and not as the whole unit. Such claims have already been put forward by several linguists who attempted to establish which of the two cues (VOT or CD) is a primary cue for gemination in CG (Armosti 2010; Arvaniti 2010a; Arvaniti & Tserdanelis 2000; Botinis et al. 2004; Christodoulou 2007; Muller 2001). The research by Armosti (2010), in which CD and VOT (or rather aspiration in the case of Armosti's research as he also investigated spectral cues characterising aspiration) were treated as separate values, implied that if treated only as temporal cues, without considering the effect of intensity of aspiration, CD tended to be a stronger cue for gemination; whereas if the intensity of aspiration is taken into consideration, aspiration (VOT and intensity of aspiration combined) appeared to be a slightly stronger cue for gemination.

Furthermore, the fact that PLOS turned out to be a significant predictor in models 1c and 1d may stem from the fact that the duration of PLOS is derived from the durations of VOT and CD. The values of PLOS are somewhat proportional to those of CD and VOT with the exceptions of samples in which extreme values of CD and VOT were combined such as in stimulus c180v10, in which CD is very long and VOT very short, or as in c60v110, which has a very short CD and a very long VOT.

Another issue that may be noticed in models 1cf – 1dv is that some of the variables that were statistically significant predictors in models 1af – 1bv, or in some of them, were not significant in any of the 1cf – 1dv models. Among these variables are ID, VTCD and VTPLOS. However, in the 1af-1bv series, ID was significant only in model 1av with its p =.018. Such results might add evidence to the claim that the models fitted with PLOS instead of VOT and CD are weaker and therefore less efficient.

7.4.2 Results by affiliation

Table 7.12 shows models that reveal which independent variables influenced the perception of the length of the plosives by listeners affiliated with Greece and by listeners affiliated with Cyprus. Although originally the ID score was calculated for each listener in experiment 1, in order to carry out the present analysis all the listeners were divided into two groups. Those listeners whose ID score was below 3.0 were assigned to a 'Greece affiliated' group, while those whose ID score was above 3.0 were classified as 'Cyprus affiliated' group. As in previous analyses, separate models were generated by entering GRCD and GRVOT values (models 1ef and 1ff) and by entering VTCD and VTVOT values (models 1ev – 1gv).

Regardless of listeners' affiliation, CD and VOT were significant predictors in all models. Even within the 'Greece-oriented' category the level of sensitivity to small changes in VOT and CD length drops as the bond with Greece decreases.

Table 7.12 Models fitted to data collected from listeners affiliated with Greece (IDGR) or with Cyprus (IDCY) separately (experiment 1).

Model		1ef IDGR	1ff IDCY	1ev IDGR (vt)	1fv IDGR (vt)	1gv IDCY (vt)
N		600	3120	600	600	3120
Omnibus tests	Chi Square	535.80	2333.00	540.9	540.91	2338.72
	Df	4	6	5	5	7
	Sig.	.000	.000	.000	.000	.000
% of correctly predicted responses	[t]	90.6	85.8	89.8	89.8	86.0
	[t:^{h}]	93.7	90.9	93.2	93.2	91.4
	Total	92.5	88.8	91.8	91.8	89.2
% of variance predicted in responses (Cox & Snall R Square - Nagelkerke R Square)		59.1 -80.0	52.7 – 71.2	59.4 – 80.5	59.4 – 80.5	52.7 – 71.4
Significance of the independent variables						
Entered variables	VOT	.000 +	.000 +	.000 +	.000 +	.000 +
	CD	.000 +	.000 +	.000 +	.000 +	.000 +
	ID	.000 -	.024 +	/	/	.021 +
	GEN	/	.000 -	/	.002 +	/
	SOCIO	.000 +	.000 -	.000 +	.001 +	.000 -
	RES	/	.051 +	/	/	.028 +
	CYCD	/	/	.002 +	/	/
	VTCD	/	/	/	/	.014 +
	VTVOT	/	/	.000 +	.045 +	.000 -

Running separate analyses for Greece- and Cyprus-affiliated listeners revealed how level of affiliation within each of those two groups affected listeners' perception. The tendencies that were discovered were not entirely in concord with those presented in model 1av (table 7.10, section 7.4.1) and therefore did not seem to entirely support hypothesis III that the less affiliated with Greece listeners are, and the less potential exposure to SMG they have, the less likely they are to perceive the stimuli as geminates. Depending on the model, listeners classified as affiliated with Greece either perceived more geminates the more their level of affiliation with Greece was (model 1ef), which was in line with earlier predictions, or did not seem to be affected by the changing level of affiliation with Greece (models 1ev and 1fv). Within the group of listeners classified as Cyprus-oriented, study participants were more likely to label stimuli as geminates the higher their ID score was (so the more they were affiliated with Cyprus). Such a result appears to imply that there may be another factor, other than the amount of exposure to SMG, which might influence the perception of the boundary. However, not only is it difficult to ascertain what this additional factor could be, but such results did not occur in similar/corresponding models fitted to data collected from Cyprus-inclined listeners in experiment 2 (see section 7.5.3).

Although in models in which GRCD and GRVOT data were entered, gender was not significant for the Greece-affiliated group, it was significant for the Cyprus affiliated group. Cyprus-oriented female listeners were less likely to perceive sounds as geminates than Cyprus oriented male listeners were. The results in models fitted with VTCD and VTVOT were different. Here, gender seemed to be a significant predictor only for the Greece oriented listeners (only in model 1fv). In this model, female listeners affiliated with Greece were more likely to perceive stimuli as geminates than male listeners affiliated with Greece were. This trend is indicated by the B coefficient values. In the whole chapter 7, a positive B coefficient for GEN means that women were more likely to classify sounds as geminates than men, and a negative B statistic stands for the opposite trend.

What should be highlighted is that in the group of Cyprus-affiliated listeners men are more likely to perceive sounds as geminates than women are, whereas in the Greece-affiliated group the tendency is the opposite. There are two possible reasons for this result. One of reasons relates to supposed increased sensitivity of women to changes in the acoustic signal which might carry social meaning and the other reason relates to the statistical model that was used in data analysis.

First of all, one of the general trends (model 1av, table 7.10) was that the more they are affiliated with Greece the more likely the listeners are to perceive sounds as geminates, and the more they

are affiliated with Cyprus, the less likely the listeners are to perceive stimuli as geminates. The results for GEN in model 1fv, which fitted to data from Greece oriented listeners, seem to suggest that for female speakers these tendencies are stronger; that is, even though on the whole the more Greek-oriented listeners are (male or female) the more geminates they hear (see models 1av and 1ef), Greek-oriented female listeners lead in labelling heard stimuli as geminates in comparison to Greece-affiliated male listeners. Such an explanation might be reasonable as differences in linguistic practices between men and women have already been reported. Eckert (1989) and Labov (1990) draw attention to how female speakers choose different forms of language when speaking and how those choices could depend on their sensitivity to symbols and their need to use symbols to secure their position in the society. Although these discussions by Eckert (1989) and Labov (1990) relate to how women speak, it seems sound to assume that female inclination to pay attention to symbols and prestige might also increase their perceptual sensitivity to prestige-linked nuances of phonetic signal.

Several perceptual studies have already drawn attention to differences between men and women in sound perception and suggested that women might possess increased sensitivity to social information in speech. These studies include Hay et al. (2006a), Hay and Drager (2010), Nygaard and Queen (2000), Namy et al. (2002) and Yozenawa Morris (2010).

Yozenawa Morris (2010) reports that in a perceptual study in which the perception of devoiced and nondevoiced vowels by residents of Tokyo and Kinki was analysed, female listeners tended to give more expected responses than male listeners did. Yozenawa Morris' (2010) interpretation of this result suggested that female listeners may be in possession of more acute sensitivity to presence and absence of voicing in vowels. Namy, Nygaard and Sauerteig (2002) observed a similar tendency among women in their accommodation study in which they asked a group of male and female listeners (shadowers) to repeat the words uttered by female and male speakers. Then, another group of male and female listeners was asked to evaluate whether shadowers accommodated to the speakers. They established that in general, female listeners accommodated more to the speakers than male listeners did. Furthermore, male listeners were more likely to accommodate to speech by male speakers whereas women accommodated more to the speech by women speakers. While interpreting the observed male and female linguistic behaviour, Namy et al. (2002) refer to and comment on the results of an experiment carried out by Nygaard and Queen (2000 cited in Namy et al. 2002) which suggested that whereas women seem to accommodate well to male and female voices, men appeared to accommodate well only to male voices. Namy et al. (2002) speculate that such dissimilarities in behaviour of male and female

participants in both studies might be rooted in the kind of rearing that women receive which puts an emphasis on attention to social detail and prestige. Such upbringing/nurturing in turn might result in the development of female sensitivity to social detail in speech or in their zealous attitude in the performance of various tasks.

Another study that suggests that female listeners might be more sensitive to social detail was carried out by Hay et al. (2006a). In the experiment by Hay et al. (2006a), female participants, who were asked to choose one of several synthesised vowels as the closest to /ɪ/, were more likely to indicate a more centralised type of /ɪ/, which in quality was more like an New Zealand /ɪ/, when the words 'New Zealand' appeared on an answer sheet than when the word 'Australia' was typed on the answer sheet. The tendency displayed by female participants was in line with predictions made by Hay et al. (2006a) as the centralised /ɪ/ sound is used in New Zealand. Interestingly, male participants showed an opposite inclination. In the same task /æ/ was perceived differently depending on participant gender too. When the data were analysed according to the condition in which the task was carried out, they revealed that when presented with a answer sheet with 'New Zealand' on it, listeners tended to choose a more New Zealand like /æ/ vowel. A detailed analysis revealed that the inclination was more robust in women. Interestingly, male listeners in the Australian condition tended to indicate more New Zealand like tokens.

In order to explain the nature of differences between perception by male and female speakers, Hay et al. (2006a) refer to assumptions by Drager (2005) who suggested that female listeners may store a larger amount of social information in exemplars of sounds than men do. Such a tendency might be a result of the way females utilise language in declaring their identities which implies that females might have developed greater sensitivity to socially meaningful detail in speech variation. However, Hay et al. (2006a) stress that the data collected in their study is not sufficient to make strong assumptions of this sort. Yet, according to Hay and Drager (2010), although this assumption is likely to explain the way women were inclined to make their choices, it fails to account for why male listeners followed the reverse trend. In a similar study carried out by Hay and Drager (2010) in which the regional labels 'Australian' and 'New Zealand' were substituted by kangaroo and kiwi toys respectively, /ɪ/ was perceived similarly to how it was in Hay et al. (2006a) by both sexes. Hay and Drager (2010) attempted to explain the perception of /ɪ/ by male listeners using social context. Namely, they assumed that due to their involvement in supporting a New Zealand rugby team against the Australian national rugby team, male listeners may hold negative attitudes towards Australia. Therefore, they might be likely to distance themselves from

Australian culture by using/choosing more New Zealand tokens when exposed to a concept associated with Australia as a result of their "strong sense of nationalism and kiwi pride" (Hay & Drager 2010). Since women are not reported to be equally involved in supporting any football team, it might be the reason why they do not display such behaviour which might indicate their neutral or even positive attitude towards Australia and its culture.

Whereas explanations suggesting that women, who pay more attention to symbols and prestige, tend to store more social information in their memories and hence are more sensitive to social information in speech could be adopted in this study, Hay and Drager's (2010) explanation of the opposite trends presented by male listeners are not likely to be applicable in the present study. Participants' answers to one of the questions included in the ID questionnaire (see Appendix 4) shed some light on the participants' opinions as to whether they would prefer to watch a football match played by a Greek or a Cypriot football team. Most importantly, contrary to Hay and Drager's (2010) assumption that women in New Zealand are less interested in rugby than men are, in the present study the percentage of female participants from Cyprus who declared that (1) they had no opinion as to which match they would watch and (2) would be happy to watch any of the two teams was equal to the percentage of male participants making the same claims (see figure 7.10). Such a result implies that, at least in the sample of people taking part in this experiment, women were not less interested in football, which appears to be the most popular sport in Cyprus. Furthermore, 44.3 % of male listeners who took part in this study declared that they would prefer to watch a football match played by the Greek National Team and only 22.1% would choose to watch the Cypriot National Football Team. 11.1% of the male participants had no opinion regarding the issue and another 11.1% would be happy to watch either of the matches. Such a tendency does not seem to indicate that the majority of male listeners in this study had negative attitudes towards Greece, at least when the issue of sport and national pride were concerned. It might be claimed that the male listeners who chose to watch the Greek National Team might have made that choice as they might prefer to watch a high quality football match and watching the Greek team is more likely to offer such an option because the team is more successful than its Cypriot equivalent. Yet, it probably could also be claimed that if the study participants really had negative attitudes towards Greece (or their team) they might resent watching the match of the Greek team having the option of watching the Cypriot team. Also, the mean ID score for male listeners in this study (3.1) was slightly lower than mean ID score for women (3.4), which meant that male listeners were on the whole affiliated with Greece more than female listeners were.

	1	2	3	4	5	0
male	16.6	27.7	11.1	5.5	16.6	11.1
female	5.5	5.5	11.1	27.7	27.7	11.1
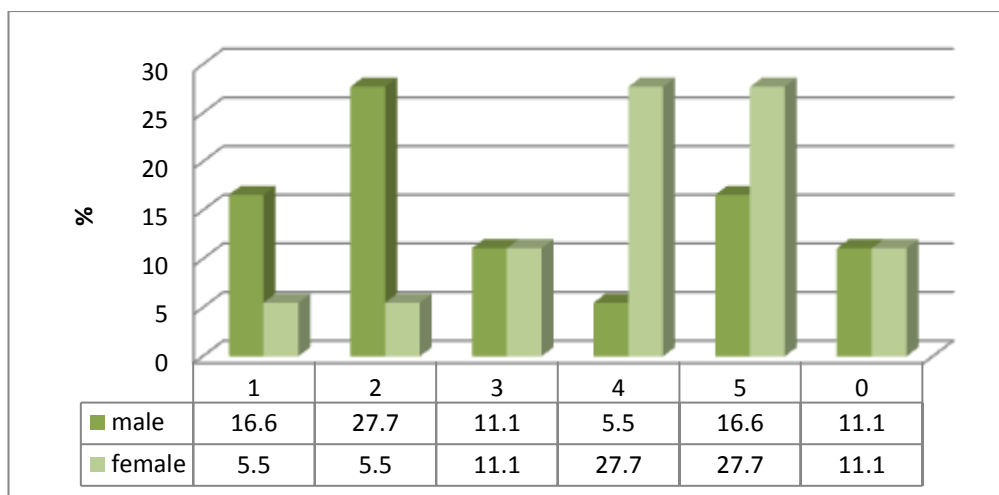
Figure 7.10 Answers to the question 'There are two football matches broadcast on two different TV channels at the same time, a match including the Cyprus National Football Team and a match including the Greek National Football Team. Which one would you choose to watch?' 1 = I'd definitely choose the Greek National Football Team, 2 = I might choose the Greek National Football Team, 3 = I would be equally happy to choose either of the two options, 4 = I might choose the Cyprus National Football Team, 5= I'd definitely choose the Cyprus National Football Team, 0 = No opinion

The IDGR models were fitted to data collected from very few participants (five participants; two women, three men), which could imply that the unexpected results were not entirely reliable. What remains to be explained is why in model 1ff, fitted to data collected from Cyprus-inclined listeners, women were less likely to label stimuli as geminates than men were. A possible explanation could be that women from that group may have had less exposure to SMG pronunciation as produced in Greece and, due to their affiliation; they also may have a slightly different definition of what prestige is as they may be more attentive to the more locally prestigious forms.

SOCIO turned out to be a significant variable in all 1ef – 1gv models. What needs to be stressed though is that SOCIO affected listeners' perceptions depending on the affiliation. In the Greece-affiliated group the higher the SOCIO the greater the odds of a sound being labelled as a geminate (models 1ef, 1ev and 1fv), whereas in the Cyprus oriented group as SOCIO increased, the chances of perceiving a stimulus as a geminate dropped. To interpret the ways socio-economic index seems to influence the perception of the boundary, it is necessary to remember what criteria were taken into consideration when the index was calculated. These were the level of education, level of prestige of profession done by the listener and/or the listeners' parents' economic situation. Thus, the higher the score was, the higher were the earnings, education and prestige.

This is why it could be understood that the Greece affiliated listeners who had higher socio-economic indexes stand a greater chance of being involved in activities which could help them bond with Greek culture more than the less economically privileged listeners who were also affiliated with Greece. In this way, the wealthier and better educated listeners might have had more exposure to SMG and therefore developed richer exemplars of [t] pronounced by SMG speakers. Such increased opportunities might have helped some listeners build up higher sensitivity to changes in the length of plosives. On the other hand, it is likely that the more economically advantaged Cyprus-affiliated listeners might have exposed themselves less to mainland Greek culture and speech. As was pointed out by Papapavlou (2004), similarly to mainland Greeks, Greek Cypriots, who do not suffer from economic or cultural deprivation, also have their unique culture and rich history. Therefore, it is fair to assume that Cyprus-affiliated individuals in economically-advantaged situation, who are likely to feel a certain level of national pride, would take advantage of their rich culture instead of looking for contact with mainland Greek culture. As a result, such individuals might have fewer exemplars of [t] sounds produced by mainland SMG speakers.

RES was significant only for listeners affiliated with Cyprus (models 1ff and 1gv) and the B coefficient values imply that residents of urban areas were more likely to perceive the target sounds as geminates. This relationship is identical to the one from models 1bf − 1bv and the explanation of it might be just the same, namely that listeners from urban areas might receive more exposure to standard speech and non-lexical singleton plosives through participating in official situations more often.

Interestingly, in models in which GRCD and GRVOT values were entered, none of the values of plosives as pronounced by the listeners were significant predictors. In contrast, in models in which VTCD and VTVOT were entered some of the values of sections of plosives produced by the listeners turned out to influence perception of the target sounds. The discrepancy between results for VTCD/VTVOT and GRCD, GRVOT might also imply that values of plosives embedded in *feta* pronounced in SMG might not be as strong predictors of listeners' perceptions as values of plosives embedded in *vata* pronounced in SMG. Yet, this explanation does not seem to be entirely convincing as in several other models (fitted to slightly different sets of data) values of plosives embedded in *feta* are also significant variables. This might further imply that the values of components of plosives embedded in *feta* are not as 'stable' and that the speakers might not have enough control over their pronunciations when trying to suppress gemination. However, the same people may have detailed and well-developed exemplars of true singleton sounds (those in

word contexts in which they are always pronounced as singletons in both accents) and they tend to activate them/refer to them when processing plosives and classifying them as geminate and singletons.

VTVOT was a significant predictor in all of the three models in which it was entered, CYCD was a significant predictor for Greece affiliated listeners, and VTCD was a significant factor in the Cyprus-affiliated group. In the Greece-affiliated group an increase in values of VTVOT and CYCD meant an increase in a number of stimuli labelled as geminates. This result was opposite to what was expected. In the Greece-affiliated group, B coefficient values indicate that, the greater the VTCD, the greater the odds of stimuli being perceived as geminates, whereas the longer the VTVOT the lower the odds of labelling a stimulus as a geminate. While the result for VTCD was again contradictory to what was predicted, the effect of VTVOT followed the expected trend. It is difficult to ascertain the reasons why the ways in which some of the values of elements of plosives affected the perception of the continuum in a manner which was opposite to what was expected. It might however be suspected that the data might not have been reliable enough due to a low number of listeners who were classified as Greece-affiliated as compared to the number of Cyprus-affiliated participants: only five study participants (out of thirty-six), three male and two female had their ID score below 3.00.

7.4.3   Results by gender

The analysis of results according to gender showed some similarities and differences between the ways male and female listeners processed the stimuli (see table 7.13). As in the previously presented models, CD and VOT were significant predictors and the way they influenced perception was identical to the way they did in the previously discussed models.

ID score turned out to be a significant variable for models 1hf, 1hv, 1jf and 1iv. Male and female listeners differed in the way the ID score impacted their perception. B coefficient values suggest that the more female subjects were affiliated with Cyprus, the more likely they were to perceive sounds as geminates. The trend followed by male listeners (models 1iv and 1if) was the opposite; the more Cyprus-oriented they were, the lower were the odds for them to perceive the stimuli as geminates. The tendency displayed by male listeners appears to be more predictable from the point of view of exemplar theory and the importance of the amount of exposure (see hypothesis III).

Table 7.13 Models fitted to data collected from men (MALE) and women (FEMALE) separately (experiment 1).

Model		1hf FEMALE	1if MALE	1jf MALE	1hv FEMALE (vt)	1iv MALE (vt)	1jvMALE (vt)
N		2160	2040	2040	2160	2040	2040
Omnibus tests	Chi Square	1692.78	1574.06	1563.59	16885.3	1567.03	1554.41
	Df	7	5	4	5	5	3
	Sig.	.000	.000	.000	.000	.000	.000
% of correctly predicted responses	[t]	87.9	87.8	87.7	88.2	86.4	85.6
	[t:^{h}]	92.3	91.5	91.7	91.9	91.2	90.6
	Total	90.6	90.0	90.1	90.5	89.3	88.6
% of variance predicted in responses (Cox & Snall R Square - Nagelkerke R Square)		54.3 – 73.6	53.8 – 72.6	53.5 – 72.3	54.2 – 73.4	53.6 – 72.4	53.3 – 72.0
Significance of the independent variables							
Entered variables	VOT	.000 +	.000 +	.000 +	.000 +	.000 +	.000 +
	CD	.000 +	.000 +	.000 +	.000 +	.000 +	.000 +
	ID	.000 +	/	.000 -	.000 +	.000 -	/
	RES	.004 +	/	/	.010 +	.045 +	/
	GRCD	.035 -	.001 -	/	/	/	/
	CYCD	.029 +	.000 -	/	/	.000 -	/
	CYVOT	.013 -	.000 -	/	.036 -	/	/
	GRPLOS	/	/	.000 -	/	/	/
	CYPLOS	/	/	/	/	/	.000 -

It seems that for women some other factor was of greater importance than exposure. At this point it would be worth remembering that the ID score not only gives an indication of how much contact with SMG a listener received. The ID score might also be remotely linked to stereotypes associated with both cultures. Generally, the literature suggests (Tsiplakou 2006; Papapavlou 1998; Sophocleous 2006) that Greece/Greek culture is considered more prestigious than Cyprus/Cypriot culture. It seems logical to assume that a person affiliated with Cyprus might experience a certain amount of (social) insecurity when confronted with concepts associated with the Greek culture. This might be particularly true when the confrontation concerns the use of language due to the widespread stereotypes around the use of CG and SMG by Greek Cypriots and due to the character of corrections Greek Cypriots are exposed at school when they misuse SMG (see chapter 2). Being asked to judge whether a sound is a geminate or not might have been interpreted by the participants as being asked to judge whether the sound is 'Greek enough'; thus, such a task might have invoked the feeling of insecurity. We might assume that with an increasing level of affiliation with Cyprus, which tends to be considered less prestigious than Greece, the level of (social) insecurity rises; therefore, it might be possible to accept that the

sensitivity to socially marked elements of speech grows with the level of affiliation with Cyprus. Moreover, if we take it into consideration that women tend to be more sensitive to prestige than men (Labov 1990, Eckert 1989), we might infer that female listeners' tendencies in perception might be a reflection of such increased sensitivity. Since, owing to their asserted need to build prestige by means of linguistic devices, women are claimed to be more sensitive to changes in sounds/to sounds which are socially marked, they might be even more sensitive to such sounds if their (social) insecurity is likely to rise due to their affiliation with the less prestigious culture/country.

Another reason for such a discrepancy in results might be due to the fact that the average ID score for men who took part in the experiment was 3.1 whereas for women it was 3.4, which meant that as a group, men were more affiliated with Greece than women were. Such an explanation should, however, be treated with caution as the difference in mean ID score between the two groups was very small, and not statistically significant (according to t-test and Mann-Whitney U test).

It seems worth noting that the results of the statistical analysis presented in table 7.13 do not seem to be in line with those presented in table 7.12, which provided an analysis of results according to affiliation. These results suggest that in the group of listeners who were more Greece-affiliated (ID score < 3.00; see section 7.4.2) female listeners were more likely to classify stimuli as geminates than male listeners from the same group did. The two results (that women tend to label more stimuli the more Cyprus-oriented they are and that Greece-oriented women tend to perceive more geminates than Greece-oriented men do) seem to mutually exclude each other. It seems most likely that it is the latter result that might be incorrect as there were only five Greece-oriented listeners, which might have affected the reliability of the result. In fact, an analysis of the percentage of tokens labelled as geminates by Greece-oriented listeners revealed that Greece-affiliated male listeners labelled a greater percentage of tokens as geminates than female listeners did (see figure 7.11). Thus, the result of the logistic regression might have been skewed by the sample size.
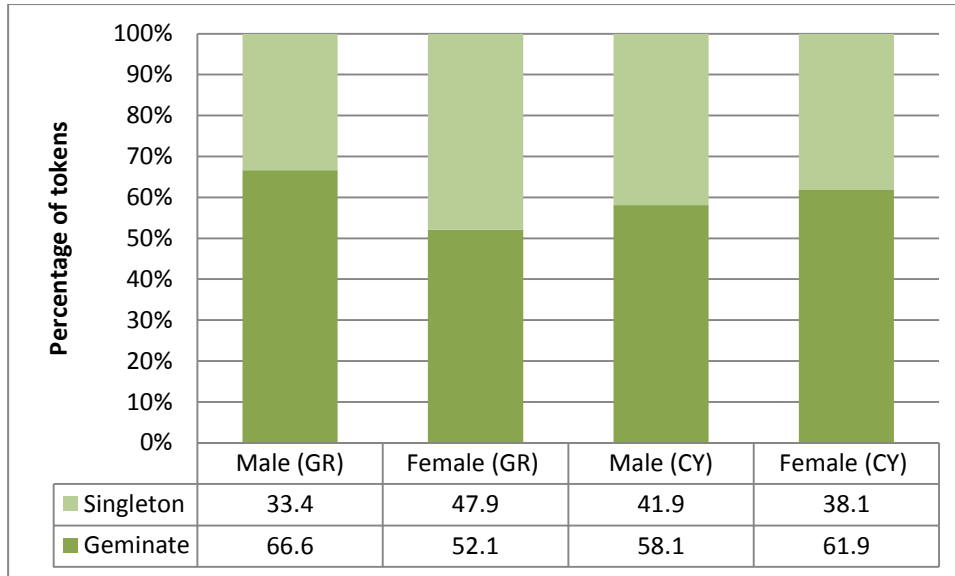
Figure 7.11 Percentages of tokens labelled as geminates and singletons by Greece-affiliated men (Male GR) and women (Female GR) and Cyprus-affiliated men (Male CY) and women (Female CY)

Similarly to the ID score, RES was a significant factor in models 1hf, 1hv and 1iv. It ought to be noted that p was equal to .045 for male speakers in model 1iv and the influence of RES was not significant for male listeners from model 1if. This might mean that RES has a very weak effect on male listeners. Regardless of gender, residents of urban areas were more likely to label sounds as geminates. This result might imply that residents of urban areas have potentially more exposure to standard speech in which singletons are used more often than in village speech. It was also taken into consideration that such an outcome might also suggest that the length of VOT and CD in CG used in urban areas might be different than in rural areas. To verify that, mean values of VOT and CD produced by listeners from rural and urban areas were compared, and according to a t-test and a Mann-Whitney U test there was no statistically significant difference between the means, which seems to reject the suggestion that in comparable contexts (GRCD, GRVOT) plosives are produced differently by residents of rural and urban areas. It must, however, be stressed that the means were calculated from a relatively small sample which is not representative of both the urban and rural population in Cyprus. Yet, the data allows a better understanding of the production of plosives by the study participants.

As regards the significance of the length of CD and VOT produced by the listeners, it should be mentioned that even though VTCD and VTVOT were initially entered in models 1hv and 1iv, their effect did not turn out to be significant. In models 1hf and 1if, GRCD, CYCD and CYVOT were significant factors for male and female listeners. For both men and women, the odds of perceiving a stimulus as a geminate declined as the length of CYVOT and GRCD grew. As it relates to CYCD, its

increase meant a rise in sounds labelled as geminates for female listeners, but a fall in the odds of perceiving stimuli as geminates for male listeners. In models 1hv and 1iv, in which VTCD and VTVOT were initially entered, CYCD was a significant factor only for male listeners and the increase in its values caused a decrease in a number of stimuli labelled as geminates, while CYVOT helped to predict only the responses by female listeners. The way CYVOT influenced responses by female listeners in model 1hv was the same as it was in models 1hf and 1if. The results for CYVOT, GRCD and CYCD followed the expected trends (see hypotheses Ib and IIb). The trend followed by CYCD in model 1if was opposite to what was anticipated. The reason for this effect is unclear.

An attempt was also made to fit models in which GRPLOS, VTPLOS and CYPLOS were entered. Their results showed that none of these three variables had a significant effect on the responses of female listeners. As regards male listeners, the increase of length in GRPLOS (model 1jf) and CYPLOS (model 1jv) reduced the odds of labelling a sound as a geminate, which was in line with the previously-made hypotheses I and II. However in both models (1jf and 1jv) there were fewer significant independent variables than in the other models fitted to data from male and female subjects separately. In fact, these models in which CYPLOS, GRPLOS and VTPLOS were entered were weaker in that they correctly predicted a slightly lower percentage of responses.

7.4.4   Results by place of residence

Table 7.14 summarises the analysis of variables influencing the responses of residents of rural and urban areas separately. In models from 1kf to 1lt values of CD and VOT pronounced by the listeners were entered, whereas values of the whole plosives produced by the listeners were entered in models 1mf - 1nv. The VOT and CD of the stimuli had the same influence on the listeners' responses as in the previous models.

The results suggest that residents of urban areas were not affected by their ID score. The variable turned out to have a significant effect on the perception of the boundary by residents of rural areas in two models (1lv and 1nf). However, the ID score turned out to affect listeners in opposite ways in the two models. It is likely that the confusing results might have been due to a relatively low number of study participants from rural areas (seven out of thirty-six). Therefore, the results from models fitted to data taken from village residents should be treated more tentatively. It should also be mentioned that when initially all independent variables (except for GRPLOS, CYPLOS, VTPLOS, VTCD and VTVOT) were inserted in the model 1lf, an error occurred in the results for ID score. Therefore, ID score was not further entered into the model (1lf). It is

suspected that the error that occurred in the result for the ID score was a result of a small sample of listeners from rural backgrounds.

Table 7.14 Models fitted to data collected from listeners from rural (RURAL) and urban (URBAN) areas separately (experiment 1).

Model		1kf URBAN	1lf RURAL	1kv URBAN (vt)	1lv RURAL (vt)	1mf URBAN	1nf RURAL	1mv URBAN (vt)	1nv RURAL (vt)
N		3240	960	3240	960	3240	960	3240	960
Omnibus tests	Chi Square	2588.791	645.92	2583.65	690.98	2575.31	656.52	2575.31	651.92
	Df	6	3	6	7	3	6	3	5
	Sig.	.000	.000	.000	.000	.000	.000	.000	.000
% of correctly predicted responses	[t]	87.6	85.5	86.8	83.8	87.7	84.7	87.7	85.0
	[t:^{h}]	91.8	91.8	91.4	92.8	92.1	90.7	92.1	89.5
	Total	90.1	89.5	89.5	89.5	90.3	88.4	90.3	87.8
% of variance predicted in responses (Cox & Snall R Square - Nagelkerke R Square)		55.0 – 74.3	49.0 – 66.8	55.0 – 74.2	51.3 – 70.0	54.8 – 74.0	49.5 – 67.5	54.8 – 74.0	49.3 – 67.2
Significance of the independent variables									
Entered variables	VOT	.000 +	.000 +	.000 +	.000 +	.000 +	.000 +	.000 +	.000 +
	CD	.000 +	.000 +	.000 +	.000 +	.000 +	.000 +	.000 +	.000 +
	ID	/	/	/	.000 -	/	.026 +	/	/
	SOCIO	/	/	/	/	/	.005 -	/	.012 -
	GEN	.029 +	/	.039 +	.000-	/	/	/	.011 -
	GRCD	.002 -	/	/	/	/	/	/	/
	GRVOT	/	/	/	/	/	/	/	/
	VTCD	/	/	.037 +	.000 +	/	/	/	/
	VTVOT	/	/	/	.000 +	/	/	/	/
	CYCD	.018 -	.009 -	.000 -	/	/	/	/	/
	CYVOT	.018 -	/	.037 -	.000 +	/	/	/	/
	GRPLOS	/	/	/	/	/	.001 -	/	/
	VTPLOS	/	/	/	/	/	/	/	.004 +
	CYPLOS	/	/	/	/	.000 -	.002 -	.010 -	/

Similarly to ID score, SOCIO turned out not to have a significant effect on the responses of listeners from urban areas. Nevertheless, there were indications that SOCIO was a significant predictor in two of the models fitted to the data collected from listeners from rural areas (models 1nf and 1nv). The B coefficient values imply that the higher the social prestige of the person was, the less likely the person was to perceive the sounds as geminates. Such a tendency might suggest that the higher the status of the person, the less sensitive that person is to the changes of the plosive length. To explain this tendency, it is worth going back to the results presented in chapter

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6 which suggest that the length of plosives can carry certain social meanings. Two of the meanings associated with non-contrastive singleton plosives are 'formal' and 'educated' as opposed to 'relaxed/informal' and 'uneducated' associated with the use of singletons. Thus, it appears logical to expect that the use of singletons in such words may be associated with prestige. The present results suggest that the higher one is on the social ladder, the less one needs to resort to linguistic devices to build his/her prestige. Therefore, a village resident with high social background might be less likely to develop a sharp sensitivity to the length of plosives. Furthermore, such a person most probably grows up and develops his/her speech in a village, where he/she may be exposed to different lengths of plosives or a larger number of longer plosives. This, in combination with the lack of the need to use linguistic devices to maintain prestige and possibly local pride, might be a reason for a weaker sensitivity to the length of plosives. However, this unpredicted direction in which this group of listeners was affected might also have stemmed from the small size of the group which may make the result unreliable.

It was also found that GEN was a significant factor in models 1kf, 1kv, 1lv, and 1nv. The B coefficient values indicated that females from rural areas were less likely to perceive the stimuli as geminates than the male listeners from rural areas, and that female listeners from urban areas were more likely to label the heard plosives as geminates. These trends for rural and urban listeners are difficult to explain, especially seeing that the analysis of the data according to gender (table 7.13) did not indicate that the place of residence significantly affected the ways male and female listeners perceived the boundary. It does seem plausible, however, that female listeners from urban areas were more sensitive to the small increases in the length of the heard plosives than men were as (1) women are claimed to be more sensitive to social information in speech than men, and additionally, (2) women from urban areas may have had more opportunities to develop their categories of singleton plosives through exposing themselves to more activities/situations in which SMG is more likely to be used than women from rural areas did.

Nevertheless, these two relationships do not seem to offer an explanation as to why the tendencies are opposite for listeners from rural areas. If the claim that women are more sensitive to social information in attempt to secure a desirable social position were universal, the trend would more likely be opposite to the present one.

Instead, an alternative explanation might be offered which would be based on a very risky assumption that the expected roles of women in rural areas might still be being a good homemaker. Such an assumption might appear to be outdated. However, although statistics from the Cyprus 2011 census (Republic of Cyprus 2013) show that a considerable number of female

village residents aged between twenty and twenty-nine years of age have completed tertiary education (including doctoral studies) it may be possible that there could be some residual attitudes in the families that a woman, despite being a professional career woman, is expected to be a mother, homemaker etc. In such a situation it might be possible that women from such families would be focusing more on the domestic sphere, in contrast to men from the same background who would be gaining power by getting involved in the affairs of the local societies. If such a state of affairs were true, which is difficult to ascertain with the data collected in this study, then it could be suggested that village women's social situation might be a reason for their reduced contact with SMG in comparison to men from rural areas and women from cities.

GRCD and GRVOT had a significant impact on the listeners' responses and according to the B coefficient values, the higher their values were, the less likely the listeners were to perceive the sounds heard in the experiment as geminates. The trend was the same for listeners from rural and urban areas and it was in line with the hypothesis II that the longer the plosives one produces in SMG, the longer the plosives he/she needs to hear to label them as geminates. The values of VTCD and VTVOT, however, suggested a trend which was opposite to what was anticipated. The increase in VTCD and VTVOT values increased the chances of stimuli to be labelled as geminates. CYCD and CYVOT also followed the predicted direction in which the increase in the values would mean a drop in the number of stimuli perceived as geminates. Only in one model from this series (table 7.14) namely in 1lv (fitted to data collected from village residents) CYVOT followed the opposite trend. It is difficult to say why the B coefficient values were different for the variable in this model, but it could be also due to the low number of participants from village areas.

The B coefficient values for GRPLOS, which turned out to be significant only in one of the models (1nf), and CYPLOS, which was significant in models 1mf, 1nf and 1mv, supported the prior hypotheses (I and II) that the increase in their values would be equal to a decrease in the number of stimuli heard as plosives. This was not true for the B statistic of GRPLOS, which was significant in model 1nv, as the number suggested that the longer GRPLOS one produces, the shorter plosives he/she might label as geminates.

7.5   Experiment 2: results and discussion

The data collected in experiment 2, which involved the exposure of listeners to either the Greek or the Greek Cypriot flag, were analysed by means of a logistic regression test using the SPSS statistical package. The dependent variable and the independent variables were entered into each model in the same way they were when analysis of data from experiment 1 was carried out. The

only difference was that two additional variables were introduced, namely the presence of the Greek flag and the presence of the Greek Cypriot flag. Several models that were fitted to all data collected in experiment 2 were generated. These were models 2af – 2bv, in which CD and VOT values were entered separately (see table 7.18), and models 2cf – 2dv, in which instead of CD and VOT, PLOS was entered (see table 7.19).

7.5.1   Overall results

In the second experiment a total of 4320 tokens were classified; 2040 were played in the presence of the Greek flag, and 2280 in the presence of the Cypriot flag (see table 7.15). Also, Appendix 12 includes a summary of ratios of tokens labelled as [t] and [t:^{h}]. The way the listeners classified individual tokens in the presence of each of the flags is presented in tables 7.16 and 7.17. Upon comparing the percentages from experiment with the Greek flag to the percentages generated from experiment 1 data (table 7.9), one will notice that there seems to be a slight shift in perception. More precisely, in the Greek condition, in many cases, there are lower percentages of tokens with shorter VOT and CD labelled as geminates, but there are higher percentages of tokens with longer plosives labelled as geminates. Also, an analysis of similar percentages from the Cyprus condition shows a similar tendency; however, the values are not identical to those in the Greek condition. Some of the percentages of tokens with shorter plosives in the Cypriot condition are lower while some of the percentages of tokens with longer and intermediate plosives are higher than in the Greek condition. A statistical analysis of the influence of flags on listeners from experiment 2 is presented further in this section and in sections 7.5.2, 7.5.4 and 7.5.5. A statistical analysis of the effect of flags making use of experiments 1 and 2 datasets is shown in sections 7.6.1 – 7.6.4. A general summary and discussion of the most important findings regarding the influence of both flags on various subsections of the data is presented in section 7.7.5. That is where the issue of difference in percentages in both conditions is revisited.

Table 7.15 Number and percentages of tokens labelled as singletons and geminates by listeners in experiment 2.

	Tokens labelled as [t]	Tokens labelled as [t:^{h}]	Total
All tokens played	1755	2565	4320
	40.6%	59.4%	100%
Tokens played to listeners exposed to the Greek flag	847	1193	2040
	41.5%	58.5%	100%
Tokens played to listeners exposed to the Cypriot flag	908	1372	2280
	38.8%	60.2%	100%

Table 7.16 Percentages of tokens with different VOT and CD values perceived as geminates in experiment 2 in the presence of the Greek flag. The values are given in percentages. Number of evaluations = 68 per very token.

