A Phonetic Study of the Status of Three Mergers in the Trøndersk Dialect of Norwegian

by

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Abstract

This study uses acoustic analysis of speech to test for the presence of three consonantal mergers in the Trøndersk dialect of Norwegian: the /ɭ/ – /l/ merger, the /ʂ/ – /ʃ/ merger, and the /ʃ/ – /ç/ merger. The literature disagrees on the the existence and status of these mergers in Standard Østlandsk (‘Standard Eastern Norwegian’), an unofficial spoken norm heard in the capital Oslo and surrounding areas, and there is even less clarity regarding the presence of these mergers in Trøndersk, a linguistically understudied dialect. To begin filling in this gap in the literature, the present study investigates the existence and/or status of these mergers in Trøndersk, through acoustic analysis of speech samples of native speakers.

The study was carried out in two parts: a pilot and a follow-up experiment. For the pilot experiment, I recorded two female speakers reading word lists and sentences. The recorded speech was analyzed for the /ɭ/ – /l/ merger and the /ʂ/ – /ʃ/ merger. For the /ɭ/ – /l/ merger, F2 and F3 measurements were taken for each token of the lateral. Statistical tests of the collected measurements showed the merger to be complete in all contexts: word-initially, postvocalically, and after /s/. For the /ʂ/ – /ʃ/ merger, a center of gravity (CoG) measurement was taken for all tokens of each fricative. Statistical tests of the data revealed that neither speaker has the /ʃ/ – /ʂ/ merger.

The follow-up experiment expanded upon the work done in the pilot in several ways. For this experiment, we recorded eight speakers reading word lists, and the recorded speech was analyzed for the /ʃ/ – /ç/ merger in addition to the two mergers examined in the pilot. For the /ɭ/ – /l/ merger, F2 and F3 transitions were measured on the preceding vowel in addition to the internal F2 and F3 measurements of the lateral itself. This time, the merger was analyzed separately for back vowels /ɑ, u/ and for non-back vowels /i, y, ʉ/. Retroflex articulation is known to be more difficult in vowel contexts like /i, y, ʉ/ (Hamann 2003). Statistical tests showed the merger to be in transition for Trøndersk speakers. There appears to be a general acoustic pressure to merge, with the articulatory difficulty of retroflexion in non-back vowel contexts applying an additional pressure to merge in such contexts, and with word-initial positions resisting merger.

For the /ʂ/ – /ʃ/ merger, frequencies of first and second spectral peaks and highest and

second-highest intensity peaks were measured in addition to CoG. Statistical tests showed a completed merger for all speakers. The same measurements were used to test for the /ʃ/ – /ç/ merger. Statistical tests of the collected measurements showed only one of the eight speakers to have the merger.

These results for the /ɭ/ – /l/ and /ʂ/ – /ʃ/ mergers contradict previous analyses of Trøndersk (Vanvik 1966, Dahl 1981, Endresen 1991). Also, these results for the /ʃ/ – /ç/ merger indicate that it may no longer be limited to large cities (Skjekkeland 2005). Future research will investigate the /ɭ/ – /l/ merger further, gathering a greater number of tokens in order to look at the merger in the context of individual vowels, rather than sets of vowels grouped by backness. Further research should also use articulatory analysis techniques to examine the mergers more closely and determine the articulation of the merged pronunciation in the mergers.

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Chapter 1
Introduction

Over the past century or so, the many dialects of Norwegian have been changing at a pace that some argue is more rapid than ever (Skjekkeland 2005:23). In the years following WWII, many language researchers were predicting a swift downfall for Norwegian dialects with the coming of modern society.[1] While this bleak projection has since shown itself to be overly pessimistic, the general trend of language change in Norway towards more uniformity among the dialects is a reality. Dialect traits with a very limited geographical extent have been disappearing, and the more rural dialects, which to city dwellers often sound "old" or "strange," have been becoming closer and closer to the dialects spoken in the neighboring larger cities (Skjekkeland 2005). Despite these tendencies towards assimilation, the resilience of dialects has surprised Norwegian dialectologists and has served to preserve overarching distinctions. Whatever the fate of the Norwegian dialects, however, it is important to document changes in dialects as they occur.

This study looks more closely at relatively recent sound changes in Trøndersk Norwegian, a dialect of Norwegian spoken in central Norway. It uses acoustic analysis of speech to test for the presence of three consonantal mergers: the merger of /ɭ/ and /l/, the merger of /ʂ/ and /ʃ/, and the merger of /ʃ/ and /ç/. The status of these mergers is controversial in the literature, for not all Norwegian linguists recognize their existence in Standard Østlandsk ('Standard Eastern Norwegian'), an unofficial spoken norm heard in the capital Oslo and surrounding areas. The literature is even more unclear regarding the presence of these mergers in Trøndersk, a linguistically understudied dialect. To begin filling in this gap in the literature, the present study investigates the existence and/or status of these mergers in Trøndersk.

[1] This sentence is a rough translation from Norwegian: "I dei første etterkrigsåra var det fleire språkkunnige personar som spådde ein rask undergang for dialektane ved inngangen til det moderne samfunnet" (Skjekkeland 2005:26).

1.1 Norwegian

Norwegian is spoken as a native language by about 4–5 million speakers in Norway, and along with Swedish, Danish, Icelandic, and Faroese, is a North Germanic language in the Indo-European family. More specifically, it is one of the three Mainland Scandinavian languages (together with Swedish and Danish), which are largely mutually intelligible by native speakers, depending on their dialects and on the amount of exposure they have had to the other languages.

Compared to other European countries, Norway is notable in that it recognizes *two* official written norms of the language but has *no* official spoken norms. For most of the time that Norway was ruled by Denmark (ca. 1380–1814), Danish was the written language used by the Norwegian upper class. Not long after Norway broke with Denmark in 1814, widespread nationalism prompted many Norwegians to advocate for the replacement of Danish with Norway's own written norm that would more clearly distinguish the country from Denmark and Sweden. However, the question of which dialect that norm should be modeled on led to much debate. Some people wanted a written language based on upper class speech, while others thought this was too close to Danish and wanted it to be representative of the rural dialects. Instead of a single compromise, two written norms were constructed to please both camps. Based on the recommendations of early linguist Knud Knudsen, Bokmål 'book language' represents the upper class speech and resembles Danish with some spelling changes that reflect Norwegian pronunciation, while Nynorsk 'new Norwegian' was devised by linguist Ivar Aasen, by incorporating different traits of the rural dialects that he had extensively researched (Kristoffersen 2000).

Though Norwegian has no official spoken norm, many people consider the dialect of Østlandsk ('Eastern Norwegian,' lit. 'Eastland-ish') to be an unofficial standard. This dialect, spoken in a geographical region in southeast Norway called Østlandet,[2] is widely considered to be the spoken equivalent of Bokmål.[3] The version of this dialect spoken by urban, middle-class speakers is often referred to in the literature as "Standard Østnorsk" or "Standard Østlandsk."[4] Centered in Oslo—the capital and largest city of Norway—Standard Østlandsk is "den form for norsk uttale som er best kjent i vårt land og også utenfor landets

[2] See Figure A-1 in Appendix A for a map. Østlandet includes the counties of Oppland, Hedmark, Buskerud, Akershus, Telemark, Vestfold, and Østfold, in addition to the city of Oslo.

[3] Due to the way in which Nynorsk was created—incorporating features of different dialects that in some cases were very dissimilar—no dialect exists that could be considered spoken Nynorsk.

[4] While the name *Standard Østnorsk* may be more common, I will refer to this dialect as *Standard Østlandsk*, since it much more accurately defines the dialect area. Østlandsk is a subdialect of Østnorsk, and this spoken norm should be clearly separated from the other subdialects of Østnorsk (see §1.4.1).

grenser [the type of pronunciation that is most well-known in our country and outside the country's borders]" (Vanvik 1979:7). This stems naturally from the fact that Oslo is not only the political center of Norway, but also an economic and cultural one.

While Standard Østlandsk may be the "most well-known" dialect in the country, it should be noted that it has not infiltrated the society like an officially recognized norm might. According to Kristoffersen (2000:7), "the official ideology behind this policy [of forbidding a standardized spoken norm] is that all spoken varieties of Norwegian shall be considered of equal status." This ideal that every Norwegian should be able to speak his own dialect in all situations and environments is largely a reality in Norway. The acceptance of dialect is much more prevalent in Norway than many other places, including Sweden and Denmark (Jahr 1990). Even when learning Norwegian at school, children are not taught a standardized spoken norm of Norwegian, and in almost no context would a speaker of another dialect attempt to speak Standard Østlandsk. Even though Oslo is the center of broadcasting and television, only reporters who are actually from southeast Norway speak Standard Østlandsk; reporters from other parts of the country speak a standard form of their own dialect (Skjekkeland 2005).[5] But linguists studying the Norwegian language often limit their research to Standard Østlandsk, leaving many dialects of Norwegian understudied.

1.2 Basic phonology of Standard Østlandsk

Norwegian's consonantal phoneme inventory closely resembles that of English with an additional contrastive set of coronals. Another difference is the labiodental approximant /ʋ/, which is similar to the English /v/ and is in fact often incorrectly described as a fricative. But according to Kristoffersen (2000), not only is /ʋ/ pronounced more like an approximant than a fricative, it also behaves phonologically more like a sonorant than an obstruent.