VOT CD	10ms	30ms	50ms	70ms	90ms	110ms
60ms	0	1.5	26.5	57.4	76.5	92.6
90ms	0	2.9	36.8	76.5	89.7	95.6
120ms	1.5	10.3	72.1	97.1	98.5	97.1
150ms	1.5	14.7	85.3	100	100	98.5
180ms	4.4	29.4	88.2	100	100	100

Table 7.17 Percentages of tokens with different VOT and CD values perceived as geminates in experiment 2 in the presence of the Cypriot flag. The values are given in percentages. Number of evaluations = 76 per every token.

VOT CD	10ms	30ms	50ms	70ms	90ms	110ms
60ms	0	0	19.7	69.7	85.5	86.8
90ms	0	2.6	43.4	82.9	93.4	98.7
120ms	1.3	5.3	77.6	98.7	100	100
150ms	2.6	19.7	92.1	100	96.1	100
180ms	5.3	30.3	96.1	98.7	98.7	100

Similarly to all models fitted to data collected in experiment 1, in models 2af – 2bv CD and VOT were significant and as their values rose, the likelihood of stimuli being perceived as a geminate increased too. The ID score was also a statistically significant variable, and, just as initially expected (see hypothesis III) the more affiliated the listeners were with Cyprus, the less likely they were to label the sounds they heard as geminates.

Gender was a significant predictor only in the two models in which VTCD, VTVOT and VTPLOS values were entered as independent variables. In both models (2av and 2bv) women were less likely to perceive sounds as geminates than men were. This result seems surprising as it has been suggested in several studies that female listeners tend to be more sensitive to details of sounds which are socially marked (Eckert 1989; Labov 1990; Hay et al. 2006a; Yozenawa Morris 2010;

Namy et al. 2002; Drager 2005). It appears logical that if women were more sensitive to such detail they would be more likely than men to notice that some of the plosives were slightly longer than others. Yet, the results presented in table 7.18 (models 2av and 2bv) suggest the opposite. What is more, in equivalent models fitted to all data collected in experiment 1, GEN was not a statistically significant variable. This state of affairs might suggest that the presence of flags may have affected the ways in which men and women processed sounds.

Table 7.18 Models fitted to all data collected in experiment 2.

Model		2af	2bf	2av (vt)	2bv (vt)
N		3840	3840	3840	3840
Omnibus tests	Chi Square	3171.87	3157.54	3179.8	3177.68
	Df	6	5	7	7
	Sig.	.000	.000	.000	.000
% of correctly predicted responses	[t]	87.5	87.5	87.6	87.5
	[t:ʰ]	91.4	91.3	91.5	91.1
	Total	89.8	89.8	89.9	89.7
% of variance predicted in responses (Cox & Snall R Square - Nagelkerke R Square)		56.2 – 75.9	56.1 – 75.6	56.3 – 76.0	56.3 – 75.9
Significance of the independent variables					
Entered variables	VOT	.000 +	.000 +	.000 +	.000 +
	CD	.000 +	.000 +	.000 +	.000 +
	ID	.000 -	.000 -	.000 -	.000 -
	GENDER	/	/	.042 -	.000 -
	GRCD	.000 +	/	/	/
	CYCD	.000 -	/	.000 -	/
	VTCD	/	/	.000 +	/
	CYVOT	.001 -	/	.034 -	/
	GRPLOS	/	.035 +	/	/
	CYPLOS	/	.000 -	/	.003 -
	VTPLOS	/	/	/	.000 +
	GREEK FLAG	/	/	/	.024 +
	CYPRIOT FLAG	/	/	/	.024 -

In the models in which the CD of plosives produced by the listeners was entered, be it CYCD, GRCD or VTCD, CD turned out to be a significant factor. According to the B coefficient values, an increase in the length of VTCD and GRCD meant a rise in the number of stimuli classified as geminates. This direction was opposite to the one predicted which suggested that the longer singleton CD one produces, the longer the CD he/she needs to hear to label the sound as a geminate. It is difficult to ascertain the reason for this tendency, but it is worth noting that in the models fitted to all the data collected in the experiment 1, VTCD also displayed such an

unexpected tendency (model 1av), whereas GRCD showed the predicted trend (model 1af, section 7.4.1). In contrast, the direction in which CYCD and CYVOT affected the results was in line with hypothesis I: the longer CYCD and CYVOT one produced, the fewer stimuli he/she was likely to classify as geminates. Equivalent directions were noticed in the way GRPLOS, VTPLOS and CYPLOS affected perception: GRPLOS and VTPLOS appeared to influence perception in the reverse way to the one that was expected, whereas the B coefficient values for CYPLOS indicated the anticipated direction in which the variable affected the results.

Also, despite being more likely to be close to the values of acoustic features of singletons stored in memory, VTCD, VTVOT and VTPLOS in various models still tend to follow the trend which is contrary to the expected one. The presence of the unexpected results indicates that there might be another factor (or factors), except for the acoustic values stored by listeners in their memories or the acoustic values of plosives pronounced by the study participants, that could affect the way these values influence the perception of geminate-singleton boundary. Potential factors which might affect listeners' perception of the discussed sounds are discussed in later sections of this chapter (see section 7.6.2).

The presence of flags turned out to be a significant predictor only in one of the four models (2bv). According to the B coefficient, the presence of the Greek flag increased the number of stimuli categorised as geminates, while the presence of the Greek Cypriot flag triggered the opposite trend. This result is, in a way, comparable to results of other similar studies: in studies by Niedzielski (1999) and Hay and Drager (2010), in which listeners were exposed to labels or objects representing an area, when matching samples of speech the listeners tended to rely on social information about the speakers in addition to the acoustic information from the speech samples. More precisely, the listeners tended to match the samples of synthesised speech that matched the stereotypical pronunciations by speakers from a given area instead of the samples that would acoustically be closer to the sample with which the listeners were asked to match a speech sample of their choice. Such behaviour by listeners indicated that while processing speech listeners do not rely only on acoustic signals of the speech sample but also on other available cues which may be indexical in nature.

In the present study, participants seemed to be affected by the presence of the flags, but in a slightly different way. When they were exposed to the Greek flag, knowing that Greeks would not pronounce geminates in this or any context, they tended to perceive more stimuli as containing geminates which might imply that they were more 'strict' about what could be classified as a singleton. In other words, they were inclined to be more sensitive to small increases in VOT and

CD of the heard samples of *feta*. This trend can be understood from the B coefficient which was positive for the GREEK FLAG variable in the models in which it was entered. A positive B coefficient for the GREEK FLAG means that listeners were more likely to classify stimuli as geminates in the presence of the Greek flag than in the presence of the Cypriot flag. A negative B statistic stands for the opposite trend. This applies to all models fitted to experiment 2 data. However, when the listeners were exposed to the Cypriot flag, they were inclined to label fewer stimuli as geminated, which could indicate their sensitivity might have been weakened by the exposure to the Greek Cypriot flag, which might have made them less attentive to the small increases in the length of heard plosives. This tendency was indicated by negative B coefficient in model 2bv. A negative B statistic for the CYPRIOT FLAG means that listeners were less likely to classify stimuli as geminates in the presence of the Cypriot flag than in the presence of the Greek flag. A positive B statistic stands for the opposite trend.

It seems unlikely that the differences in perception of the stimuli by listeners from both conditions were an effect of a skewed sample in terms of SOCIO index or ID score. Even though there was a slight difference in average SOCIO index suggesting that the listeners in the Greek condition, on average, had a higher SOCIO index (21.55 in the Greek condition and 20.45 in the Cypriot condition), according to a t-test and a Mann-Whitney U test, the difference was not statistically significant. Were the difference greater and/or statistically significant, it could be claimed that, at least to some extent, the difference in SOCIO index might have been the reason why the listeners in the Greek condition were more likely to perceive test stimuli as geminates. The difference between average ID scores, which was close to statistically significant ($p=.011$ in t-test and $p=.022$ in Mann-Whitney U test), revealed that the listeners from the Greek condition were more affiliated with Cyprus than those from the Cypriot condition were. In line with hypothesis III, if this difference had an effect on how listeners from the two conditions perceived the test stimuli, it would have had the opposite effect to the observed one.

It is necessary to point out that the way the data were entered in these statistical tests might have caused the situation in which the influence of one flag negates the effect of the other flag, and vice versa. Such a situation might not be caused by two different effects of the two flags, but by the way the information regarding the presence/absence of flags was entered in the models. The data were entered as dummy variables – when the Greek flag was present, the Cypriot one was absent and vice versa. Therefore, the results should not be interpreted as 'the presence of a Greek flag increased the number of stimuli labelled as a geminate' , but rather 'in the presence of the Greek flag the listeners were more likely to label more stimuli as geminates than they were in

the presence of the Cypriot flag' and vice versa. However, the results in this form do not give a clear-cut answer as to which of the flags really influenced the listeners' perceptions. In order to answer the question, more models (equivalent models) were fitted to data that were collected with the presence of each of the flags (separately) and in the absence of any of the flags. The results of those models are presented and discussed in section 7.6.

Table 7.19 Models fitted to all data collected in experiment 2.

Model		2cf	2df	2cv (vt)	2dv (vt)
N		3840	3840	3840	3840
Omnibus tests	Chi Square	1821.41	1811.17	1823.3	1822.71
	Df	5	3	5	5
	Sig.	.000	.000	.000	.000
% of correctly predicted responses	[t]	71.3	71.1	70.7	70.4
	[t:^{h}]	83.5	83.7	83.8	84.3
	Total	78.5	78.6	78.7	78.6
% of variance predicted in responses (Cox & Snall R Square - Nagelkerke R Square)		37.8 – 51.0	37.6 – 50.7	37.8 – 51.0	37.8 – 51.0
Significance of the independent variables					
Entered variables	PLOS	.000 +	.000 +	.000 +	.000 +
	ID	.000 -	.004 -	.000 -	.001 -
	GENDER	/	/	.039 -	.013 -
	GRCD	.005 +	/	/	/
	CYCD	.000 -	/	.002 -	/
	VTCD	/	/	.003 +	/
	CYVOT	.011 -	/	/	/
	GRPLOS	/	/	/	/
	CYPLOS	/	.000 -	/	.001 -
	VTPLOS	/	/	/	.004 +

Similarly to the results described in section 7.4.1, it seems that despite being a significant predictor, PLOS does not allow as precise predictions as CD and VOT analysed separately. Models 2cf – 2dv, which were fitted with PLOS instead of CD and VOT separately, had a lower percentage of correctly predicted responses, which ranged from 78.5% to 78.7%. As a comparison, the percentage of correctly predicted responses in models 2af – 2bv extended from 89.7% to 89.9%. The models 2cf – 2dv also had fewer statistically significant independent variables. For instance, RES was not a significant factor in any of them, and neither was the presence of any of the flags. GRPLOS did not turn out to be significant in the model in which it was entered. Also, although CYVOT was significant in model 2cf and although it had the same effect on the results as it did in

the corresponding model 2a, it was not significant in the model 2g. Some variables which were significant predictors in all or some of the 2af − 2bv models were also significant in the corresponding 2ecf – 2dv models, and these variables also affected the results in the same way as they did in models 2af – 2bv. Among these variables were ID score, GEN, GRCD, CYCD and VTCD. All things considered, it appears that models including PLOS are weaker than their counterparts with CD and VOT entered independently.

7.5.2 Influence of flags

The data were also analysed in a way which allowed comparison of the independent variables that significantly affected the responses of listeners from the two conditions (i.e. with the Greek flag or with the Greek Cypriot flag). Table 7.20 summarises all the models which portray the way responses were affected in the two conditions (2ef − 2gv). The reason why there is a double number of models for the Greek condition is that for each condition I fitted models with two types of data – (1) those with CD and VOT values as pronounced by the listeners, and (2) those with the whole length of plosives uttered by the listeners. As the VTPLOS, GRPLOS and CYPLOS were not significant in the Cypriot condition, only two models were generated for data collected in the presence of the Cypriot flag only. It seems that the only common feature of all the models in this set was that CD and VOT were statistically significant and they had the same effect on the responses as they did in the previous models.

The ID score was a significant factor only in models fitted to data collected in the Cypriot condition (models 2ef, 2efi and 2ev), and the B coefficient values indicated that the more Cyprus-affiliated a listener was, the less likely he/she was to perceive a heard stimulus as a geminate. This inclination was in line with those observed in some of the models fitted to data collected in experiment 1 (i.e. 1av, 1ef, 1jf and 1iv). All of these models appear to support the prediction made regarding the influence of ID score on the perception of the boundary. Yet, the same was not observed in the models fitted to data collected in the Greek condition, which may imply that if the presence of the Greek flag influences the perception of the boundary, it affects all listeners equally regardless of their affiliation. It seems that in the presence of the Greek flag the ID score of a listener becomes irrelevant. It is difficult to ascertain why ID score affects listeners choices differently in the presence of the two flags (or why the presence of the Greek flag seems to influence listeners in the same way regardless of their ID score), however, the results suggest that listeners tend to use other cues than the purely acoustic ones when processing sounds, and also, that the processing of the sound may depend on the combination of cues and the listeners' background.

Table 7.20 Models fitted to data collected in the Greek (GREEK FLAG) and the Cypriot (CYPRIOT FLAG) condition separately (experiment 2).

Model		2ef CYPRIOT FLAG	2ef beta CYPRIOT FLAG	2ff GREEK FLAG	2gf GREEK FLAG	2ev CYPRIOT FLAG (vt)	2fv GREEK FLAG (vt)	2gv GREEK FLAG (vt)
N		2280	2240	1800	1800	2280	1800	1800
Omnibus tests	Chi Square	1945.06	1731.34	1456.86	1434.49	1945.06	1449.82	1442.79
	Df	4	4	5	4	4	4	4
	Sig.	.000	.000	.000	.000	.000	.000	.000
% of correctly predicted responses	[t]	87.8	87.9	87.0	87.3	87.8	87.3	87.7
	[t:^{h}]	91.7	92.8	90.6	90.5	91.7	90.4	90.4
	Total	90.1	90.9	89.1	89.1	90.1	89.1	89.2
% of variance predicted in responses (Cox & Snall R Square - Nagelkerke R Square)		57.4 – 77.6	57.2 – 77.5	55.5 – 74.6	54.9 - 73.8	57.4 – 77.6	55.3 – 74.3	55.1 – 74.1
Significance of the independent variables								
Entered variables	VOT	.000 +	.000 +	.000 +	.000 +	.000 +	.000 +	.000 +
	CD	.000 +	.000 +	.000 +	.000 +	.000 +	.000 +	.000 +
	ID	.014 -	.002 -	/	/	.014 -	/	/
	GEN	.000 -	/	/	.029 +	.000 -	/	/
	SOCIO	/	/	/	/	/	/	/
	GRCD	/	/	.000 +	/	/	/	/
	GRVOT	/	/	.000 -	/	/	/	/
	CYCD	/	/	.000 -	/	/	.000 -	/
	VTCD	/	/	/	/	/	.000+	/
	CYPLOS	/	.001 -	/	.000 -	/	/	.000 -
	VTPLOS	/	/	/	/	/	/	.000 +

Another difference between the two conditions was the role played by GEN. GEN was significant in the Cypriot condition (in both models), but of all four models describing the variables in Greek condition, GEN was significant only in one (2gf). It needs to be added that of all the listeners exposed to the Cypriot flag, women were less likely to perceive sounds as geminates than men were, whereas in model 2gf, which is in the presence of the Greek flag, female listeners were more prone to classifying sounds as geminates. Model 2bv shows that in general, when exposed to the Greek flag, the listeners classified more stimuli as geminates, and when exposed to the Cypriot flag, they perceived fewer sounds as geminates. The models 2ef, 2gf and 2ev seem to indicate that these results are more robust for women who took part in the experiment.

Such a result might suggest that women tend to be more likely to be influenced by non-linguistic detail than men are and that this tendency could be caused by their need to reaffirm/confirm their identity and/or prestige. This interpretation resonates with the claims by Labov (1990) and Eckert (1989) who suggest that women might be more sensitive to social information associated with elements of languages as a result of their need to gain prestige. The directions observed in the present study, in which the presence of flags affected perceptions, appear to further support this claim. Previously women were reported to be carriers of similar trends in other studies which investigated the way in which listeners (also of different genders) were affected by non-linguistic information while processing sounds (Hay et al. 2006a; Hay & Drager 2010; Niedzielski 1999). Those studies also proposed that the behaviour of female listeners could be a result of their increased sensitivity to social aspects of speech.

In the Cypriot condition the way listeners produced plosives did not turn out to show any statistically significant effects except for CYPLOS being a significant factor in model 2ef (beta). In contrast, in the Greek condition the way listeners realised the length of plosives had an effect on how they perceived the stimuli that were presented to them. Several values were significant, such as GRCD, VTCD and CYCD. The increase in the length of GRCD and VTCD meant an increase in the number of stimuli labelled as geminates; this result was opposite to what was expected and did not support the hypothesis that the longer the singleton plosives listeners produce, the longer the plosives they need to hear before they label them as geminates. The increase in values of CYCD reduced the odds of the stimuli being perceived as geminates. CYPLOS and VTPLOS were significant in the models in which they were entered, but GRPLOS was not significant despite being entered into the 2gf and 2ef (beta) model. The way the length of CYPLOS and VTPLOS affected the results was similar to how CYCD and VTCD did respectively. That is, the longer the average duration of the whole singleton plosive produced by a listener was, the more likely that listener was to classify the stimuli as geminates, whereas the longer the average duration of a geminate plosive produced by a listener, the lower were the odds of perceiving a heard plosive as a geminate. This direction was as predicted. Furthermore, GRVOT turned out to be significant in model 2ff, and the increase in its values caused a drop in the number of stimuli classified as [t:^{h}], which supports the previous claims about how changes in the length of singleton plosives could affect perception of the boundary.

While, in the Cypriot condition, the perception of the boundary depended on the listeners' ID score and gender, in the Greek condition it was gender and various values of plosives as pronounced by the listeners that were significant. Such a pattern appears to suggest that

depending on the flag to which listeners are exposed, they seem to refer to different information stored in their brain. Since in the Cypriot condition their responses depend on their ID scores, it might be assumed that in the presence of the Cypriot flag listeners depend more on the number of exemplars of certain values of VOT and CD stored in their brains. When exposed to the Greek flag they seem to rely more on the values of VOT and CD they produce themselves. Of course, the values the listeners produce should be equal to at least some of the values of CD and VOT stored in their memories. The data collected in the present study do not provide any explanation of the potential reasons for such a state of affairs, nor do they allow for making confident statement that this is exactly how the two flags influence the way sounds are processed by Greek Cypriot listeners. Nevertheless, the data draw attention to a possible avenue for further investigations of how social information is used by Greek Cypriots in speech processing.

7.5.3   Results by affiliation

It was also investigated whether Greece- and Cyprus-oriented listeners' perceptions of the singleton-geminate continuum depended on the same factors (models 2hf – 2jv, table 7.21). Splitting the listeners into the two groups was done the same way as discussed in section 7.4.2. CD and VOT affected the listeners' choices in the same way they did in all the previous models. For Cyprus-affiliated listeners the ID score was a significant factor. As it was predicted by hypothesis III, the more the listeners were affiliated with Cyprus, the less likely they were to label the sounds heard in the experiment as geminates. The way Greece-oriented listeners perceived the test stimuli did not seem to be affected by the listeners' ID scores. This result might have been an outcome of the fact that very few listeners who took part in this experiment were Greece-affiliated (only ten listeners had ID score below 3.00). It is feared that such a small sample might have been the cause of the lack of significance of the variable. Getting a substantial sample of listeners who were Greece-oriented was a very difficult task as it was difficult to predict whether the volunteers who wished to take part in the experiment were Greece- or Cyprus-oriented. All eligible volunteers were accepted as study participants. As the number of Greece-oriented listeners was low, these results should possibly be treated more tentatively than results in other models. However, an argument against such a way of thinking would be the percentage of correctly predicted responses for both models fitted to data that came from Greece-affiliated listeners. Namely, both models (2hf and 2hv) predicted a higher percentage of responses (92.6%) than the models fitted to data that came from Cyprus affiliated listeners (2if =89.8%, 2iv=89.9%), which would make the two models (2hf and 2hv) stronger ones.

SOCIO affected only Cyprus-oriented listeners; however, the variable was significant only in two out of four models fitted to data collected from listeners who preferred Cyprus over Greece. The higher their prestige was, the more geminates they heard. This result was opposite to the one reported in section 7.4.2. It seems likely that the presence of the flags might have affected the group of listeners but it is difficult to explain how exactly that happened.

Table 7.21 Models fitted to data a collected from Greece- affiliated (IDGR) and Cyprus-affiliated (IDCY) listeners separately (experiment 2).

Model		2hf IDGR	2if ID CY	2jf IDCY	2hv IDGR (vt)	2iv IDCY (vt)	2jv IDCY (vt)
N		840	2880	2880	840	2880	2880
Omnibus tests	Chi Square	814.95	2332.27	2335.27	814.95	2367.46	2340.77
	Df	4	6	7	4	7	7
	Sig.	.000	.000	.000	.000	.000	.000
% of correctly predicted responses	[t]	90.1	87.1	87.4	90.1	87.5	87.1
	[t:^{h}]	94.2	91.7	91.2	94.2	91.5	91.3
	Total	92.6	89.8	89.7	92.6	89.9	89.5
% of variance predicted in responses (Cox & Snall R Square - Nagelkerke R Square)		62.1 – 84.4	55.5 – 74.8	55.6 – 74.9	62.1 – 84.4	56.0 – 75.5	55.6 – 74.0
Significance of the independent variables							
Entered variables	VOT	.000 +	.000 +	.000 +	.000 +	.000 +	.000 +
	CD	.000 +	.000 +	.000 +	.000 +	.000 +	.000 +
	ID	/	.000 -	.000 -	/	.000 -	.000 -
	GEN	.000 -	/	/	.000 -	/	/
	SOCIO	/	/	.000 +	/	/	.000 +
	RES	/	/	.000 +	/	.000 +	.000 +
	GRCD	/	.000+	/	/	/	/
	CYCD	/	.000 -	/	/	.000 -	/
	VTCD	/	/	/	/	.000 +	/
	CYVOT	.016 +	.000-	/	.016+	.000-	/
	GRPLOS	/	/	.000+	/	/	/
	CYPLOS	/	/	.000 -	/	/	.000 -
	VTPLOS	/	/	/	/	/	.000 +

Also, the results indicate that Greece-oriented female listeners were less likely to perceive stimuli as geminates than the Greece-affiliated male listeners. This result is opposite to the one obtained in the models fitted to data collected in experiment 1, and it seems to oppose the assumption that women tend to be more sensitive to social information linked to sounds as a results of women's strive to secure their prestige. It might be argued that such a result, which seems to be difficult to explain, could be caused by a small sample of Greece-oriented listeners (ten Greece-

affiliated listeners; seven male and three female) which might influence the reliability of results. However, the sample of Greece-oriented listeners which was used in experiment 1 was smaller (only five listeners), which appears to suggest that the results of the present test could be more reliable. Furthermore, GEN values obtained in models 3gf, 3gv and 3jv (labels starting with the prefix '3' are used for models fitted to data collected in experiments 1 and 2), which will be further discussed in section 7.6.3, are in line with those in models 2hf and 2hv. Although the number of Greece-oriented listeners in models 3gf, 3gv and 3jv was relatively low (fifteen Greece-oriented participants; ten men and five women), it was higher than in similar models fitted to data collected in experiments 1 and 2 separately.

Bearing in mind that models 1ff and 1fv were fitted to data collected without the exposure to any of the flags and models 2hf and 2hv were fitted to data collected with the exposure to the flags, it might also be suggested that the change in the directions might have been triggered by the use of flags in experiment 2. Yet, models 3gf, 3gv and 3jv, which were fitted to data collected either in the presence of flags or without the exposure to any flag, yielded similar results to those obtained in models 2hf and 2hv.

Taking all the possible scenarios into consideration, the low number of Greece-oriented participants seems to be the most likely, although not definite, explanation.

RES turned out to be a significant predictor only in models fitted to data that were collected from Cyprus-affiliated listeners. As in previous models in which RES was a significant factor, being a resident of urban areas increased the likelihood of perceiving sounds as geminates. CD (GRCD, VTCD, CYCD) was a statistically significant predictor only for Cyprus-oriented listeners. As GRCD and VTCD values rose, the odds of perceiving a sound as a geminate rose too, which does not support hypotheses I and II. The reason for this tendency seems to be difficult to explain at this stage. The way CYCD affected perception was the same as in all previous models, and it supported hypothesis I regarding how the production of geminates by a listener affects the perception of the singleton/geminate boundary.

As regards the influence the values of VOT produced by the listeners, CYVOT was significant in all models in which it was entered but depending on the group – Cyprus- or Greece-affiliated – the direction in which the variable affected the listeners was different. Hence, the longer CYVOT Cyprus-oriented listeners pronounced, the fewer stimuli they perceived as geminates, whereas the longer CYVOT Greece-affiliated listeners produced, the more stimuli they labelled as geminates. The latter trend was not in line with what was anticipated. It is difficult to establish

what could be the reason for this outcome, but it is likely that the result might be an effect of a smaller, and therefore not so reliable, sample of Greece-oriented listeners. However, it cannot be stated with confidence that this is the exact reason for such a result.

Greece-affiliated listeners were not significantly influenced by GRPLOS, CYPLOS and VTPLOS. However, this tendency might have been caused by a low number of Greece-affiliated listeners that took part in the study (only ten). Yet, the three variables had a significant impact on the perception of the singleton-geminate boundary by Cyprus-oriented listeners. Contrary to what was expected, the longer GRPLOS and VTPLOS the listeners produced, the more likely they were to perceive the sounds played in the experiment as geminates. The likelihood of Cyprus-affiliated listeners to perceive the stimuli as geminates declined as they produced longer CYPLOS. This direction was in line with earlier predictions.

In contrast to Cyprus-inclined listeners, the Greece-oriented ones were affected by gender but not by their own values of plosives except for CYVOT. Also, they were not affected by their identity score. It is interesting to speculate on what could be the reason for this group of subjects to be affected by fewer variables. One of the explanations for the lack of significance of many of the variables is the small sample of Greece-oriented listeners (ten). The lack of significance of variables such as VTCD, VTVOT, GRCD and GRVOT might in a way support this claim. It seems fair to assume that, through more extensive exposure to SMG, Greece-oriented listeners would have developed categories of singleton plosives rich in exemplars deriving from SMG spoken by Greeks. For such listeners it would be more likely to be affected by the way they produce singleton plosives, especially those plosives appearing in *vata*. It is likely, then, that sample of listeners was too small for the significance of the discussed variables to be detected by the statistical test. It also seems possible that the way the listeners pronounced the singletons was still not close enough to the exemplars of sounds the listeners stored in their memories due to limitations in the mastery of production of those sounds. However, it might be possible that there are some other factors behind such discrepancies. Yet, similar patterns are not observed in models fitted to data collected in experiment 1 or in models fitted to combined data from experiments 1 and 2.

7.5.4 Results by gender

The analysis of the data by gender repeated some of the results of previous analyses carried out on the same data and revealed some new relationships between some of the variables. In models 2kf – 2mv CD and VOT had the same influence on the data as previously, and the ID score turned out to be significant once again showing the same type of effect on listeners' responses thus

adding further evidence to the claim that the potential amount of exposure to SMG linked to the ID score may have an influence on the perception of the continuum.

Table 7.22 Models fitted to data collected from male (MALE) and female (FEMALE) listeners separately (experiment 2).

Model		2kf FEMALE	2lf MALE	2mf FEMALE	2nf MALE	2kv FEMALE (vt)	2lv MALE (vt)	2mv FEMALE (vt)
N		2280	1560	2280	1560	2280	1560	2280
Omnibus tests	Chi Square	1924.84	1331.73	1910.48	1327.73	1952.44	1336.28	1926.45
	Df	7	6	7	6	8	7	8
	Sig.	.000	.000	.000	.000	.000	.000	.000
% of correctly predicted responses	[t]	86.6	87.6	88.3	88.0	87.3	87.6	
	[t:ʰ]	92.3	92.0	91.9	91.0	91.3	92.0	
	Total	90.0	90.1	90.5	89.7	89.7	90.1	
% of variance predicted in responses (Cox & Snall R Square - Nagelkerke R Square)		57.0 – 77.2	57.4 – 77.1	56.7 – 76.9	57.3 – 77.0	57.5 – 77.9	57.5 – 77.7	57.0 – 77.3
Significance of the independent variables								
Entered variables	VOT	.000 +	.000 +	.000 +	.000 +	.000 +	.000 +	.000 +
	CD	.000 +	.000 +	.000 +	.000 +	.000 +	.000 +	.000 +
	ID	.000 -	.000 -	.000 -	.003 -	.000 -	.000 -	.000 -
	Socio	/	.000 -	.022 +	.004 -	.033 +	.000 -	.014 +
	RES	/	/	.000 +	/	.001 +	/	.039 +
	GREEK FLAG	.011 +	/	/	/	.031 +	.014 −	.005 +
	CYPRIOT FLAG	.011-	/	/	/	.031 -	.014 +	.005 -
	GRCD	.000 +	.000 -	/	/	/	/	/
	CYCD	.000 -	/	/	/	.000 -	.000 -	/
	VTCD	/	/	/	/	.000 +	/	/
	GRVOT	.000 -	.000 -	/	/	/	/	/
	CYVOT	/	/	/	/	/	.001 -	/
	GRPLOS	/	/	.000 +	.027 -	/	/	/
	CYPLOS	/	/	.000 -	.022 -	/	/	.047 -
	VTPLOS	/	/	/	/	/	/	.000 +

SOCIO was significant in models 2lf – 2mv, but it appeared to affect male and female listeners differently. Female listeners tended to perceive more geminates the higher their status was, whereas male listeners demonstrated the opposite tendency; the higher they were on a socio-economic ladder, the less likely they were to classify the heard sounds as geminates. Such an inclination might be explained through referring to differences in social needs of both genders. Namely, women's increasing awareness of geminates linked to increasing social status/prestige might be explained as a result of their attempt to build their social status through using symbols

of power including linguistic ones, such as more frequent use of standardised speech (Eckert 1989, Labov 1990). In order to project the image of women with high social status, women are likely to draw more attention to the use of more prestigious forms and therefore develop a sharper sensitivity to certain phonetic detail. Thus, it is fair to assume that to find themselves in a situation of having actual social or economic power, women first need to develop their powerful image. In contrast, men, who are claimed to gain power through earning money and holding respectable jobs, are likely to be less sensitive to the social meaning of sounds the higher socio-economic status they have. Hence, a male study participant who managed to achieve success/prestige/power in socio-economic terms may feel that he does not need to resort to linguistic devices to prove his position in a society and may therefore have a weakened sensitivity to social meaning of sounds.

Only seven listeners taking part in this experiment came from rural areas and only two of them were male. This might be the reason why RES was not a significant factor for male listeners. Despite only five female listeners being village residents, RES turned out to be a statistically significant factor in three models which were fitted to the data collected from female subjects only. According to this result, women residing in urban areas were more likely to hear the stimuli as geminates than women from rural areas were. This outcome may indicate that residents of cities may have more interactions involving the use of SMG and therefore may have better developed their categories of non-contrastive singleton. However, the result may also be an offshoot of the fact that only five female listeners in this study came from rural areas.

The effect of flags was not significant in three out of seven models presented in this set. Two of the insignificant results appeared in models fitted to data collected from men and one of the insignificant results was obtained in the model fitted to female data. The models in which the influence of flags was significant suggested that both sexes were affected by the presence of flags differently. Specifically, in the presence of the Cypriot flag, female listeners were less likely to perceive the sounds as geminates, while when exposed to the Greek flag the tendency was reversed. Men, on the other hand, were more likely to label the stimuli as geminates in the presence of the Cypriot flag, whereas the presence of the Greek flag had the opposite effect on them.

Similar tendencies have been previously reported by Hay et al. (2006a) and Hay and Drager (2010). In their interpretation of the results, Hay and Drager (2010) suggest that New Zealand men distanced themselves from Australian culture. However, the mean ID score of all male listeners who took part in the present study indicate that male listeners in both conditions in the

present study on average were more Greece- than Cyprus-oriented (ID=2.745 in the Greek condition and ID=2.77 in the Cypriot condition). Also, 42.9% of listeners in the Greek condition had their ID score below 3.00, while 44.4% of those in the Cypriot condition had their ID score lower than 3.00. What is more, average ID scores of female subjects in the same study were higher than those of male study participants (3.46 in Greek condition; 3.43 in Cypriot condition), which means that women were more Cyprus-oriented on the whole and stood greater chances of distancing themselves from the Greek culture. These numbers make the interpretation by Hay and Drager (2010) seem less likely to be applicable in the present study, unless it is assumed that the 53.6% of male listeners who were more Cyprus-affiliated had tried to distance themselves from Greek culture. However, this cannot be ascertained with the present data.

Another way of explaining the inclination of male listeners in the present study could be that being exposed to a Cypriot flag, male listeners assumed that they would hear many geminates, since Greek Cypriots are widely known to use them, and therefore they relied more on the stereotype than on the actual acoustic signal. Opposite behaviour in the presence of the Greek flag could then be explained by the binary character of the independent variables 'Greek flag' and 'Cypriot flag' as entered in the models or by using the opposite stereotype instead of acoustic signal when being exposed to the Greek flag. The opposite stereotype would be that Greeks, who use SMG, do not use geminates. In such a situation the listeners would be expecting to hear singletons, and upon hearing a plosive with intermediate CD and VOT values, the listeners would rely more on the stereotype than on the actual acoustic features of the plosives. Why would female listeners not use the stereotype in the same way, then?

It is likely that due to their presumed inner need to strive for prestige (Labov 1990; Eckert 1989), women might have paid more attention to the stereotype carried by a symbol associated with higher prestige, but in a different way from men. Specifically, instead of assuming that they would hear singleton plosives in the presence of the Greek flag, they became more attentive to the features of the acoustic signal. Such increased attention to detail might have caused them to notice even the smallest increases in the values of CD and VOT. Therefore, their inclination to label more sounds as geminates in the presence of a Greek flag might be stronger than that of male listeners. It is also possible that in the presence of the Cypriot flag, female listeners were more 'relaxed' and did not pay so much attention to acoustic detail, hence labelling fewer stimuli as geminates. Nevertheless, such a result might also have been an outcome of the binary character of the data in this section.

One more piece of evidence for this outcome is linked to the results of statistical tests comparing means of CD and VOT in [t] uttered in *feta* and *vata* produced by the listeners who took part in this experiment. The tests revealed that there was a statistically significant difference in the value of CD in both words (p<.0005 in Mann-Whitney U test and in t-test) and that the difference in the mean values of VOT of *vata* and *feta* was close to statistically significant (p=.015 in Mann-Whitney U test and p=.068 in t-test). In such a situation it might be assumed that female listeners paid equal attention to acoustic detail when exposed to both flags, but when processing acoustic features of speech in the presence of the Cypriot flag, and knowing that Cypriots tend to produce longer VOT and CD even when producing singletons, they simply allowed slightly longer plosives to be labelled as singletons.

In order to solve the problem of the binary character of data regarding the influence of the presence of the Greek and the Cypriot flag additional models were fitted to data that were collected in experiments which involved the use of flags and from the experiments in which flags were not used. The models are discussed in section 7.6.

GRCD and GRPLOS were significant predictors for male and female listeners, yet they had a different effect on the two groups. In female listeners, the longer the GRCD and GRPLOS were, the higher the odds of perceiving the stimuli as a geminate. The trend was opposite for men. It is unclear why the way GRCD and GRPLOS affected the genders differently, but it was the trend which was followed by male listeners that was in line with earlier predictions about how the values of plosives produced by listeners would affect their perception. As regards VTCD and VTPLOS, they significantly affected only female listeners. Female listeners were more likely to label the sounds as geminates, the longer VTCD and VTPLOS female listeners produced themselves. Also this trend was opposite to what was anticipated. CYCD did not seem to significantly affect male listeners in one model (2lf). In the remaining models, regardless of the gender of listeners, the likelihood of perceiving a stimulus as a geminate declined as the value of CYCD increased. CYPLOS, whenever significant, affected both genders equally. The longer CYPLOS the listeners produced the fewer stimuli they labelled as geminates. The tendencies followed by CYPLOS and CYCD were in line with hypothesis I.

GRVOT turned out to be a significant predictor for men and women affecting them in the same way. Namely, the longer GRVOT they produced, the less likely they were to classify the heard sounds as geminates. This result is in conformity with prior predictions. CYVOT, which was significant only in one model fitted to data collected from male speakers (2lv), also affected

responses of the listeners in the expected way. The B coefficient suggested that the longer the value of CYVOT was, the fewer played speech samples male speakers recognised as geminates.

7.5.5   Results by place of residence

Analysis of the data by place of residence was also carried out. The models generated did not differ from the earlier ones in the way CD and VOT of the stimuli affected perception of the target sounds. The way in which the ID score influenced listeners' perception depended on whether the model was fitted to data collected from village or city/town residents. Residents of urban areas were inclined to perceive fewer stimuli as geminates the more they were affiliated with Cyprus. This trend was as anticipated. Village residents followed the opposite trend, just the way village residents from experiment 1 had (see table 7.14, section 7.4.4). This trend is difficult to explain, but it is likely that it could have been caused by the small sample of village residents (eight out of thirty-six).

The small number of participants from rural areas might have also been a reason for confusing results regarding the influence of listeners' socio-economic background on their perception of the continuum. SOCIO turned out to be significant only in two models fitted to data collected from listeners from rural areas. However, in one of the models (2of) the B coefficient suggested that the more prestige a listener had, the less likely that person was to perceive the heard stimuli as geminates, whereas in the other model (2ov) the tendency was the reverse. The results in equivalent models fitted to data collected in the first perceptual study were not that imbalanced and indicated that rural listeners tended to perceive fewer stimuli as geminates the higher their socio-economic background was. The opposing trends in models 2of and 2ov might be a result of a small sample of listeners from rural areas (eight out of thirty six). However, models fitted to rural data from experiment 1 and models fitted to combined rural data collected in experiments 1 and 2 (see section 7.6.4) indicate that listeners' sensitivity to small increases in the length of plosives fell as their socio-economic background decreased. Therefore, it might be likely that the tendency could be a result of listeners' satisfaction with their status and the place where they reside. Such listeners may not feel such a strong need to build their prestige by means of using more prestigious language forms. The lack of attention to prestigious forms in language might have influenced their perception of language elements that carry prestige.

Table 7.23 Models fitted to data collected from residents from rural (RURAL) and urban (URBAN) areas separately (experiment 2).