The plain rhotic phoneme in Norwegian varies depending on geographical area. In the southwest part of the country, it is pronounced as a velar or uvular fricative [ʁ] or sometimes as a trill or approximant. However, in Standard Østlandsk the realization of /r/ is almost always an apical alveolar tap [ɾ], though it can sometimes be pronounced as a trill [r] (Kristoffersen 2000).

The articulatory place of the consonants listed as *alveolar* in Table 1.1 can vary greatly from speaker to speaker and can range from dental to denti-alveolar to alveolar, but they are always pronounced laminally with the blade of tongue (Simonsen et al. 2000, 2008). In

[5] A "standard form" of a dialect is usually closest to the variety spoken by middle-class speakers in the largest city of the region.

recent decades, there has been much discussion about the exact articulation of the retroflex consonants, which will be discussed in §1.3.

The phonemic status of the retroflex flap /ɽ/ has been much debated in the literature (see studies published in Jahr & Lorentz 1981). In general, it alternates freely with both [ɾ] and [l] in Standard Østlandsk, but there do exist a few words that must be pronounced with [ɽ], such as [møːɽ], *møl* 'worthless.'

	bilabial	labiodental	alveolar	post-alveolar	retroflex	palatal	velar	laryngeal
stops	p, b		t, d		ʈ, ɖ		k, ɡ	
nasals	m				ɳ	ɲ		
fricatives		f	s	ʃ	ʂ	ç		h
rhotics			r		ɽ			
laterals			l		ɭ			
approximants	w	ʋ				j		

Table 1.1: Consonants of Standard Østlandsk.

Norwegian has an unusually large number of contrasting vowels. It has a set of 9 vowel pairs, each with a short and long (or lax and tense) variation that can contrast in minimal pairs. The set of long vowels [iː, yː, ʉː, uː, eː, øː, oː, æː, ɑː] corresponds exactly to the short vowels [ɪ, ʏ, ʉ̞, ʊ, ɛ, œ, ɔ, æ, ɑ]. In addition, a derived [ə] can show up in unstressed syllables in certain contexts. The transcriptions of the short vowels vary in the literature, and linguists also disagree on which vowels should be considered underlying. Kristoffersen (2000) does not consider there to be an underlying distinction between tense and lax vowels, while others (e.g., Vanvik 1972) do. Kristoffersen considers the phonemic status of /æ/ to be questionable as well, since it is usually derived from underlying /e/ before rhotics. In addition to its monophthongs, Norwegian also has up to seven diphthongs: [æi, œy, æʉ, ɑi, ɔy, uy, ʉy] (Sivertsen 1967), but the last four of these occur only in loanwords and interjections.

	front		central		back	
high	i	y		ʉ		u
near-high	ɪ	ʏ		ʉ̞		ʊ
upper mid	e	ø	ə			o
lower mid	ɛ	œ			ʌ	ɔ
low	æ				ɑ	

Table 1.2: Vowels of Standard Østlandsk.

Another interesting feature of Norwegian is that it has lexically contrastive use of pitch, often referred to as "pitch accent." The realizations of the two tonemes differ depending on dialect. In Standard Østlandsk, the first toneme is realized as LH, and the second as HLH. This contrast can produce minimal pairs like [bœ̀nːɾ̩́] (*bønder* 'farmers') and [bœ̂nːɾ̩́] (*bønner* 'beans').

1.3 The Norwegian retroflexes

Because retroflexion is particularly relevant to at least two of the mergers examined in this study, we will look at it in more depth. Most of the literature (e.g., Endresen 1974, Kristoffersen 2000) shows the Norwegian retroflexes to be the product of an assimilation rule (1) that applies across morpheme and word boundaries. Historically, only dialects with /r/ pronounced as [ɾ] have retroflex consonants.[6] The Norwegian retroflexes are classified as underlying phonemes in most sources (e.g., Steblin-Kamenskij 1965, Kristoffersen 2000; see Sandøy 1996 for an alternative analysis). While the fact that there exists a morpho-phonological rule that reliably assimilates underlying clusters of /r/ and a coronal consonant across morpheme and word boundaries into retroflexes could point to a different analysis, the existence of minimal pairs and the fact that the rule does not apply consistently within single morphemes have led many to analyze the retroflexes as independent phonemes (Kristoffersen 2000). Retroflexes that are within single morphemes are considered underlying phonemes,[7] while retroflexes that are assimilated from a consonant cluster spanning a morpheme or word boundary are derived. Examples of the retroflex rule are shown in (2).

(1) /r/ + coronal consonant → retroflex counterpart

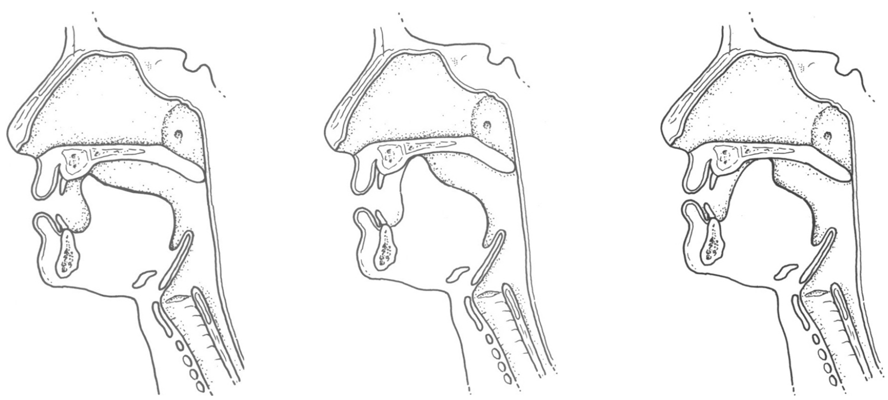
(2)	*hårnål*	/hornol/	[hoːɳoːl]	'hairpin'
	surt	/sʉrt/	[sʉʈ]	'sour'
	ferdig	/ferdi/	[fæɖi]	'finished'
	verst	/verst/	[væʂt]	'worst'
	dårlig	/dorli/	[doːɭi]	'bad'
	far deler	/fɑr deler/	[fɑː ɖeːlɾ̩]	'Dad shares'

[6] More recently, however, retroflex consonants have been spreading westward and southward to the non-retroflex dialects.

[7] Historically, these too would have been derived from the retroflex rule at one point.

1.3.1 The articulation of retroflex sounds

The word "retroflex" is actually not a very explicit term. Though it is listed as a *place* of articulation in the IPA chart, it can refer to consonants ranging widely in articulatory place. In general, retroflex sounds are articulated apically behind the alveolar ridge. However, the active articulator has been seen to vary from the "tongue tip or blade to the extreme underside of the blade" (Hamann 2003:xx) in retroflex consonants, and the passive articulator can vary from alveolar to palatal (including the intermediate post-alveolar and pre-palatal articulations). In his book on phonetics and phonology, Endresen (1991) refrains from using the term retroflex because it doesn't follow the systematic place-of-articulation terminology that we use for other consonants. Instead, he chooses to employ more descriptive terms like "apico-postalveolar," "sublamino-postalveolar," and "sublamino-prepalatal," depending on the articulation of the particular retroflex. The articulations depicted in Figures 1.1(a–c), all of which are considered retroflex, demonstrate the wide range in articulation for this class of consonants.



(a) apico-postalveolar (b) sublamino-postalveolar (c) sublamino-prepalatal

Figure 1.1: Endresen's (1991) three types of retroflex articulation.

Retroflex consonants usually involve some sort of backward bend in the tongue (hence the name). According to Ladefoged & Maddieson (1996), "a retroflex articulation is one in which the tip of the tongue is curled up to some extent." They differentiate between two types of retroflex articulations, one which they describe as a sub-apical palatal retroflex and denote in the traditional way (e.g. /ʈ/) and one which they describe as an apical alveolar or post-alveolar retroflex and denote as /ṭ/. In the latter type, the tip of the tongue is "curled only slightly upwards" (25). The difference between this and a regular apical consonant (/t̺/) is unclear, though they do provide evidence that the tip of the tongue moves as it makes contact for /ṭ/, a property typical of retroflex consonants.

1.3.2 The retroflexness of Norwegian retroflexes

In recent years, some linguists have stopped defining the Norwegian retroflexes as retroflex and have instead found other ways of describing them articulatorily (e.g. Endresen 1991). In response to the many who were questioning the retroflexness of these consonants, Simonsen et al. (2000, 2008) and Moen et al. (1997, 2003) used electropalatography (EPG) and electromagnetic articulography (EMA) to study their articulatory properties. In terms of place of articulation, they found a great degree of variation among speakers in the realization of both retroflex and non-retroflex coronals. The place of /t d/ ranged from dental to alveolar, and /ʈ ɖ ɭ/ ranged from alveolar to post-alveolar (i.e., not necessarily posterior). They also saw variation in tongue configurations; usually, the tongue tip was not bent backwards (which is why people contest their *retroflex*ness). Therefore, they concluded that what distinguished the retroflexes from the other coronals in Norwegian was their **apical** (pronounced with the tongue tip) as opposed to laminal (pronounced with the blade) articulation.

The findings of Simonsen et al. and Moen et al. are evidence that these consonants are actually apical consonants, and not retroflexes. However, Hamann (2003b) argues that the Norwegian apicals should be classified as retroflexes because they so closely resemble retroflexes of other languages, not only in articulatory characteristics but also in phonological behavior. She points out that the class of retroflexes has more cross-linguistic variation than any other articulatory class, so she proposes a less restrictive definition of retroflex, which includes four "defining characteristics of a prototype retroflex": apicality, posteriority, sublingual cavity, and tongue retraction (or displacement of the tongue back towards the velum or pharynx). Retroflex consonants have varying degrees of each property, and we can describe segments as more or less retroflex based on how much of these properties they have. The retroflexes of most languages satisfy all four properties, but Hamann shows examples of retroflex segments that are not posterior.

Following Hamann and traditional descriptions of Norwegian, I will refer to the disputed Norwegian consonants as "retroflexes," with the understanding that they are usually pronounced more like apicals, with no backward-bend in the tongue.

1.3.3 Factors that influence degree of retroflexion

Even within a single language, retroflexion sees a high degree of both inter- and intra-speaker variation, more so than any other class of sounds. This greatly increases the difficulty of describing the articulatory properties of the class of retroflex sounds. According to Hamann (2003b), variation in vocal tract anatomy and articulator flexibility plays a large role in inter-speaker variation. In terms of intra-speaker variation, various factors can play a role in determining the degree of retroflexion.[8] **Vowel context** is one of these factors, due to the effects of coarticulation. Simonsen et al. (2008) describe how the tongue position of the vowel /i/ (with the body of the tongue close to the roof of the mouth, the tongue blade raised and fronted close to the alveolar ridge, and the tongue tip often behind the lower teeth) is not very compatible with the tongue shape of a retroflex consonant. Coarticulation requirements would therefore lead to a decrease in the frontness of the vowel or in the retroflexness of the consonant. The tongue position for the vowel /ɑ/ is much more neutral; neither the tongue body nor the blade is raised, and the tongue can easily move into a posterior place. The vowel /u/ is perhaps even more compatible with retroflexion, with a raised and retracted tongue back (recall that tongue retraction is a property of retroflexion as well), and the tip of the tongue is "free to move to or from the retroflex gesture" (Simonsen et al. 2008:387).

Simonsen et al. (2000) used EPG and EMA to study the articulation of Norwegian coronals in the vowel contexts of low-back /ɑ/ and high-front /i/. As expected, they found that for the retroflex consonants /ʈ, ɖ/, the contact on the palate was slightly more fronted in /i/ contexts than in /ɑ/ contexts. They also found that the contact area on the palate was significantly greater for retroflexes following /i/ than for those following /ɑ/. In addition, they found that retraction and retroflexion were greater in post-vocalic contexts than in pre-vocalic contexts, and that vowel-dependent variation was greater for post-vocalic retroflexes. This means that the preceding vowel has a greater amount of coarticulatory impact on a retroflex segment than the following one, an attribute that has been shown to be unique to retroflexion (Hamann 2003a).

Rate of speech has also been seen to influence retroflexion, such that the degree of backward bend in the tongue decreases with the speed of the utterance. This follows logically from the fact that there is less time in which to complete the movement, and the movement must therefore be abbreviated to some extent. In a study of Swedish retroflex and post-alveolar fricatives, Lindblad & Lundqvist (1997) found that that retroflex fricative had an alveolar place of articulation in phrasal, fast speech but a post-alveolar or even palatal one in isolated, slower speech. As Hamann notes, whether or not the active articulator is also influenced by speech rate is unclear from this study, and further research has to be done. It is also unclear whether this finding can be applied to non-fricative sounds, like plosives or laterals.

[8] When we talk about *degree of retroflexion*, we're looking at the amount of upward curling in the tongue, which increases as contact is made farther back on the roof of the mouth and on the underside of the tongue. The retroflex in Figure 1.1(a), for example, has a lesser degree of retroflexion, whereas the retroflex in Figure 1.1(c) has a great degree of retroflexion.

This leads to **manner of articulation** as another contributing factor in degree of retroflexion. Retroflex fricatives do not show the same degree of retroflexion as retroflex stops, probably because of articulatory requirements like the longer contact area and longer duration of contact that are necessary for frication. While Hamann found instances of retroflex stops with what she considered extreme backward curling of the tongue tip (like in the language of Tamil), she could not find a fricative with such an extreme articulation in any of the literature. Laterals, on the other hand, should show as much retroflexion as the stop consonants. According to Ladefoged & Maddieson (1996), the place of articulation of a lateral is usually the same as the corresponding stop consonant in the same language. Hamann confirms that this applies to retroflex laterals as well, which can have as extreme an articulation (sub-apical, palatal articulation with acute backward bend of the tongue) as any retroflex stop consonant. The articulation of Norwegian retroflex laterals will be discussed in §1.5.1.

Hamann also notes that **language family** can be a predictor of retroflex articulation, such that languages in the same family will often have a similar type of retroflex in terms of place of articulation relating to both the passive and the active articulator. She points out that the two North Germanic languages with retroflex consonants—Norwegian and Swedish—both have an alveolar or post-alveolar, apical articulation.

Finally, and this may interact with language family, the phonemic **inventory size** of a language is correlated with degree of retroflexion and amount of variation. According to Simonsen et al. (2008), languages with fewer sets of coronal consonants have a retroflex place of articulation more front than retroflexes of languages with larger coronal inventories, which tend to show an articulation farther back with a distinctive backward bend in the tongue. Languages with smaller inventories also allow for more inter- and intra-speaker variation in retroflexes compared to languages with larger inventories, which allow for less variation (Hamann 2003b). Most Norwegian dialects have only a two-way distinction in coronals (with just one set of apicals), and the retroflex consonants follow the pattern for smaller inventories.

1.4 Dialects of Norwegian

Norwegian dialectology is a thriving field, and dialects are a subject of great interest even among non-linguists. According to Jahr (1990), most of the evolution of dialects took place between the middle of the 14th century and well into the 16th century. Except for areas along the coast, the geographical landscape of Norway—with its high mountains and wide plains—kept large distances between people and prevented direct contact, either through travel or communication. This led to the development of many dialects that varied greatly from village to village and from countryside to city, even if the distance between them was small. Jahr goes so far as to consider every *kommune* ('municipality') to have its own dialect.[9] While this may be an exaggeration, the truth is that in many cases, it has been possible using only a person's dialect to pinpoint where he is from to the exact town (Jahr 1990).

If dialects continue changing as dramatically as they have been since WWII, however, this may not be true for very long. Many distinctive dialectal traits unique to certain villages or valleys have disappeared, and differences among dialects have become less substantial. As Skjekkeland (1997:22) notes, with developments in society came developments in language, and he points specifically to the "overgang frå eit bufast til eit mobilt samfunn og store endringar i busetjingsmønsteret," or the transition from a stationary to a mobile society and great changes in settlement patterns. Today, people are more likely to move away from their hometowns to settle, and rural villages are no longer as isolated as they used to be, so dialects are mixing more. Plus, developments in communications and media have increased people's exposure to other dialects via radio, television, and cinema.

Most researchers believe that dialect change in Norway is leading to a *regionalization* of dialects, such that dialects within a definite area or region are losing their distinctiveness in relation to each other, but these broader, regional dialects are remaining separate (e.g., Skjekkeland 2005, Dalen 1990). This has resulted in the disappearance of dialectal traits with a limited spread that are unique to local areas, while traits that encompass a larger geographical area remain or spread even farther. Cities play an important role in this process of regionalization. Usually a region has a city at its center that dictates the cultural life of the area, and it is the language spoken in this city that influences the dialects in the surrounding areas. The spoken norm that dominates in the region is not the language of the upper-class people, but that of the common people (in the city), and this norm spreads to smaller towns and villages. Usually a dialect trait will first spread from the large city to other cities and towns in the region, and then it will penetrate from these urban centers outwards into the villages and countryside. These developments do not always spread across the entire country; sometimes they stop midway and create a new dialect boundary (Skjekkeland 2005).

While Skjekkeland acknowledges the reality that many of the more unique dialectal

[9] The use of the term *dialect* is inconsistent, even among linguists. What some people may call a dialect, others might refer to as an accent. It would be impossible to say how many dialects of Norwegian exist. Some people might find fewer than ten or even five dialects in Norway; others, like Jahr, will count more than a few hundred.

traits have disappeared among youth, and that dialect change has been pretty substantial in the past several decades, he also stresses the fact that the dialects have survived much better than people had expected. With the process of regionalization, of course, unique traits of less standard dialects are disappearing, as are the dialects themselves, especially those that are more rural and/or limited to small geographical areas. But as Jahr (1990) points out, dialect use is a way of identifying oneself as being *from* a certain place, something that is very important in Norwegian society (more so than in other places), and this has probably played an important role in curbing dialect assimilation.

1.4.1 Dialect branches

While they can differ greatly in terms of pronunciation, vocabulary, and inflection, the Norwegian dialects are on the whole mutually intelligible. Dialect researchers do not agree perfectly on where to place the dialectal boundaries in Norway, but we will follow Skjekkeland (1997, 2005). Skjekkeland identifies the two broad categories of East Norwegian ('Østnorsk') and West Norwegian ('Vestnorsk') based on which dialects have the *jamvekt* system.[10] He then further divides East Norwegian into three language branches: Østlandsk, Midlandsk, and Trøndersk,[11] and West Norwegian into two: Vestlandsk and Nordnorsk. Figure 1.2 shows a dialect tree of Norwegian according to Skjekkeland's distinctions, and the geographical boundaries of dialects can be seen in the map in Figure 1.3.