Model		2of RURAL	2pf URBAN	2qf RURAL	2rf URBAN	2ov RURAL (vt)	2pv URBAN (vt)	2rv URBAN (vt)
N		1080	2760	1080	2760	1080	2760	2760
Omnibus tests	Chi Square	962.77	2241.83	947.9	2234.5	997.41	2257.92	2251.27
	Df	6	6	6	5	9	9	7
	Sig.	.000	.000	.000	.000	.000	.000	.000
% of correctly predicted responses	[t]	89.8	86.8	89.6	86.5	89.8	86.6	86.5
	[t:^{h}]	93.2	90.7	93.7	91.3	93.2	91.3	91.2
	Total	91.9	89.1	92.0	89.3	91.9	89.4	89.2
% of variance predicted in responses (Cox & Snall R Square - Nagelkerke R Square)		59.6 – 80.6	55.6 – 75.0	58.4 – 79.0	55.5 – 74.8	59.5 – 80.5	55.9 – 75.3	55.8 – 75.2
Significance of the independent variables								
Entered variables	VOT	.000 +	.000 +	.000 +	.000 +	.000 +	.000 +	.000 +
	CD	.000 +	.000 +	.000 +	.000 +	.000 +	.000 +	.000 +
	ID	/	.000 -	.039 +	.000 -	.000 +	.000 -	.000 -
	SOCIO	.001 -	/	/	/	.015 +	/	/
	GENDER	/	/	.012 -	.035 -	/	.009-	.000-
	GREEK FLAG	/	/	.000 +	/	.000 +	.039 +	.028 +
	CYPRIOT FLAG	/	/	.000 -	/	.000 -	.039 -	.028 -
	GRCD	.000 +	.005 +	/	/	/	/	/
	CYCD	/	.000 -	/	/	.000 +	.002-	/
	VTCD	/	/	/	/	.000 -	.000 +	/
	GRVOT	.000 -	/	/	/	/	/	/
	VTVOT	/	/	/	/	.001-	.038 +	/
	CYVOT	.002 +	.004 -	/	/	.000 +	.018-	/
	CYPLOS	/	/	.031 +	.004 -	/	/	.014 -
	VTPLOS	/	/	/	/	/	/	.000 +

As regards gender, in all models in which the variable turned out to be significant, female listeners were less likely to perceive target sounds in the experiment as geminates. The result is surprising as in equivalent models fitted to data collected without the use of flags and from listeners from urban areas the tendency was in the opposite direction. The direction is not only difficult to explain, but also it cannot be attributed to an error caused by a low number of study participants from urban areas. The trend can neither be explained the same way as it might be in the case of the models fitted to data coming from villagers. The only factor which might be blamed for this state of affairs is the presence of flags. Yet, it is difficult to see how the presence of the flags might affect this relationship. As regards the way gender affected the listeners from rural areas, it

was the same as in models 1lv and 1nv, hence the results might be interpreted the way they were for those models.

The presence of flags proved to be insignificant only in three models. In the remaining models, the presence of the Cypriot flag reduced the odds of stimuli being heard as geminates, whereas the presence of the Greek flag had the reverse effect. The directions in which the flags affected the listeners might mean two things. First of all, the directions might indicate that in the presence of a Cypriot flag the listeners were less sensitive to small increases in the length of plosives and therefore accept longer plosives as singletons. The other explanation could be that when being exposed to a Cypriot flag, the listeners may be using stereotypes attached to Cypriot speakers and expect to hear singletons to be slightly longer than they would be when pronounced by Greeks. In the case of the influence of the Greek flag, the explanation could be that upon being exposed to the Greek flag the listeners may become more alert to small increases in the duration of plosives and label more stimuli as geminates. Yet, it needs to be remembered that the binary character of the results for the influence of the Greek and the Greek Cypriot flag might be an outcome of the way the data were entered in the model which caused that the presence of one flag will always give the opposite effect to the presence of the other flag (see section 7.5.1). Equivalent models which do not have this problem are discussed in section 7.6.4.

Both GRCD and VTCD were significant in several models in which they were entered, but they did not affect the perception of stimuli in the same way. In contrast to what was anticipated, the increase in the values of GRCD amplified the number of stimuli being perceived as geminates. As VTCD increased for village citizens the likelihood of stimuli of being classified as geminates decreased; this was in line with the predictions. Residents of urban areas were affected in the opposite way. CYCD also proved to be a significant factor. For listeners from urban areas the longer the CYCD, the fewer stimuli they classified as [t:^{h}], whereas the longer CYCD the residents of rural areas produced, the more geminates they heard in the experiment. The tendency followed by the listeners from villages was not predicted. This result might have been caused by the small size of the sample of listeners from rural areas.

GRVOT was significant in only one model (2of fitted to the village data), and, in line with the expectations, as it rose, the number of perceived geminates dropped. As regards VTVOT, its values had a different influence on residents of rural and urban areas. The longer VOT the residents of villages produced, the fewer sounds they classified as [t:^{h}]. The inclination was opposite for residents of towns/cities and it was not in line with what was anticipated. Finally, the longer CYVOT villagers produced, the more sounds they labelled as geminates, but the longer

CYVOT residents of cities uttered, the less likely they were to perceive the stimuli as [t:ʰ]. The latter of the two trends was in the predicted direction.

CYPLOS was significant in three out of four of the models in which it was entered. The B coefficient values imply that the longer CYPLOS values were produced by residents of urban areas the fewer stimuli they labelled as geminates, but residents of rural areas tended to label more sounds as [t:ʰ] the longer CYPLOS they uttered. In this case, only the inclination of city residents was predicted. GRPLOS was not significant in any of the models in which it was entered. VTPLOS turned out to affect only the listeners from towns/cities. Against the expectations, the longer VTPLOS the listeners produced, the more sounds they perceived as [t:ʰ].

7.6   Experiments 1 and 2 combined data: results and discussion

Since in the section 7.5, all the results presented were results of models in which the presence of flags was a dichotomous variable (the presence of one flag meant the absence of another), the influence of one of the flags was reported to be the opposite to the influence of the other. Such results did not facilitate a detailed analysis of the ways the presence of either of the flags influenced the perception of the singleton/geminate boundary. Using pooled data from experiments 1 and 2 should be a solution to the binary character of the results, since pooled data from both experiments included data collected in the presence of the flags and in the absence of any of them. Hence, all models presented in this section are fitted to data collected in experiments 1 and 2 combined.

7.6.1   Overall results

All the data collected in experiments 1 and 2 were analysed by means of logistic regression. The dependent variable was listeners' responses in experiments 1 and 2, whereas the independent variables were VOT, CD, SOCIO, ID, RES, GEN, the Greek flag, the Cypriot flag, GRCD, GRVOT, CYCD, CYVOT, GRPLOS and CYPLOS.

Table 7.24 presents four models fitted to data collected in experiments 1 and 2. Just as in the case of all the previous models, increase in the values of CD and VOT caused an increase in the labelling of the sounds as geminates. ID and RES were also significant predictors in models presented in table 7.24. Once again, the B coefficient values implied that ID scores influenced sound perception in line with hypothesis III. As regards the influence of RES, it appears that listeners from urban areas classified more sounds played in the experiment as geminate sounds.

Table 7.24 Models fitted to all data collected in experiments 1 and 2.

Model		3af	3bf	3av	3bv
N		8040	8040	8040	8040
Omnibus tests	Chi Square	6241.56	6235.62	6376.83	6364.3
	Df	5	6	7	7
	Sig.	.000	.000	.000	.000
% of correctly predicted responses	[t]	86.8	86.5	87.4	87.0
	[t:^{h}]	91.4	91.4	91.7	91.4
	Total	89.5	89.4	89.9	89.7
% of variance predicted in responses (Cox & Snall R Square - Nagelkerke R Square)		54.5 – 73.7	54.5 - 73.6	54.8 – 74.0	54.7 – 73.9
Significance of the independent variables					
ENTERED VARIABLES	VOT	.000 +	.000 +	.000 +	.000 +
	CD	.000 +	.000 +	.000 +	.000 +
	ID	.000 -	.000 -	.000 -	.000 -
	RES	.000 +	.000 +	.001 +	.000 +
	GREEK FLAG	/	.024 +	.049 +	.020 +
	VTCD	/	/	.000 +	/
	CYCD	.000 -	/	.000 -	/
	CYPLOS	/	.000 -	/	.000 -
	VTPLOS	/	/	/	.002 +

In none of the four models did the effect of the Cypriot flag prove to be statistically significant. The influence of the Greek flag turned out to be statistically significant in three of the models presented. In model 3af it was not significant; however, it should be noted that in a model similar to 3af, from which the 'Greek flag' variable was not removed, the coefficient's p was not that high (p=.065). That model was also a significant one (chi=6244.977, df=6, p<.0005) and could predict 89.6% of overall responses, which is slightly more than 3af can. The p value in model 3av was also quite high (.049). Judging from the p values, it might be inferred that the Greek flag had some effects on the study participants, but the effects were weak. Throughout this section, positive B coefficients for the GREEK FLAG and CYPRIOT FLAG mean that listeners were more likely to classify heard sounds as geminates in the presence of the Greek flag. A negative B statistic stands for the opposite trend. In all the models, (3bf, 3av, 3bv) the positive B coefficient values suggest that the presence of the Greek flag increased the number of stimuli classified by the listeners as geminates. This trend was in agreement with earlier predictions and suggests that in the presence of the Greek flag the study participants became more sensitive to phonetic detail and accepted fewer sounds as singletons, labelling a greater number of plosives with intermediate CD and VOT values as geminates. Alternatively, it might be assumed that while being exposed to the Greek

flag the listeners assumed that the samples would include more singletons as Greeks do not use geminates, and therefore the listeners tended to rely on the visual (indexical) cue instead of the phonetic cues when hearing some of the stimuli with intermediate plosive values which were more difficult to classify as either singletons or geminates. No matter which of the two explanations is correct, the results indicate that while processing speech, listeners tend to use indexical information.

CYCD, CYPLOS, VTCD and VTPLOS also turned out to have a significant influence on the responses in the models in which they were entered, and their influence was in line with hypotheses I and II. Yet, neither GRCD nor GRPLOS were significant predictors in models fitted to all data coming from both experiments, although they were significant in several other models fitted to some of the data collected for the purpose of this study. This might suggest that GRCD and GRPLOS might have been weaker predictors than VTCD and VTPLOS. GRCD and GRPLOS might have been weaker as predictors due to their status. As these plosives are in the word context in which they are pronounced as singletons in SMG and as geminates in CG, the Greek Cypriot study participants may not have been able to suppress gemination completely when using SMG, so as a result the VOT and CD values of the plosives uttered may not have been entirely equivalent to those which are stored in the same speakers' memories.

In fact, a Mann-Whitney U-test and a t-test comparing differences in VOT and CD normalised (using the procedure discussed in section 7.2.5) mean values in *feta* and *vata* pronounced in SMG by participants of both experiments show that VOT and CD in *feta* were significantly longer than in *vata*. Thus, it might be possible that the values of CD and VOT for singleton plosives which are stored in speakers' memories are different from the words the speakers produce; this might be a result of limitations in production and of difficulties in suppressing gemination. The lack of control over suppressing gemination by the speakers seems to be further supported by the standard deviation values for CD and VOT which were larger in case of GRCD and GRVOT.

7.6.2 Results by gender

Analysis of the data by gender, which is presented in table 7.25, enabled the examination of how the stimuli were processed by male and female listeners. As in previous tests, also here CD and VOT were significant in every model fitted and the changes in values of the two variables affected the responses the same way as it did in the earlier models.

Table 7.25 Models fitted to data collected from male (MALE) and female (FEMALE) listeners separately (experiments 1 and 2 combined).

Model		3cf FEMALE	3df MALE	3ef FEMALE	3ff MALE	3cv FEMALE	3dv MALE	3ev FEMALE
N		4440	3600	4440	3600	4440	3600	4440
Omnibus tests	Chi Square	3520.12	2881.56	3529.92	2871.4	3543.38	2885.19	3545.68
	Df	5	6	8	5	7	7	8
	Sig.	.000	.000	.000	.000	.000	.000	.000
% of correctly predicted responses	[t]	88.1	87.2	87.3	87.1	87.2	87.6	87.6
	[t:h]	91.8	91.5	92.0	91.7	92.0	91.3	91.5
	Total	90.4	89.7	90.1	89.8	90.1	89.8	90.0
% of variance predicted in responses (Cox & Snall R Square - Nagelkerke R Square)		54.7 – 74.2	55.1 – 74.2	54.8 – 74.3	55.0 – 74.0	55.0 – 74.5	55.1 – 74.3	55.0 – 74.5
Significance of the independent variables								
Entered variables	VOT	.000 +	.000 +	.000 +	.000 +	.000 +	.000 +	.000 +
	CD	.000 +	.000 +	.000 +	.000 +	.000 +	.000 +	.000 +
	ID	/	.000-	.005 -	.001 -	.000-	.000-	.000 -
	RES	/	/	.010 +	/	.012 +	.014 +	.000 +
	SOCIO	/	/	.050 +	/	/	/	.016 +
	GREEK FLAG	.020 +	/	/	/	/	/	.014 +
	CYPRIOT FLAG	.027-	.020 +	.018 -	/	.011-	/	/
	GRCD	.005 +	/	/	/	/	/	/
	VTCD	/	/	/	/	.000 +	/	/
	CYCD	/	.000 -	/	/	.006 -	.000 -	/
	CYVOT	/	.008 -	/	/	/	.001 -	/
	VTVOT	/	/	/	/	/	.025 +	/
	GRPLOS	/	/	.000 +	.000 -	/	/	/
	VTPLOS	/	/	/	/	/	/	.000 +
	CYPLOS	/	/	.001 -	.017 -	/	/	.000 -

The ID score affected male and female listeners. The only model in which ID score did not prove to be significant was model 3cf, which was fitted to data collected from women. As expected, the more men and women were affiliated with Cyprus, the less likely they were to perceive the sounds heard as geminates. These results replicate the results of equivalent models fitted to data collected in Greek and Cypriot conditions (models 2kf-2mv in table 7.22). Equivalent models which were fitted to data collected without the exposure to any of the flags indicated that female listeners tended to perceive more geminates the more affiliated the female listeners were with Cyprus. It is, however, unclear why the results of models fitted to data collected in experiment 1 were different from those in models fitted to all data or data from all the three conditions.

RES was significant only in some of the models in this set (3ef, 3cv, 3dv and 3ev). As in former models in which RES was significant, models suggested that being a resident of an urban area increased the number of stimuli that were perceived as geminates.

The role the presence of both flags played in these models was somewhat different from what could be observed in the models fitted to all the data collected in experiments 1 and 2. Although the presence of the Greek flag had a significant effect on the responses in models 3bf, 3av and 3bv (see table 7.24), in this series it significantly affected responses in only two models (3cf and 3ev) and both of the models were fitted to data collected from female listeners. The way the presence of the Greek flag influenced the responses was the same as in earlier models. More precisely, its presence increased the odds of female listeners perceiving the stimuli as geminates. Such an inclination appears to confirm earlier claims made regarding equivalent models fitted to experiment 2 data only that female listeners, who may have increased sensitivity to the presence of indexical information that may carry social meaning such as social prestige, may pay more attention to acoustic detail when being exposed to indexical cues.

The fact that in these models the Greek flag turned out not to have any influence on male listeners seems to support the theory that in the equivalent models fitted to data from experiment 2 only, the significance of the Greek flag was only a result of the binary character of the independent variable. This assumption would then further support the claim that male listeners' choices of labels for the heard stimuli do not signify that the listeners distance themselves from Greek culture. If they did, the influence of the Greek flag would be significant in the models discussed in this section.

Even though the presence of the Cypriot flag was not significant in models fitted to all the combined data from experiment 1 and experiment 2, in this series it turned out to significantly affect responses in four out of seven models. Only one of the models in which the presence of the Cypriot flag was significant was fitted to data collected from male listeners. Also, the two genders were influenced differently; female listeners classified fewer sounds as geminates while exposed to the flag, whereas male listeners perceived more stimuli as geminates in the Cypriot condition.

The tendency followed by female listeners seems to suggest that in the presence of the Cypriot flag women become less concerned about social prestige and therefore allow longer plosives to be classified as singletons. It seems that their sensitivity to the small differences in the values of CD and VOT decreases in the presence of the Cypriot flag. Alternatively, it may be understood that female listeners do pay attention to the changes in VOT and CD length; nonetheless, since the

values in such a context are likely to be pronounced longer as compared to singletons in words such as *vata*, the female listeners allowed for longer VOT and CD values to be labelled as singletons.

Male listeners, on the other hand, appear to rely on the stereotype instead of acoustic features of speech when exposed to the Cypriot flag. Thus seeing a Cypriot flag, and knowing that Cypriots are likely to use geminates in the given word context, male listeners tend to rely on the stereotype when encountering plosives with values which are intermediate between a geminate and a singleton and classify more plosives as geminates. The ways the presence of flags influenced men and women suggests that even though representatives of both genders use indexical information in sound processing, they are likely to use the information in different ways. Men seem to use stereotypes and label ambiguous sounds on the basis of the stereotypes attributing the ambiguous sounds with features with which the stereotyped speech would be characterised. In contrast, upon being exposed to symbols representing any of the cultures, women pay more attention to the acoustic signal and filter this information according to what values are expected to be heard for a given sound in a given culture/cultural setting. When filtering, women tend to aim at choosing the best possible match. This scenario was already taken into consideration when equivalent models fitted to experiment 2 data only were analysed.

GRCD and VTCD were significant predictors only for female subjects. Increases in their values amplified the likelihood of female listeners perceiving experiment stimuli as geminates. This result was opposite to what was anticipated. An increase in the value of CYCD, as expected, caused a drop in the odds of perceiving the stimuli as geminates. CYVOT and VTVOT had an influence on the responses of male listeners only. In contrast to the effect of VTVOT, the longer the CYVOT was, the lower the likelihood was that men would label a heard sound as a geminate. Thus, only the trend followed by CYVOT was as predicted.

GRPLOS proved to be a significant predictor; however it influenced the two genders in different ways: the longer the plosives women produced, the more sounds heard in the experiment they labelled as geminates. Male listeners were affected in the opposite way. Female listeners were also affected by the length of VTPLOS, and they were affected by its length in the same way as they were affected by GRPLOS. Both trends were again in contrast to what was predicted. VTPLOS did not turn out to be a significant factor for male listeners, whereas the influence of CYPLOS was not significant only in one model which was fitted to male data. In all the remaining models in which CYPLOS was entered, B coefficient values suggested that, in line with the predictions, the

longer CYPLOS the listeners produced themselves the less likely they were to label the stimuli as geminates.

7.6.3   Results by affiliation

There were also some differences in the ways perception by Greece-affiliated and Cyprus-affiliated listeners was affected by various variables. As presented in table 7.26, VOT and CD affected the listeners' perception the same way as in earlier models. In line with hypothesis III made prior to running the experiments, in all the models, regardless of which group the listeners belonged to (Greece- or Cyprus-oriented), the higher their ID score was (so the more they were Cyprus-inclined), the less likely they were to label the sounds played in the experiment as geminates.

Gender was significant only in three of the models in this set; two of them were fitted to data taken from Greece-oriented subjects, whereas the remaining one was fitted to data collected from the Cyprus-affiliated listeners. The B coefficient values suggest that men and women in both groups perceived the sounds differently. Regardless of whether the listeners were Greece- or Cyprus-affiliated, women were less likely to label the heard stimuli as geminates. The results, similarly to those of equivalent models fitted to experiment 2 data only, are not in line with the assumption that women are more sensitive to social information associated with sounds.

SOCIO turned out to significantly affect the perception of Greece-oriented listeners only. The more prestigious a position a person had in society, the more likely he/she was to perceive stimuli as geminates. As the elements on the basis of which SOCIO was calculated included place of residence (rural vs. urban), economic situation and educational background, it might be assumed that the higher SOCIO the better conditions the person had to get involved in activities bringing the person closer to mainland Greek culture and to improve his/her command of SMG. Thus, this result might reflect the situation in which, out of the listeners who are affiliated with Greece, those who have a more privileged socio-economic situation get better exposure to SMG and become more sensitive to small changes in the length of plosives. These results resonate with the hypothesis IV (chapter 5).

With regard to RES, it turned out not to be significant only in two models (3gv and 3iv). In the remaining ones, the B coefficient values suggested that being a resident of an urban area increased the likelihood of perceiving sounds as geminates. Village residents followed the opposite trend. This result is in line with those in earlier models. It was also suspected that in the speech of people from rural areas, non-contrastive singleton plosives might have different, longer

values than those produced by residents or urban areas. Such a state of affairs might influence the perceptual boundary between singletons and geminates in listeners from urban areas. However, a t-test and a Mann-Whitney U test revealed that there was no significant difference in VOT and CD values produced by study participants from rural and urban areas. This result seems to reject such a hypothesis.

Table 7.26 Models fitted to data collected from Greece-affiliated (IDGR) and Cyprus-affiliated (IDCY) listeners separately (experiments 1 and 2 combined).

Model		3gf IDGR	3hf IDCY	3if IDGR	3jf IDCY	3gv IDGR (vt)	3hv IDCY (vt)	3iv IDGR (vt)	3jv IDCY (vt)
N		1440	6000	1440	6000	1440	6000	1440	6000
Omnibus tests	Chi Square	1331.11	4499.93	1298.64	4605.77	1319.86	4645.52	1313.08	4621.56
	Df	8	7	7	6	8	8	5	8
	Sig.	.000	.000	.000	.000	.000	.000	.000	.000
% of correctly predicted responses	[t]	91.2	85.9	90.9	86.3	90.1	84.6	90.5	86.1
	[t:^{h}]	93.8	90.9	93.5	91.2	94.0	90.9	92.9	91.0
	Total	92.8	88.9	92.5	89.2	92.5	89.1	91.9	89.0
% of variance predicted in responses (Cox & Snall R Square - Nagelkerke R Square)		60.3 – 81.9	53.5 – 72.2	59.4 – 80.6	53.6 – 72.4	60.0 – 81.4	53.9 – 72.8	59.8 – 81.2	53.7 – 72.5
Significance of the independent variables									
Entered variables	VOT	.000 +	.000 +	.000 +	.000 +	.000 +	.000 +	.000 +	.000 +
	CD	.000 +	.000 +	.000 +	.000 +	.000 +	.000 +	.000 +	.000 +
	ID	.000 -	.000 -	.000 -	.003 -	.000 -	.000 -	.000 -	.000 -
	GENDER	.000 -	/	/	/	.007 -	/	/	.015 -
	SOCIO	.000 +	/	.000 +	/	.001 +	/	.005 +	/
	RES	.000 +	.000 +	.035 +	.001 +	/	.000 +	/	.000 +
	GREEK FLAG	/	.004 +	/	.006 +	/	.010 +	/	.003 +
	CYPRIOT FLAG	/	/	.006 -	/	/	/	/	
	GRCD	.000 -	/	/	/	/	/	/	/
	VTCD	/	/	/	/	.000 -	.000 +	/	/
	CYCD	.000 +	.000 -	/	/	.003 +	.000 -	/	/
	CYVOT	/	.000 -	/	/	.037 +	.000 -	/	/
	GRPLOS	/	/	.000 -	/	/	/	/	/
	VTPLOS	/	/	/	/	/	/	.000 -	.000 +
	CYPLOS	/	/	/	.000 -	/	/	/	.000 -

The presence of the Cypriot flag turned out to be significant only in one model in this set (3af). It proved to have a significant effect on Greece-inclined listeners. The presence of the Cypriot flag decreased the number of sounds perceived as [t:^{h}]. This direction might suggest that when exposed to the presence of the Cypriot flag listeners are less alert to small increases in the length

of singleton plosives or that they allow longer plosives to be labelled as singletons when seeing the flag since Cypriots are likely to produce longer singletons in words like *feta* even when using SMG .

Similarly to earlier models, in all models in this set which were fitted to data collected from the Cyprus-oriented listeners, the presence of the Greek flag increased the likelihood of sounds being perceived as geminates. Just as in the previous similar models, the direction may be interpreted in such a way that the presence of the Greek flag makes the listeners more alert to slight increases in the length of plosives which are meant to be singleton. As they become more alert to those changes they are more likely to classify such plosives as geminates.

GRCD was significant only for Greece-oriented listeners, whereas VTCD was significant for both groups (Greece- and Cyprus-affiliated). In line with hypotheses I and II, the greater the GRCD and VTCD was for Greece-oriented listeners, the lower the number of geminates they heard. In contrast, the longer VTCD was for Cyprus-affiliated listeners, the more sounds they perceived as geminates. Also, CYCD was significant in all models in this series and CYVOT in three out of four models. For Greece-affiliated listeners, the odds of perceiving a geminate increased as the values of CYCD and CYVOT increased, which seems difficult to explain, while for Cyprus-inclined listeners the trend was reversed and but consistent with hypothesis I.

Furthermore, GRPLOS was significant only for Greece-affiliated listeners and the longer GRPLOS the listeners produced the fewer sounds they were likely to perceive as [t:^{h}]. VTPLOS significantly affected both groups of listeners. However, the longer VTPLOS Greece-oriented listeners produced the fewer stimuli they labelled as geminates. Cyprus-affiliated listeners followed the opposite, unexpected, trend. CYPLOS affected only Cyprus oriented listeners. In agreement with earlier predictions, the longer CYPLOS they produced the fewer sounds they were likely to perceive as geminates.

7.6.4 Results by place of residence

Table 7.27 summarises models fitted to data collected from listeners from urban and rural areas separately. As in all models, the longer the CD and VOT in a stimulus the greater were the odds that the stimulus would be perceived as a geminate. ID score turned out to be a significant factor in five out of seven models: the more a listener was affiliated with Cyprus, the fewer plosives he/she classified as geminates.

Table 7.27 Models fitted to data collected from listeners from rural (RURAL) and urban (URBAN) areas separately (experiments 1 and 2 combined).

Model		3kf RURAL	3lf URBAN	3mf URBAN	3kv RURAL (vt)	3lv URBAN (vt)	3nv RURAL (vt)	3mv URBAN (vt)
N		2040	6000	6000	2040	6000	2040	6000
Omnibus tests	Chi Square	1581.24	4804.15	4799.52	1611.56	4814.65	1574.27	4812.75
	Df	6	5	4	10	6	6	6
	Sig.	.000	.000	.000	.000	.000	.000	.000
% of correctly predicted responses	[t]	88.8	87.6	86.9	87.5	87.7	86.1	87.1
	[t:h]	91.5	91.1	91.3	92.3	91.4	92.1	91.3
	Total	90.4	89.6	89.5	90.4	89.9	89.8	89.6
% of variance predicted in responses (Cox & Snall R Square - Nagelkerke R Square)		53.9 – 73.2	55.1 – 74.3	55.1 – 74.3	54.6 – 74.1	55.2 – 74.4	53.8 – 73.0	55.2 – 74.4
Significance of the independent variables								
Entered variables	VOT	.000 +	.000 +	.000 +	.000 +	.000 +	.000 +	.000 +
	CD	.000 +	.000 +	.000 +	.000 +	.000 +	.000 +	.000 +
	ID	/	.000 -	.001 -	.020 -	.000 -	/	.001 -
	GENDER	.000 -	/	/	.000 -	/	/	/
	SOCIO	.005 -	/	/	.000 -	/	.016 -	.005 +
	RES	/	/	/	/	/	/	/
	GREEK FLAG	.000 +	/	/	.000 +	/	.000 +	/
	CYPRIOT FLAG	/	/	/	/	/	/	/
	GRCD	/	/	/	/	/	/	/
	VTCD	/	/	/	.000 +	.000 +	/	/
	GRVOT	/	/	/	/	/	/	/
	CYCD	/	.000 -	/	.002 -	.000 -	/	/
	CYVOT	.000 +	.051 -	/	.001 +	.040 -	/	/
	VTVOT	/	/	/	.000 +	/	/	/
	GRPLOS	/	/	/	/	/	/	/
	VTPLOS	/	/	/	/	/	.004 +	.001 +
	CYPLOS	/	/	.000-	/	/	.003 -	.000 -

Female listeners from villages were less likely to perceive the sounds as geminates than their male counterparts from rural areas. This result is the same as in equivalent models fitted to data from the first and second experiment separately, thus the same explanations, however tentative, seem to apply in results of models 3kf and 3kv, which might suggest the effects of upbringing or the effects of a small sample size to be the factors behind the direction observed. Yet, it must be stressed that in the present models the number of listeners who came from rural areas (fifteen out of seventy-two) was higher than in the models fitted to data from experiment 1 and experiment 2 separately.

In models fitted to data from urban listeners (experiments 1 and 2 combined) gender did not turn out to be a significant factor even though it was significant in equivalent models fitted to data from experiments 1 and 2 separately. Interestingly, in models fitted to data from both experiments separately, the directions in which gender influenced perception were opposite (in experiment 1 female listeners heard more geminates and in experiment 2 male listeners heard more geminates), whereas in models fitted to pooled data gender turned out not to be a significant variable. As the lack of balance in these results could not be blamed on a small sample of listeners from urban areas, such a situation might mean that the presence of the flags might be influencing male and female listeners from towns and cities differently, that is in the presence of flags male listeners seem to be more likely to label the stimuli as geminates. Nevertheless, the relationship and its causes cannot be investigated further with the present data.
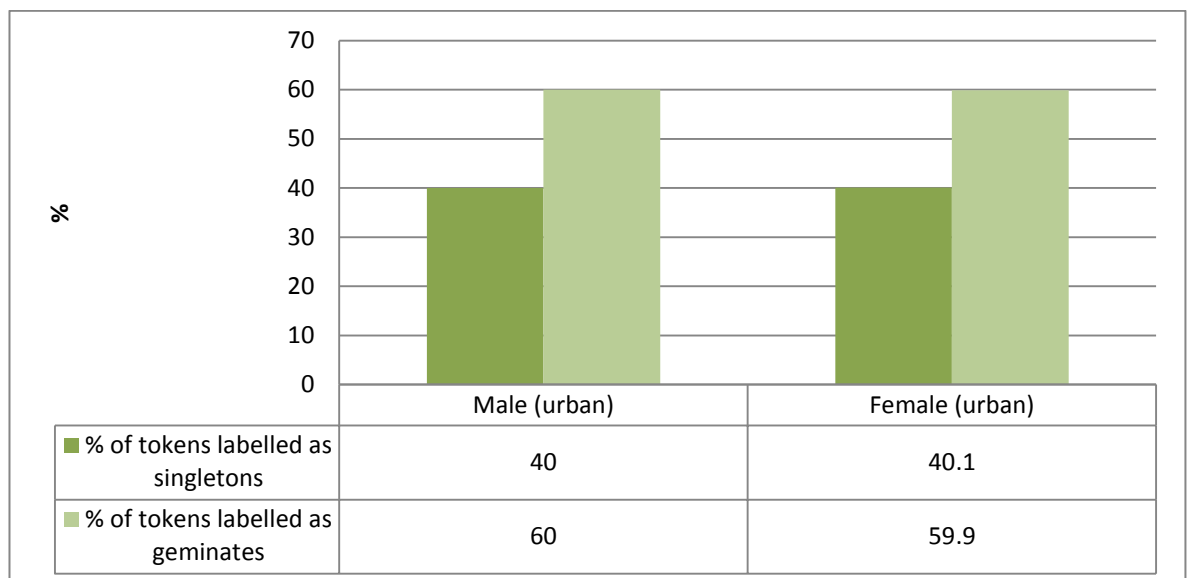
Figure 7.12 Percentage of tokens labelled as singletons and geminates by male and female listeners from urban areas taking part in experiment 1.

Another explanation could be that in the models fitted to the pooled data (from experiments 1 and 2) the effect of gender was cancelled due to an interaction between the tendencies observed in models fitted to data from experiment 1 and those observed in models fitted to data from experiment 2. A close look at the percentages of tokens perceived as geminates by male and female listeners across experiments (see figures 7.12, 7.13 and 7.14) seems to shed some light on this issue. Figures 7.12 and 7.13, summarising the percentages responses by male and female participants in experiments 1 and 2 respectively, suggest that the differences in percentages of tokens labelled as geminates are very small, especially in experiment 1 in which the difference is only 0.1% (in experiment 2 it is only 3.1%). This difference is also small in the data pooled from

both experiments (1.5% difference; see figure 7.14), and it indicates that men heard slightly fewer geminates than women heard. It seems likely that this lack of balance in the results might be an outcome of very small differences between the percentages of stimuli perceived as geminates which turned out to be significant in some of the models despite their low values.

	Male (urban)	Female (urban)
% of tokens labelled as singletons	42.4	39.3
% of tokens labelled as geminates	57.6	60.7

Figure 7.13 Percentage of tokens labelled as singletons and geminates by male and female listeners from urban areas taking part in experiment 2.

	Male (urban)	Female (urban)
% of tokens labelled as singletons	41.2	39.7
% of tokens labelled as geminates	58.8	60.3
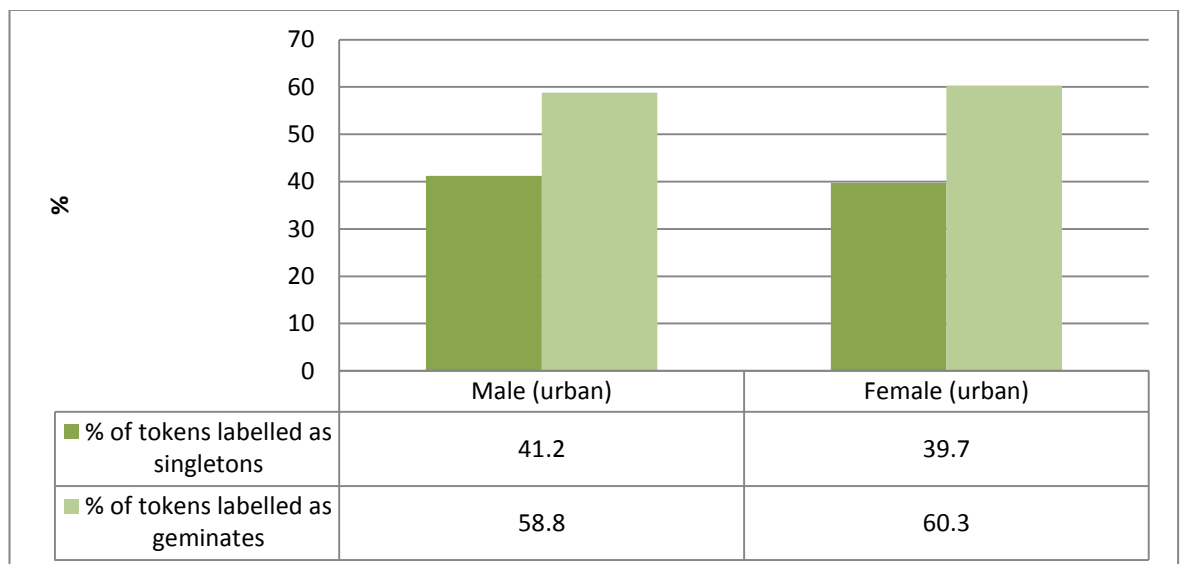
Figure 7.14 Percentage of tokens labelled as singletons and geminates by male and female listeners from urban areas taking part in experiments 1 and 2.

The higher the social status of a listener from a village was, the lower were the odds that he/she would perceive the stimuli as [t:ʰ]. Such a trend has already been observed in model 2ov fitted to data coming from village residents. Just as is the case in model 2ov, here the direction could be

analysed from the point of view of using linguistic tools to secure power. One might assume that the higher social status a person holds, the less that person needs to use linguistic devices to gain prestige (see section 7.5.5). SOCIO proved to be a significant factor in only one model fitted to data collected from residents of urban areas (i.e. 3mv). Yet, in that model, the B coefficient seemed to suggest that the likelihood of labelling stimuli as a geminate rose with the socio-economic background of the listener. This result is in line with hypothesis IV and the reasoning behind it.

Models 3kf, 3kv and 3nv seem to reinforce the result from models 1nf, 1nv and 2of which suggested that, for village residents, the ability to notice small increases in the length of plosives tends to decrease as their SOCIO increases. In the previous models (1nf, 1nv, 2of) one of the explanations of the tendency was the questionable reliability of the small sample of village residents. Models 3kf, 3kv and 3nv were fitted to a slightly increased number of study participants (fifteen), which might make this argument less convincing although not completely refutable. One more previously suggested explanation for such a propensity is that the higher the socio-economic background a village resident has, the more likely he/she is to be content with his/her situation and the place where the person resides. For that reason, such a person would be likely to be less interested in trying to gain prestige by using and paying attention to prestigious language forms. Such a person might also be appreciative of the local facilities and customs and seek less contact with urban culture and/or residents or even mainland Greek culture.

Another reason for such tendencies among residents of rural areas could relate to the claims that in villages speakers tend to use a 'stronger' Cypriot accent. The popular belief that villagers use more Cypriot features seemed to be supported by some of the discoveries by Yiakoumetti et al. (2005). Yiakoumetti et al. (2005), who researched the effect of a language learning programme on primary school children in Cyprus, tested the extent to which schoolchildren employed elements of SMG and elements of CG in speech and writing. The programme focused on teaching differences between SMG and CG and aimed to improve the students' skills at using SMG. The use of features of both varieties was measured by means of three tests that were administered at different stages of their programme. The first test, which was administered before children started the programme, revealed that children from rural areas tended to use more features of CG than children from urban areas did. It is not clear from the article whether the differences between the two groups related also to the length of plosives of the frequency with which geminate plosives are employed, however, such results appear to support a claim that village speakers may be using geminate plosives more frequently. In such a situation it could be possible

that even though village residents get educated, their speech remains heavily accented and may include higher frequencies of geminate plosives. This claim could be further supported by the data on language practices of teachers in class. Even though school teachers are required to use SMG in the classroom, Papapavlou (2004) reports that teachers do tend to switch to CG in class. This may imply that village children may not be exposed to SMG all the time while at school, especially that it is difficult to generalise over the accents with which all primary school teachers speak in Cyprus.

The majority of the listeners in this study were still university students and most of them held part time jobs. Thus, they were only about to start their professional careers, except for several listeners who could be classified as beginning professionals (FE13, FE26, ME4, ME28, ME29). For that reason, those listeners from rural areas who had a higher SOCIO index owed the high indexes to their education and their parents' financial and social position. It seems fair to expect that at that stage the SOCIO score might not have reflected the number of situations involving professional contact with urban or rural areas during which SMG would be used. Such individuals might be in a stronger/ more powerful social position without receiving increased exposure to singleton plosives in the relevant word context. This situation might be a cause of their decreased sensitivity to increases in the length of plosives.

It needs to be mentioned that the average SOCIO index of listeners from rural areas was 1.3 points lower than the average SOCIO index of the listeners from the cities. According to the results of the t-test, the difference between the averages is significant. Some might claim that the discrepancy in the ways SOCIO affected listeners from both groups (rural vs. urban) might be a result of the differences in the spread of SOCIO in both groups. However, it should be remembered that when the index was calculated, information regarding place of residence was also used. Thus, listeners who lived in cities were assigned between one to two points more depending on whether they lived in the centre or in the outskirts. Therefore, it might be assumed that the difference in means of SOCIO were a result of differences in place of residence and not of other socio-economic factors.

The presence of the Cypriot flag did not prove to have any effect on the listeners in any of the models 3kf – 3mv. However, it seems worth noting that in one model fitted to data collected from rural areas the p value for the Cypriot flag was .053 (chi 1615.336; df = 11; 90.1%; p = .053). In that model the presence of the Cypriot flag decreased the number of sounds perceived as geminates. The direction might indicate that the listeners influenced by the presence of the flag might have become less sensitive to increases in the length of plosives.

Interestingly, the presence of the Greek flag affected only listeners with a rural background. When exposed to the Greek flag the listeners tended to perceive more target sounds as [t:ʰ]. The direction in which the presence of the Greek flag influenced the reactions of the listeners can be interpreted as in the previous models in which the flag triggered the same behaviour. Thus, it might be inferred that the presence of the flag increased the listeners' sensitivity to increases in the length of plosives.