1.4.2 Trøndersk

The dialect of Trøndersk is spoken mainly in the counties of North ('Nord') Trøndelag and South ('Sør') Trøndelag.[14] Both Bindal (a municipality in Nordland County that borders North Trøndelag) and Nordmøre (the northeast district of the county of Møre og Romsdal

[10] *Jamvekt* means 'even stress.' The jamvekt system is a prosodic pattern that has its origins in Old Norse and is still present in some Norwegian and Swedish dialects. Two-syllable words (usually verbs), that in Old Norse had a short or light root syllable, were given even stress on both the root and the ending syllable instead of the expected full stress on the initial root syllable. The root syllable vowel and the ending syllable vowel in these words, called *jamningsord*, have since become more like each other (*tiljamning*) or in some regions, completely alike (*utjamning*). In addition, two-syllable infinitive verbs that in Old Norse had long or heavy root syllables have seen a reduction in the vowel of the ending syllable to /e/, or in most Trøndersk dialects, the vowel has been completely dropped.

[11] Skjekkeland calls this dialect 'Trøndsk.' While some dialectologists like Skjekkeland refer to Trøndersk as Trøndsk, it is known as Trøndersk among Norwegians.

[13] Skjekkeland's term is 'Ytretrøndsk."

[13] Skjekkeland's term is 'Indretrøndsk."

[14] See Appendix A for map of Norway showing county ('fylke') divisions.

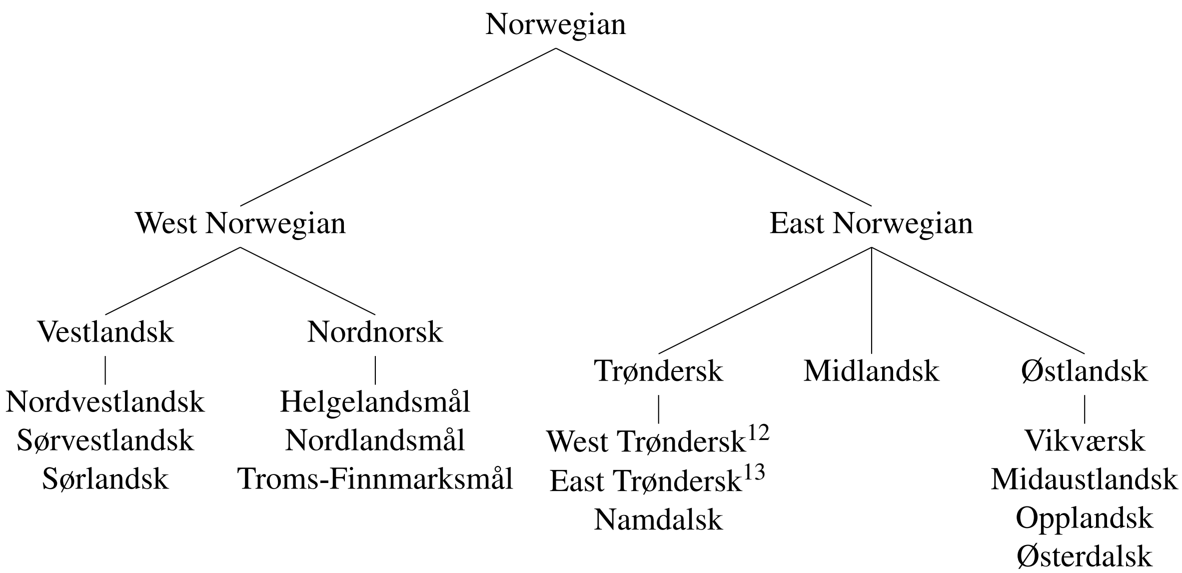


Figure 1.2: Dialect branches of Norwegian.

that borders South Trøndelag) are also included in the dialect area. Researchers divide up the subdialects of Trøndersk differently, but I will follow Jenstad & Dalen (1997); see tree in Figure 1.2 for Skjekkeland's interpretation. Trøndersk can be divided into the branches of East Trøndersk and West Trøndersk.[15] West Trøndersk can be separated into Nordmørsmål, Fosenmål, and West Namdalsk, and East Trøndersk can be divided into Southeast Trøndersk, Northeast Trøndersk, and East Namdalsk.[16] Figure 1.4 shows a visual representation of the dialect branches. In addition, even though the city of Trondheim (the political, cultural, and economic center of the region) lies in the middle of the East Trøndersk dialect region, the city's dialect is usually considered to be Fosenmål dialect. Even so, it does not pattern perfectly with this dialect and therefore is often given separate status (like other big cities in Norway). Figure 1.5 shows a map of the Trøndersk dialect regions; the starred area is Trondheim.

Trøndersk is the only main dialect in Norway that has widespread negative social connotations. Speakers of other dialects will sometimes mimic the dialect in jest, and jokes about the Trønder people or their language are familiar to most people. According to Vanvik

[15] This distinction is made on the basis of the *jamvekt* system as well. East Trøndersk has *utjamning*, West Trøndersk has *tiljamning*. See Footnote 14 (is there a way that i can label-ref a footnote???) for more information.

[16] West and East Namdalsk ('Ytrenamdalsk' and 'Innernamdalsk') are the dialects spoken in western and eastern Namdal, respectively, which is a district in northern Nord Trøndelag.

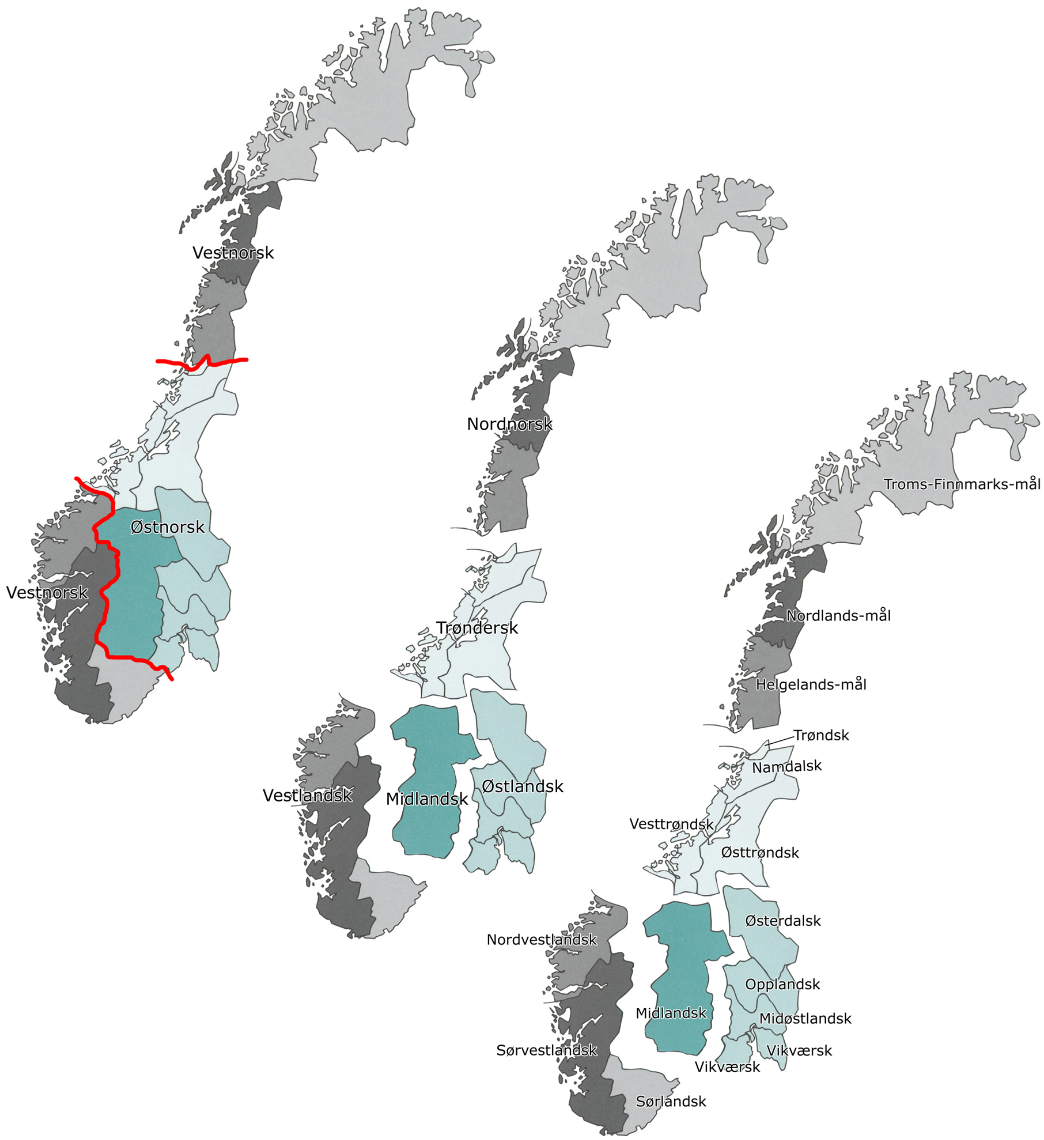


Figure 1.3: Main dialect regions in Norway (adapted from Skjekkeland 19xx).

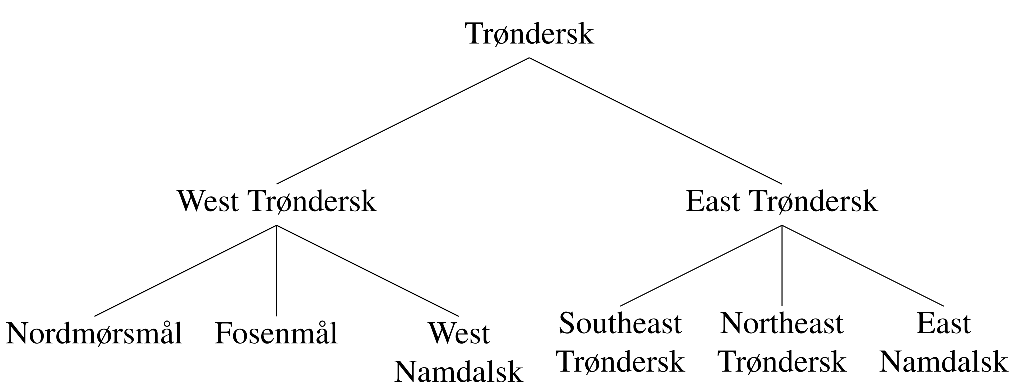


Figure 1.4: Dialect branches of Trøndersk.

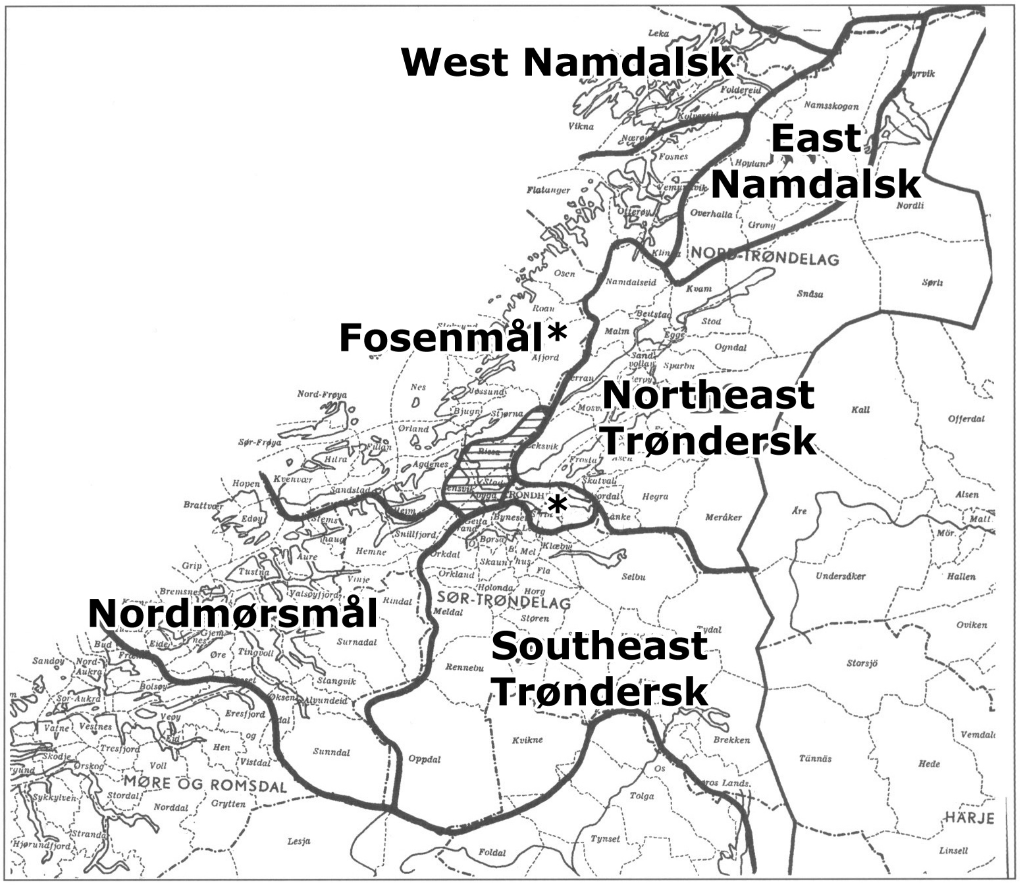


Figure 1.5: Main dialect regions of Trøndersk (adapted from Jenstad & Dalen (1997)).

(1966), the dialect is considered in other parts of Norway to be anything from "vulgar" to "ugly" to "funny" and "amusing," but nowhere is it considered "beautiful." Vanvik claims that the palatal consonants abundant in Trøndersk may be what cause its negative perception among other Norwegians. Interestingly, recent sociolinguistic research has shown that the palatals (as well as first-syllable stress in loanwords) are being taken over by the Standard Østlandsk pronunciation (Hårstad 2008). Trøndersk is in a sense becoming "diluted," though this process has not been proven to be linked to the negative connotations.

Trøndersk is easily recognizable because of several idiosyncratic traits that distinguish it from other dialects. Not only do verb forms and noun suffixes differ, Trøndersk also shows differences in pronoun forms, pitch-accent realizations, word stress patterns,[17] and phonemic

[17] Trøndersk has a distinctive trait of stressing the first syllable in loan words (e.g. /ˈbɑnːɑn/ instead of /bɑˈnɑːn/).

inventory. The consonant inventory of Trøndersk is shown in Table 1.3. Depending on which sounds are considered to be underlying phonemes, Trøndersk has more consonants than most other dialects. Trøndersk palatalizes alveolar stops after short vowels,[18] and in some dialects, velar stops get palatalized as well. In addition, Trøndersk also has the retroflex flap /ɽ/ as a stable phoneme. Known as "thick l" in Norway, this sound is strongly associated with Trøndersk but also appears in free variation in Standard Østlandsk.

	bilabial	labiodental	alveolar	post-alveolar	retroflex	palatal	velar	laryngeal
stops	p, b		t, d		ʈ, ɖ	c, ɟ	k, g	
nasals	m		n		ɳ	ɲ		
fricatives		f	s	ʃ	ʂ	ç		h
rhotics			r		ɽ			
laterals			l		ɭ	ʎ		
approximants	w	ʋ				j		

Table 1.3: Consonants of Trøndersk.

[If you want to mention this, just do it as a parenthetical in the text] (Vanvik also lists /ʎ̥/ as an underlying phoneme, but that's ridiculous:).)

In general, the majority of Trøndersk dialects have the same monophthong vowels as Standard Østlandsk (see Table 1.2). Many dialects have seen a simplification of diphthongs, such that [æi] is pronounced somewhere in between [æ] and [e], [œy] is pronounced as [ø] or [œ], and in some places even the [æʉ] has gone over to [ø] or [œ] (Dalen 1990). Interestingly, the opposite process has also been taking place in many Trøndersk dialects. The diphthongization of [oː] to [ou] or [ɑu] has spread from some Vestlandsk dialects into Nordmøre, Fosen, Namdalen, and north Innherad.

Another distinctive trait of Trøndersk is apocope, or vowel deletion at the end of a word, which is a product of the *jamvekt* system (see footnote 14). Apocope has only affected *overvektsord* (lit. 'overweight words'), or words that in Old Norse had a heavy, or long, root syllable. In addition to verb infinitives, this has also affected past tense forms of weak verbs and the indefinite form of weak feminine nouns. A very unique characteristic of Trøndersk that is rapidly disappearing is a dative case ending that has several different realizations which vary by geographical area. The dative appears in all Trøndersk dialects except for Fosenmål, West Namdalsk, and the Trondheim dialect.

[18] Vanvik considers the palatal consonants to be underlying phonemes.

The dialect spoken in the city of Trondheim has been influenced by the desire of the urban society to distinguish and distance itself from the rural villages. This fact, along with the general tendency of city dialects to simplify complicated phonemic and inflection systems, has contributed to the development of a unique dialect within the city itself (Dalen 1990b). Even within the city, there is a separation between a "fintrøndersk" dialect and a "breitrøndersk" dialect, the former a more prestigious dialect of the upper class and the latter the dialect of the common people.

1.5 Mergers examined in the present study

This study tests for the presence of three mergers in the Trøndersk dialect. These mergers: -, -, and -Studies of these mergers have been studied mostly in the context of Standard Østlandsk.

1.5.1 The /ɭ/ – /l/ merger

According to some sources, /l/ is in the process of changing from a denti-alveolar laminal into an alveolar apical, which has led to a neutralization with the retroflex /ɭ/ (e.g., Vanvik 1979, Kristoffersen 2000).[19] However, this merger is only recognized in some of the literature, and there is no consensus on the environments in which the merger occurs. The earliest mention of this change is made by Vogt (1939). He first observes that in words like "vitterlig" and "ergerlig," the retroflex /ɭ/ is often replaced by the laminal /l/.[20] He then notes that after the back vowels /u, ɑ/, /ɭ/ occurs "to the exclusion of /l/" (190), such that the lateral in "skole" is pronounced the same as the lateral in "nordlig,"[21] both retroflex. Vogt's discussion implies that after unstressed vowels, the contrast is being neutralized to a pronunciation of /l/, while after back vowels, the contrast is being neutralized to a pronunciation of /ɭ/.

Sivertsen (1967), on the other hand, sees the contrast as being intact after non-high back vowels /ɑː, oː/, though the sounds have merged after /uː, ʉː, æʉ/. According to her, they are also starting to merge after front vowels and unstressed vowels, though the exact pattern varies from dialect to dialect. Papazian's (1977) analysis is similar to Sivertsen's: the contrast no longer exists after /u, æʉ, o/, where the sounds have merged to a more or

[19] Recall the retroflex rule discussed in §1.3 and how /ɭ/ is derived from underlying clusters of /rl/ across word and morpheme boundaries.

[20] Vogt refers to the retroflex as an alveolar and to the laminal as a dental.

[21] The orthographic 'd' here is not pronounced.

less retroflex pronunciation. In other contexts, however, the distinction is still intact. Jahr's (1981) analysis of the merger shows it to be in the most advanced stages; he writes that the retroflex /ɭ/ has taken over for /l/ everywhere, although /l/ is still possible in certain contexts (especially among older speakers), mostly before and after front high vowels, where it can vary freely with /ɭ/.