Neither GRCD nor GRVOT turned out to be statistically significant predictors in any of the models in which the variables were entered. However, VTCD proved to have a significant effect on listeners from urban and rural areas, and VTVOT had an influence on listeners from villages. Contrary to what was anticipated, whenever VTCD and VTVOT were significant the increase in their values meant an increase in the number of stimuli labelled as geminates. In line with earlier expectations, an increase in the value of CYCD meant a decrease in the number of stimuli being labelled as geminates. The increase in values of CDVOT had different effects in different models. In models fitted to data collected from the listeners from rural areas, an increase in the value of CYVOT caused an increase in the likelihood of stimuli being labelled as geminates, whereas in the models fitted to data collected from listeners from towns/cities the increase in CYVOT value was the opposite. Only the latter trend was in line with the hypotheses I and II.

Finally, GRPLOS turned out not to be statistically significant in any of the models in which it was entered in this set. The number of stimuli labelled as geminates rose with the length of VTPLOS produced by the listeners, while it dropped as the values of CYPLOS rose for the listeners. Only the tendency observed in the way CYPLOS affected the listeners' perception was according to the predictions made.

7.7 General discussion of all perceptual study results

This subchapter presents a summary of the most important findings of the present study and their discussion. First, discussed is how the values of CD and VOT stored in listeners' memories affect their perception of the singleton/geminate boundary (section 7.7.1). This discussion is followed by an analysis of the influence of the amount of exposure to SMG measured by means of ID score (section 7.7.2) and by means of SOCIO index (section 7.7.3). Section 7.7.4 focuses on the examination of the influence of the duration of plosives in the acoustic stimuli, whereas section 7.7.5 provides a discussion of the ways the presence of the Greek and the Cypriot flags affected listeners' perception of the boundary. Sections 7.7.6 and 7.7.7 sum up the way inclusion of gender

and place of residence benefitted the study as independent variables in logistic regression analyses.

7.7.1 The influence of the parameters of remembered categories

ET assumes that (1) parameters of the plosives produced by listeners match the parameters of plosives they store in their memories and (2) while processing an incoming sound, listeners try to match it to the most similar exemplar of a sound stored in their memory. Following these two assumptions, a set of hypotheses regarding perception of plosives were posed. Hypotheses I, Ia and Ib made predictions regarding the influence of the values of geminate plosives produced by listeners in this study, while hypotheses II, IIa and IIb concerned the influence of the length of singletons produced by these listeners.

Hypothesis I: The longer geminate plosives a person produces, the longer plosives that person will need to hear to classify them as a geminate plosive.

Hypothesis Ia: The longer VOT in geminate plosives one produces, the longer VOT one will need to hear to classify the consonant as a geminate plosive.

Hypothesis Ib: The longer CD in geminate plosives one produces, the longer CD one will need to hear to classify them as a geminate plosive.

Hypothesis II: The longer singleton plosives a person produces, the longer plosives that person will still perceive as singleton plosives.

Hypothesis IIa: The longer VOT in singleton plosives a person produces, the longer the VOT that person will perceive as belonging to singleton plosives.

Hypothesis IIb: The longer CD in singleton plosives a person produces, the longer CD that person will perceive as belonging to singleton plosives.

As far as the influence of geminate plosives' duration pronounced by the listeners are concerned, most of the significant results followed the direction predicted in hypotheses I, Ia and Ib and indicated that the longer geminate plosives one produces, the longer plosives one needs to hear to label them as geminates. There were a few instances of results which were opposite to the predicted ones, but most of the opposite results might have been an outcome of the small number of participants in the tested sample, except for one case (table 7.13, section 7.4.3) in which the opposite result occurred in models fitted to data collected from female listeners. Nevertheless, apart from those exceptions, statistically significant results appear to add evidence

to the hypothesis I that perception of the boundary depends on the length of geminate plosives produced by the listeners.

Figures 7.15, 7.16 and 7.17 illustrate the influence of CYCD, CYVOT and CYPLOS (in other words CD, VOT and PLOS of *feta* uttered in CG) in all the models fitted to all the three complete data sets (experiment 1, experiment 2 and both experiments combined) in which the variables turned out to be statistically significant predictors. It needs to be pointed out that the influence of VOT was not statistically significant in models fitted to all data from experiment 1 and all data from experiments 1 and 2 combined. For that reason, the data from these two sets are not included in figure 7.17. It also needs to be mentioned at this point that trend lines in figures 7.15, 7.16 and 7.17 were generated in order to provide a graphical visualisation of the direction of the trends that were indicated in the logistic regression results for CYCD, CYVOT and CYPLOS. The regression lines were not meant to visualise results of correlation tests between percentages of tokens labelled as geminates and the values of CYCD, CYVOT and CYPLOS. Such correlation tests were not a part of data analysis in this study and logistic regression tests, which were used for the analysis in this study, are based on calculation of probabilities and odds rather than percentages. For those reasons, r squared and p values are not given for any of the displayed regression lines. This is the case with all the figures illustrating similar correlations between percentages of tokens labelled as geminates and various independent variables included in the whole of section 7.7.

Figure 7.15 Percentages of tokens labelled as geminates as a function of CD values produced by listeners in *feta* in CG (CYCD).

Figure 7.16 Percentages of tokens labelled as geminates as a function of VOT values produced by listeners in *feta* in CG (CYVOT) (experiment 2).

Figure 7.17 Percentages of tokens labelled as geminates as a function of whole plosive values produced by listeners in *feta* in CG (CYPLOS).

In order to verify hypotheses II, IIa and IIb, the impact of two types of singleton plosives produced by the listeners was analysed. These included (1) singletons in words such as *feta*, in which the plosive may be pronounced as a singleton or a geminate depending on the language variety used, and (2) singletons in words such as *vata*, in which a plosive is always pronounced as a singleton regardless of the variety. The length of the first type has been referred to as GRPLOS, while its VOT and CD have been labelled as GRVOT and GRCD respectively. The duration of the second plosive type and of its sections have been referred to as VTPLOS (the whole plosive), VTCD (closure duration) and VTVOT (voice onset time).
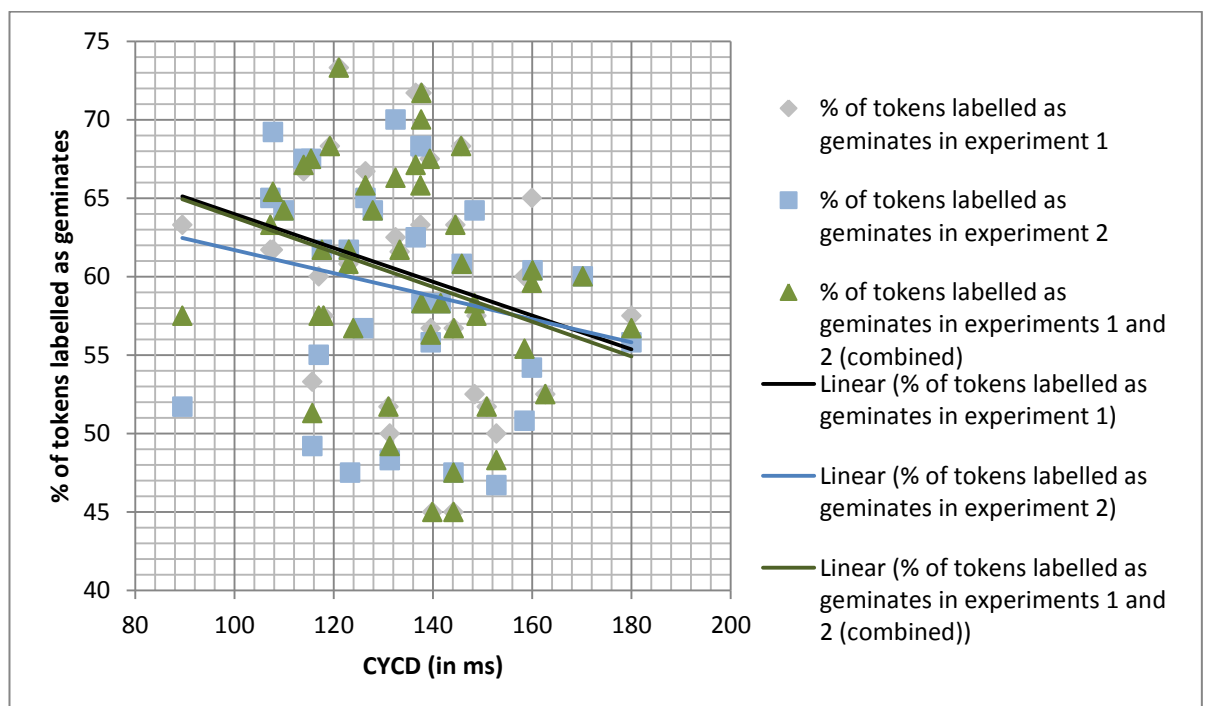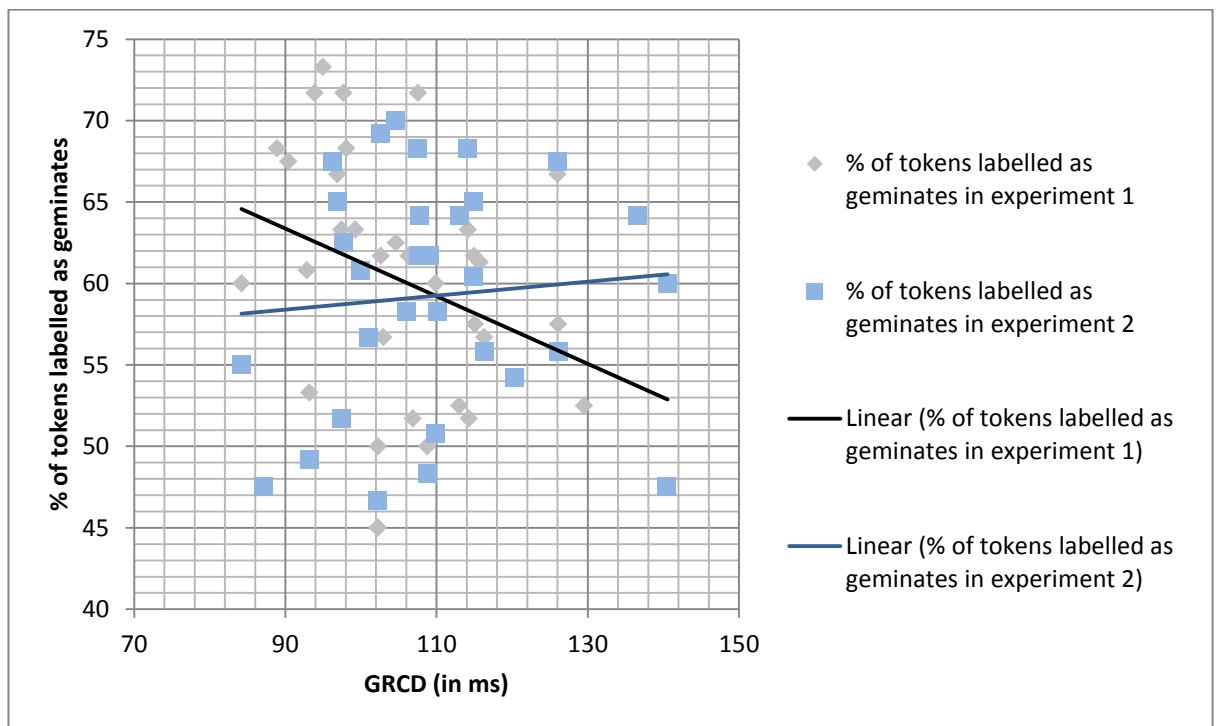

Figure 7.18 Percentages of tokens labelled as geminates as a function of CD values produced by listeners in *feta* in SMG (GRCD).
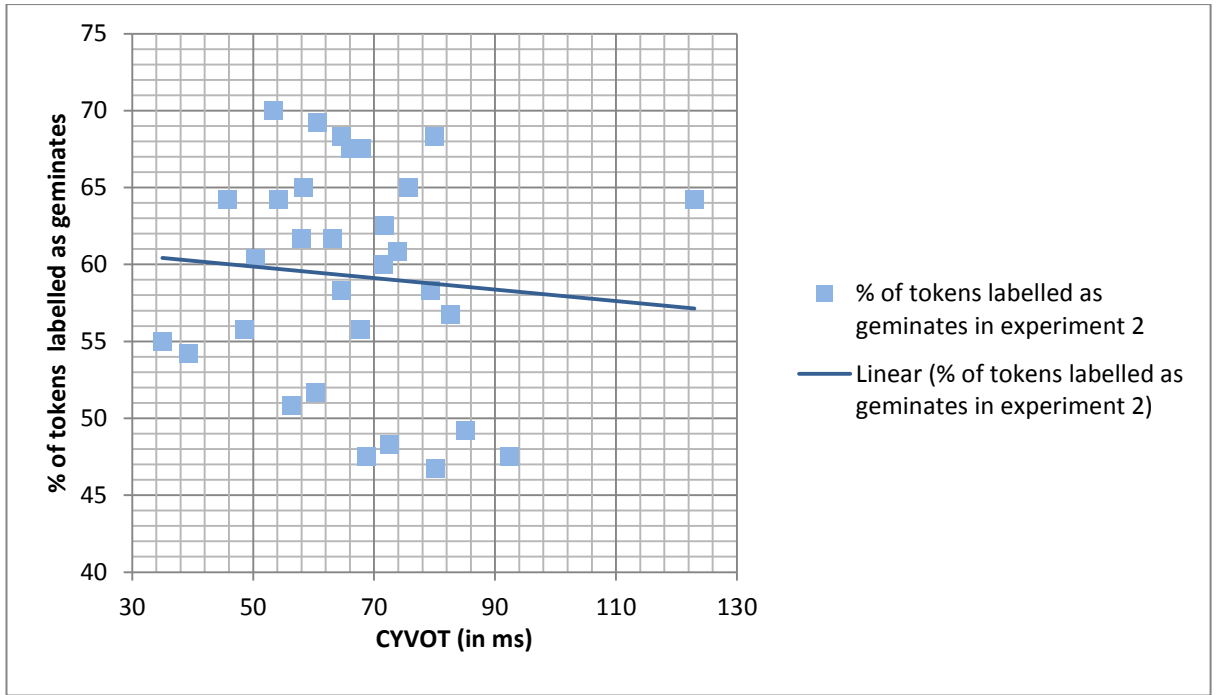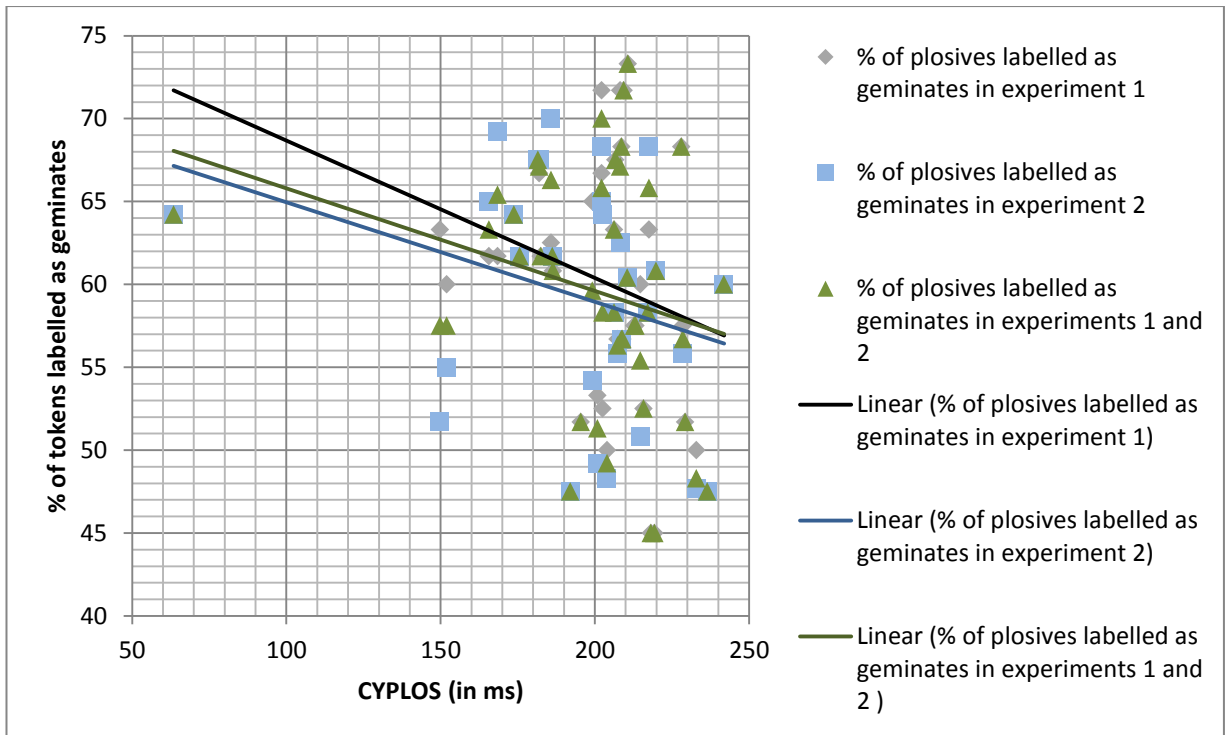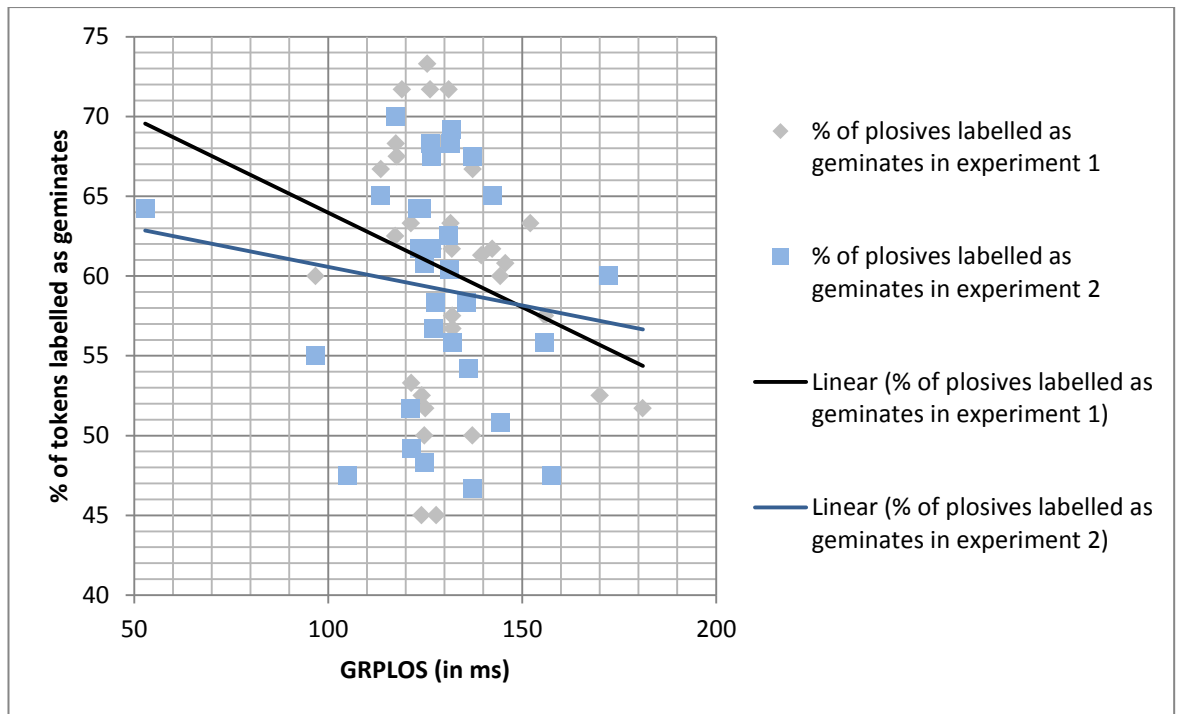
Figure 7.19 Percentage of tokens labelled as geminates as a function of the whole plosive values produced by listeners in *feta* in SMG (GRPLOS).

The influence of the length of singleton [t] in *feta* pronounced in SMG was not as clear-cut as the influence of values of geminates uttered by the listeners. Models fitted to all data collected in experiment 1 showed that the GRCD values in [t] influenced the perception of the boundary in line with the hypothesis II (see figure 7.18). The expected trend was also followed by several subsections of listeners in experiment 1. For these listeners, GRCD and GRPLOS turned out to be statistically significant predictors (table 7.28). Yet, in models fitted to all data collected in the presence of the flags (experiment 2), GRCD (figure 7.18) and GRPLOS had the opposite impact on the perception of the boundary. However, the regression line in figure 7.19 does not reflect the trend revealed by the positive value of the B coefficient generated in logistic regression tests in models fitted to all data from experiment 2 (see the data set 'ALL' in table 7.28, or table 7.18 section 7.5.1). This positive value of the B coefficient indicates that the probability of a token being perceived as a geminate rose with the value of GRPLOS. One of the reasons for that could be the level of significance of the result (p=.035 in logistic regression). The other reason could be that the trends and significances in logistic regression are not calculated on the basis of percentages (as the regression line in figure 7.19), but on the basis of probabilities and odds. More precisely, logistic regression is based on the transformation of probability of a certain binary outcome (here the probability of a sound being labelled as a geminate) to a log distribution (or log of odds) of this outcome (Burns & Burns 2008). The transformation may be expressed as:

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$$logit\ (p) = \log\left[\frac{p}{1-p}\right] = \ln\left[\frac{p}{1-p}\right]$$

where *p* is the probability of a certain binary outcome, and *ln* is the natural logarithm. The notation of logistic regression is as follows:

$$logit[p(x)] = log\left[\frac{p(x)}{1-p(x)}\right] = a + B_1x_1 + B_2x_2 + B_3x_3 + \ldots$$

where a is the constant of the equation, *B* is the *B* coefficient of each predictor variables (x_1, x_2, x_3, and so on). The value of the B coefficient gives the indication of the direction in which a predictor variable influences the result. The differences between calculations done in logistic regression and those necessary to create scatter plots such as the one in figure 7.19 may be the reason why the latter will not always yield the same results as the former. The influence of the values of GRPLOS on listeners' perception may be expressed and illustrated by exponentiated B coefficient, often referred to exp(B). Exp(B) is another statistic that is generated in logistic regression and it indicates the change in odds per an increase in one unit when other variables are kept at the same value (Burns & Burns 2008). Thus, logistic regression takes the values of other independent variables into consideration unlike the regression lines in scatter plots such as the one in figure 7.19. Exp (B) values above 1 indicate the increase in the odds of a given outcome (here 'a heard token perceived as a geminate') per an increase in one unit (here '1 millisecond'), whereas values below 1 indicate decrease in the odds per an increase in one unit (Brace et al. 2006). Figure 7.20 shows that the exp(B) for GRPLOS in model 2bf was slightly above the 1 mark (see the blue line). This result indicates that an increase in GRPLOS by 1ms is likely to cause an increase in the odds of labelling a token by a factor of 1.02.

Figure 7.20 Exp(B) for GRPLOS in a model fitted to all data collected in experiment 2.

Results which were opposite to those predicted by hypothesis II were also observed in models fitted to subsections of experiment 2 data and to combined data with two exceptions, that is, models fitted to female data (experiment 2, table 7.22, section 7.5.4) and models fitted to data from Greece-affiliated listeners (combined experiments, table 7.26, section 7.6.3), one of which could be related to the small sample of participants in the tested group (Greece-affiliated listeners). In the same models, however, GRVOT values suggested that the longer [t] one produces, the fewer stimuli one perceives as geminates. The disparity between the results of models fitted to data collected in the absence of flags and the models fitted to data collected in the presence of the flags is difficult to explain, however, it is suspected that the presence of the flags might have influenced the way listeners processed the sounds. If this were so, the result would add evidence to the claim that listeners tend to store indexical information together with the acoustic characteristics of sounds in the exemplars of those sounds.

One might ask why the presence of flags did not affect the way [t:ʰ] values influenced the boundary perception. This might be linked to the difference in strength of the values of stored geminates and singletons as predictors. Even the percentage of significant results for both sections of geminates was higher in this study than for both types of singleton plosives (see figure 7.23 later in this section). In that respect, the value of geminate length seems a more stable cue. Also, it is worth reiterating that Greek Cypriots, on the whole, are more likely to hear words like *feta* pronounced with geminates and not with singletons. Taking such arguments into account, it might be presumed that the non-contrastive singleton category is not very well developed in the

memory of Greek Cypriots, and therefore the indexical information stored within the exemplar of those sounds might be of greater importance than in exemplars of geminate plosives. Thus, the presence of a visual cue might have such a significant influence on the perception of the boundary. Additionally, the claim that the presence of flags did not affect the way [t:ʰ] values in CG influenced the boundary perception might stem from the category being well-developed might be further supported by the fact that the way [t] in *vata* influenced the perception of the boundary also did not change depending on the presence or absence of any of the flags. Similarly to the [t:ʰ] pronounced in *feta* in CG, the [t] sound of *vata* is likely to be well-developed as Greek Cypriots tend to have regular exposure to [t] produced in a word-context similar to the one in *vata*.

Table 7.28 Summary of ways in which the values of VOT, CD and PLOS produced by the listeners in different contexts influenced their perception of the singleton/geminate boundary. (+) – positive sign in B coefficient values; (-) – negative sign in B coefficient values.

	TABLE	DATA SET	GRCD	GRVOT	GRPLOS	VTCD	VTVOT	VTPLOS	CYCD	CYVOT	CYPLOS
Experiment 1	7.10	ALL	-		-	+		+	-		-
	7.11	ALL	-						-		-
	7.12	IDGR					+		+		
	7.12	IDCY				+	-				
	7.13	MALE	-		-				-	-	-
	7.13	FEMALE	-						+	-	
	7.14	URBAN	-			+			-	-	-
	7.14	RURAL			-	+	+	+	-	+	-
Experiment 2	7.18	ALL	+		+	+		+	-	-	-
	7.19	ALL	+			+		+	-	-	-
	7.20	GREEK FLAG	+	-		+		+	-		-
	7.20	CYPRIOT FLAG						+			-
	7.21	IDCY	+			+		+	-	-	-
	7.21	IDGR								+	
	7.22	FEMALE	+	-	+	+		+	-		-
	7.22	MALE	-	-	-				-	-	-
	7.23	URBAN	+			+	+	+	-	-	-
	7.23	RURAL	+	-		-	-		+	+	+
Experiments 1 and 2	7.24	ALL				+		+	-		-
	7.25	MALE			-		+		-	-	-
	7.25	FEMALE	+		+	+		+	-		-
	7.26	IDCY				+		+		-	-
	7.26	IDGR	-		-	-		-	+	+	
	7.27	RURAL				+	+	+	-	+	-
	7.27	URBAN				+		+	-	-	-

To understand this relationship between indexical and linguistic information, it is necessary to remember the claims regarding frequency of exemplars and robustness of sound categories. In her discussion of category development, Pierrehumbert (2003a) suggested that frequent exposure to exemplars of a category is likely to increase the category's strength, whereas inadequate exposure to a category exemplars may impede the category's development even to an extent which will lead to assimilation of the underrepresented category by a more robust one with similar linguistic parameters. Also, in line with the assumptions that exemplars of sounds are indexed (Foulkes 2010), it may be expected that, in the Cypriot context, samples of *feta* uttered with a geminate might be indexed with the meaning 'Cypriot' or 'informal', whereas samples of *feta* pronounced with a singleton might be indexed with meanings such as 'Greek' or 'formal'. According to Johnson (1997a), when processing an incoming signal, listeners compare the linguistic and indexical information attached to it to the linguistic and indexical information of the saved exemplars, in order to find the best match.

It seems plausible that Greek Cypriots are likely to have fewer exemplars of *feta* with singletons stored in their memories rather than those of *feta* with geminates. In experiment 1 (carried out in the absence of the flags) the listeners had only acoustic information at their disposal, and therefore it seems that all their attention was focused on matching the incoming stimuli to the stored exemplars of singleton plosives however scarce they were. Being focused solely on the phonetic parameters of the stimuli, listeners seemed to match the incoming samples to the closest exemplars stored in their memories in both categories (singleton and geminate).

In experiment 2, the listeners had two types of incoming information at their disposal: phonetic and indexical (the flags). While processing the incoming information, especially the information about sounds with intermediate CD and VOT values, they probably had to match it to (1) scarce exemplars of (possibly) inadequately developed sound category with few exemplars, and (2) indexical information. Each type of indexical information ('Greek' or 'Cypriot') in their memory is stored together with certain phonetic realisations of sounds. These realisations might have developed into stereotypical realisations of a given sound by a speaker with a given background or in a given context (for instance, formal versus informal). For example, one may have remembered that singleton plosives (with a range of particular VOT and CD durations) in *feta* are produced in a formal situation. In the experiment, indexical information (implied by the presence of any of the flags) was paired with various values of phonetic parameters. Some of these values might not have matched those stored in the listeners' memories possibly due to the intermediate character of the values in the incoming sound tokens or inadequate number of stored exemplars

with similar values. It appears likely that, in a situation when a listener experienced problems with matching the phonetic values of an incoming sound to the values of the stored (scarce) exemplars, he/she might rely more on the incoming indexical information which might imply that a speaker with a background (or in a context) suggested by the indexical information is more likely to use sounds classified as a geminate or a singleton (depending on the type of the present flag). In such a situation, indexical information might have had more strength (or value) than the linguistic information. The increased strength of indexical information as opposed to the strength of linguistic information might have caused a shift of listeners' attention from linguistic to non-linguistic information.

The possibility for indexical information to become stronger than linguistic information appears to be more likely in situations in which indexical information is not clearly/regularly linked to a certain set of phonetic parameters. In such cases, the development of a link between the two types of information would depend on the kind of exposure a listener received earlier and the kind of associations he/she developed between indexical/social situations and phonetic content of sounds. Existence of such levels of indexicality has already been mentioned by Foulkes (2010).

A question remains whether it was the presence of both of the flags or just one of them that caused the shift in perception in experiments 1 and 2. Models 2ef and 2ef beta (see table 7.20 section 7.5.2) suggest that, in the presence of the Cypriot flag, GRCD, GRVOT and GRPLOS did not have any effect on the perception of the heard tokens. On the other hand, in the presence of the Greek flag (see model 2ff, table 7.20, section 7.5.2), GRCD affected the perception the way it did in the models fitted to all experiment 2 data, which might partially indicate that it was the Greek flag that initiated the shift in perception. Yet, this assumption is not supported by the way GRVOT affected perception in the Greek condition, as it affected perception in line with hypothesis II. However, the question why there seemed to be an effect of only the Greek flag cannot be answered with the present data. Nevertheless, what seems to be likely is that in some situations, indexical information may receive more attention from a listener, especially when the audio parameters of the incoming stimulus need to be matched to exemplars stored as a part of an underdeveloped category.

What is, intriguing about the way [t] in *vata* affected the perception of the boundary, is that the longer [t] in *vata* one produced, the more geminate the plosives one heard during the test. This pattern affected values of VTCD and VTPLOS in models fitted to all data from experiment 1, experiment 2 and experiments 1 and 2 together (figures 7.21 and 7.22) and in several models fitted to subsections of these data sets with a very few exceptions (see table 7.28). These results

imply that the longer [t] in *vata* the study participants produced, the shorter the plosives they needed to hear to label them singleton plosives. This result is opposite to what was expected, and it does not support the claim that the values of singleton and geminate plosives that are produced by a person are equivalent to the values one needs to hear to perceive plosives as singletons and geminates. This might indicate that there could be another factor linked to the length of singleton plosives produced by the listeners that affects the way the boundary is processed.
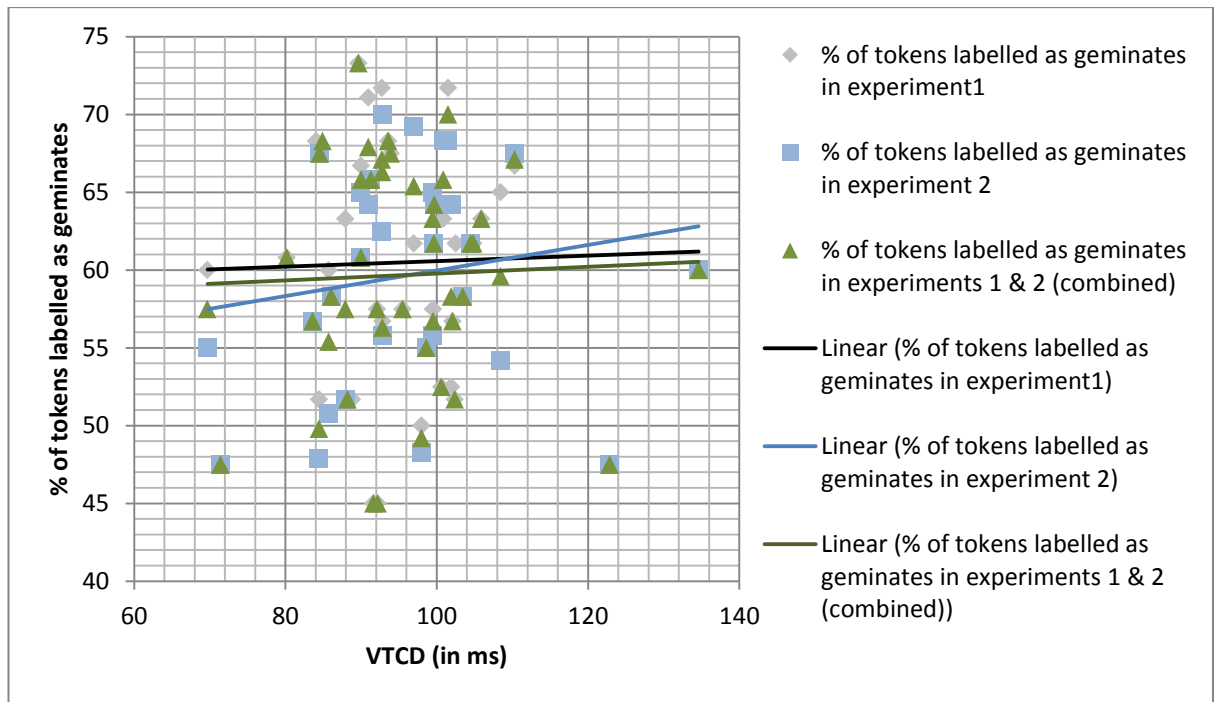
Figure 7.21 Percentages of tokens labelled as geminates as a function of CD values produced by listeners in *vata* (VTCD).
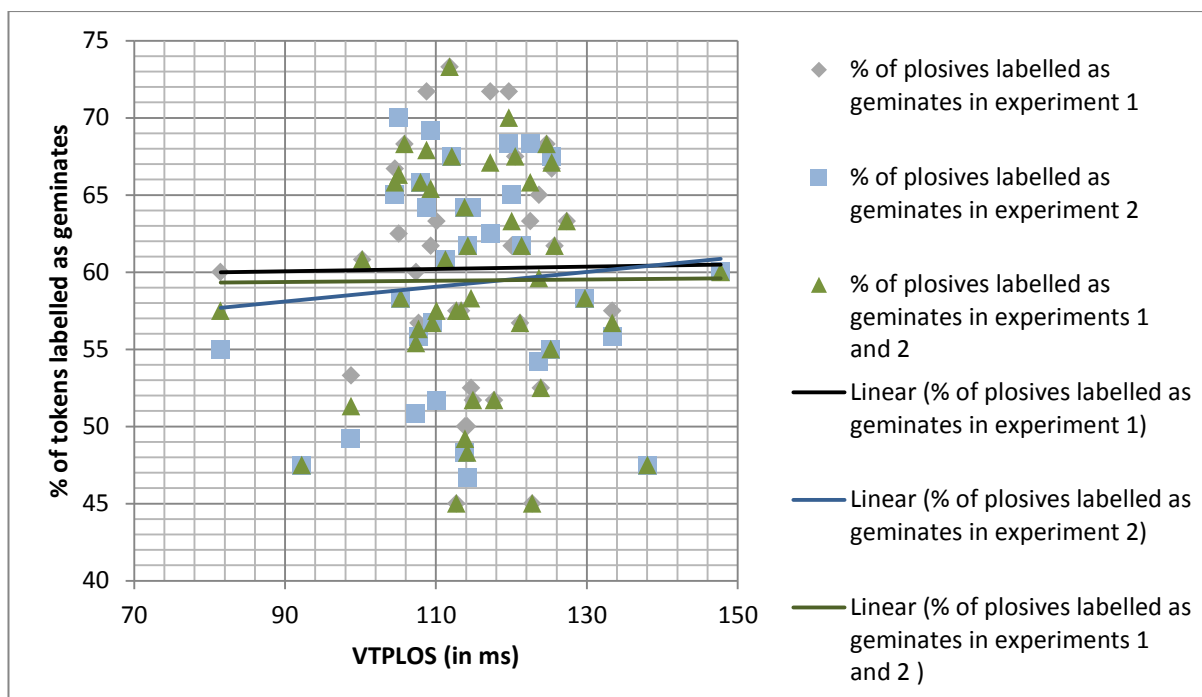
Figure 7.22 Percentages of tokens labelled as geminates as a function of the whole plosive values produced by listeners in *vata* (VTPLOS).

One explanation for such unexpected tendencies is based on the theory that Greek Cypriots believe that they produce longer plosives than Greeks do. In several interviews carried by Alexander (2008a) Greek Cypriot interviewees claimed that Greek Cypriot sounds are 'heavier' and 'longer' than the Greek ones and that Greek Cypriots produce 'double Ps' and 'double Ts'. Although such claims referred to geminate plosives, it seems reasonable to believe that some Greek Cypriots might think that their singleton plosives are longer than those produced by Greeks from the Mainland. It must be stressed that this claim has not been tested yet and it is only a speculation which might shed some light on the presently discussed issue. Should the suggestion turn out to be true, it might be possible that those Greek Cypriots who produce slightly longer singleton plosives realise that, and the longer [t] they produce, the more likely they are to be strict about the length of the plosives they classify as singletons in attempting to choose as close equivalents to SMG singletons as possible. It is worth remembering that when at school Greek Cypriots are reported to be heavily corrected and sometimes even mocked by their teachers when using CG, which is claimed to reinforce negative stereotypes about using CG (Papapavlou 2004). Therefore, it seems likely that if the speakers who use longer [t] in words such as *vata* may also use other CG sounds, and therefore they might have been extensively corrected by their teachers (and not only) in the past. Such individuals may have become so self-conscious about the way they speak that they may even overdo when judging what a 'true' singleton plosive is.