Endresen (1991) breaks the merger down by dialect. While most Trøndersk, Nordnorsk, and North Østlandsk dialects still have the retroflex /ɭ/[22] pronunciation in the traditional contexts that condition the retroflex rule, it seems that the prevocalic lateral, which used to be pronounced as a dental or laminal-alveolar, is being pronounced as apico-alveolar by young speakers in the cities.[23] An opposite process has happened in the Midaustlandsk dialect, where the phoneme /ɭ/ that has marginal status has merged to a dental or lamino-alveolar pronunciation, such that there is no difference in the pronunciation of the laterals in "Karl" and "sal." In Standard Østlandsk, according to Endresen, there is still a distinction after /ɑ, o/, but the laterals have merged to an apical after other vowels.[24]

Data in (4) show examples of the different contexts of the merger. Each of these contexts has been attested by at least one source. However, not all sources see the merger as happening in all of the contexts in (4).

(3) Standard Østlandsk: /l/ , /ɭ/ → ?

(4)	*lat*	[lɑːt]	>	[ɭɑːt]	'lazy'
	lim	[liːm]	>	[ɭiːm]	'glue'
	klage	[klɑːgə]	>	[kɭɑːgə]	'complain'
	slem	[slɛm]	>	[ʃɭɛm]	'mean'
	skole	[skuːlə]	>	[skuː rə] / [skuːɭə]	'school'
	bil	[biːl]	>	[biːɭ]	'car'

However, only Endresen's discussion mentioned above includes Trøndersk within its scope, and while he seems to be describing the first steps toward a merger, he maintains that the sounds have not merged in Trøndersk. Though he does not explicitly mention the merger, Vanvik (1966) implies that it does not exist in Trøndersk by transcribing the lateral in words like *perle* as retroflex /ɭ/ and the lateral in words like *hale* as /l/. Similarly, Dahl

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[22] Endresen uses the term apico-postalveolar instead of retroflex to describe this lateral.

[23] Note the small difference between this apico-alveolar allophone and the retroflex phoneme, described by Endresen as apico-postalveolar.

[24] Endresen sees the development of the retroflex pronunciation as a trend from /l/ towards /ɽ/, with /ɭ/ an intermediate stage.

(1976), who analyzed laterals in the Trøndersk dialect spoken in Namsos, only found /ɭ/ in the traditional context of the retroflex rule.

1.5.2 The /ʂ/ – /ʃ/ merger

Post-alveolar /ʃ/ (orthographically: *skj*, *sk*, and *sj*) and retroflex /ʂ/ (orthographically: *rs*)[25] are described in some of the literature on Norwegian as having merged, with little consensus on the merged phoneme. Vanvik (1972) and Rinnan (1969) describe it as /ʃ/, while Kristoffersen (2000) and Endresen (1974) describe it as /ʂ/.[26] Others (e.g., Molde 2005, Dalen 1985, and Skjekkeland 1997) don't recognize a merger at all. An interesting theory on these two sounds is that of Lindblad (1980), who concludes that there is only a theoretical difference between them; while we should differentiate between the two sounds articulatorily, we should classify them as one sound auditorily or acoustically.

While a description of the Trøndersk realization of these fricatives is hard to find in the literature, both Vanvik (1966) and Dahl (1981) implicitly imply the merger by transcribing the fricative in words like *hesje* and the fricative in words like *Lars* both as post-alveolar /ʃ/, though they do not explicitly mention the merger. In his survey of Norwegian dialects, Christiansen (1976:20) finds a merger only *på en del av østnorsk område*, or 'in parts of the East Norwegian area,' without specifically addressing whether this includes Trøndersk. Christiansen is the only source to show the merger as differing across geographical dialects, while Sivertsen (1967) shows the merger as possibly differing across generations. According to her, some East Norwegian speakers, *kanskje særlig av den eldre generasjon* ('perhaps especially ones of the older generation'), contrast between these two sounds (79).

Furthermore, the phoneme /s/ is realized as post-alveolar (or retroflex) before /l/.[27] In non-merged dialects and dialects that merge /ʂ/ and /ʃ/ to /ʃ/, /s/ is post-alveolar before /l/. But it is described as retroflex by writers who assume the merged pronunciation of /ʂ/ and /ʃ/ to be /ʂ/. Data in (5) is representative of a dialect without the /ʂ/ – /ʃ/ merger. This rule also applies across morpheme/word boundaries.

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[25] See §1.3 for the assimilation rule from which this sound is derived.

[26] Kristoffersen observes the lack of phonetic data pertaining to this merger, and he qualifies his assumption as follows: "lacking a thorough investigation of the articulatory properties of this sound, I do not mean to imply that it will be a retroflex sound for all speakers and in all environments" (xx).

[27] Jahr (1985) and Kristoffersen (2000) see this as an assimilation rule spreading the apical feature of the lateral onto the the preceding sibilant. It can only be interpreted as such if Jahr's (1988) assertion that the lateral has been changing this century from a laminal articulation to an apical one is true. Still, the timing doesn't seem quite right. Already in 1907, Larsen noted that the postalveolar realization of /s/ before a lateral was almost without exception in the vernacular. The first mention of the /ɭ/ – /l/ merger didn't come until Vogt's 1939 remarks on his own pronunciation.

(5)	*slikker*	/slikker/	[ʃlɪkkɾ̩]	'lick' (pres.)
	slå	/slo/	[ʃloː]	'hit' (inf.)

Other complications in determining the merged pronunciation of the /ʂ̻/ – /ʃ/ merger include the fact that the pronunciation of these segments varies among speakers and dialects, and possibly the fact that the palatal fricative /ç/ is merging with the post-alveolar fricative in certain areas (see §1.5.3). Data in (7) show the merger.

(6) Standard Østlandsk: /ʃ/ , /ʂ̻/ → ?

(7)	*skip*	[ʃiːp]	>	[ʂ̻iːp]	'ocean'
	hEsje	[heʃə]	>	[hɛʂ̻ə]	'to harvest'
	slå	[sloː]	>	[ʂ̻ɭoː]	'to hit'
	Lars	[lɑːʂ̻]	>	[lɑːʂ̻]	(proper name)

1.5.3 The /ʃ/ – /ç/ merger

The /ʃ/ – /ç/ merger was first noticed in 1964 among youth in Bergen (Sandøy 2002). These sounds appear orthographically in Norwegian as *skj*, *sj*, and *sk* before *i* and *y* (for /ʃ/) and *kj*, *tj*, and *k* before *i* and *y* (for /ç/), spellings which reflect the original pronunciation of these sounds. Both sounds have several different sources, namely consonant clusters that have assimilated into one sound. It is unknown exactly when these assimilation processes took place, but it is clear that neither of these sounds were present in Old Norse, so the sounds must have arisen after that time (Dalbakken 1997).

Whether /ç/ is merging with /ʃ/ or /ʂ̻/ varies from source to source, depending on the phonemic inventory that is presented. For those researchers who still consider /ʃ/ and /ʂ̻/ to be separate phonemes, /ç/ is merging with /ʃ/. For those who consider the two coronal fricatives to have merged to a retroflex /ʂ̻/ pronunciation, /ç/ is merging with this merged product /ʂ̻/. We will assume that the /ʂ̻/ – /ʃ/ merger is not necessarily complete in all dialects of Norwegian and will therefore label this merger as in (8) below.

(8) Norwegian: /ʃ/ , /ç/ → /ʃ/

The status of the other component of the merger (/ç/) is contested as well. According to some sources, the sound is often pronounced as /ç̟/, with an alveolo-palatal (or pre-palatal) place of articulation. This pronunciation has been becoming more and more common in the last thirty years for speakers of East Norwegian (which would include Trøndersk speakers), but whether the variation in pronunciation is dependent on social, geographic, or age-related factors is still unknown (Endresen 1991). According to Kristoffersen (2000), this variation in pronunciation is closely linked to the /ʃ/ – /ç/ merger. He describes the /ʃ/ – /ç/ merger as a result of the fronting process of /ç/ to /ɕ/ having been “taken further” by some speakers. Whether this is a two-step process, such that only speakers who already have the fronted articulation /ɕ/ of the palatal can have the merger with the postalveolar, has not been studied. We will follow the literature and refer to the merger and its components as in (8) above. In (9) below are examples of the merger.

(9)	*kyssen*	[çʏsːn̩]	>	[ʃʏsːn̩]	‘kiss’
	skyssen	[ʃʏsːn̩]	>	[ʃʏsːn̩]	‘ride’
	kjære	[çærə]	>	[ʃærə]	‘dear’
	skjære	[ʃærə]	>	[ʃærə]	‘to cut’

The /ʃ/ – /ç/ merger has so far been a large city phenomenon; it has been heard in the speech of younger speakers in the large cities in the southern half of the country, like Bergen, Oslo and Stavanger. More recently, it seems to have made its way as far north as Trondheim. Dalbakken (1997) conducted a study of 12- and 16-year olds in Trondheim in which she found up to 1/3 of the speakers articulating the palatal as postalveolar in some instances. She concluded that the main reason for this was related to ease of pronunciation: while the speakers were *able* to pronounce /ç/ and sometimes did, it was easiest for them to just use /ʃ/.

The palatal fricative has long been a common problem for young East Norwegian children growing up (Papazian 1994). According to Vanvik (1979), /ç/ is normally the last phoneme to be developed in the speech of Norwegian children. This is easily explained by the articulatory difficulty of this sound, which is also a reason for its infrequency among the languages of the world (Lindblad 1980). Morever, this sound is relatively infrequent within Norwegian, for it can only appear word-initially. Papazian argues that the reason children (who are clearly able to pronounce /ç/) use /ʃ/ instead is not an uncertainty about which words have and don’t have the sound, but actually due to *makelighet og gammal vane*, ‘laziness and old habits’ (91). He notices that in certain groups of children and youth, the incorrect pronunciation /ʃ/ is considered the norm and not a mistake, and he warns that if this attitude continues to spread, the palatal fricative will not have a long future in Norwegian.

Chapter 2
Methods

The study consisted of two phases: a pilot experiment for the /ʎ/ – /l/ and /ʃ/ – /s̺/ mergers, and a follow-up experiment for those mergers as well as the/ʃ/ – /ç/ merger. The follow-up experiment expanded upon the work done in the pilot, not only by looking at a third merger, but also by increasing the number of speakers, number of tokens collected per speaker, and the number of acoustic properties measured in the speech sounds of interest.

Recording sessions for both the pilot and follow-up experiments began with a casual interview to ease the speakers into a more natural register, after which the speakers were asked to read aloud from written wordlists. A native Trøndersk speaker conducted the recording sessions. Speakers were instructed to speak naturally and conversationally, as if talking informally with an acquaintance. Their speech was recorded digitally as mono-sounds using Praat (Boersma & Weenink 1992/2009), at a sampling frequency of 44100 Hz. The microphone used for recording sounds was a Logitech PC Headset 120.

2.1 Pilot experiment

The pilot experiment analyzed the speech of two TN speakers (identified here as P1 and P2, to distinguish them from the speakers in the follow-up) from just outside Malvik, a municipality about 25 kilometers east of Trondheim.[1] Speaker P1 is a 25-year-old female who spent the first 19 years of her life in Malvik, and all but one of the next six years in Trondheim. Her mother is from Selbu, and her father is from the island of Hepsøya (in Osen

[1] "Municipality" is the most common way of translating the Norwegian word *kommune*. These municipalities are really just subdivisions within Norway's 19 "counties" (*fylke*) and may include more than one town. See Figure A-2 in Appendix A for a map showing the municipalities of North and South Trøndelag. Trondheim is its own municipality.

municipality). She speaks English at an advanced level and has briefly studied German.[2]

Speaker P2 is a 26-year-old female, who also spent her first 19 years in Malvik before moving to Trondheim, where she has lived since. Her mother is from Trondheim, and her father is from Malvik. She has basic proficiency in English and has also studied German.

For the pilot experiment, two recording sessions were held with each speaker. The materials presented to the subjects during the first session contained eight sets of seven sentences and nineteen sets of six words. Materials from the second session contained four sets of five words and two sets of seven sentences. For the wordlists, the first and last word of each set of six were "dummy" words, to avoid any adverse effects from list intonation. Test sentences were alternated randomly with non-test sentences, with a higher concentration of test sentences later in the list. Materials were written in Trøndersk[3] and read aloud by the speakers (see Appendix B for materials used).

2.2 Follow-up experiment

For the follow-up experiment, data from eight new TN speakers was gathered. These speakers were from a variety of municipalities, all within 50 miles of Trondheim. See Figure 2.1 for a map showing the speakers by geographical location. All speakers were between 19 and 28 years old.

Speaker 1 is a 24-year-old male who grew up in Trondheim and has lived there all but two years of his life. As an adult, he spent one year in England and one year in Oslo. His mother is from Stadsbygd (Rissa municipality), and his father lived in both Røros and Selbu growing up. He speaks near-fluent English and has studied some German.

Speaker 2 is a 28-year-old female who grew up in Lensvik (Agdenes municipality) until the age of 16. She has since lived in Trondheim for three years, Geneva for one year, Oslo for three years, Bergen for three years, and Harstad for almost two years. Her mother is from Moldtun (Snillfjord municipality), and her father is from Lensvik. She speaks near-fluent English and has moderate proficiency in French.

[2] In addition to the languages explicitly listed for each speaker, we can also assume that they are all able to understand a good amount of Swedish and Danish, due to the linguistic similarity of the languages.

[3] While the Trøndersk dialect doesn't officially have an orthographic form, it is common, especially among youth, to write informally in a nonstandard from of written Trøndersk, which basically modifies Bokmål to fit the Trøndersk pronunciation. While pronunciation can greatly differ among subdialects of Trøndersk, since both P1 and P2 were from Malvik, it was possible to use an orthography familiar to both of them. This was deemed preferable to using materials written in Bokmål because it was important that the speakers speak in dialect, and in some cases (especially in the sentences), the Bokmål form of a word would not have even resembled the Trøndersk word. This could have forced the speaker to switch into a register in which they were reading Bokmål aloud instead of speaking naturally in dialect.

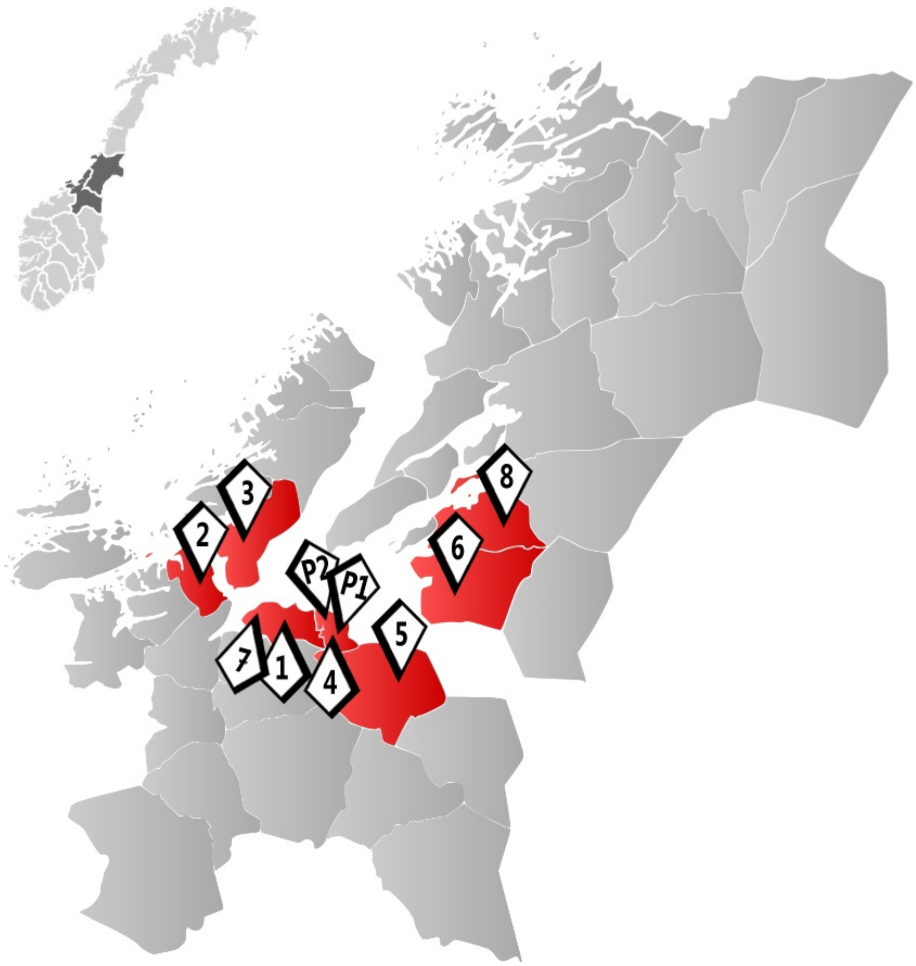


Figure 2.1: Home municipalities by speaker (adapted from Wikipedia).

Speaker 3 is a 23-year-old male, who spent the first three years of his life in Namsos, the next 8 in Nærbø, and the next eight in Stadsbygd (Rissa municipality). He lived one year in Molde and has since lived in Trondheim (for almost four years). His mother is from Stavanger, and his father is from Sand. He has moderate proficiency in English and has studied some German.

Speaker 4 is a 26-year-old female. She lived in Malvik for 23 years and has lived in Trondheim since. Her mother is from Muruvika (Malvik municipality), and her father is from Trondheim. She speaks English proficiently in addition to basic French.

Speaker 5 is a 24-year-old male. He grew up in Selbu, a rural municipality in South

Trøndelag.[4] He lived a little more than 16 years in Selbu, followed by a year in Malvik, and has spent the last almost eight years in Trondheim. His mother is from Hegra (Stjørdal municipality), and his father is from Selbu. He has basic to moderate proficiency in English and has studied some German.

Speaker 6 is a 24-year-old female who grew up in Lånke (Stjørdal municipality) until she was 17. Afterwards, she lived one year in Levanger, four years in Trondheim, and has recently moved to Selbu. Her mother is from Selbu, and her father is from Lånke. She speaks English with moderate proficiency.

Speaker 7 is a 20-year-old male speaker who has lived in Trondheim his whole life. His mother is from Haugesund, and his father is from Kristiansund. He speaks near-fluent English.

Speaker 8 is a 19-year-old male who grew up in Levanger and only recently moved to Trondheim. His mother is from Hareid, and his father is from Fannrem (Orkdal municipality). He has moderate proficiency in English.