It is hypothesised here that such individuals, who may not be able to reduce the length of plosives or who may have developed categories of singleton plosives which are longer than in the case of other individuals, may have become so self-conscious about the way they speak that, when evaluating speech produced by others, they might overdo judging what a 'true' singleton is. This could be because they may feel that since they have been corrected by others (and possibly despite not hearing the problem with their own pronunciation) the 'correct' singletons should be shorter than those they perceive as singletons. Alternatively, they may simply feel that they have to be strict about the way they judge the length of those sounds and do it blindly/indiscriminately to an extent. Such situations might have made them more (far more) strict when classifying the stimuli which have intermediate values of CD and VOT. This may be done without the listeners being absolutely certain that their answers are appropriate and would be the same with the answers of other people who are considered to be more accurate in the production of SMG.
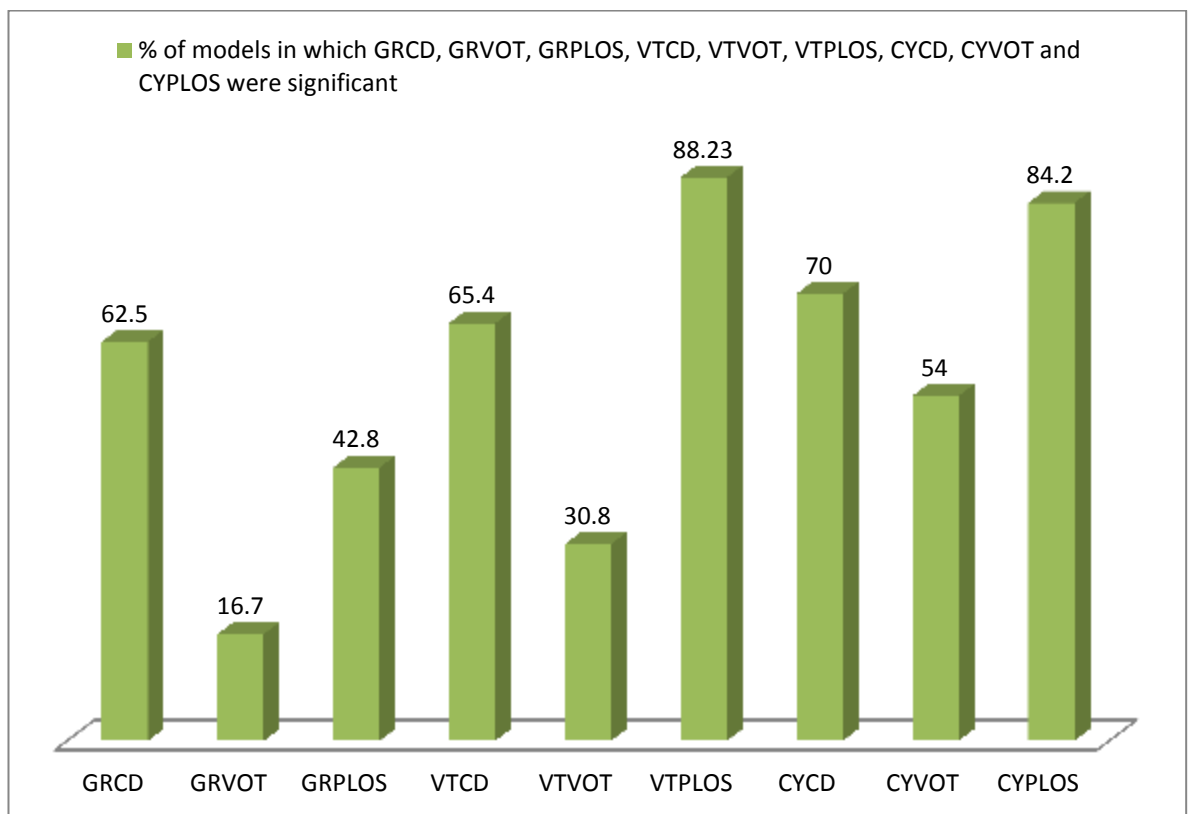
Figure 7.23 Percentage of logistic regression models in which the influence of CD, VOT and PLOS length values produced by listeners in experiments 1 and 2 turned out to be statistically significant predictors.

Summarising the percentages of statistically significant results for each of the portions of plosives in various accents and word contexts (see figure 7.23) facilitated an analysis of the differences in the number of models in which VOT and CD were statistically significant predictors. One of the

patterns is that in each type of plosive ([t:ʰ] in *feta*, [t] in *feta* and [t] in *vata*) VOT turned out to be a significant predictor less often than CD. On the one hand, such a tendency might suggest that VOT is a weaker cue for gemination than CD is. On the other hand, such a result might be an offshoot of the way aspiration was analysed in this study, that is, only the temporal cue was taken into consideration (VOT), whereas the intensity of VOT was not taken into consideration in these tests. Portions of [t] (i.e. CD or VOT) embedded in *vata*, which is a word that is produced with a singleton plosive in SMG and CG, were significant in more instances than the values of [t] portions which were found in *feta* pronounced in SMG. Although there was only a slight difference between the percentages of significant results for GRCD and VTCD, the differences in the percentages of significant results between GRVOT and VTVOT and between GRPLOS and VTPLOS were much greater. These differences might have been caused by the fact that the values of [t] pronounced in *feta* in SMG were less stable than those of [t] in *vata* (the difference between means of VOT and CD of the two sounds were statistically significant, and the standard deviation for the [t] values in *feta* were greater than those in *vata* [t] values). This lack of stability is likely to derive from the speakers' inability to completely/successfully suppress gemination in words such as *feta*. The greatest percentage of statistically significant results was found in the values of portions of [t:ʰ], which might mean that the exemplars of [t:ʰ] and their values are the most reliable determinants of what is a singleton and what is a geminate.

To sum up, the results discussed in this section suggest that the values of plosives produced by the listeners have an influence of their perception of the singleton/geminate boundary. Hypotheses I and II have been proven correct to a certain extent. Nevertheless, it appears from the results that values of geminates produced by listeners are a better predictor than singletons, especially the singletons in words such as *feta*. Moreover, hypothesis II did not effectively predict the influence of [t] values in *vata*. It seems that there could be another factor which might have disrupted the link between the values of remembered plosives and the processing of incoming plosives. This factor might be related to the listeners' linguistic insecurity.

7.7.2 The influence of the amount of exposure measured by ID score

In order to analyse the supposed role of the amount of exposure to a sound category, hypothesis III was put forward, which assumed that the level of the speakers' affiliation with Greece or Cyprus could help estimating the likely amount of exposure to SMG.

Hypothesis III: The more one is affiliated with Greece and its culture, the more likely that person is to notice small increases in VOT and CD of plosives and to perceive such plosives as geminates.

The results presented in sections 7.4, 7.5 and 7.6 seem to partly support the hypothesis. Overall, according to the logistic regression models' results, the factor turned out to have significant influence on the perception of the singleton/geminate boundary in several models fitted to data collected in experiment 1, experiment 2 and experiments 1 and 2 together. The influence of ID score on the three sets of data is illustrated by figure 7.24.

The regression lines illustrating the influence of ID on the percentage of stimuli perceived as geminates by listeners from experiment 2 and by listeners from both experiments combined (figure 7.24) appear to support the assumption that the more exposure to SMG one gets, the richer exemplars of [t], including [t] pronounced in the word *feta*, one is likely to develop. The listeners who were more Cyprus-affiliated tended to perceive fewer stimuli as geminates. As the number of stimuli classified as geminates rose with the values of CD and VOT of the stimuli in all fitted models, it appears logical to assume that these were the 'intermediate' values that caused the listeners most difficulties. Therefore, it is assumed here that Cyprus-oriented listeners, who classified fewer stimuli as geminates, tended to classify the stimuli with these 'intermediate' values differently from the Greece-oriented listeners. This might indicate that due to lesser exposure to SMG, and to not having a rich enough database of [t] uttered in *feta*, the Cyprus-oriented listeners accepted/tolerated longer VOT and CD values as singletons than the Greece-oriented listeners did.
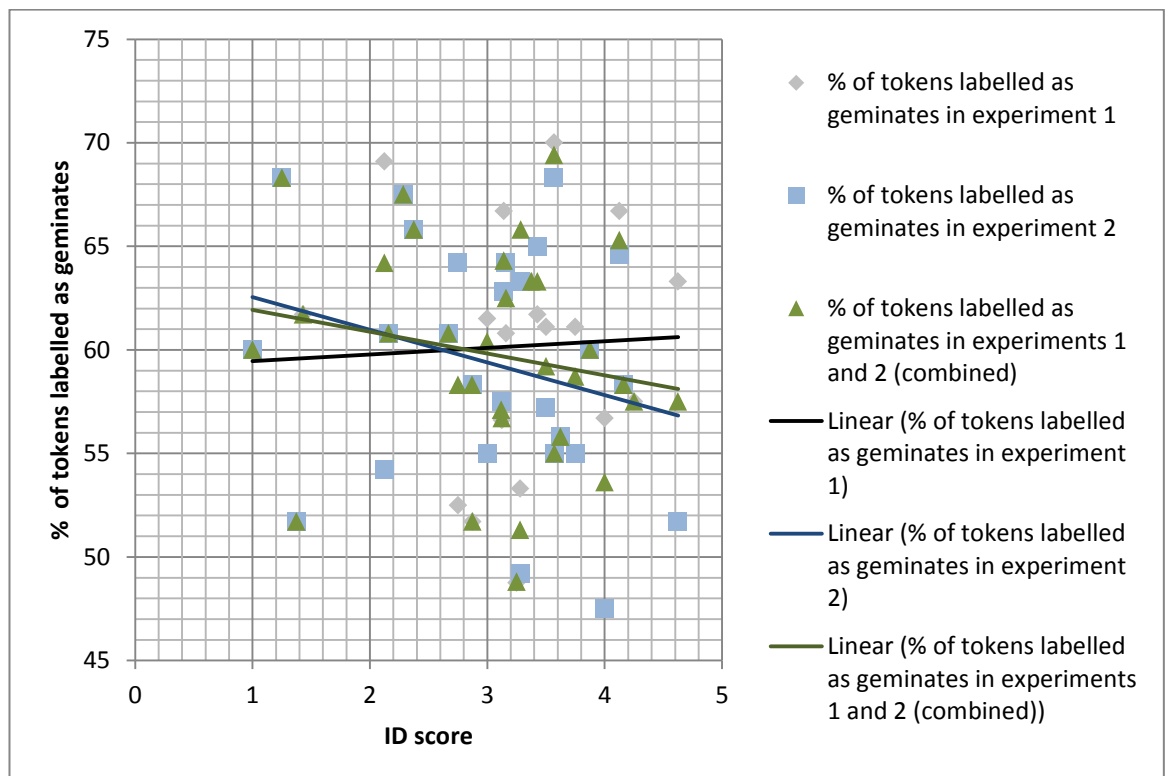

Figure 7.24 Percentages of tokens labelled as geminates by listeners with different ID scores.

Even though the negative value of the B coefficient in model 1av (see section 7.4.1) indicated that listeners from experiment 1 followed the predicted trend, the regression line in figure 7.24 shows the opposite tendency. There could be several reasons of this situation. One of the reasons could be interaction between several other independent variables such as gender (figure 7.26) or place of residence (figure 7.28). Also, as other models indicated (1ef, 1ff and 1gv, table 7.12, section 7.4.2), when the experiment 1 listeners were split into Greece-affiliated and Cyprus-affiliated groups, the former group of listeners followed the trend indicated by hypothesis III, whereas the latter followed the opposite one (see also figure 7.27). These opposing tendencies, especially the one followed by the Cyprus-affiliated group, might have been the cause of the discrepancies discussed. It also seems noteworthy that the angle of the trend line is very low which indicates that the trend might not be strong. The p value in 1av model was .018 could also signify that the trend was not robust. The p value in 1av model (p=.018), the low angle of the relevant regression line in figure 7.24 and the lack of significance of the ID score in the other three models fitted to all experiment 1 data might further support the plausibility of this scenario. Also, the angle of the line could be changed by removing one of the two extreme cases, that is, the percentage of the listener with an ID score equal to 4.125 or the percentage of the listener with an ID score of 4.625. The percentages of these outliers seem much higher in comparison to other cases with similar ID values, and an attempt to remove any of these two cases was followed with a change of the angle of the said regression one to the one in line with hypothesis III.

However, another reason why the regression line in question does not reflect the trend indicated by the negative B coefficient could be that such regression lines are not calculated the same way as the B coefficient in logistic regression models. This issue has already been discussed in section 7.7.1. The trend illustrated by means of exp(B) coefficient in figure 7.25 which shows that the exp(B) for ID score in model 1av is below the 1 mark (see the blue line). This result indicates that an increase in ID score by one point on the ID scale is likely to cause a decrease in the odds of labelling a token by a factor of .802.

Figure 7.25 Exp(B) for ID score in a model fitted to data collected from all experiment 1 listeners.

Figure 7.26 Percentages of tokens labelled as geminates by male and female listeners with different ID scores (experiment 1).
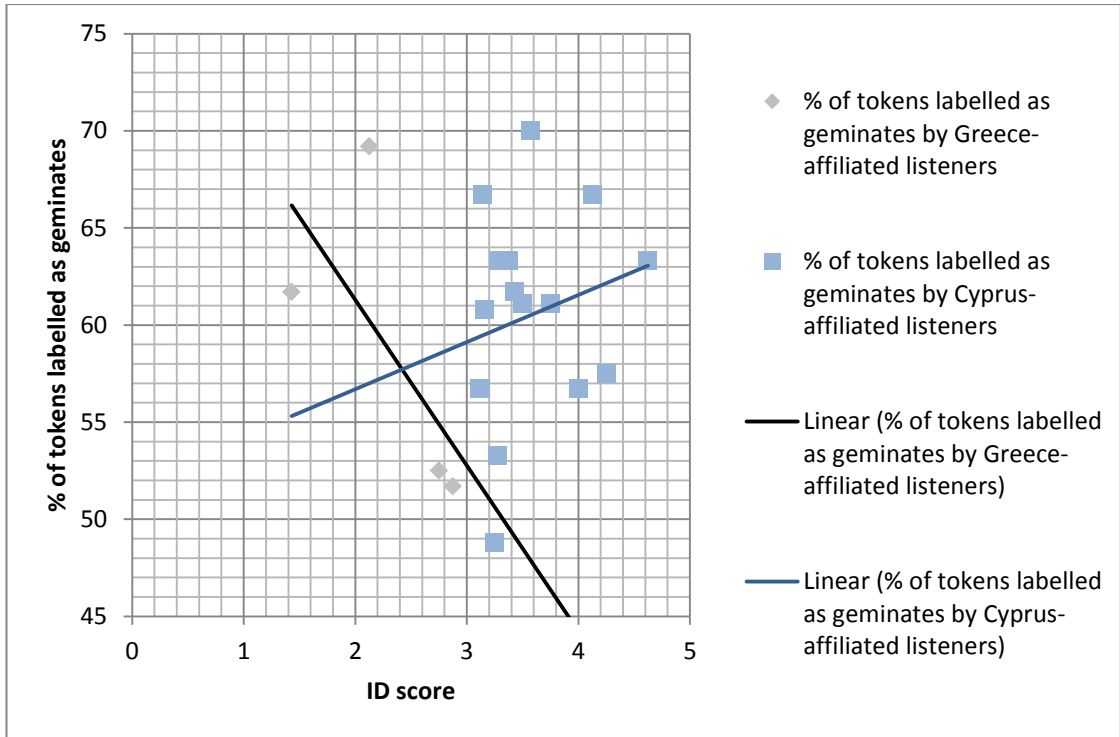
Figure 7.27 Percentages of tokens labelled as geminates by Greece- and Cyprus-affiliated listeners with different ID scores (experiment 1).
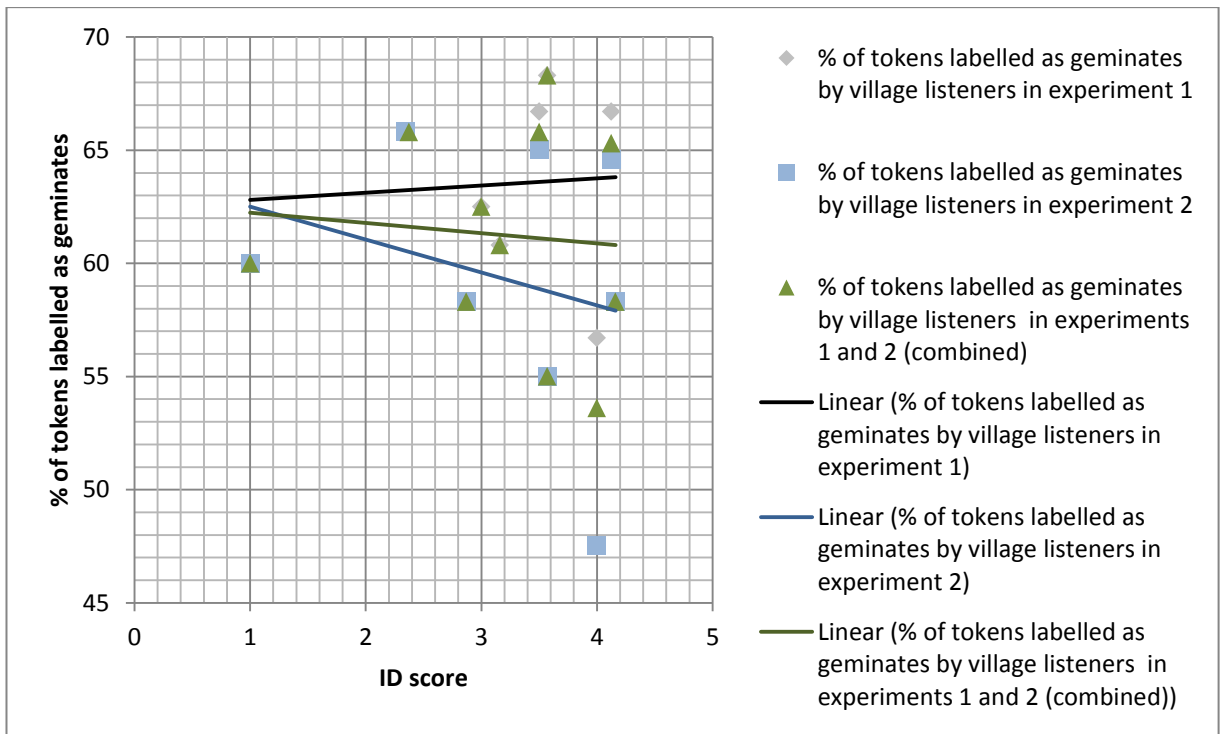
Figure 7.28 Percentages of tokens labelled as geminates by listeners from rural areas with different ID scores.

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As it could be noticed in several models presented in sections 7.4.2, 7.4.3, 7.5.5 and 7.6.4 and from figures 7.26, 7.27 and 7.28, influence of ID score on different sections of the three data sets did not always show the pattern predicted by hypothesis III. The analyses of data subsets by means of regression models revealed that some groups of listeners (a) were not influenced by ID score or (b) were influenced by it but in the opposite way to the expected one. The subsets of study participants who followed the opposite trend to the one suggested in hypothesis III include: (1) Cyprus-affiliated listeners from experiment 1 (figure 7.27), (2) female listeners from experiment 1 (figure 7.26) and (3) village listeners from experiments 1 and 2 (analysed as two separate data sets) (figure 7.28). Greece-oriented listeners from experiment 2 (figure 7.27) were not significantly affected by their ID score.

The reasons for subsections of listeners to follow trends opposite to those predicted by hypothesis III were attributed to two likely factors. These include a small size of a sample subset or possible linguistic insecurity of some groups of listeners. Both factors are discussed in the remaining part of this section.

	Model 1lv	Model 1nf	Model 2qf	Model 3kv
■ exp(B) for ID in experiment 1	0.051	3.145		
■ exp(B) for ID in experiment 2			2.725	
■ exp(B) for ID in experiments 1 & 2				0.609
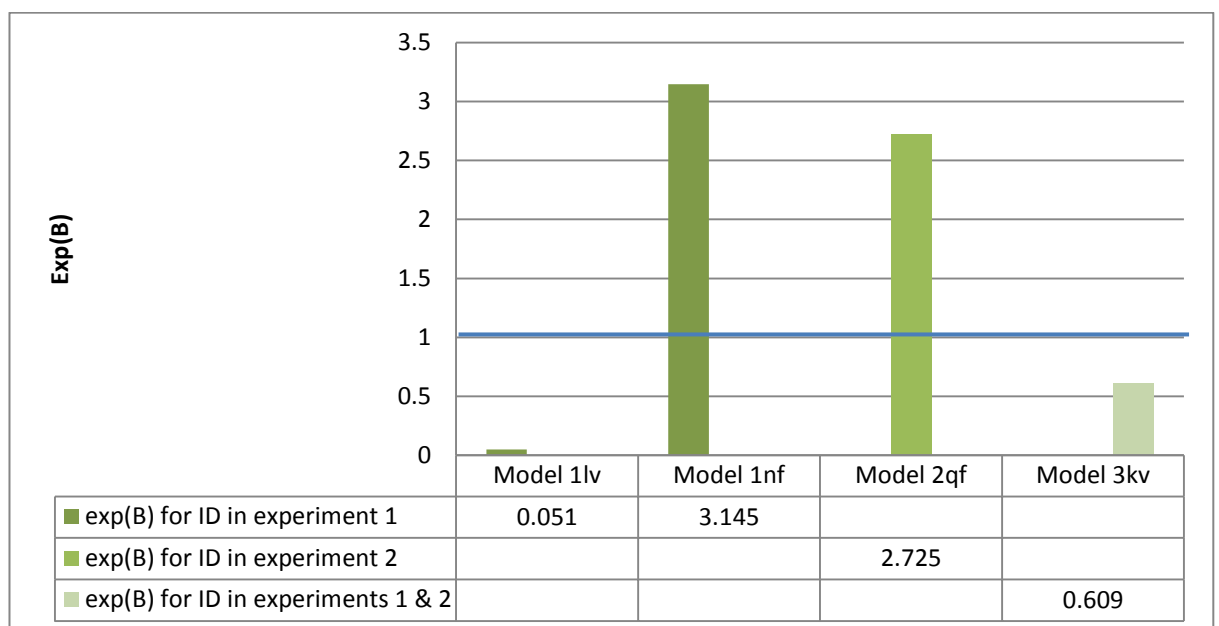
Figure 7.29 Exp(B) for ID score in different models fitted to data from village listeners.

Trends followed by village listeners might be partly a result of a small sample size. Interpretation of these trends seems particularly complicated. This is because in different regression models fitted to all data from experiment 1, opposing trends were reported. Hence, in one of them (1lv) the trend was in line with hypothesis III whereas in the other (1nf), which is demonstrated by the regression line in figure 7.28, it was the opposite. In the models fitted to experiment 2 rural data, wherever ID score was significant, the result was the opposite to the one predicted by hypothesis

III. In models fitted to the pooled data from experiments 1 and 2, on the other hand, the trends followed by village listeners were in as predicted in hypothesis III (figures 7.28 and 7.29). These models were fitted to data from 15 participants, those who took part in experiments 1 and 2. An initial interpretation of such instability in results could be that the opposite results might be an effect of a small sample (7 rural participants in experiment 1 and 8 in experiment 2). Additionally, the small sample size in experiment 2 might have been one of the reasons why the corresponding regression line (figure 2.78) does not reflect the results of the corresponding logistic regression tests (model 2qf). Another reason for the difference between the trend indicated by the regression line and the one suggested by the positive value of B coefficient for ID score in model 2qf (table 7.23, section 7.5.5) could be the already described discrepancies between calculation of regression lines in scatterplots and the B coefficient in logistic regression. For this reason exp(B) illustrating the influence of ID score in model 2qf is incorporated in figure 7.29.

There appears to be another factor behind the unpredicted results and it does not seem to be linked to the sample size. It seems that the trend opposite to that predicted by hypothesis III is followed by groups of listeners who in a way seem to be in a disadvantaged position. Such a disadvantaged position might make them more sensitive to prestige-connected nuances of speech than it makes the members of other groups. First of all, it needs to be highlighted that there are various suggestions in the literature (Tsiplakou 2006; Papapavlou 1998; Sophocleous 2006) that Greece/Greek culture is often assigned a higher status than Cyprus/Cypriot culture. In such a situation it might be logical to suspect that there could be some sense of insecurity among the less Greece-affiliated listeners related to their language use. It also seems logical to believe that this feeling of insecurity could increase with closer affiliation to Cyprus and its culture. The results of statistical tests presented in this chapter suggest that there are three groups of listeners who might be particularly susceptible to the level of insecurity related to the use of/knowledge of/mastery of the more prestigious variety and who follow the unanticipated trends in perception of the boundary. These are: (1) women, who are claimed to be more sensitive to social information carried by various elements of speech, (2) Cyprus-affiliated listeners (all those whose ID score was higher than 3.0), who may be distancing themselves from the prestigious culture and its language, and (3) listeners from rural areas, who are stereotypically believed to speak with a 'heavy' Cypriot accent. Individuals belonging to these three groups, when processing plosives in words such as *feta*, might be more strict with how long a singleton plosive could get due to their insecurities; moreover, they may notice small increases in the values of CD and VOT, and, as a result, label more plosives as geminates, than other listeners would. Such a way of thinking might

be further supported by the way listeners who produced longer [t] in *vata* classified the heard stimuli in the experiments (see section 7.7.2).

A similar situation, but concerning the production of more prestigious sounds, has already been reported (Labov 1966, cited in Labov 1972; Labov 1971, 1972, 2006). Labov (1966, cited in Labov 1972), in his investigation of patterns of stratification of different variables used in New York City, observed that the frequency of use of [r] - the presence of which is believed to be more prestigious than the absence of it - changes depending on the speakers' social class and the speaking style (ranging from casual speech to reading of minimal pairs). He noticed that members of the classes other than upper middle class (which was the highest class investigated in the study) tend to produce a significantly larger number of [r] sounds when speaking in a more formal and a more controlled setting, for instance when reading word lists or minimal pair lists as opposed to being involved in a casual conversation. The lower-middle-class representatives (i.e. the members of the second highest social group included in this study) were reported to show the most radical increase in the use of [r] in reading word lists and minimal pairs. In fact, their frequency of [r] when reading word lists and minimal pairs was much higher than that of members of the upper middle class, who produced the largest frequency of [r] sounds in their natural, uncontrolled speech. This pattern was reported to be present in the production of other New York City variables that were subject to linguistic change at the time the study was carried out. When interpreting the linguistic behaviour of lower-middle-class study participants, Labov (1972) states:

> A great deal of evidence shows that lower-middle-class speakers have the greatest tendency towards linguistic insecurity, and therefore tend to adopt, even in middle age, the prestige forms used by the youngest members of the highest-ranking class. This linguistic insecurity is shown by the very wide range of stylistic variation used by lower-middle-class speakers; by their great fluctuation within a given stylistic context; by their conscious striving for correctness; and by their strongly negative attitudes towards their native speech pattern (p. 116).

Even though the study by Labov (1966, cited in Labov 1972) concerned production of prestigious forms, in a way its results could be compared to some of those collected in the present study. Similarly to the Labov's lower-middle-class study participants, who were hypercorrect in their choice of sounds and as a result produced more prestigious forms than the upper-middle-class representatives did, the present study participants who could be considered less privileged were

hypercorrect in judging how short a singleton plosive should be and as a result labelled shorter plosives as geminated than more advantaged listeners did.

This comparison of the two types of study participants is possible if we assume that lower-middle-class members are in a less advantaged position than the members of the upper middle class. Also, it is necessary to note that members of other social classes, lower than the lower middle class, also amplified their use of [r] in the discussed speech styles, although the degree of the increase was not as great as in the case of lower-middle-class speakers. As mentioned earlier, female, Cyprus-affiliated listeners and listeners from villages might also be considered to be in a less advantaged position than male, Greece-affiliated listeners and people from urban areas respectively. Thus, it appears reasonable to suspect that their strict way of classifying plosives as singletons may be an effect of "conscious striving for correctness" (Labov 1972: 116), due to their linguistic insecurity.

Likewise, the present-study listeners who produced longer [t] when uttering *vata* and classified shorter plosives as singletons than other listeners did (i.e. those who produced shorter [t] when using words such as *vata*), might also be categorised as less privileged, as they might have been stereotyped or mocked because of their language use in the past. Their propensity to be very strict when classifying cases of [t] as singletons might also be a case of struggling to be correct and/or a result of "their strongly negative attitudes towards their native speech pattern" (Labov 1972: 116).

It seems that Labov's study (1966, cited in Labov 1972) was not the only one that yielded results which suggested that linguistic insecurity might be a reason for the use of hypercorrection. Labov (1971) refers to a study by Levine and Crockett (1966) who compared the frequency of the use of [r], a marker of prestige, by male and female speakers and by speakers with different educational backgrounds (the four categories were 'any college', 'high school graduate', 'some high school' and 'grade school or none') . The speakers were asked to read a list of sentences (less controlled speech) and a list of words (more controlled speech). The results by education revealed that the greatest increase in the use of [r] at the time of reading a word list occurred in the second highest group, that is, the high school graduate group. Also, even while reading a sentence list, high school graduates produced more [r] sounds than the members of the 'any college' group. The second highest increase in the production of [r] happened in the 'some high school group'. In the 'any college' group the increase was greater only than in the lowest, 'grade school or none', group.

The results by Levine and Crockett (1966) show a very similar pattern to that reported by Labov (1966, cited in Labov 1972), with the difference that Levine and Crockett (1966) took only the educational background into consideration when dividing study participants into groups, whereas in Labov's study (1966) the social stratification was based on (1) education of the study participant, (2) the profession of the person who was the main source of income in the family, and (3) family income (Labov 1972). This difference in estimating the prestige of a person's background strengthens the argument that the sources of hypercorrection, which might be a result of linguistic insecurity, may vary. Thus, a source of linguistic insecurity could be a person's socio-economic background encompassing factors such as education, economic situation and the prestige of occupation held, or a person's educational background only. What's more, the study by Levine and Crockett (1966) reports that the increase in the frequency of [r] at the time of reading the word list was much higher for women than for men. This result and the claims made by Eckert (1989) and Labov (1990) regarding women's need to build up prestige by means of the use of prestigious language forms might be interpreted as females being one of the groups of language users who are prone to linguistic insecurity. Going back to the outcomes of the present study, it should be pointed out that one of the groups of listeners who were very strict with classifying plosives as singletons was the group of female listeners. Earlier in this section it was suggested that such practices among female listeners could be an outcome of insecurity. It is likely that such a phenomenon might be another example of linguistic insecurity.

The results of a recently published study by Preston (2013) seem to indicate that there could be different types of linguistic insecurity. Preston (2013) concludes that:

> There are those who find their region (or group) incorrect and apparently extend that to personal insecurity (…); there are those who find their own region (or group) relatively correct and extend that to their personal security (…), but there are also those who find their own area correct (perhaps even considerably so) but may find their individual performances lacking, particularly when local norms do not guide them (p. 323).

It seems that some of the groups of listeners who in the present study were considered to be affected by linguistic insecurity might fall into the first category, that is, those who believe the language of their group or region is incorrect and therefore consider their own speech as incorrect. These groups include (1) Cyprus-oriented listeners, (2) listeners from rural areas and (3) listeners who produce longer singletons in words such as *vata*. However, women cannot be classified as any of the three categories suggested by Preston (2013) as there do not seem to be

any reports indicating that Greek Cypriot women believe that as a group they do not speak correctly.

Since linguistic insecurity could affect various groups of language users who are in a disadvantaged position as compared to some other group of language users, it could also be possible to claim that the results of Cyprus-affiliated listeners and village residents from the present study might also stem from certain levels of linguistic insecurity experienced by those groups.

It is also thought-provoking that the unanticipated results for female and Cyprus-inclined listeners are not repeated in models fitted to data that were collected in the presence of the flags or in models fitted to the combined data from experiments 1 and 2. It looks as if in the absence of flags, which might be treated as cultural context, the listeners did not get any additional cues helping them process the sounds and they had to rely only on the acoustic signal of the heard sounds. However, at this stage, with the existing data, it is impossible to establish the true reason for such changes in patterns.

To conclude, to a certain extent, the effect of the listeners' ID score was consonant with hypothesis III in line with which the potential amount of exposure to SMG may indeed have an influence on the way listeners perceive the singleton/geminate boundary. This in turn seems to add evidence to the claim that a large exposure to a certain type of a sound, or in other words, being exposed to a large number of exemplars of the type of sound, is likely to strengthen the category of sound and make it more robust. However, it needs to be noted that the amount of exposure to SMG may not be the only factor behind ID score influencing the perception of the boundary. As discussed in sections 7.4.3 and 7.4.2, the positive value of the B coefficient for female listeners in models 1hf and 1hv and the positive B coefficient for Cyprus-oriented listeners in models 1ff and 1gv suggest that there could be another factor behind the ID score which has an effect on perception of the boundary. That factor could be linguistic insecurity of certain groups of listeners who tend to be more sensitive to increases in plosive duration regardless of being exposed to SMG less than their more linguistically secure counterparts. This factor, which could be linguistic insecurity, might sometimes supersede the effects of the amount of exposure associated with ID score.

7.7.3 The amount of exposure measured with SOCIO index

The influence of the presumed amount of exposure to a sound category was also investigated through the analysis of the influence of socio-economic background on the perception of the

singleton/geminate boundary. It was assumed that listeners' exposure to SMG is likely to increase with their socioeconomic background (see chapter 50 as it was stated in hypothesis IV).

Hypothesis IV: The higher a person's socioeconomic background, the more likely he or she is to label plosives with only slightly increased values of CD and VOT as geminate plosives.

The SOCIO index did not turn out to be a significant predictor in any of the logistic regression models fitted to all data collected in experiment 1, experiment 2 and experiments 1 and 2 combined. This lack of statistical significance might have been caused by opposing ways in which subsections of the sample were affected by SOCIO index. As an example, in experiment 1, Greece- and Cyprus-affiliated listeners followed opposite trends (figure 7.30), in models fitted to data from both experiments combined, village and city residents were influenced in opposite ways (figure 7.31), and in experiment 2, male and female listeners were affected differently (figure 7.32). All of these trends were statistically significant in several logistic regression models (2mf, 2kv, 2mv, 2lf, 2nf, 2lv, 1ef, 1ev, 1fv, 1ff, 1gv, 2jf, 2jv, 3gf, 3if, 3gv and 3iv).
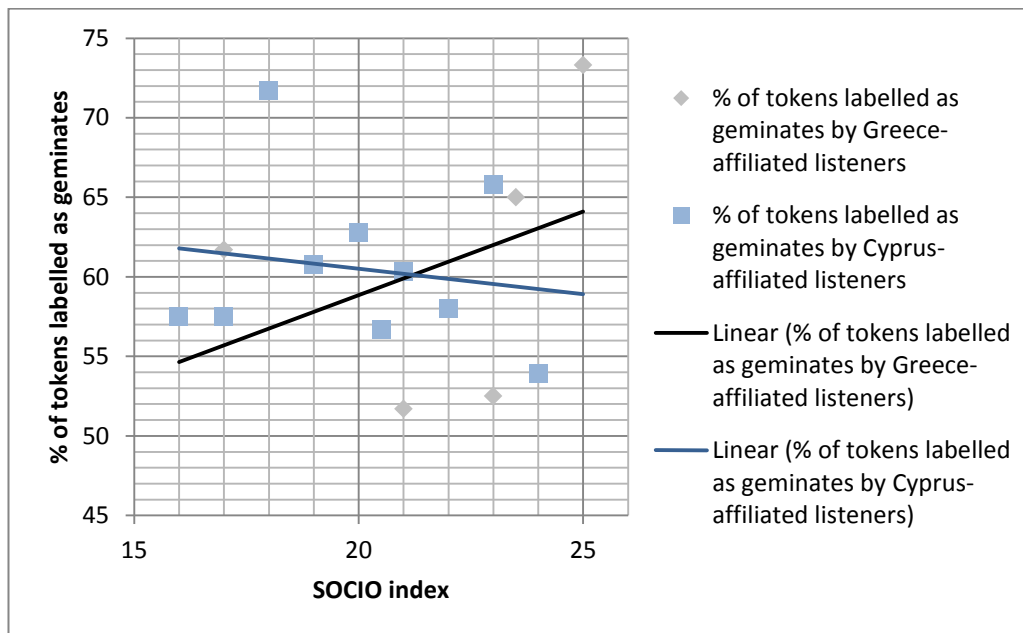
Figure 7.30 Percentages of tokens labelled as geminates by Greece- and Cyprus-affiliated listeners with different SOCIO indexes (experiment 1).
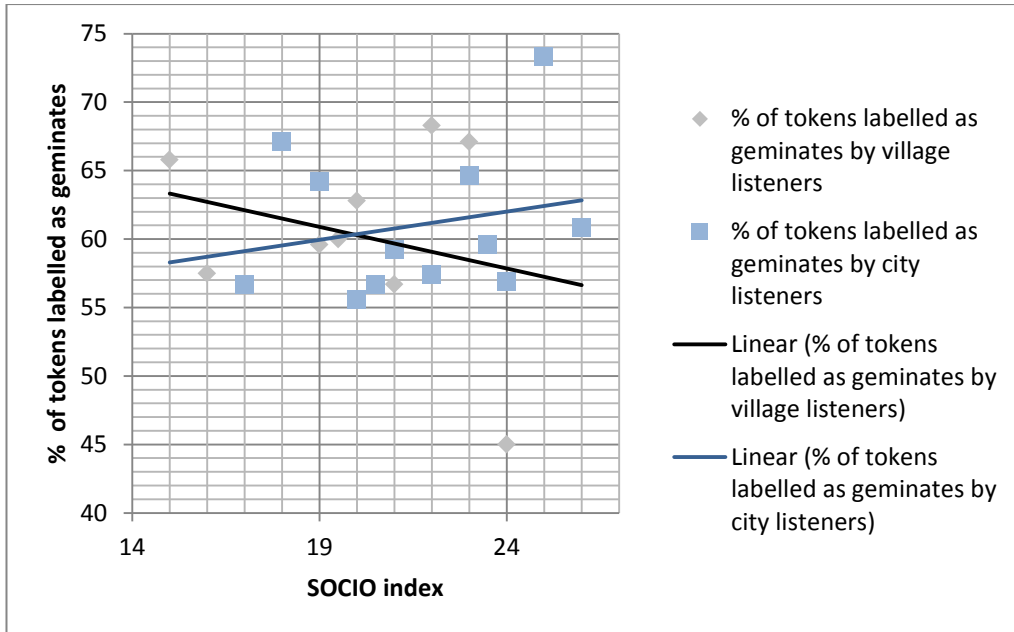
Figure 7.31 Percentages of tokens labelled as geminates by village and city listeners with different SOCIO indexes (combined experiments 1 & 2).
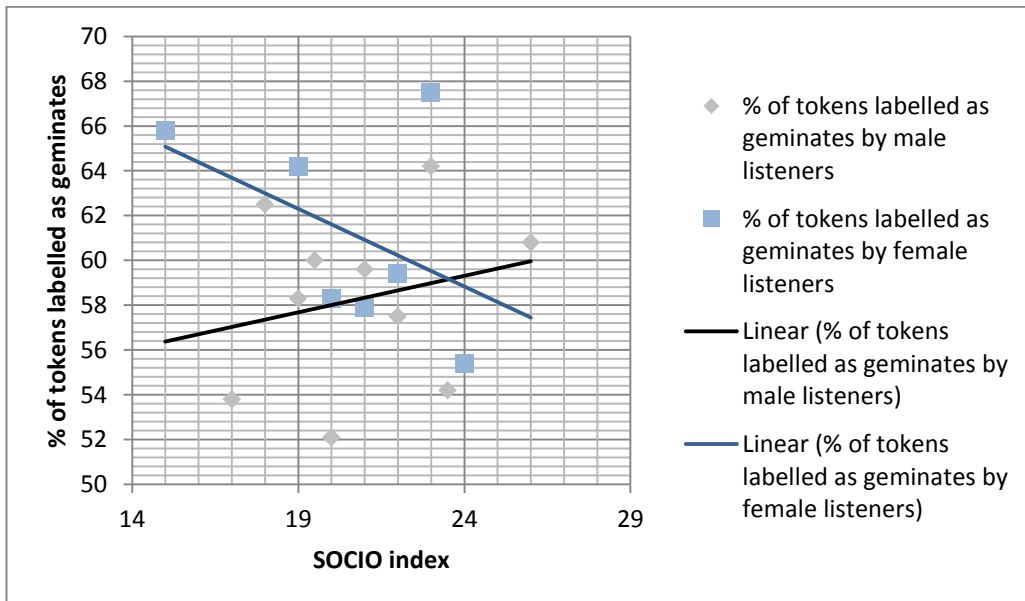
Figure 7.32 Percentages of tokens labelled as geminates by male and female listeners with different SOCIO indexes (experiment 2).

It should be noted that even though the results of relevant logistic regression models (that is 2mf, 2kv, 2mv, 2lf, 2nf and 2lv) indicate that the increase in the SOCIO of female participants caused the rise in likelihood of stimuli being perceived as geminates, and the increase in the SOCIO of male participants triggered the opposite reaction, the regression lines in figure 7.32 indicate the

opposite trends. This situation might have been caused by the discrepancy between the way the regression line in this scatter plot (figure 7.32) was generated and the way likelihood is calculated in logistic regression tests. The trends followed by male and female listeners are demonstrated by means of exp(B) coefficient for SOCIO in the relevant logistic regression models (see figure 7.33).

Figure 7.33 shows exp(B) values for SOCIO index generated in models fitted to male and female data collected in experiment 2 and it demonstrates the differences in which different values of SOCIO index influenced both genders. It can be observed that the exp(B) values for SOCIO index in models fitted to female data are slightly above the 1 mark (the blue line), which signifies that an increase of one point on the SOCIO index scale tends to increase the odds of women to label a stimulus as a geminate by a factor of circa 1.1. Exp(B) values for SOCIO index in male models were below the 1 mark, which indicates that a one-point increase in the SOCIO index decreases the odds of men to perceive a heard stimulus as a geminate by a factor of around .787 - .808.

	FEMALE Model 2mf	FEMALE Model 2kv	FEMALE Model 2mv	MALE Model 2lf	MALE Model 2nf	MALE Model 2lv
■ exp (B) for FEMALE	1.118	1.106	1.129			
■ exp (B) for MALE				0.787	0.843	0.808
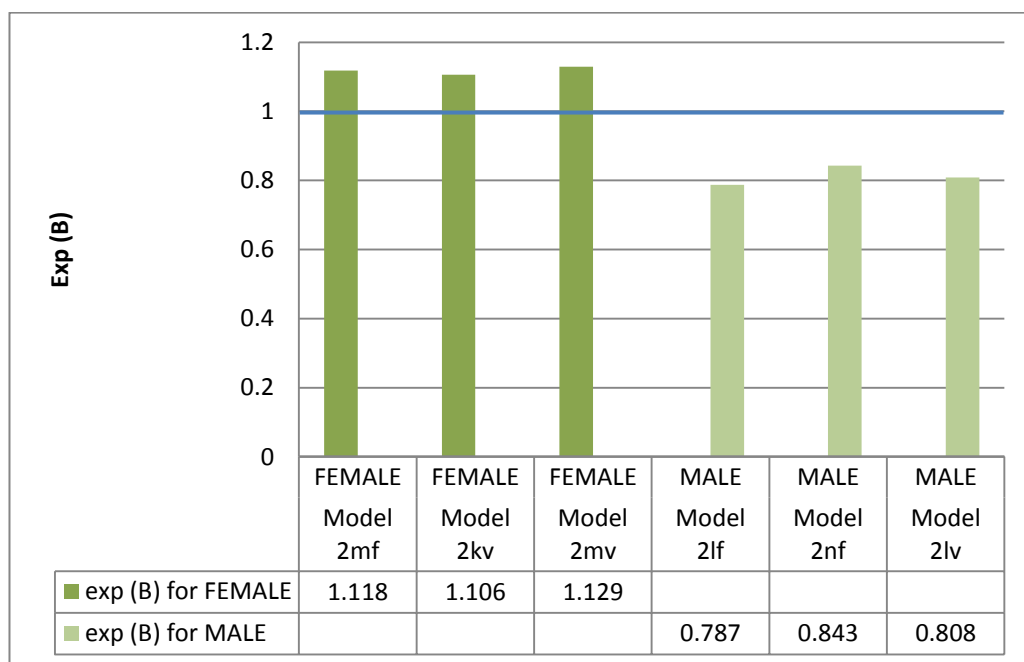
Figure 7.33 Exp(B) for SOCIO index in models fitted to data from male and female listeners (experiment 2).

In some of the cases in which the SOCIO index turned out to be a significant predictor, the way it affected the perception of the boundary was in line with hypothesis IV. This was true in some of the models fitted to data collected from (1) female listeners (experiment 2; figure 7.33), (2) Cyprus-affiliated listeners (experiment 2; figure 7.34), (3) Greece-oriented listeners (experiment 1 and experiments 1 and 2 combined; figures 7.30 and 7.35 respectively) and (4) urban listeners

(experiments 1 and 2 combined; figure 7.31). Such results suggest that some subsections of the sample tended to be affected by the possible amount of exposure to SMG as measured by the SOCIO index.

Figures 7.34 and 7.35 also illustrate the influence of SOCIO on Greece-oriented listeners (experiment 2) and Cyprus-affiliated listeners (experiments 1 and 2 combined) respectively. These trends were not statistically significant in logistic regression models fitted to those data sets, yet it seems worth noting that the opposite character of those trends might have also contributed, however marginally, to the lack of significance of SOCIO in models fitted to all data collected in experiment 1 and both experiments combined even if that was a very slight contribution.
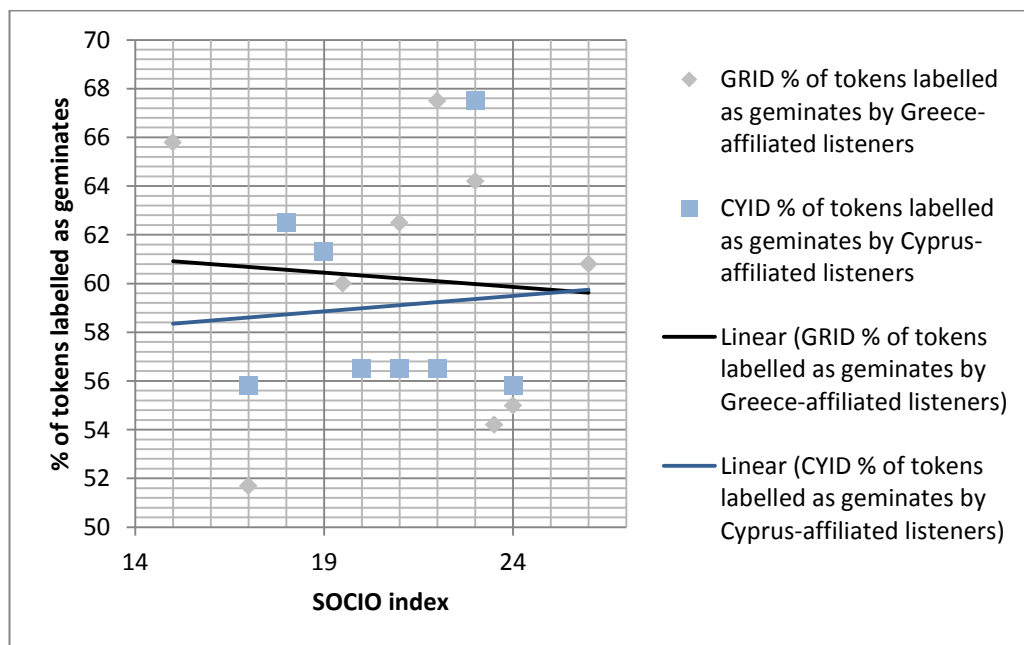
Figure 7.34 Percentages of tokens labelled as geminates by Greece- and Cyprus-affiliated listeners with different SOCIO indexes (experiment 2).
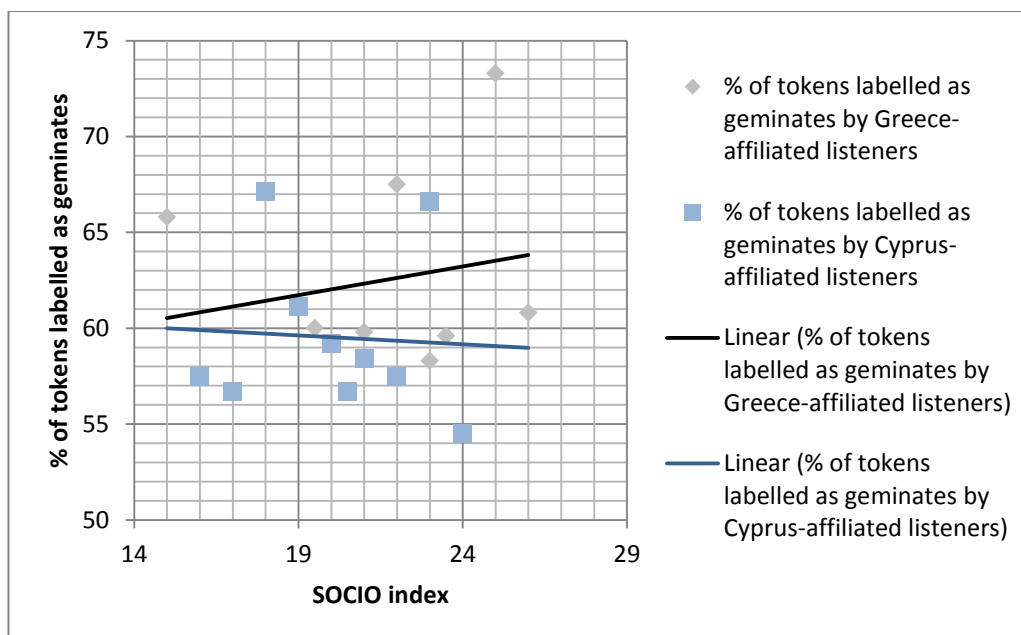
Figure 7.35 Percentages of tokens labelled as geminates by Greece- and Cyprus-affiliated listeners with different SOCIO indexes (combined experiments 1 and 2).

Some of the statistically significant results indicated that some groups of listeners were affected by SOCIO in a way opposite to that predicted by the hypothesis IV. These were (1) Cyprus-oriented listeners from experiment 1 (figure 7.30), (2) village listeners from both experiments combined (figure 7.31), and (3) male listeners from experiment 2 (figure 7.33). These results were interpreted in several ways. Since there were very few participants who came from rural areas, it is suspected that some of the unpredicted results could be an outcome of the unreliable sample. Yet, this may not be the only interpretation of the result, especially that the models that were fitted to those data were statistically significant and the models 3kf, 3kv and 3nv (figure 7.35 and table 7.27, section 7.6.4) were fitted to data that came from fifteen listeners, which is not a very small sample. It was therefore suggested that the other reasons for the result could be (1) a decreased need for gaining prestige among self-confident listeners and (2) extensive contact with geminate plosives in rural areas combined with a privileged social position of the listeners who might need to make less effort to gain prestige in comparison to other village listeners from less privileged backgrounds.

The decreased need for gaining prestige might be supported by the results reported by Pappas (2008) who analysed perception of stigmatised palatal realisations of [l] and [n] by speakers from Kefalonia. One of the results indicated that the speakers who had 'advanced' education used the palatalised variants more frequently than study participants who had 'standard' education. Pappas (2008) suggests that the tendency followed by participants with 'advanced' education

might be a result of their satisfaction with the social position they managed to achieve as "their high level of education neutralizes the effects of the stereotype regarding sophistication and intelligence" (Pappas 2008: 30). Pappas (2008) claims that the participants with 'standard' education used lower frequency of the palatalised variants since they did not have "the diplomas and life experience that will counteract their linguistic insecurity" (Pappas 2008: 30). It seems reasonable to assume that to an extent 'standard' and 'advanced' education might be compared to higher and lower SOCIO respectively, especially since level of education was one of the factors taken into consideration when SOCIO was calculated in this study. It might be suspected that in the case of listeners from rural backgrounds higher SOCIO might have a similar effect to the one 'advanced' education had on the users of palatalised [l] and [n].

The results for Cyprus-affiliated listeners were linked to listeners' assumed local pride, assuming that 'local' stands for 'Cypriot' in this context, content with their social position and the tendency to feel less concerned with the need to expose themselves to Greek culture and with the social information associated with [t] or [t:^{h}]. Yet, the result was not the same in equivalent models fitted to data collected in the presence of the flags (in those models the variable did not have a statistically significant effect on the listeners' responses). Finally, the unanticipated result obtained in the models fitted to data collected from men who were exposed to the flags were explained as the more prestigious situation men found themselves in, the less attention they paid to gaining prestige. The less men were concerned with gaining status, the less attention they paid to the social meaning of used or heard sounds.

The unanticipated results seem to indicate that there could be another factor linked to the socio-economic background of a person, other than the amount of exposure to the more prestigious variety. This factor is likely to affect the way Greek Cypriot listeners process the singleton/geminate boundary. The importance of the amount of exposure seems to be overridden by the other factor, which appears to be a form of linguistic security or content with one's social position. Such state of affairs indicates that the ET assumption regarding the importance of the amount of exposure may not be as efficient as it was initially considered. Nevertheless, the data collected for the purposes of the present study is not sufficient to fully address the question pertaining to the nature of the factor. Possible explanations for unexpected results are discussed in chapter 8.

7.7.4 The influence of stimuli duration

According to literature on VOT and CD in CG (Armosti 2010; Arvaniti 2010a; Arvaniti & Tserdanelis 2000; Botinis et al. 2004; Christodoulou 2007; Muller 2001) the values of two acoustic features influence the perception of plosives as geminates or singletons. For that reason, Hypotheses V, Va and Vb were put forward.

Hypothesis V: The longer the plosive a listener hears, the more likely that listener will be to label that plosive as a geminate.

Hypothesis Va: The longer the VOT a listener hears, the more likely that listener will be to classify the plosive containing that VOT as a geminate.

Hypothesis Vb: The longer the CD a listener hears, the more likely that listener will be to classify the plosive containing that CD as a geminate.

VOT and CD turned out to be the strongest predictors of all the independent variables tested in this study. In all the models in which the variables were entered, they turned out to be statistically significant variables and the direction in which they were reported to affect the perception of the boundary was in line with the hypotheses V, Va and Vb (figures 7.36, 7.37 and 7.38) and with the results obtained by Armosti (2010).
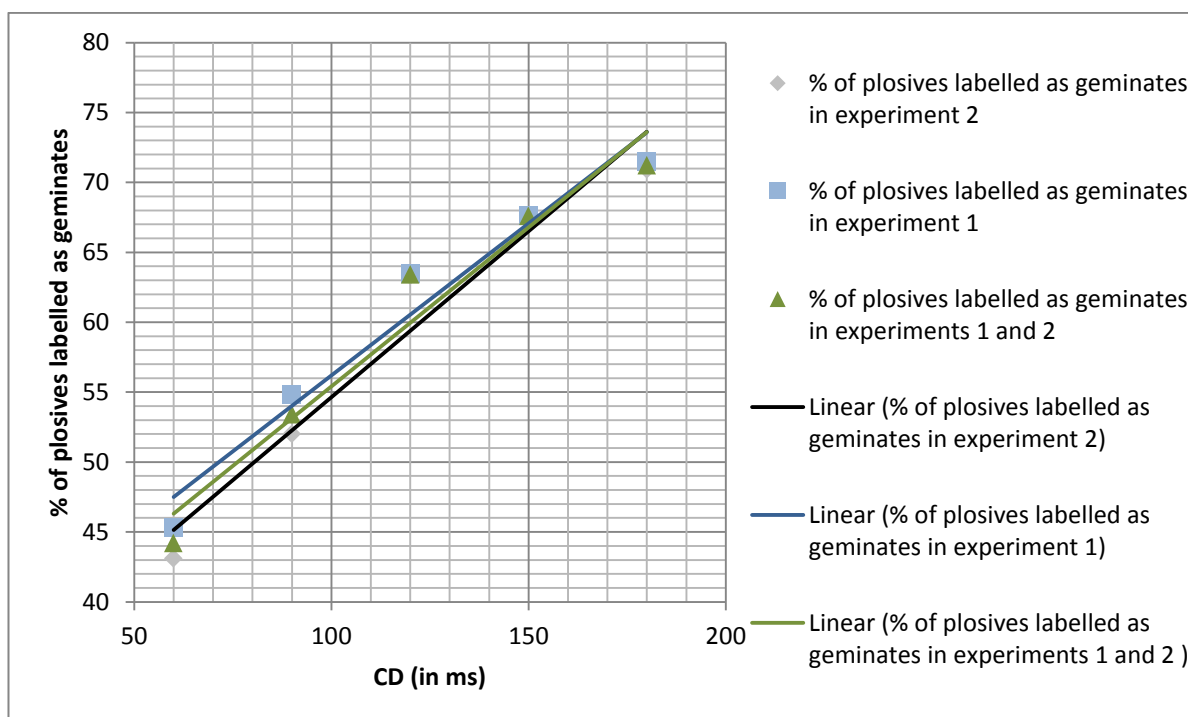
Figure 7.36 Percentages of tokens labelled as geminates as a function of the CD values in the acoustic stimuli.
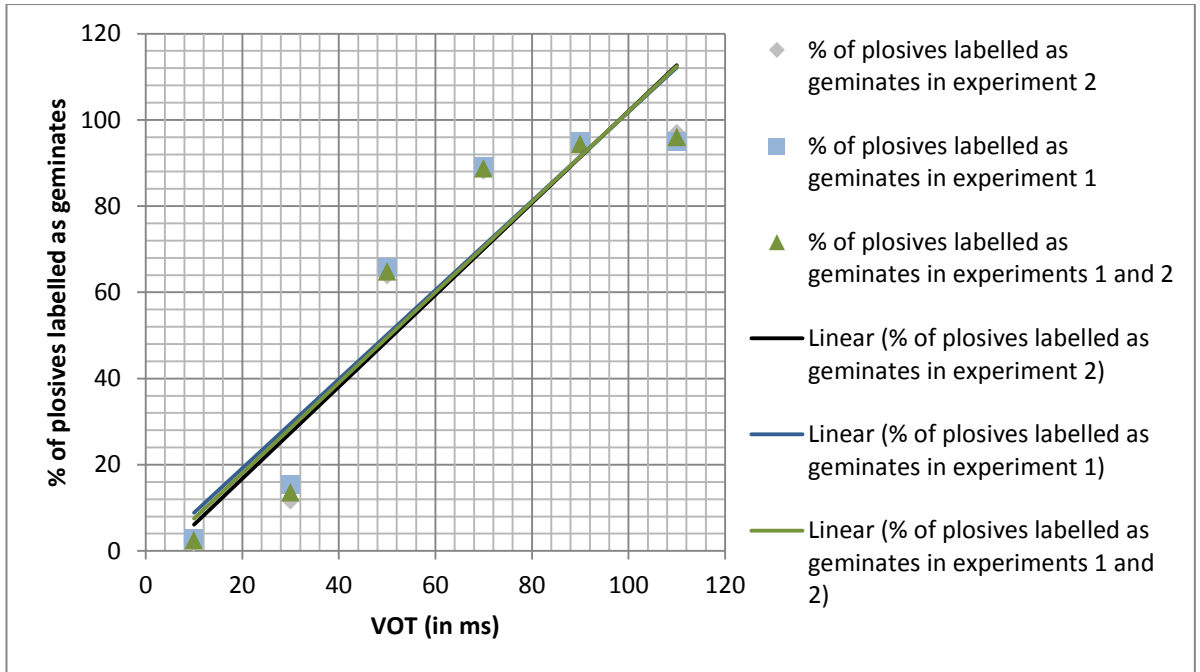
Figure 7.37 Percentages of tokens labelled as geminates as a function of the VOT values in the acoustic stimuli.
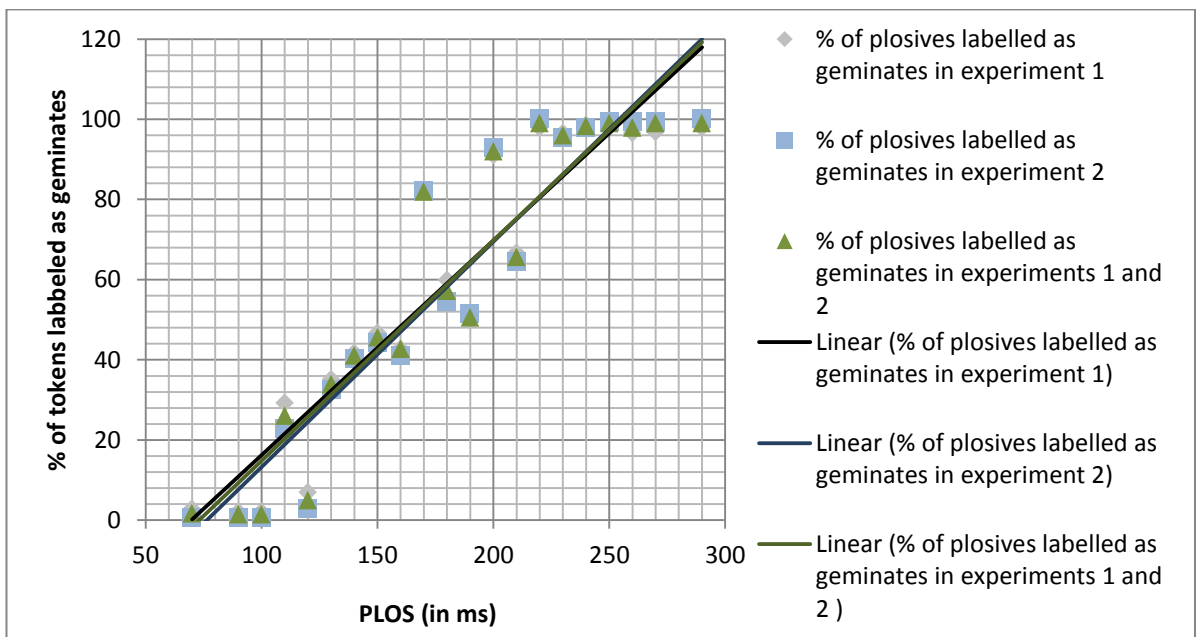
Figure 7.38 Percentages of tokens labelled as geminates as a function of the whole plosive (PLOS) values in the acoustic stimuli.

Even though PLOS turned out to be a statistically significant variable in each of the models in which it was entered and the positive values of B coefficient of PLOS across models implied that the odds of labelling a stimulus as a geminate increase with increasing values of PLOS, the percentage of correctly predicted responses in models with PLOS was much lower than in models in which VOT and CD were introduced separately. This result suggests that listeners tend to

process VOT and CD separately when processing speech and it seems to be in line with previous accounts of perception of gemination in CG plosives (Armosti 2010; Arvaniti 2010a; Arvaniti & Tserdanelis 2000; Botinis et al. 2004; Christodoulou 2007; Muller 2001).

Nevertheless, it is difficult to speculate as to whether VOT or CD is a more important cue for gemination on the basis of the present results for CD and VOT. However, the significant results for GRCD and CYCD may indirectly support the possibility that for Greek Cypriot speakers CD is a primary cue for gemination as opposed to VOT. The significance of GRCD, VTCD and CYCD suggests that the way a listener produces CD in CG and SMG, to a certain extent, has an influence on how he/she perceives the boundary between geminates and plosives. Yet, the way listeners produce VOT in either of the two accents turned out to have a statistically significant influence on how they perceive the singleton-geminate boundary in fewer models than CD did. For example, VTVOT turned out to be significant in four models and CYVOT was significant in three models. GRVOT was not significant in any of the models fitted to data collected in experiment 1. The fact that GRCD and VTCD turned out to be a significant predictor more often than VTVOT and GRVOT, it seems reasonable to suspect that CD is a slightly more robust cue for gemination than VOT.

However, such a claim is not supported by the results obtained by Armosti (2010), according to whom it is aspiration that is marginally stronger as an acoustic cue for gemination. Also, it is important to note that Armosti's (2010) results suggested that, in the case of aspiration, it is not only VOT but also the intensity of VOT that cues gemination for Greek Cypriot listeners. Thus, it is difficult to compare Armosti's study (2010) with the present one, as the present study used VOT of the listeners only (without its intensity) as an independent variable in the study. Not all the results that were obtained supported the assumptions regarding the way the independent variables influenced the way listeners perceived the stimuli.

Additionally, it may be induced from figure 7.37 that the VOT boundary between singletons and geminates might be somewhere between 30 and 50ms as that is where the greatest surge in the percentage of stimuli labelled as geminates occurs. A similar sharp rise in the number of stimuli perceived as geminates occurs between 90 and 120ms in the case of CD and that might be the range of duration where the boundary could exist (figure 7.36).

7.7.5 The influence of flags

One of the research questions posed in this study (1d) asked *'Does exposure to a concept associated with a region influence the perception of the boundary between singleton unaspirated*

and geminate aspirated plosives?' For this reason, in experiment 2 some of the listeners were exposed to the Greek flag and some of them were exposed to the Greek Cypriot flag.

The presence of the flags turned out to be statistically significant predictor in several, but not all, models fitted to data collected in experiment 2 and to combined data collected from both experiments. Even though the effects of the flags did not turn out to be statistically significant in some of the generated models, it seems that the significance of these variables in some of the models seems to support, to a certain extent, the claim that in sound processing listeners not only rely on the acoustic information about the sounds but also on indexical data stored in their memories. It is hypothesised here that the lack of statistical significance in some of the models fitted to experiment 2 data and the combined data (from experiments 1 and 2) might be a sign of the possibly small level of impact indexical information might have on sound perception. In the models in which the flags turned out to be statistically significant predictors, each of the flags influenced the perception of the boundary in a different way.

Figures 7.39 to 7.43 summarise the ways each of the flags influenced various groups of study participants. It needs to be noted that all figures in this section illustrate the influence of categorical independent variables by means of the exp(B) coefficient. The reason for choosing this coefficient over percentages of tokens labelled as geminates is that calculation of the said percentages does not take into consideration the interactions between various independent variables which are statistically significant predictors in the relevant logistic regression models. For that reason, percentages do not always reflect the analysed trends adequately. This has already been the case in the analysis of continuous variables (see sections 7.7.1 and 7.7.2). Since dichotomous variables do not have their percentages of perceived geminates spread across multiple values, as it is the case in continuous variables, the percentages of perceived geminates for dichotomous variables may be affected even more by the interactions with other statistically significant variables in the analysed models. In contrast to scatterplots with percentages, exp(B) coefficients show the influence of analysed variables with great precision and with reference to other predictors in the same models (Burns & Burns 2008). In case of a binary independent variable (for example GREEK FLAG or CYPRIOT FLAG) exp(B) higher than 1 means that belonging to a tested category (for example GREEK FLAG) increases the odds of a given outcome (in our case perceiving a token as a geminate) over a factor equal to the value of exp(B), while exp(B) lower than 1 signifies that belonging to a tested category decreases the odds by a factor equal to exp(B) value.
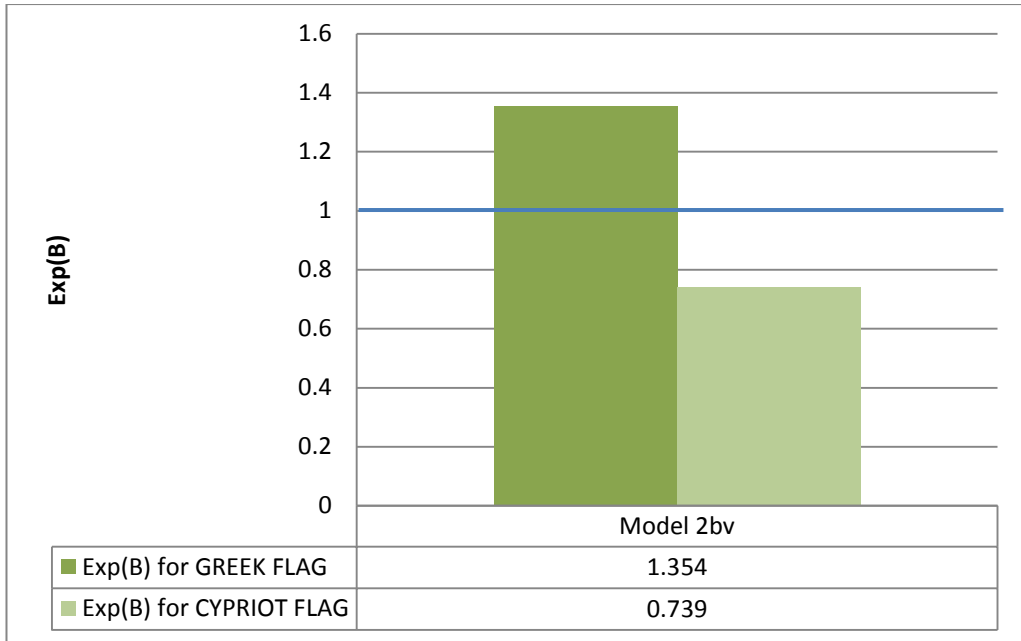
Figure 7.39 Exp(B) for listeners in experiment 2 exposed to the Greek and the Cypriot flag.
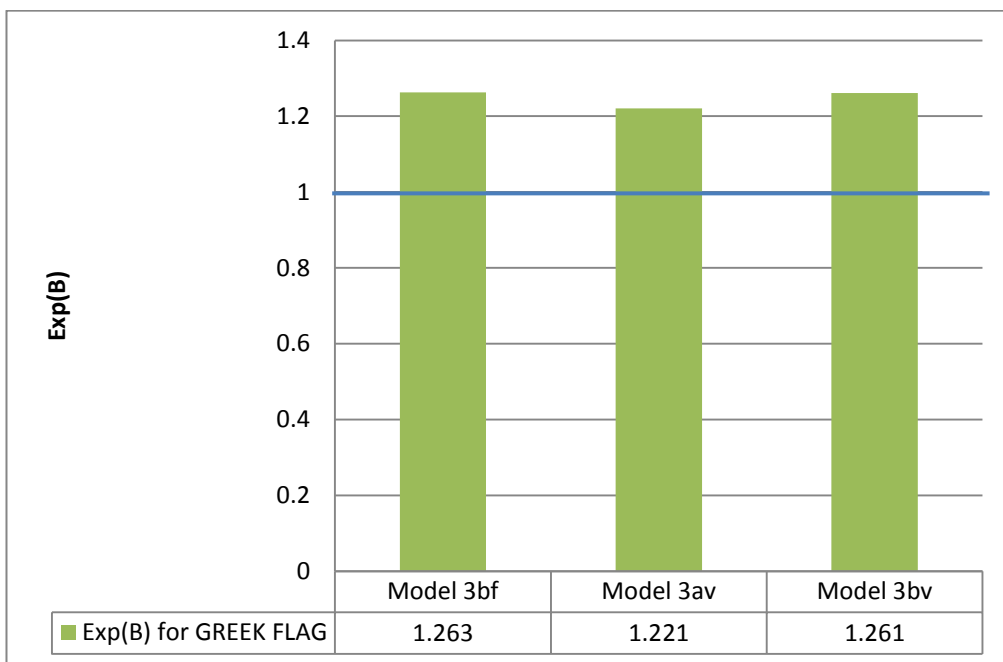
Figure 7.40 Exp(B) for listeners in experiments 1 and 2 (combined) exposed to the Greek and the Cypriot flags.

	Model 3hf IDCY	Model 3jf IDCY	Model 3hv IDCY	Model 3jv IDCY	Model 3if IDGR
■ Exp(B) for GREEK FLAG	1.368	1.331	1.314	1.383	
■ Exp(B) for CYPRIOT FLAG					0.438
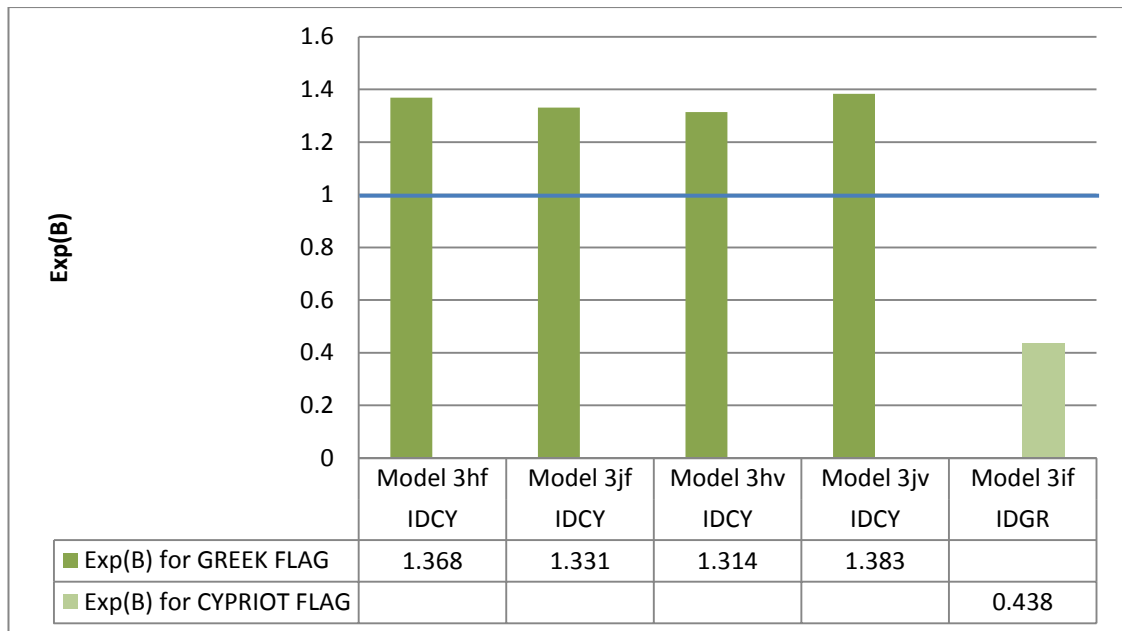
Figure 7.41 Exp(B) for Greece-oriented (IDGR) and Cyprus-oriented (IDCY) listeners from both experiments (1 and 2 combined) exposed to the Greek and the Cypriot flags.

In models fitted to (a) all data collected from experiment 2 (figure 7.39), (b) all data collected in experiments 1 and 2 combined (figure 7.40) and (c) from all Cyprus-oriented listeners in experiments 1 and 2 combined (figure 7.41) the presence of the Greek flag resulted in increased odds of plosives being perceived as geminates. As it can be seen in the relevant figures, exp(B) for the GREEK FLAG variable had values higher than 1 in models fitted to all the above-mentioned groups of listeners. It might be understood that the presence of the Greek flag increased the listeners' sensitivity to the small increases in the length of CD and VOT. The presence of the Cypriot flag had the opposite effect but in models fitted to all experiment 2 data only and to Greece-oriented listeners from experiments 1 and 2 (combined). The exp(B) for CYPRIOT FLAG in figures 7.39 and 7.41 had values below 1, which signifies that being exposed to the Cypriot flag decreased the odds of perceiving the heard sounds as geminates by the members of the two groups of listeners.

It needs to be restated at this point that in the experiment 2 data set, the variables GREEK FLAG and CYPRIOT FLAG had a binary character, and it is suspected the results of the experiment 2 regression models do not clearly indicate whether both Greek and Cypriot flag influenced the perception of the boundary, or only just one of them did, but due to the binary character of the variables the other flag only appeared to have the influence too. For that reason, logistic regression models were also fitted to combined data from experiments 1 and 2. As a result, in that dataset there were three categories GREEK FLAG, CYPRIOT FLAG and NO FLAG. That

procedure facilitated the analysis of GREEK FLAG and CYPRIOT FLAG as non-dichotomous variables. The analysis of the combined data from experiments 1 and 2 (figure 7.40) suggested that the influence of the Cypriot flag might have only been an outcome of the dichotomous character of the variables GREEK FLAG and CYPRIOT FLAG because the CYPRIOT FLAG variable turned out not to be statistically significant in any models fitted to those data.

	FEMALE Model 2kf	FEMALE Model 2kv	FEMALE Model 2mv	MALE Model 2iv
Exp(B) for GREEK FLAG	1.602	1.546	1.706	0.015
Exp(B) for CYPRIOT FLAG	0.624	0.647	0.586	1.739

Figure 7.42 Exp(B) for the Greek flag and the Cypriot flag in models fitted to male and female data subsets collected in experiment 2.

	FEMALE Model 3cf	FEMALE Model 3ef	FEMALE Model 3cv	FEMALE Model 3ev	MALE Model 3df
Exp(B) for GREEK FLAG	1.374			1.382	
Exp(B) for CYPRIOT FLAG	0.076	0.719	0.715		1.372
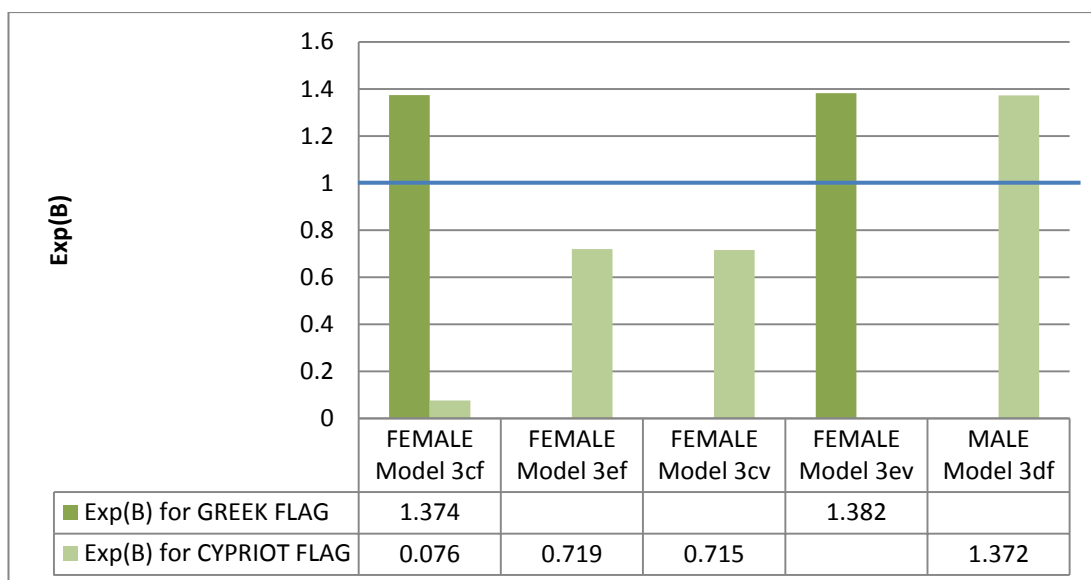
Figure 7.43 Exp(B) for the Greek flag and the Cypriot flag in models fitted to male and female data subsets collected in experiments 1 and 2. Empty spaces signify no significant effect.

Additional analyses of various subsets of data revealed that exposure to the flags had a different effect on male and female listeners. The results seem to imply that even though both genders are affected by such non-linguistic cues, they tend to process these cues differently. It seems that when exposed to any of the flags, women activate (Greek flag) or deactivate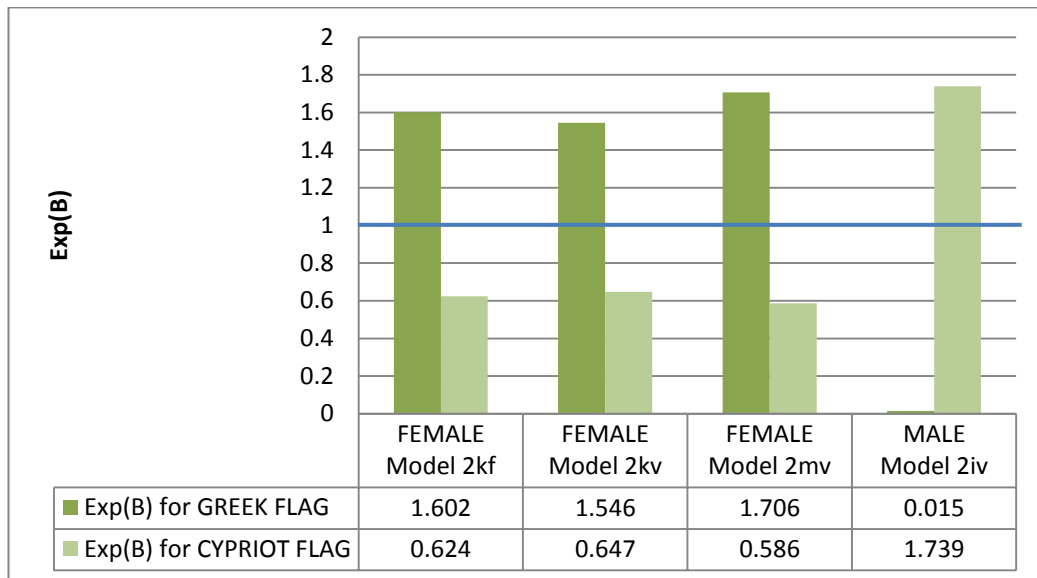 (Cypriot flag) their linguistic insecurity. If their linguistic insecurity is activated, they may become more strict/hypercorrect with how they classify the heard sounds and they are more likely to label the heard sounds as geminates. When women's linguistic insecurity is deactivated under the influence of the Cypriot flag, they tend to label fewer heard plosives as geminates. These tendencies were observed in logistic regression models fitted to data from experiment 2 (figure 7.42) and in those fitted to combined data from combined experiments 1 and 2 (figure 743).

Men, on the other hand, seem to make use of stereotypes upon being exposed to the Cypriot flag as it was indicated by models fitted to combined data (figure 7.43). It appears that if they are not sure how to classify a sound, they make use of the stereotype that Cypriots use geminates and label such ambiguous stimuli as geminates. Logistic regression models fitted to experiment 2 data suggested that men were also affected by the presence of the Greek flag and that they were less likely to label the heard tokens as geminates in their presence (figure 7.42). Yet, the results of the models fitted to the combined data indicate that this trend might have been a result of binary character of the variable (the presence of either the Greek flag or the Greek Cypriot flag) in experiment 2 data set. In logistic regression models fitted to combined data (experiments 1 and 2) the presence of the Greek flag did not have statistically significant influence on men's perception of the singleton/geminate boundary (figure 7.43).

The results showing that women were affected by both flags while men only by the Cypriot flag also might suggest that men and women may be giving different levels of attention to different pieces of such information. It appears that, for some reason, men were not significantly affected by the presence of the Greek flag, even though they were influenced by the Cypriot flag. Nevertheless, the reason for such situation cannot be explained with the data collected in this study.

The comparison of data collected in the presence of both flags separately indicated which variables seem to matter more when processing sounds when listeners are exposed to the Greek flag than when they are exposed to the Cypriot flag. This analysis implied that when exposed to the Greek flag listeners tend to be influenced more by the values of plosives they produce themselves, whereas when listeners are exposed to the Cypriot flag their perception tends to be

more affected by variables such as their gender or ID score. The reason for such discrepancies remains unexplained.
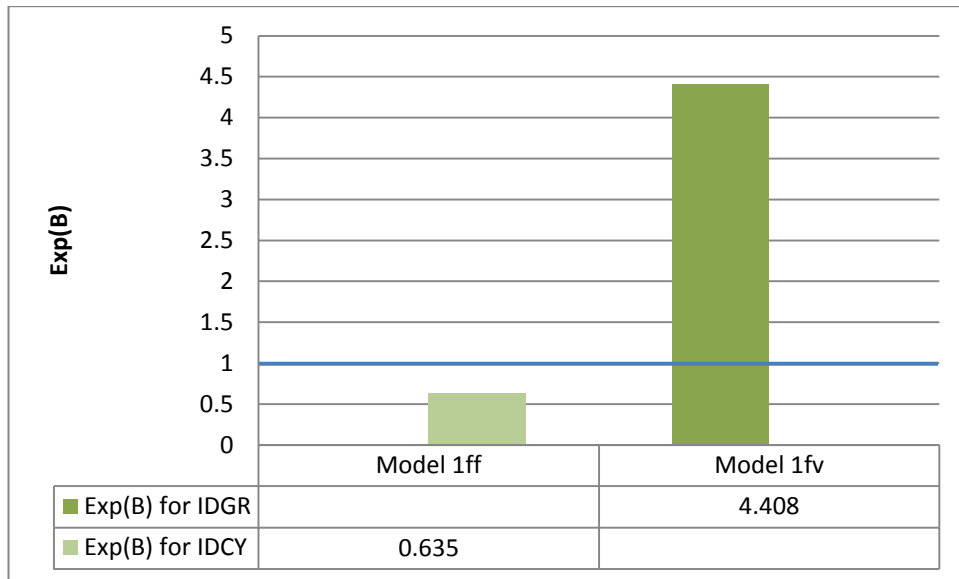
Figure 7.44 Exp(B) for Greece- and Cyprus-oriented female listeners (experiment 1).
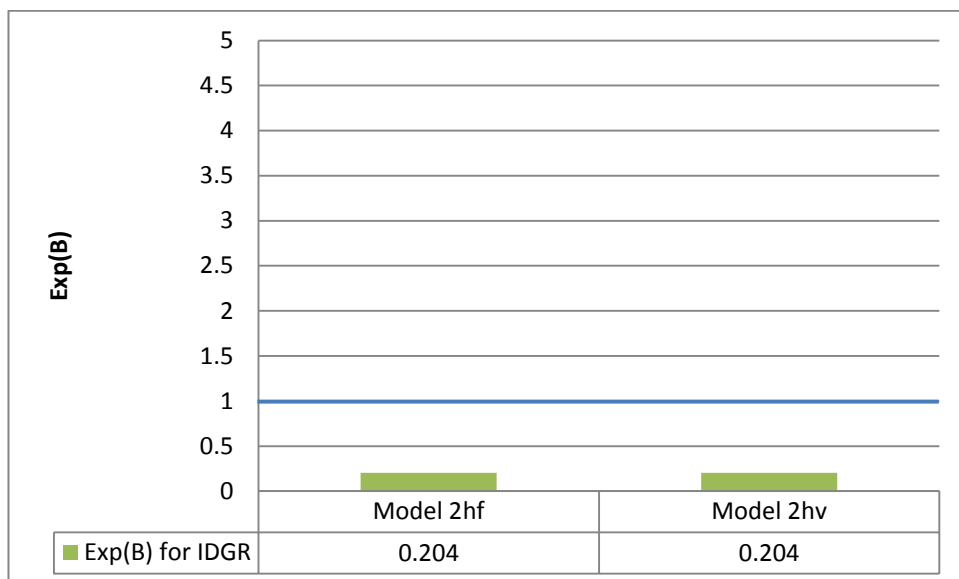
Figure 7.45 Exp(B) for Greece- and Cyprus oriented female listeners (experiment 2).

An analysis of how the presence and the absence of the flags affected some of the subgroups of study participants also revealed some interesting patterns. It was discovered that some sections of female population are more sensitive to social information carried by target sounds, and that the sensitivity might be activated or deactivated depending on the context in which a target sound is processed. For example, Greece-affiliated women who were not exposed to either of the flags were more likely to label the sounds as geminates than Greece-affiliated male listeners who were not exposed to any flags (figure 7.44). On the other hand, Greece-affiliated women who

were exposed to flags were less likely to classify the stimuli as geminates than Greece-oriented male listeners who took part in the same experiment (figure 7.45). However, it is not possible to explain why the presence and the absence of the flags influenced men and women in such a way.

Taking into consideration all the ways in which each of the flags affected the perception of the boundary, it could be concluded that not only do listeners seem to make use of indexical information stored in exemplars of plosive sounds, but they also appear to use the information in different ways depending on their background.

7.7.6 The influence of gender

Even though including gender as one of the variables in the presented models was not a primary aim of the study, it allowed for an analysis of how being a man or a woman may affect one's way of processing sounds. Entering GEN as an independent variable in various models fitted to all the three sets of data and fitting models to separate male and female data subsets revealed that male and female study participants were influenced by several variables besides CD and VOT of the heard stimuli and that the two genders were sometimes affected in different ways.

The main differences in the way men and women were affected are presented in sections 7.7.2, 7.7.3 and 7.7.5. Some of the results imply that variables such as SOCIO or ID may have a different impact on the perception of the boundary depending on whether the listener is male or female. As it was earlier mentioned in sections 7.7.2 and 7.7.3, such interactions between variables indicate that variables such as SOCIO and ID should not only be analysed from the point of view of the probable amount of exposure to SMG or CG, and that there might be some other factors associated with those values which might have an effect on perception of gemination. One of these factors could include women's increased sensitivity to social meaning carried by the target sounds. Including gender in the analysis of the collected data also exposed differences in the way men and women reacted to the presence of the flags. Some of these differences, especially those linked to the effects of insecurity, served as the basis for drawing conclusions that are closely linked to new contribution of this study which seems to give evidence that there is a need for new assumptions to be added to the ET assumptions list.

7.7.7 The effect of the place of residence

Similarly to gender, analysing the influence of the place of residence was not one of the principal aims of carrying out the study. The influence of the variable (RES) was analysed as the data was available to the researcher and seemed to be a potential source of additional information on the way the singleton/geminate boundary is processed by listeners. Even though the data did not

seem to be entirely reliable due to the low number of listeners from villages, some preliminary results were obtained and facilitated several observations which implied that residents of urban areas are more likely to notice small increases in the length of VOT and CD, and as a result, classify shorter plosives as geminates. This tendency was observed in all models in which RES turned out to be a statistically significant predictor. Such an influence of RES on boundary perception appears to be linked to the claim that SMG is used more often in urban areas than in rural areas. If in urban areas SMG is used more often, then residents of cities and towns are likely to be exposed more to singleton plosives in words such as *feta*. This increased exposure might be the reason for their increased sensitivity to small increases in the length of VOT and CD. Thus, indirectly, the influence of RES on the perception of the boundary could add evidence to the hypothesis that the amount of exposure to a category has an influence on its perception.

Furthermore, several trends indicating that the choices made by village listeners might have been a result of possible linguistic insecurity or security (depending on their social standing) contributed to the development of the argument that perception of sounds may also be conditioned by listeners' level of linguistic confidence. The issue is further discussed in section 8.2.4.

7.8   Conclusion

The data collection in this study was used to generate multiple logistic regression models which gave insights into what variables contribute to the perception of the singleton/geminate continuum, and in what way they do so. The models were fitted to data collected in different conditions (no flags, with flags, etc.) and to data collected from different cross sections of study participants separately (men, women, Cyprus-affiliated, Greece-affiliated, etc.). Analysing data in all these ways aided the investigation of how variables affected different groups of listeners. The outcomes of the study not only seem to add evidence for the validity of some of the previously made hypotheses (see chapter 5), but also indicated that there could be other factors than the predicted ones that are likely to affect the perception of the singleton/geminate boundary. The way the results support some of the exemplar theory assumptions and the way the results add to the existing knowledge on the perception of singleton/geminate boundary by Greek Cypriots are discussed in chapter 8.

8   Discussion

8.1   Social evaluation of geminate plosives and its significance

This social evaluation study was carried out to ascertain whether the use of [t:ʰ] is noticed and socially evaluated by listeners, and, if so, to establish how the use of the sound is evaluated. It was believed that such a study would help establish whether the singleton/geminate boundary is a suitable variable for carrying out research that would test several of the ET assumptions.

Additionally, apart from demonstrating the suitability of the boundary between [t] and [t:ʰ] as a cue for the perceptual study, the outcomes of the social evaluation study provided new information on how the use of [t:ʰ] and [t] is viewed by Greek Cypriot listeners and how those evaluations differ from general evaluations of CG and SMG respectively.

8.1.1   Justification of the perceptual study methodology

The results of the social evaluation study (chapter 6) shed light on how the two sounds, geminate and singleton plosives, are perceived by Greek Cypriot listeners, which as a result helped with the design of the perceptual experiments in the perceptual study (chapter 7).

In particular, the attitudinal study identified that each of the two sounds, [t:ʰ] and [t], carries a set of social meanings consistent with those which are associated with the use of CG and SMG respectively, according to previous attitudinal studies. The traits attributed to the use of [t:ʰ] were successfully linked by the results of the present study to an overarching meaning 'Cypriot', which turned out to be in line with meanings assigned to CG by subjects in studies by Papapavlou (1998), Sophocleous (2006) and Papapavlou and Sophocleous (2009).

The study outcome implied that the meaning of the variable is associated with a geographical area and/or a culture. For this reason, it was decided that the use of the Cypriot flag, as a symbol of a geographical area and/or a culture, would be justifiable in an experiment designed to verify whether social information, such as 'Cypriot', is likely to be stored in listeners' memories and to be activated at the time of sound processing.

Since (1) the use of [t] tended to get evaluations opposite to those of [t:ʰ] when it was used in words such as *feta* in SMG, which is the mother tongue of Greece, and (2) its use in the discussed context tends to be associated with mainland Greeks, it was hypothesised that the likely overarching meaning of [t] might be 'Greek' (see chapter 6). If such a theory were correct, according to the assumptions of ET, the meaning 'Greek' should be stored in exemplars of [t] with acoustic information of this sound in the memories of Greek Cypriot listeners. Therefore, the

outcomes of the attitudinal study indirectly justified the use of the Greek flag as a possible symbol of both the geographical area (that is Greece) and Greek culture in the perceptual test, which aimed to verify whether the presence of an element associated with the social meaning(s) 'Greece' or 'Greek' could be used in the processing of the singleton/geminate boundary together with acoustic information about the sound.

Summing up, carrying out the attitudinal study justified the use of flags in perceptual experiment 2 (discussed in section 7.4) by adding evidence supporting the hypothesis that indexical information stored in exemplars of [t] and [t:^{h}] could relate to one of the two regions, Cyprus or Greece, and/or the cultures of the respective regions.

8.1.2 Further understanding of attitudes towards CG and SMG

Apart from being helpful in supporting the methodological choices in perceptual experiment 2, the results of the attitudinal study added to the general knowledge of attitudes towards the Cypriot dialect.

First of all, the results imply that [t:^{h}] belongs to the group of CG variables which are salient and socially evaluated by Greek Cypriot listeners. The data collected in this attitudinal study, supplemented with information gathered through observations, facilitated a preliminary classification of [t:^{h}] according to Labov's (1971) and Silverstein's (2003) categorisations. Thus, it is estimated that the variable could be classified at least as a *marker* and potentially as a *stereotype* in line with Labov (1971), or at least as the second and potentially third indexical order according to Silverstein's (2003) ordering.

Despite the fact that a lot of research has been done in establishing the way CG and SMG are evaluated by Greek Cypriot listeners, this study, to the best of my knowledge, is the first one which analyses the way the use of [t:^{h}] and [t] is evaluated by Greek Cypriot listeners. A comparison of the meanings of [t:^{h}], which are revealed in this study, and the traits assigned to CG in general, by earlier studies (Papapavlou 1998; Sophocleous 2006; Papapavlou & Sophocleous 2009; Tsiplakou 2006; Karyolemou 2006; Panayiotou 1996, cited in Pavlou and Papapavlou 1998; Pavlou 1997, cited in Pavlou & Papapavlou 1998; Yiakoumetti et al. 2005) showed that not all the social meanings reported to be associated with CG could also be associated with the use of [t:^{h}]. Only some of the meanings carried by the use of CG turned out to be assigned to the use of geminate plosives. Such a pattern implied that not all the salient features of CG are evaluated exactly the same way. Such evidence might help in understanding how different features of CG

make up the dialectal continuum which, according to Sophocleous (2006), Terkourafi (2005) and Tsiplakou (2006, 2009), exists in Cyprus.

8.2   Contribution to research on exemplar theory

The study, especially the two perceptual experiments 1 and 2 (see chapter 7), enabled establishing whether some of the assumptions of ET regarding perception of sounds apply in the singleton/geminate plosive boundary perception by Greek Cypriot listeners. The tested assumptions included (1) the claim that sound categories are generated on the basis of statistical similarity of stored exemplars of sounds (Pierrehumbert 2003a; Johnson 1997a), (2) the reasoning that the 'strength' of a sound category could be proportional to the amount of exposure to (or amount of stored exemplars of) that (category of) sound (Pierrehumbert 2003a; Johnson 1997a), and (3) the proposition that extralinguistic information is stored in with the phonetic signal (Semon 1923, as cited in Johnson 2007: 27; Goldinger 1997; Johnson 1997a, 2007; Pierrehumbert 2003a; Scobbie 2006; Hay and Drager 2010; Niedzielski 1999).

Even though the results of the study added evidence to the claim that indexical information is stored together with acoustical features of sounds, the results only partially supported the claim that the amount of exposure to certain categories and the acoustical values of the stored categories have an influence on sound perception. The limited extent of the influence of the amount of exposure and the acoustical values of the stored categories seems to suggest that ET, despite being a fairly good predictor of some perceptual patterns, might not be able to serve as an efficient model of speech perception if considered without acknowledging certain sociolinguistic principles.

8.2.1   The role of indexical features in perception

According to several sources discussed in chapter 4 (Semon 1923, as cited in Johnson 2007: 27; Goldinger 1997; Johnson 1997a, 2007; Pierrehumbert 2003a; Scobbie 2006), when sound categories are created in the memories of listeners, listeners store indexical information together with the acoustic properties of the occurrences of the sounds they hear. As an example, the indexical information could be a speaker's (perceived) age (Hay et al. 2006b), gender (Strand 1999), socio-economic background (Hay et al. 2006b) or geographical background (Niedzielski 1999; Hay et al. 2006a; Hay and Drager 2010).

The perceptual study discussed in chapter 7 was aimed to establish whether the presence of a symbol associated with a culture and geographical area could influence the perception of the

singleton/geminate boundary, and, therefore, to add evidence to the claim that such information tends to be stored in exemplars of geminate and singleton plosives by Greek Cypriot listeners.

Logistic regression models fitted to all data collected in experiment 2 indicated that the presence of the Greek and the Cypriot flags influenced the perception of the singleton/geminate boundary. Similarly, models fitted to all data collected in experiments 1 and 2 (combined) suggested that the perception of the boundary is affected by the presence of the Greek flag. It needs to be noted that the influence of both flags may not be very strong as the p values tended to be fairly high in the models that suggested the flags were statistically significant predictors (table 7.18: p=.024 for the influence of both flags, table 7.24: p=.024, p=.049 and p=.020 for the influence of the Greek flag in three different models). Furthermore, on the whole, the influence of the Cypriot flag might be less robust than that of the Greek flag, as the influence of the Cypriot flag turned out to be statistically significant in fewer models fitted to all data from experiment 2 or experiments 1 and 2 (combined) than the Greek flag's influence.

Since the presence of the Greek and the Greek Cypriot flags turned out to affect the listeners' perception of the boundary, it may be claimed that information such as 'Greek' or 'Cypriot' is likely to be stored with the values of the acoustic signal. Such a result may further support earlier conclusions drawn by Niedzielski (1999), Hay et al. (2006a) and Hay and Drager (2010) that indicated there is a relationship between the presence of indexical cues relating to a geographical area and the shift in perception of sounds heard, as well as those studies that reported the influence of indexical cues other than geographical ones on the processing of heard sounds (Hay et al. 2006b; Strand 1999).

The various ways in which the flags influenced perceptions may also shed light on how those indexical cues are processed by different sections of the population. An analysis of the present study's outcomes and the outcomes presented by Niedzielski (1999), Hay et al. (2006a) and Hay and Drager (2010) suggests that indexical information may be processed differently. These processing differences may possibly be an effect of different social, sociolinguistic and experimental contexts of the three studies.

Regarding how the flags influenced the perception of the boundary in models fitted to all data collected in experiment 2, when a Cypriot flag was included, listeners were less sensitive to small increases in the length of plosives than when there was a Greek flag. On the other hand, the Greek flag caused an increase in the number of sounds labelled as geminates. This result might

suggest that, in general, the presence of the flag may increase listeners' sensitivity to what should be classified as a standard pronunciation of alveolar plosives.

Such a way of understanding the results implies that, in general, the listeners in the present study reacted differently to visual cues than the listeners did in studies by Hay et al. (2006a) and Hay and Drager (2010), in which they tended to choose more Australian-like stimuli when exposed to 'Australian' visual cues and more New Zealand-like stimuli when exposed to 'New Zealand' visual cues. This appears to suggest that the listeners in the two New Zealand studies tended to rely less on the auditory cues when exposed to visual ones, and they seem to have made use of the stereotypes about New Zealander and Australian speech, when making their choices of stimuli that matched the sounds they heard. In a similar manner, the listeners in Niedzielski's (1999) study, who were from Detroit, tended to match stimuli with a Canadian-like raised variant of the target vowels to the heard samples of speech by a speaker who they were told was from Canada. Niedzielski (1999) attributed this performance to the use of stereotypes instead of acoustic features of speech. She claims that:

> Listeners 'hear' the stereotyped raised variant if the speaker fits the social description of someone who is expected to raise it—that is, someone from Canada. If, however, the speaker does *not* fit this social description—if the speaker is believed to be from Michigan—then listeners are less likely to 'hear' or notice the raised Variant (Niedzielski 1999: 69).

If the Greek Cypriot subjects in the present study had used the same strategy of dealing with the visual cues, their performance would have been the opposite of the one that they showed. As there is a stereotype that Greek Cypriots use geminate plosives in their speech, the presence of the Greek Cypriot flag during the perceptual task would have caused the listeners to label more heard stimuli as geminates. In a similar manner, listeners exposed to the Greek flag would be more likely to label more stimuli as singletons, since mainland Greeks are known not to use geminate plosives including words like *feta*. Nevertheless, in general, listeners tended to use these cues as a catalyst which made them more or less alert to increases in the length of the heard plosives.

It seems likely that these differences in using visual cues may have originated in the differences between sociolinguistic settings in the three speech communities. What makes Greek Cypriots different from Detroiters and New Zealanders is that Greek Cypriots use both researched target sounds ([t] and [t:^{h}]) in their speech, and the use of the two variants depends on the situation in

which the speech act occurs. Also, as established in chapter 6, the use of [t] and [t:ʰ] tends to carry social information and the variable could be classified as a marker, according to the classification by Labov (1971). For this reason, it seems logical to suspect that Greek Cypriots make their choices regarding the use of [t] and [t:ʰ] consciously and are alert (to a certain extent) to the changes in the length of the two target sounds. In various situations for Greek Cypriots, the need to choose the right form that would convey the right social message might be crucial, so for that reason they may be less prone to using stereotypes the way Detroiters or New Zealanders did in the above-mentioned studies. Instead, Greek Cypriots are more prone to using cues, such as the ones in the present study, as signals to act in a way that will facilitate the creation of the intended persona. The choices they make may have implications for their social and professional lives.

The Detroit and New Zealand situations are different in this respect. Hay et al. (2006a) and Hay and Drager (2010) tested the influence of indexical cues on the perception of sounds (/ɪ/, /e/ and /æ/), which have different variants in Australian English and New Zealand English. New Zealanders do not switch from one variant to another (that is from New Zealand-like to Australian-like, and vice versa) depending on the formality of the situation, as is the case in the use of [t] and [t:ʰ] in Cyprus. Thus, for New Zealanders, processing such sounds is not likely to involve paying attention to issues such as social prestige, whereas Greek Cypriots pay (more) attention to social prestige. Even if prestige is carried by either of the sounds, it is not as significant in the lives of New Zealanders as is the prestige (or the lack of it) associated with the use of singleton and geminate plosives by Greek Cypriots. Thus, it seems reasonable to suspect that the use of one sound or the other from the pairs in this study would be limited to labelling speech as Australian-like or New Zealand-like, which is not likely to involve any additional issue of the lack or presence of prestige. In the study by Niedzielski (1999), the influence of indexical cues on perception affected sounds which are stereotyped as non-standard, but at the same time Detroiters believe that the sounds are used only by Canadians and not by Detroiters themselves. As Detroiters are reported to be convinced of the standard character of their accent and unaware of the presence of CR vowels in their own speech, it appears likely that, for them, making distinctions between 'Canadian' and 'Detroit' sounds would not involve as much preoccupation with status as it would for Greek Cypriots when they are processing the [t] - [t:ʰ] boundary.

It could be concluded that, in general, the way visual cues relating to geographical areas (or cultures developed in those areas) may be processed differently by listeners depending on their social background and the sociolinguistic meanings carried by the sounds. The presence of a cue is

likely to suggest an answer (such as in the case of Detroit and New Zealand studies) or increase/decrease listeners' attention to acoustic detail (as reported in the present study).

The diversity of effects that such indexical cues may have on listeners' behaviour is also noticeable in a careful analysis of the data across different sections of study participants. Such examination reveals that there are further differences in the ways listeners in the three studies processed the cues. A breakdown of the results by gender exposes more discrepancies.

Even though the present study and the studies by Hay et al. (2006a) and Hay and Drager (2010) report variations in the way men and women processed indexical cues, there are differences in their manifestation, as seen in the studies on New Zealanders' perceptions and in the present study. Specifically, Hay et al. (2006a) and Hay and Drager (2010) show that, even though overall results suggest that, in general, listeners tended to choose vowel stimuli with more Australian-like acoustic features when exposed to an 'Australian' label or kangaroo toys and were more likely to choose more New Zealand-like vowels stimuli upon being exposed to a 'New Zealand' label or kiwi toys, in both experiments, the results were more robust for female listeners. However, further analysis of the data revealed that male listeners were more likely to choose New Zealand-like vowel samples when exposed to 'Australian' stimuli than female listeners did. In fact, male listeners in Australian conditions in both studies chose more New Zealand-like stimuli than in the New Zealand conditions. This pattern was explained by referring to the listeners' kiwi pride linked to the rivalry between Australian and New Zealand sport teams (Hay and Drager 2010).

In the present study, the perceptual patterns of men also did not turn out to be in line with the general trends revealed in the models fitted to all data collected in experiment 2 or those in the models fitted to all data collected in both experiments combined. Male listeners appeared to process the non-linguistic cues differently than women did. In particular, women became more sensitive to increases in the length of the plosives in the presence of the Greek flag but less sensitive in the presence of the Cypriot flag, while men, when exposed to the Greek Cypriot flag, seemed to judge the sounds according to the stereotypes they tend to have regarding the speech of Greek Cypriots. Niedzielski (1999), on the other hand, reported no differences in perception between men and women.

Such differences in how men and women react to visual cues relating to geographical areas, as seen in the New Zealand, Detroit and the present studies, indicate that the way such non-indexical cues affect men's and women's perceptions may also depend on the social setting. In the Cypriot context, the use of items symbolising the two geographical areas involves the issue of

prestige. As men and women tend to have different attitudes towards prestige (or its absence), there seem to be additional effects of the presence of indexical cues symbolising geographical areas on male and female listeners in the Cypriot context. Such trends are not observed in the case of the two New Zealand studies. This may be due to the lack of an association of prestige with the sounds used in New Zealand or Australia. As far as the Detroit study is concerned, even though the distinction between shifted vowels and standard American vowels may involve issues of prestige, male and female listeners from Detroit may be affected by these issues to a much lower degree than Greek Cypriot listeners because of the issue of prestige linked to the geminate/plosive distinction, as Detroiters tend to believe the vowels they use are standard American. In fact, Niedzielski (1999, 2010) points out that Detroiters are characterised by linguistic security. Thus, when classifying a sound as Detroit-like or Canadian-like, the choice did not seem to be affected by any additional issues relating to increased sensitivity to prestige by female listeners, and therefore the criteria for choice seem to be the same for men and women.

The last issue that remains to be discussed is how the beliefs the participants in all three studies had, regarding the background of the speakers they heard, influenced the way the listeners processed the visual cues. Niedzielski (1999) concluded that her study participants who received answer sheets with a 'Canadian' label on them assumed they were listening to a Canadian and, therefore, they tended to choose more Canadian-like vowels. The link can be further confirmed by a case of one listener who was convinced the speaker he heard was not Canadian, and made his choices of stimuli in a similar manner to those listeners who were made to believe that they had listened to a speaker from Detroit. The listeners in the present study were not made to believe that the speaker they listened to was a Greek or a Greek Cypriot as no comments were made by the researcher regarding this issue. Most likely, the listeners suspected or even knew that the speaker was a Greek Cypriot, as they heard a great number of geminate plosives, which are not used by mainland Greeks. Yet, the presence of the flags caused listeners' shift in the perception of the boundary. Such a situation might further support the claim by Hay et al. (2006a) and Hay and Drager (2010), whose study participants were aware of the speaker's background, that the mere presence of a concept associated with an area may activate a notion in exemplars of sounds, which is likely to cause a shift in perception.

8.2.2 The role of the amount of exposure in perception

Exemplar theory assumes that sound categories are formed bottom-up, on the basis of all heard occurrences of sounds, which are kept in memory without abstraction. That is, every occurrence of sound is remembered and the categories are created on the basis of statistical similarity

(Pierrehumbert 2003a). The volume of similar exemplars of sounds stored in a person's memory is claimed to be linked to and responsible for the strength of a category that those sounds belong to (Pierrehumbert 2003a; Bybee 2006). The larger the number of exemplars there are, the better defined that sound category is and the better it is separated from other exemplars and similar categories.

As mentioned earlier in chapter 5, the SOCIO and ID score might, to a certain extent, help to estimate a person's possible amount of exposure to SMG and therefore to [t] singleton plosives in words such as *feta*. This would be possible as the higher SOCIO (as measured in this study) one has, the more likely the person is to have contact with SMG through having more contact with people from prestigious professions, receiving better education (often in prestigious educational institutions), living in places where SMG is more likely to be used or even having more means to travel to Greece. A similar argument has already been used by Hay and Drager (2010) and Hay et al. (2006a) who explained the way that their study participants with varying social backgrounds perceived a vowel continuum when exposed to a 'New Zealand' or 'Australian' label on their answer sheets. As it was reported, the participants with a higher social background who were exposed to the 'Australian' label chose more Australian-like vowels (from the available synthesised vowels set) than participants with lower social backgrounds who were exposed to the same label. Hay et al. (2006a) and Hay and Drager (2010) attributed this tendency to the greater ability of listeners from higher social backgrounds to travel to Australia and receive more exposure to Australian English. Such increased exposure to Australian English vowels would have resulted in richer sets of exemplars of Australian-like vowels (Hay et al. 2006a; Hay & Drager 2010).

It was also assumed in chapter 5 that ID, the level of affiliation with Greece or Cyprus, could also affect the amount of contact with SMG. That is, the more a person is affiliated with Greece, the more likely that person is to get involved in activities that implicate exposure to SMG.

Such amplified exposure to SMG, which could be a result of an increased SOCIO or increased affiliation with Greece, would entail a greater development of a single plosive category in words such as *feta* as a listener exposed to SMG more is likely to hear and store in his/her memory more exemplars of [t] in *feta* as pronounced in SMG or even in SMG by Mainland Greeks. As a result, the categories formed in such listeners' memories are likely to be closer to those of Greeks and people who use SMG and [t] in *feta* more often. Then upon hearing a sample of [t], a listener who has received greater exposure to SMG may be more sensitive to phonetic detail than a listener with less developed categories of [t] in words such as *feta* and such a listener with greater

exposure to SMG may be more accurate in classifying a sound as a true singleton. Such increased exposure to SMG singleton plosives seems to be necessary in order to sufficiently separate the category of singleton plosives included in words such as *feta* from the category of geminate plosives. This necessity is supported with results of acoustic analyses of singleton plosives, which indicate that some Greek Cypriots experience difficulties suppressing gemination when using SMG and produce plosives which are longer than expected (Alexander 2008b). The problem with suppressing gemination might be caused by the difficulty with controlling articulatory gestures by the speakers or by inadequately developed categories of the discussed sounds.

Several results obtained in the perceptual study (chapter 7) seem to support the assumption that the amount of possible exposure to SMG estimated through SOCIO, ID and RES may affect the way the boundary is perceived.

Although SOCIO was not a significant predictor in models fitted to all data collected in experiment 1, experiment 2 or both experiments together, some of the results for some cross-sections of the data appeared to support the hypothesis that the amount of exposure to SMG, estimated on the basis of SOCIO, may influence the perception of the boundary. These results were discovered in models fitted to data from (1) Greece-oriented listeners taking part in experiment 1, (2) Cyprus-affiliated listeners from experiment 2, (3) female listeners from experiment 2, (4) female listeners from both experiments analysed together, (5) Greece-oriented listeners from experiments 1 and 2 analysed together and, (6) urban listeners from both experiments analysed together. Yet, this only seems to lend partial support for the hypothesis, especially that several results did not support the posed hypotheses.

As far as the ID score is concerned, the results in models fitted to all data collected in experiment 1, experiment 2 and in both experiments combined seemed to confirm the hypothesis that the closer a person's affiliation was with Greece, the more sensitive that person was to the increases in the length of plosives. Also, this trend turned out to be true for several models fitted to data taken from cross-sections of the study participants. Such a state of affairs seems to support the idea that the possible amount of exposure to [t], measured through the degree of affiliation with Greece, could cause a better development of [t] category in words such as *feta* and as a result influence the perception of the singleton and geminate boundary. The influence of this variable seems stronger than that of SOCIO.

RES may also be linked to the amount of exposure to [t], as it is claimed that, in rural areas of Cyprus, characteristic sounds of CG are used with higher frequency than in cities (Yiakoumetti et

al. 2005) and, even though research by Yiakoumetti et al. (2005) does not specify whether [t:ʰ] is one of these features, it is likely that it might be. Several results of the present study seem to support the claim that listeners from rural areas are less likely to be sensitive to small increases in the length of plosives. The trend was observed in models fitted to all data collected in experiment 1 and combined data from experiments 1 and 2. The tendency was also seen in a number of models fitted to several sections of the study participants. Such outcomes add further evidence to the claim that the amplified amount of exposure to [t] in words such as *feta* may sharpen listeners' sensitivity to changes in the duration of plosives in the discussed word context.

Yet, in several cases, the ID score, SOCIO and RES had the opposite effect on the perception of plosives. Such contradictory results indicate that behind these three variables there could be some other factors affecting perception other than the amount of exposure to the target sound. These factors are further discussed in section 8.2.4.

8.2.3   The role of the acoustic properties of stored exemplars

In line with the suggestions by Pierrehumbert (2003a), the production of a sound involved several steps. First, the speaker chooses which sound category is to be produced, and then chooses a random exemplar of a sound from that category. Pierrehumbert (2001, 2003a) suggest that the choice of the exemplar may be affected by the stylistic needs of the speaker. The acoustic characteristics of the sound to be produced are established on the basis of average features of exemplars in the neighbourhood of the previously chosen exemplar. Finally, the target sound is produced. The production of the sound may involve inclusion of noise origination in the performance of the articulatory gestures.

In consideration of the model of speech production suggested by Pierrehumbert (2001, 2003a), it was assumed that the values for the production of a sound belonging to a particular category would be chosen from the same set of exemplars as the one used in the perception of the sounds belonging to that given category. This led to a hypothesis that the values of produced sounds belonging to a certain category should correspond to the values of sounds classified as belonging to that category in perception.

Some of the results reported in chapter 7 seemed to support this supposition; however, just as in the case of the predictions regarding the way SOCIO and ID would influence the results, another factor turned out to be behind the way the values of CD, VOT and the whole plosives produced by the listeners influenced their perception of the boundary. It was suggested that some of the cases of unpredicted patterns in perception (most of which concerned the influence of values of [t] in

feta pronounced by the listeners) could be a result of linguistic insecurity. Linguistic insecurity is claimed to be a possible reason for several instances of unforeseen perceptual patterns and its role in sound perception is discussed further in section 8.2.4.

Values of geminate plosives produced by the listeners were, on the whole, reported to be the most stable predictors of perceptual patterns of all the values of plosives produced by the listeners as they turned out to be statistically significant in the highest number of generated logistic regression models and, in most cases, the three variables (CYVOT, CYCD and CYPLOS) affected the listeners' performance in the predicted way. The values of singletons produced in *vata* or *feta* (pronounced in SMG) did not turn out to be as reliable predictors as CYVOT, CYCD and CYPLOS did. They turned out to be statistically significant predictors in fewer models and the ways they were reported to affect the listeners' behaviour was not always as predicted. This is particularly true for the values of singleton plosives in *feta*.

The diminished reliability of singleton values as predictors might be a result of inadequately developed categories of singletons in the discussed word context. This appears to support the claim, by Pierrehumbert (2001, 2003a), that the strength of the category depends on the type and amount of exposure to exemplars of sounds that could be grouped in a given category. In line with the claims by Maye and Gerken (2000), Maye et al. (2002) and Pierrehumbert (2001, 2003a), in situations when one is exposed to categories which are not well separated, classification of sounds may pose difficulties. It needs to be remembered that Greek Cypriots are not exposed to singleton plosives in such a context as much as to geminates, unless they have additional exposure to the speech by mainland Greeks. Furthermore, the results of production tests (figures 7.2 and 7.3, section 7.1.4) indicate that singleton plosives produced by Greek Cypriots tend to have a fairly wide range of values. Even though these results are not representative of the whole Greek Cypriot population, they may be treated as an indication that Greek Cypriots are perhaps exposed (within their society) to various values of singleton plosives. This type of exposure may resemble the type of exposure experienced by a group of the study participants in Maye and Gerken (2000). If that were the case, it would seem reasonable that in a situation when the lack of separation and the inadequate number of exemplars might be compensated for by the listeners by using other cues or strategies to categorise the heard sounds. Then the influence of flags and/or hypercorrection linked to linguistic insecurity might be the other way of dealing with the task, as opposed to using the acoustic features of the stimuli themselves.

Another reason for such irregularities in the results could be difficulties with the study participants' actual mastery of articulatory gestures by the subjects who were listeners in this

study. It needs to be taken into consideration that even though the listeners may have been exposed often to singleton plosives and they may have developed rich sets of exemplars of the sounds, they may also be experiencing difficulties with the production of that sound. In this situation, their realisations would not exactly reflect the categories that have developed in their memories. However, it needs to be remembered that the sounds were produced in a very controlled task/environment (reading a list of words), which gave the study participants fairly convenient conditions to perform to the best of their abilities. Yet, the fact that they might not have been able to produce the singletons in the exact form in which they are stored in their memories could be considered a weakness of the study.

8.2.4   The significance of unexpected results: issues for further investigation

The unexpected trends in perception of the boundary clearly show that there could be other factors behind the influence of SOCIO, ID and RES other than the amount of exposure to the target sounds. Introduction of the variable GEN also facilitated in exposing how various variables affected perception, although they could not be explained by means of any ET assumption, and which suggested that there are other factors behind the differences in perception.

The factors seem to include the tendency for hypercorrection due to linguistic insecurity and decreased sensitivity to socially marked sounds as a result of a listener's satisfaction with his/her social situation. The two factors appeared to have opposite effects on the boundary perception in the present study, and the effects could not be explained by means of any of the assumptions of ET.

The problem of hypercorrection, which could be attributed to linguistic insecurity, was observed in the way the boundary was perceived by several groups of listeners. These include: (1) women, who are claimed to be more sensitive to social information carried by various elements of speech, (2) Cyprus-affiliated listeners (all those whose ID score was higher than 3.0; see section 7.4.2), who may be distancing themselves from the prestigious culture and its language, (3) listeners from rural areas, who are stereotypically believed to speak with a 'heavy' Cypriot accent, and (4) listeners who tended to produce longer [t] in words like *vata*, in comparison to other listeners. Listeners belonging to all four groups perceived shorter plosives as geminates than listeners did from the other (counterpart) groups (e.g. women and village residents were more sensitive than men and people from cities to the increases in the duration), or followed a trend in perception which was opposite to the one predicted in the hypotheses presented in chapter 5.

The issue of decreased sensitivity to changes in acoustic signal of the target sound, which might be attributed to a listener's satisfaction with his/her social position, was observed in the way SOCIO affected the perception of the boundary by several groups of participants. Thus, within the group of Cyprus-oriented listeners who took part in experiment 1, the higher SOCIO those listeners had, the fewer geminates they heard. That would suggest that the better social position a person had, the less attention that person paid to the prestige carried by the singletons. A similar trend was followed by male listeners from experiment 2 and village listeners from experiments 1 and 2. The higher their SOCIO was, the longer were the plosives they tended to accept as singletons. It needs to be noted that in one model fitted to male data, the opposite trend was the observed. The reasons for that result are not known.

A similar, although not identical, situation in which listeners were characterised by decreased sensitivity to acoustic signal was reported by Peterson and Barney (1952). Michigan listeners were asked to listen to a Michigan speaker produce a sentence including vowels that were affected by a vowel shift in the speech in Michigan area, and to match these vowels to other vowels that were supposed to be chosen from a set of synthesised vowel samples. The majority of the listeners chose speech samples with vowels that were standard American English vowels and not the vowels the Michigan speaker actually used. Niedzielski (2010) and Peterson and Barney (1952) suggest that this behaviour indicates that listeners from Michigan are linguistically secure and believe that Michigan speech is standard. This linguistic security and strong belief that they are users of standard English made the Michigan listeners pay little attention to the acoustic signal of the sounds they heard in the experiment carried out by Peterson and Barney (1952).

The situation described by Peterson and Barney (1952) and Niedzielski (2010) is similar to the way SOCIO influenced listeners in the present study, because, in both studies, linguistic security and increased satisfaction with one's social situation seem to make them desensitised to the characteristics of acoustic signal of a potentially socially marked sound.

The two factors under consideration, listener's satisfaction with social position and linguistic insecurity, seem to have opposite effects on perception of the singleton/geminate boundary, as the former decreases and the latter increases the sensitivity to changes in plosive duration. It appears that two factors are behind what could be described as the level of motivation for sensitivity to changes in acoustic signal of socially marked sounds. This level of motivation might depend on various social circumstances of a person, which would define if and to what extent that person is socially (or even sociolinguistically) secure or insecure. Such circumstances might include age, socio-economic situation, place of residence, the use of prestigious or negative

stereotype language varieties, or any other circumstances that might place a person in a more or less privileged position in a society (or a language community). A level of motivation for sensitivity to socially marked sounds might be another variable that could potentially influence the perception of sounds and be the reflection of the amount of attention that a listener pays to certain linguistic features.

For ET to be a theory that offers a model which could facilitate an effective analysis of perception placing perception in the social context, it would need to offer ways of dealing with effects, such as increased or decreased sensitivity to socially marked elements of speech. In the light of the outcomes of the present study, it appears reasonable to propose that for ET to be an efficient model of sound perception, an assumption relating to a listener's motivation for sensitivity to changes in socially marked sounds, or, in other words, a listener's attention to linguistic detail, would need to be considered and incorporated.

This claim might be reinforced by the fact that there have already been studies published reporting similar linguistic practices to those reported in this study, and linked to linguistic insecurity (Eckert 1989; Labov 1990) or decreased preoccupation with prestigious forms of speech (Niedzielski 1999, 2010). As some of these patterns are not only true for production but also for perception, this problem should no longer go unnoticed when promising models of sound perception are being proposed which acknowledge the importance of social context of speech, such as exemplar theory.

Several studies in the framework of exemplar theory have investigated in great detail the influence of a perceived background of the speaker on the way listeners processed speech. As far as the background of the listeners is concerned, there are also a few studies which take information on the background of the listeners into consideration (for instance, Hay et al. 2006b; Hay et al. 2006a; Hay & Drager 2010). Such studies and the results of this study indicate that ET might need to be supplemented with an additional assumption which would allow factors, such as ID, SOCIO or motivation, to be incorporated into the model.

The reported trade-off between linguistic security/insecurity and the amount of exposure to a category, due to which the effect of the former may override the effect of the latter, seems to imply that individual variables may vary in the magnitude of influence they have on perception. Such variability in the degree of influence seems to be dependent on the listeners' social background. The relationship between linguistic security/insecurity and the amount of exposure is not the only example of changeability in the degree of variable influence on perception which was

revealed in this study. The present study results also indicate that the strength of linguistic as opposed to indexical cues may also be changeable and conditioned by certain factors.

As was discussed in section 7.7.1, the strength indexical cue influence on perception of a sound may depend on the degree of development of the category remembered by the listeners to which the processed sound could be potentially matched. The results appeared to suggest that the potential influence of indexical cues on perception of a sound may depend on the strength of a relevant sound category internalised in a listener's memory. More precisely, the effect of the geminate plosives' length on the perception of stimuli did not seem to be affected by the presence of the flags. However, the influence of singleton plosives in *feta* changed as listeners were exposed to the flags. It seems that the influence of geminates' duration did not change as the category is very well-developed in the memories of listeners, most probably due to the extensive exposure to words with non-contrastive geminates. The influence of singletons in *feta* changed in the presence of the flags. This influence could be a result of insufficient development of the sound category in listeners' memory (for a more detailed discussion see section 7.7.1) as its use in Cyprus is not as frequent as that of equivalent non-contrastive geminates. Thus, it is suggested that indexical cues tend to be stronger cues than linguistic cues of insufficiently-developed categories, but non-linguistic information is likely to be a weaker cue than linguistic information of well-developed sound categories. This would be particularly possible in the case of indexical information which is not as transparent as a speaker's sex tends to be, but rather arbitrary and dependent on the type of exposure a listener has received in his/her life.

The results pertaining to (1) the context-dependent, increased strength of indexical information and (2) the role of motivational factors suggest that the level of influence of various variables may not be stable across listeners and/or languages, and may depend on a variety of influences. The weight of various cues may be conditioned by factors such as listeners' background and/or dynamics in a given speech community.

The potentially changeable hierarchy of variables influencing perception seems to imply that there could be some inner weighting system determining the degree of effects of individual variables influencing perception. Mendoza-Denton (2010) notices that the knowledge of how such weighting systems work is still insufficient, especially that social mechanisms determining the distribution of variables weight are still not entirely clear. The present study appears to provide some insight into how the Cypriot social context might influence the weighting system of Greek Cypriot listeners at least in respect to some of the variables affecting speech perception. It needs to be noted that the list of potential variables in the Greek Cypriot context is likely to be longer

than the one presented in this study. The study indicates that, in Cyprus, factors such as linguistic security and insecurity (or decreased/increased motivation for attention to sound features) may override the importance of the amount of exposure. The study also points out that inadequate amount of exposure to a sound (linked to social attitudes and related language practices) may lead to an increase of strength of indexical information in speech perception. It is very likely that the study does not report on the whole range of similar effects and trade-offs which are a part of the Greek Cypriot weighting system. Furthermore, it is not entirely clear whether the results would be replicated if different sampling of Greek Cypriot study participants were employed in the future.

The role of the motivational factor and the levels of strength of indexical and linguistic cues in speech perception need further investigation and more evidence in order to support the existence of relationships indicated by the present research. Incorporating variables linked to the motivational factor in perception models and carrying out research into the degree of strength of indexical and linguistic cues could provide further insights into the ways in which weighting systems are likely to operate for listeners from Cyprus and how these systems are influenced by the local social dynamics.

Having more studies of this kind but in different social settings might also show whether such patterns are only specific to the Greek Cypriot context or maybe they are also detectable in other settings. Taking into consideration the dissimilarity of the Cypriot social setting from the social settings in societies in which similar perceptual studies were carried out (such as Niedzielski 1999 or Hay and Drager 2010), it needs to be pointed out that possible diverse patterns may not only be a result of the investigated variables but also the social dynamics which tend to differ across societies. This would further suggest the necessity to investigate the influence of social context in the status of the relationships mentioned (such as the one between available cues and the social background of a listener) to see if the relationships exist in other linguistic settings, and if so, in what form.

Results of such research might provide further evidence supporting the suggestion that the motivational factor should be incorporated as one of the ET assumptions. It would also facilitate answering the question whether the hierarchy of indexical and linguistic cues should indeed be considered as not stable/universal but dependent on other factors (explain the factors).

8.3   Contribution to research on the perception of gemination of plosives in CG

The analysis of the perception of the singleton/geminate plosive boundary by Greek Cypriot listeners has so far been undertaken by only a few linguists (Armosti 2010; Botinis et al. 2004; Christodoulou 2007; Muller 2001, 2002). Yet, to the best of my knowledge, the present study is the first one which analyses the perception of the boundary from a more sociophonetic point of view and takes into consideration the influence of factors other than only the influence of phonetic signal perceived by a listener.

Up to now, the studies which focused on the perception of the boundary looked at perception of minimal pairs with singleton and geminate plosives. Thus, in those studies, perceiving a sound as a geminate of a singleton entailed the change of literal meaning of a word. In the present study, I looked at perception of the sounds in words which do not change their literal meaning with the change of the target sound. The study separates words with geminate plosives used by Greek Cypriots into two separate categories. The first category of words with geminates includes those in which substitution of a geminate with a singleton plosive changes the meaning of that word. The other category comprises words in which substitution of a geminate with a singleton plosive would not entail a change in a word's meaning but might cause a change of social information about the speaker. Such division facilitated looking at the perception of the boundary between singleton and geminate plosives from a new perspective which acknowledges the role of factors pertaining to the social background and level of affiliation of the listeners in the perceptual processing of the boundary. The results of this study provide new evidence regarding factors which influence the perception of the discussed boundary, including the listeners' social background and their level of affiliation.

8.4   Study limitations

Some of the limitations of the study concern the issues of sample size and the type of study participants included in the sample. The number of listeners that took part in the each of the studies was not representative of the entire Greek Cypriot population. Also, the listeners came from only one age group (the youngest was eighteen and the oldest was thirty-seven). Most of the study participants were university students or had already graduated from a university. The study participants were also not representative of the whole Cypriot society if analysed from the socio-economic point of view. The lowest and highest strata of Cypriot society were not represented. It was estimated that the lowest SOCIO index one could have in this study was eight (this would be an index calculated for an unskilled worker with only primary education who rents

a 1-2 bedroom flat in a village and is a child of unskilled workers) and the lowest reported in the study was sixteen. Similarly, the highest possible SOCIO index was twenty-eight, but the highest reported in the study was twenty-six. However, even though the previously mentioned social groups were not represented, there was a fairly wide spread of SOCIO among the study participants, which allowed for some preliminary conclusions to be made.

The method of recruiting subjects did not allow for recruiting a large number of participants who were more Greece-oriented. The initial idea was to collect data from listeners with various degrees of affiliation with one country or the other, so that data from people with various ID scores could be used in logistic regression models as a continuous variable in order to see if perception of the boundary changes with a gradual change of the level of affiliation. The collected data seemed sufficient to analyse how the degree of affiliation with each of the countries influenced the perception of the boundary. Nevertheless, as there were few listeners that had an ID score lower than 3.0, only preliminary tests dividing listeners into two groups were possible. For that reason, the results of analyses which involved data collected from Greece-affiliated listeners should only be used tentatively.

The analysis of data according to the place of residence was not one of the main goals of this study. The information regarding listeners' place of residence was collected in order to calculate their socio-economic index. As the data were available, they were used as an independent variable in the regression models. As there was a low number of listeners from rural areas, analyses carried out on data collected from village residents only should be treated only as an indication of possible trends in perception.

Some weaknesses of the study may also be attributed to the way socio-economic index and the identity score were established, as they may not be very precise and may only give approximate information about the participants' backgrounds. As an example, the ID score was calculated on the basis of answers to eight questions only. In fact, in some of the questions participants chose the 'No opinion' option (for instance if a person who is completely uninterested in football was asked which football match he/she would prefer to watch) which signified the lack of interest in the subject matter. In such a case, the answer to such a question was not included in the calculations, which further decreased the extent to which the person's degree of affiliation could be estimated. A small number of questions might have negatively influenced the precision of the ID scores assigned to the listeners. Similarly, the data collected in order to calculate the SOCIO index also might not have helped calculating the index very precisely. Yet, the ways of calculating

SOCIO index and ID score facilitated establishing listeners' background information to a degree which allowed noticing differences in the study participants' backgrounds.

8.5 Conclusion

The present study facilitated answering several questions, which were presented in chapter 5, regarding perception of the continuum between [t] and [t:ʰ] by Greek Cypriot listeners. Some of the analysed tendencies concerned social evaluation of the two variables, whereas others related to establishing what variables affect the perception of the singleton/geminate boundary and were aimed to test whether several assumptions of ET are likely to explain the way the boundary is processed.

The MGT tests presented in chapter 6 established differences in evaluation of [t] and [t:ʰ] by Greek Cypriot listeners, and therefore contributed to the general knowledge of Greek Cypriot attitudes towards CG and SMG, and to the status of [t] and [t:ʰ] as sociolinguistic variables. These results gave the basis for certain methodological decisions taken when the perceptual study, presented in chapter 7, was designed. Furthermore, I believe that these results might later on be useful in research on the analysis of dialectal continuum in Cyprus, as they seem to indicate that not all Greek Cypriot sounds tend to be evaluated the same way.

The perceptual study, presented in chapter 7, gave a preliminary overview of whether and to what extent some of the assumptions of ET can explain the way Greek Cypriots process the singleton/geminate boundary in words in which substituting a singleton plosive with a geminate plosive will not change the meaning of those words and vice versa. The study indicated that the presence of items associated with Greek or Greek Cypriot culture tends to influence listeners' perceptions and discussed the ways in which the presence of the flags affected the perception of the said continuum. These results add further evidence to the claim that indexical information is stored along acoustical signal in listeners' memory and tends to be used in the processing of sounds.

The perceptual study (chapter 7) also showed that, to a certain extent, the amount of exposure to SMG may influence the way Greek Cypriots process the boundary. However, as the variables through which the likely amount of exposure to SMG was established (socio-economic background and ID score) turned out to be connected to other factors that could also influence perception, but, in a different way, the amount of exposure as measured in this study did not always seem to be an accurate predictor of the listeners' perceptual behaviour. As I indicated in the current chapter, such results seem to suggest that one of the future directions that ought to

be taken is investigating the influence of the amount of exposure to SMG by means of different variables measuring/estimating the likely amount of exposure of SMG the listeners might have received throughout their lives.

Finally, the study seems to indicate that the perception of the boundary also tended to be affected by other factors that appear to be linked to listeners' increased or decreased sensitivity to changes in the length of plosives. Factors such as listener's linguistic insecurity or listener's satisfaction with his/her social situation appeared to increase or decrease listeners' sensitivity to acoustic properties of the heard sounds. As these outcomes are only preliminary ones and had a fairly tentative character, there seems to be the need for further research aiming at exploring the issue to a greater extent.

All in all, I hope that I have managed to provide convincing explanations pertaining to the methodological decisions taken in this study and to present interpretations of the results that are exhaustive and plausible.

APPENDIX 1
Socio-economic background questionnaire
The questionnaire was administered in Greek.

1. Age:
2. Place of residence: …………………………………………
3. Parents' nationalities *(tick the correct answer)*:

Mother   ☐Greek Cypriot   Other: _____
Father   ☐ Greek Cypriot   Other: _____

4. Number of years lived abroad *(fill in the table below)*

Number of years	Number of months	Country

5. Occupation
Your occupation …………………………………………,
spouse's occupation …………………………………… (if married)

Your parents' occupation?
Mother:……………………………
Father:……………………………

6. Education *(tick the appropriate)*
primary school   …
gymnasium   …
lyceum   …
technical school   …
college/university education   …   current academic programme: …………………

7. Language of instruction used in the schools you attended *(tick the appropriate)*.

	Greek	English	Other (list them)
primary school			
gymnasium			
lyceum			
technical school			
college/university			

8. Type of housing *(tick the appropriate)*

		Flat	terraced house	semi-detached house	detached house
Number of bedrooms	1				
	2				
	3				
	4				
	5				
	6				
	7				

9. the type of housing you indicated in section 6 is: *(tick the appropriate)*

a place you rent   …

owned by you/your family   …

10. If you are a student, do you additionally rent another place (not the one mentioned in point 6)? *(circle the appropriate)*

11. My family house/flat is in: *(tick the appropriate)*

a city centre   …

the outskirts of a city   …

a village   …

a place away from a city or a village   …

Ways of assigning points for socio-economic background questionnaire answers

I. Occupation: 1-5 points

II. Parents' occupation: 1-5 points

III. Education:
primary school   1 point
gymnasium   2 points
lyceum/technical school   3 points
college/university education   4 points

IV. Housing:

a)
flat   1 point
terraced house   2 points
semi-detached house   3 points
detached house   4 points
b)
1– 2 bedrooms   1 point
3 – 4 bedrooms   2 points
4 – 5 bedrooms   3 points
> 5 bedrooms   4 points
c)
Rented   1 point
Owned   2 points

V. Location

a city centre   4 points
the outskirts of a city   3 points
a village   2 points
a place away from a city or a village   1 point

An example of an answer sheet in MGT tests
The answer sheet was administered in Greek.

Speaker 1

Do you know the speaker? (*underline the correct answer*)

YES   **NO**

Indicate how you feel about the speaker you have just heard by choosing the number you believe to be the most appropriate.

Intelligent	5	4	3	2	1	Unintelligent
Ambitious	5	4	3	2	1	Unambitious
Educated	5	4	3	2	1	Uneducated
Hardworking	5	4	3	2	1	Lazy
Confident	5	4	3	2	1	Unconfident
Sincere	5	4	3	2	1	Insincere
Friendly	5	4	3	2	1	Unfriendly
Humorous	5	4	3	2	1	Humourless
Casual	5	4	3	2	1	Formal
Speaks like me	5	4	3	2	1	Does not speak like me
Lives in a village	5	4	3	2	1	Does not live in a village

APPENDIX 4
Affiliation questionnaire
The questionnaire was administered in Greek.

Dear Respondent

For each of the following questions circle the answer which best expresses your preferences.

1. **If you wanted to go shopping, where would you choose to go: to Makariou Street in Nicosia, or to Ermou Street in Athens?**
a. I'd definitely choose Ermou Street in Athens
b. I might choose Ermou Street in Athens
c. No opinion
d. I would be equally happy to choose any of the two options
e. I might choose Makariou Street in Nicosia
f. I'd definitely choose Makariou Street in Nicosia

2. **If you wanted to go on holiday to a nice place, where would you choose to go: to one of the Cypriot beaches, or to one of the Greek Islands?**
a. I'd definitely choose one of the Greek Islands
b. I might choose one of the Greek Islands
c. No opinion
d. I would be equally happy to choose any of the two options
e. I might choose one of the Cypriot beaches
f. I'd definitely choose one of the Cypriot beaches

3. **If you could choose where to live/be brought up, where would you choose to live/to be brought up: in Nicosia, or in Athens?**
a. I'd definitely choose Athens
b. I might choose Athens
c. No opinion
d. I would be equally happy to choose any of the two options
e. I might choose Nicosia
f. I'd definitely choose Nicosia

4. **If you wanted to see a comedy, which comedy would you choose to watch: a Greek Cypriot comedy, or a Greek comedy?**
a. I'd definitely choose a Greek comedy
b. I might choose a Greek comedy
c. No opinion
d. I would be equally happy to choose any of the two options
e. I might choose a Greek Cypriot comedy
f. I'd definitely choose a Greek Cypriot comedy

5. **There are two football matches broadcasted on two different TV channels at the same time, a match of the Cyprus National Football Team and a match of the Greek National Football Team. Which one would you choose to watch?**
a. I'd definitely choose the Greek National Football Team
b. I might choose the Greek National Football Team
c. No opinion
d. I would be equally happy to choose any of the two options
e. I might choose the Cyprus National Football Team
f. I'd definitely choose the Cyprus National Football Team

6. **Which news programme would you choose to watch, a news programme on SIGMA or A news programme on MEGA?**
a. I'd definitely choose the news programme on MEGA
b. I might choose the news programme on MEGA
c. No opinion
d. I would be equally happy to choose any of the two options
e. I might choose the news programme on SIGMA
f. I'd definitely choose the news programme on SIGMA

7. **If you could choose where to be educated, what country would you choose to be educated in: the Greece, or in Cyprus?**
a. I'd definitely choose Greece
b. I might choose Greece
c. No opinion
d. I would be equally happy to choose any of the two options
e. I might choose Cyprus
f. I'd definitely choose Cyprus

8. **You are about to throw a party. There are two excellent restaurants in your area; one of them employs a Greek chef, whereas the other one employs a Cypriot chef. Which restaurant would you choose?**
a. I'd definitely choose the one with the Greek chef
b. I might choose the one with the Greek chef
c. No opinion
d. I would be equally happy to choose any of the two options
e. I might choose the one with the Cypriot chef
f. I'd definitely the one with the Cypriot chef

APPENDIX 5

A sample of an information sheet given to participants (listeners) in the evaluation study

Date: 11 July 2011

INFORMATION SHEET

As part of my Doctoral studies in the Department of Linguistics and English Language, I have been asked to carry out a study involving listening/perceptual tests. I am going to analyse the answers you give in the listening tasks.

I have approached you because I am interested in the way we perceive speakers using different pronunciations. I would be very grateful if you would agree to take part.

You will be asked to listen to several sentences read by a few speakers and to answer some multiple choice questions about the speakers. Additionally you will be asked a few questions about your background (place of birth, the schools you attended). The experiment will last approximately 15 minutes.

You are free to withdraw from the study at any time. At every stage, your name will remain confidential. The data will be kept securely and will be used for academic purposes only.

If you have any queries about the study, please feel free to contact myself or my course supervisor, Professor Paul Kerswill who can be contacted on p.kerswill@lancaster.ac.uk or by phone on 01524594577. You may also contact the Head of Department, Prof. Greg Myers, on 01524 592454.

Signed

Katarzyna Alexander

k.rysiewicz@lancaster.ac.uk / alexander.k@unic.ac.cy

Lancaster University
Lancaster LA1 4YL
United Kingdom
Tel: +44 (0)1524 593045
Fax: +44 (0)1524 843085
http://www.ling.lancs.ac.uk

Appendix 6

A sample of an information sheet given to participants (speakers) in the evaluation study

Date: 11 July 2011

INFORMATION SHEET

As part of my Doctoral studies in the Department of Linguistics and English Language, I have been asked to carry out a study involving listening/perceptual tests. I am going to analyse the answers you give in the listening tasks.

I have approached you because I am interested in the way we perceive speakers using different pronunciations. I would be very grateful if you would agree to take part.

You will be asked to read several words and sentences in Standard Modern Greek and Greek Cypriot. You will be audio-recorded while reading. Additionally you will be asked a few questions about your background (place of birth, the schools you attended). The experiment will last approximately 15 minutes.

You are free to withdraw from the study at any time. At every stage, your name will remain confidential. The data will be kept securely and will be used for academic purposes only.

If you have any queries about the study, please feel free to contact myself or my course supervisor, Professor Paul Kerswill who can be contacted on p.kerswill@lancaster.ac.uk or by phone on 01524594577. You may also contact the Head of Department, Prof. Greg Myers, on 01524 592454.

Signed

Katarzyna Alexander

k.rysiewicz@lancaster.ac.uk / alexander.k@unic.ac.cy

Lancaster University
Lancaster LA1 4YL
United Kingdom
Tel: +44 (0)1524 593045
Fax: +44 (0)1524 843085
http://www.ling.lancs.ac.uk

Appendix 7

A sample of an information sheet given to participants (listeners) in the perceptual study

Date: 11 July 2011

INFORMATION SHEET

As part of my Doctoral studies in the Department of Linguistics and English Language, I have been asked to carry out a study involving listening/perceptual tests. I am going to analyse the answers you give in the listening tasks.

I have approached you because I am interested in how different sounds are perceived by different listeners. I am also interested in how these sounds are pronounced by the listeners. I would be very grateful if you would agree to take part.

You will be asked to listen to several words read by one speaker and to say which word you hear. You will be asked a few questions about your background (place of birth, the schools you attended). In addition you will be asked to read several words in Standard Modern Greek and Greek Cypriot. You will be audio-recorded while reading. The experiment will last approximately 20 minutes.

You are free to withdraw from the study at any time. At every stage, your name will remain confidential. The data will be kept securely and will be used for academic purposes only.

If you have any queries about the study, please feel free to contact myself or my course supervisor, Professor Paul Kerswill who can be contacted on p.kerswill@lancaster.ac.uk or by phone on 01524 01524594577. You may also contact the Head of Department, Prof. Greg Myers, on 01524 592454.

Signed

Katarzyna Alexander

k.rysiewicz@lancaster.ac.uk /alexander.k@unic.ac.cy

Lancaster University

Lancaster LA1 4YL

United Kingdom

Tel: +44 (0)1524 593045

Fax: +44 (0)1524 843085

Appendix 8

A sample of a consent form given to all participants in the perceptual and the evaluation studies

UNIVERSITY OF LANCASTER

Department of Linguistics and English Language

<u>**Consent Form**</u>

Project title: **Perception of the boundary between singleton and geminate plosives by Greek Cypriots**

1.   I have read and had explained to me by **Katarzyna Alexander** the Information Sheet relating to this project.
2.   I have had explained to me the purposes of the project and what will be required of me, and any questions have been answered to my satisfaction. I agree to the arrangements described in the Information Sheet in so far as they relate to my participation.
3.   I understand that my participation is entirely voluntary and that I have the right to withdraw from the project any time.
4.   I have received a copy of this Consent Form and of the accompanying Information Sheet.

Name:

Signed:

Date:

Appendix 9

A sample screenshot of a Power Point slide show used in MGT tests
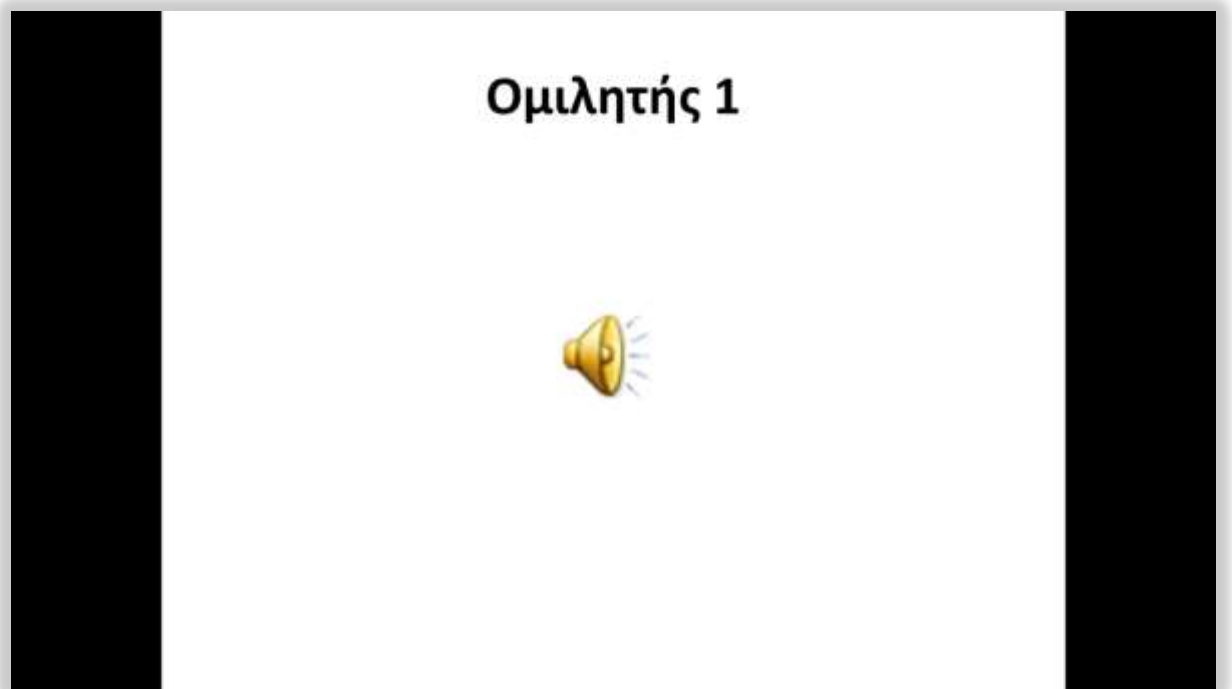
Ομιλητής - speaker

Appendix 10

Word list used as a part of the reading task (see section 7.1.1)

The font used for the word list given to the study participants was Calibri 18.

1	Ταφή	Και	Φέτα	Βάτα
2	Έχει	Φέτα	Και	Τάβλι
3	Έχει	Τάβλι	Βάτα	Ταφή
4	Τάβλι	Βάτα	Και	Φέτα
5	Και	Βάτα	Ταφή	Τάβλι
6	Τάβλι	Τάβλι	Και	Φέτα
7	Φέτα	Έχει	Ταφή	Ταφή
8	Έχει	Ταφή	Τάβλι	Βάτα
9	Ταφή	Φέτα	Και	Τάβλι
10	Βάτα	Φέτα	Τάβλι	Φέτα
11	Και	Βάτα	Έχει	Φέτα
12	Ταφή	Έχει	Και	Βάτα
13	Και	Βάτα	Έχει	Ταφή
14	Έχει	Ταφή	Και	Βάτα
15	Και	Φέτα	Έχει	Τάβλι

Word	Meaning	SMG pronunciation	CG pronunciation
Φέτα	Feta, kind of cheese	[ˈfɛte]	[ˈfɛt:ʰe]
Βάτα	Cotton, wadding	[ˈvete]	[ˈvete]
Ταφή	Burial	[teˈfi]	[teˈfi]
Τάβλι	Backgammon	[ˈtevli]	[ˈt:ʰevli]
Και	And	[cɛ]	[tʃɛ]
Έχει	Has	[ˈɛxi]	[ˈɛʃi]

Screenshots showing the perceptual experiment interface (experiments 1 and 2)
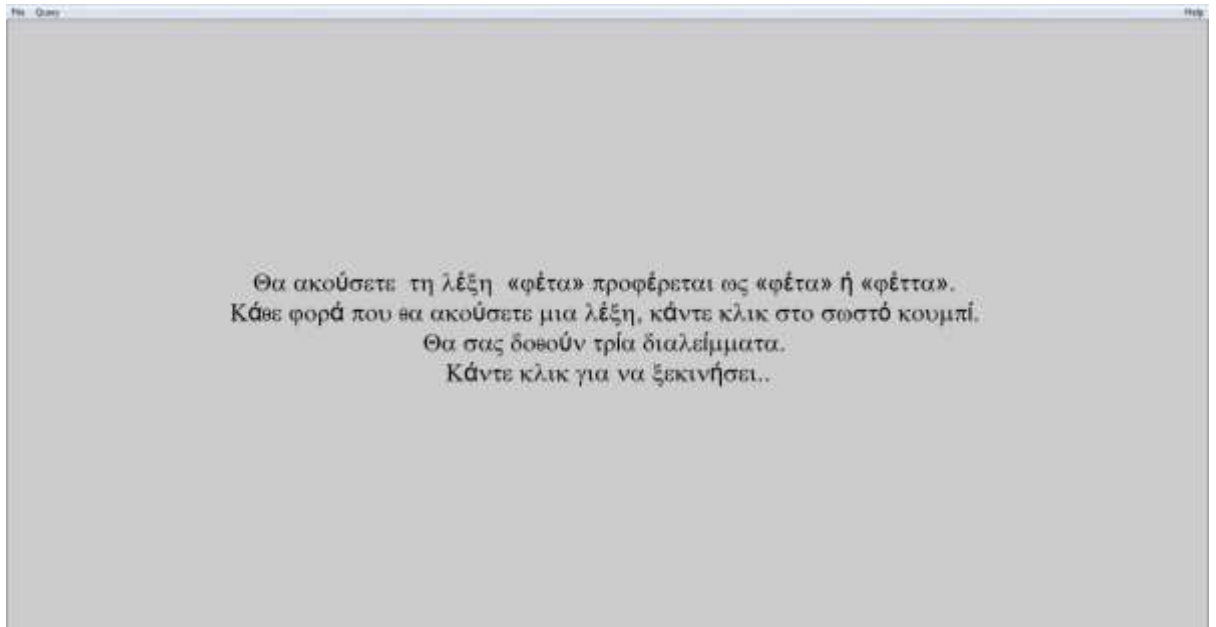
A screenshot with the introductory note to experiments 1 and 2.

Translation of the introductory note:
You will hear the word 'feta' pronounced as 'feta' or 'fetta'. Each time you hear a word, click the appropriate button. You will be given three breaks. Click to start.

A screenshot showing experiment interface with the options of heard words (['feta] or [fet:ʰa]) to choose.
Translation of the visible text: *Click the appropriate box.*
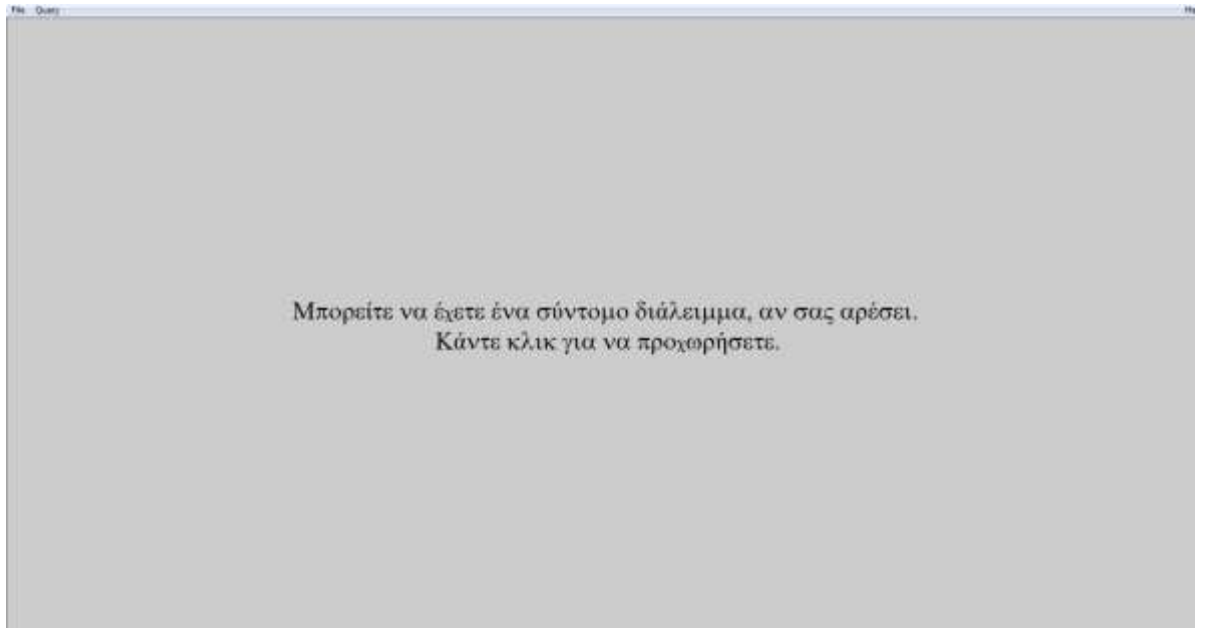
A note announcing a short break.

Translation of the text announcing the break:
You can have a short break if you like. Click to proceed.

Percentages of tokens labelled as singletons and geminates by listeners in experiments 1 and 2.

Response	Listeners					
	FE3	FE4	FE5	FE6	FE8	FE9
[t]	37.5	43.3	40.0	39.2	47.5	33.3
[t:ʰ]	62.5	56.7	60.0	60.8	52.5	66.7
	Listeners					
	FE10	FE11	FE12	FE14	FE15	FE16
[t]	46.7	48.3	50.0	43.3	33.3	38.3
[t:ʰ]	53.3	51.7	50.0	56.7	66.7	61.7
	Listeners					
	FE17	FE18	FE19	FE20	FE21	FE22
[t]	28.3	38.3	38.3	36.7	28.3	36.7
[t:ʰ]	71.1	61.7	61.7	63.3	71.7	63.3
	Listeners					
	ME1	ME4	ME5	ME9	ME10	ME12
[t]	48.3	35.0	36.7	50.0	42.5	40.0
[t:ʰ]	51.7	65.0	63.3	50.0	57.5	60.0
	Listeners					
	ME19	ME21	ME22	ME24	ME25	ME28
[t]	32.5	29.2	31.7	47.5	28.3	38.3
[t:ʰ]	67.5	70.8	68.3	52.5	71.7	61.7
	Listeners					
	ME29	ME31	ME32	ME33	ME34	ME35
[t]	38.3	26.7	55.0	31.7	42.5	42.5
[t:ʰ]	61.7	73.3	45.0	68.3	57.5	57.5

Percentages of tokens labelled as singletons and geminates by listeners in experiment 1. Number of all evaluated tokens = 4320, number of tokens evaluated by each listener = 120.

Percentages of tokens labelled as singletons and geminates by listeners in experiment 2. Number

Response	Listeners exposed to the Greek flag						
	FE5	FE9	FE18	FE21	FE22	FE23	FE24
[t]	45.0	32.5	30.8	31.7	48.3	40.0	32.5
[t:ʰ]	55.0	67.5	69.2	68.3	51.7	60.0	67.5
	Listeners exposed to the Greek flag						
	FE26	FE27	FE29	ME6	ME12	ME13	ME14
[t]	34.2	38.3	52.5	40.0	49.2	48.3	35.8
[t:ʰ]	65.8	61.7	47.5	60.0	50.8	51.7	64.2
	Listeners exposed to the Greek flag						
	ME15	ME16	ME17	ME25	ME36		
[t]	52.5	39.2	43.3	37.5	41.7		
[t:ʰ]	47.5	60.8	56.7	62.5	58.3		
	Listeners exposed to the Cypriot flag						
	FE3	FE4	FE8	FE10	FE12	FE15	FE16
[t]	30.0	44.2	35.8	50.8	51.7	35.0	35.0
[t:ʰ]	70.0	55.8	64.2	49.2	48.3	65.0	65.0
	Listeners exposed to the Cypriot flag						
	FE19	FE25	FE28	ME4	ME5	ME8	ME9
[t]	38.3	45.0	35.8	45.8	31.7	39.2	53.3
[t:ʰ]	61.7	55.0	64.2	54.2	68.3	60.8	46.7
	Listeners exposed to the Cypriot flag						
	ME10	ME11	ME18				
[t]	44.2	31.7	41.7				
[t:ʰ]	55.8	68.3	58.3				

of all evaluated tokens = 4320, number of tokens evaluated by each listener = 120.

List of abbreviations

CD   closure duration of a plosive

CG   Cypriot Greek

CYCD   average closure duration in 'feta' pronounced in CG by listeners,

CYPLOS   the length of the whole plosive in 'feta' pronounced in CG

CYVOT   average VOT in 'feta' pronounced in CG by listeners,

Df   Degrees of freedom

EPG   electropalatography

ET   exemplar theory

GCM   generalised context model

GEN   gender

GRCD   average closure duration in 'feta' pronounced in SMG by listeners

GRPLOS   the length of the whole plosive in 'feta' pronounced in SMG by listeners

GRVOT   average VOT in 'feta' pronounced in SMG by listeners

GRFLAG   Greek flag

ID   identity score

IDCY   models fitted to data collected from Cyprus-affiliated listeners

IDGR   models fitted to data collected from Greece-affiliated listeners

MGT   matched-guise technique

PLOS   the length of the whole plosive (VOT + CD) included in the stimulus used in MGT tests
            and in experiments 1 and 2

RES   place of residence (rural versus urban),

Sld   seal duration

SMG   Standard Modern Greek

SOCIO socio-economic index

VOT   Voice Onset Time

vt   label appearing in names of models in which VTVOT, VTCD and VTPLOS values were
     entered instead of GRVOT, GRCD and GRPLOS

VTCD average CD in 'vata' pronounced in SMG by listeners

VTPLOS the length of the whole plosive in 'vata' pronounced in SMG by listeners

VTVOT average VOT in 'vata' pronounced in SMG by listeners

(-)   negative sign in B coefficient

(+)   positive sign in B coefficient

(/)   non-significant result

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