Each recording session for the follow-up experiment consisted of two parts. The first part was an informal interview in which relevant demographic information was obtained. Each speaker was also asked to talk a little bit about his/her hometown and childhood in the hopes of increasing comfort level and perhaps causing the speaker to speak truer to his home dialect (assuming the speaker had moved from home and had since altered his dialect). Next, speakers were asked to read aloud a wordlist consisting of 42 sets of six words (see Appendix B for wordlist). Target words for all three mergers were in random order, and the first and last word in each set of six were non-test words. Words were written in Bokmål, though speakers were instructed to speak their own dialect, even if the Bokmål spelling didn't reflect their pronunciation of a word.[5]

2.3 Measurements

Decisions regarding what measurements to take for the acoustic analysis were based on a survey of the literature. Since two of the mergers of interest involve a retroflex consonant

[4] The dialect spoken here, called Selbygg, is very distinctive. Among its characteristic traits are nasalized vowels and generalization of apocope beyond contexts typical for TN (see §1.4.2 for more on apocope).

[5] This was a departure from the pilot experiment. Since the follow-up experiment encompassed more speakers and included speakers of up to five subdialects of Trøndersk, no orthographic dialectal norm existed that could include all speakers. However, since Bokmål is the written language used in the region, it is completely normal for Trøndersk speakers to read aloud from Bokmål in their own dialect. Also, only wordlists were used in the follow-up experiment and not sentences, so speakers weren't as likely to stumble over hard-to-translate Bokmål words.

merging with its non-retroflex counterpart, acoustic measurements that distinguish retroflex from non-retroflex sounds were essential. In addition, two of the mergers involve fricatives, so it was necessary to measure acoustic properties of these sounds that reliably differentiate among fricatives with different places of articulation.

2.3.1 Acoustics of retroflex consonants

The acoustic effects of retroflexion have been interpreted differently by different authors. While some have found that retroflexion affects F2, F3, and/or F4, Hamann (2003b) argues that a lowered F3 is the only consistent characteristic of retroflexion seen across all studies and all languages. She argues that both the posterior articulation of a retroflex segment and the resulting sublingual cavity lower F3 in coronals, as does tongue retraction (which necessarily co-occurs with apicality and posteriority/sublingual cavity).

The acoustic effects of retroflexion on F2 are not as clear. Whereas apicality has been shown to lower F2 in coronals, posteriority, sublingual cavity, and tongue backing have the effect of raising F2. Hamann (2003b) concludes that since three articulatory properties predict a raised F2, we can expect this formant to either be somewhat raised or not affected by retroflexion, depending on vowel context. Stevens & Blumstein (1975) argue that F2 will not be noticeably affected by retroflexion; that is, F2 transitions should be similar for both retroflex and non-retroflex sounds. Actual acoustic analyses have shown varying results. While some researchers have found a high F2 in retroflexes (e.g., Ohala & Ohala 2001), Dart & Nihilani (1999) found a lowered F2 for retroflexes in Malayalam. It seems that F2 as a cue for retroflexion is largely language-specific. Without any acoustic data on F2 frequencies in Norwegian retroflexes, we cannot expect F2 to be a dependable cue for retroflexion without further research.

Retroflex consonants are distinctive among consonants in their stronger VC (postvocalic) than CV (prevocalic) cues (Simonsen et al. 2008, Hamann 2003a). Because the tongue moves forward during the constriction of a retroflex consonant towards a less displaced articulation, a motion sometimes referred to as “flapping out” (Ladefoged & Maddieson 1996), the consonant is therefore not as retroflex going into the following vowel as it was coming from the preceding vowel. Thus, the CV cues of a retroflex consonant would not be as valuable as its VC cues in distinguishing it from a non-retroflex sound. In addition, Simonsen et al. (2008) found that retraction and retroflexion were greater in post-vocalic contexts than in pre-vocalic. We would therefore expect the degree of F3 lowering (as a result of greater retroflexion and retraction) to be more prominent in VC transitions.

We also expect the acoustic cues of retroflexes to vary by vowel context, in the same way that their articulation does (as discussed in §1.3.3). Since adjacent front vowels have been shown to decrease the retroflexness of pronunciation (Simonsen et al. 2008, Hamann 2003b), we predict that F3 lowering—the acoustic correlate of retroflexion—will not be as prominent after front vowels as after back ones.

2.3.2 Acoustics of laterals

The first merger under investigation involves two lateral consonants. Laterals belong to the class of sonorant consonants and are "characterized acoustically by well-defined formant-like resonances" (Ladefoged & Maddieson 1996). Not only do laterals have the formant transition cues of other consonants, they also have their own internal formants, similar to vowels. The F2 frequency of laterals increases as the size of the cavity behind the constriction decreases (Stevens 1998). We might therefore expect retroflex laterals to have a higher F2 than their non-retroflex counterparts (because of their more posterior articulation). A study of Australian languages, however, showed the opposite to be true, namely that /ɭ/ had the lowest F2 compared to /l̪, l, ʎ/ (Busby 1979) [6]. The data in the same study shows F3 to be a robust cue of retroflexion in laterals; the F3 value of /ɭ/ is the lowest by 211 Hz.

In addition, laterals show a greater degree of coarticulation variation than other consonants, due to "the resonant nature of laterals and their somewhat vowel-like acoustic structure" (Ladefoged & Maddieson 1996). Therefore, we might expect to see internal formants and formant transitions vary significantly based on the articulatory properties of the adjacent vowels.

2.3.3 Measurements for the /l/ – /ɭ/ merger

In the pilot experiment, the /ɭ/ conditioned by the retroflex rule in (1) (both within and across morpheme/word boundaries) was compared to /l/ in three different contexts: word-initally, in an *sl*-cluster, and postvocalically.[7] There were eight target words for each context.[8] Internal formants F2 and F3 were measured from a segment 10–20 ms in duration selected from the middle of each lateral.

[6] The average F2 value of the /ɭ/ was only lower than that of the /l/ by 16 Hz.

[7] Two other groups were eliminated—pre-vocalic after non-coronal and post-vocalic after short vowel—since the laterals in the first case were realized as retroflex flaps [ɽ] and those in the latter were realized as palatals [ʎ].

[8] For /l/ and /ɭ/, each of the eight words within the same context preceded or followed a different vowel: /ɑ, o, u, ʉ, e, ɛ, ø, i, y/. It was not possible to find /ɭ/ in a /e, ɛ/ vowel context, however, so /æ/ was used instead.

In the follow-up experiment, the postvocalic /ɭ/ conditioned by the retroflex rule across morpheme boundaries was compared to word-initial and postvocalic /l/ in addition to /l/ in a word-initial *sl*-cluster. This time, instead of comparing the averages of all /ɭ/ sounds to averages of all /l/ sounds, enough tokens were gathered to compare the laterals by vowel context. This was not only to control for the strong acoustic effects of coarticulation in laterals (as noted above), but also to see if the merger has happened in some vowel contexts but not in others, as Papazian and others found to be true for speakers of Standard Østlandsk (see §1.5.1). Also, in addition to measuring the formants of the lateral itself, the formant transitions in the preceding vowels were also measured (in relevant contexts). Transitions were calculated by subtracting the F2 or F3 value at the end of the vowel from the F2 or F3 value in the middle of the vowel, such that a negative number represented a lowering of the formant from the vowel into the consonant.

Laterals were taken from five vowel contexts: /i, y, ʉ, u, ɑ/.[9] For word-initial /l/ and postvocalic /l/ and /ɭ/, four tokens were collected for each of the five vowel contexts. With the *sl*-clusters, only two tokens per vowel context were collected (a total of 10 items). This was because none of the literature showed the *sl*-laterals to vary by vowel context with respect to the merger (see §1.5.1).

2.3.4 Acoustics of fricatives

Researchers have so far been unable to find a single acoustic measurement that can classify fricative place of articulation consistently and accurately. This is partially due to the "considerable variability in the observed spectral characteristics of fricatives" (Stevens 19xx), which can mean substantial inter- and intra-speaker variation in acoustic properties of the same fricative. In addition, the more acoustically similar the sounds are, the more difficult it is to find an acoustic cue that differs reliably, such that differentiating between sibilant fricatives and fricatives at other places of articulation has proven much easier than differentiating among the sibilant fricatives themselves. This fact has particular consequences for the analysis of the /ʂ/ – /ʃ/ merger, since both of these sounds are sibilants. !!!

Center of gravity. Center of gravity (CoG), or spectral mean, is a mathematical measurement that characterizes the spectral energy across all frequencies as a single average frequency and is the most common spectral measurement used by speech researchers studying fricatives (see e.g., Żygis & Hamann 2004, Nowak 2006, Gordon et al. 2002, Hamann &

[9] The vowel context was determined by the preceding vowel for postvocalic laterals and by the following vowel for word-initial and *sl*-cluster laterals.

Avelino 2007, Żygis 2003). In terms of articulation, CoG is related to the size of the cavity in front of the constriction; thus, the farther forward the constriction, the smaller the cavity, and the higher the CoG. CoG is useful because it can characterize a fricative's spectral shape in a single value. In a study of sibilant fricatives in Slavic languages, Żygis (2003) found CoG to be a reliable measurement for distinguishing between different fricative phonemes. In another crosslinguistic study of fricatives, Gordon et al. (2002) had similar (though not universal) results: "gravity center frequencies robustly differentiated many of the fricatives in the examined languages" (xx). But in their study of Toda, Gordon et al. found that retroflexion was not reliably associated with lower CoGs (in comparing [ʂ] with [s] and [ʃ]). Also, in a study by Żygis & Hamann (2003), CoG values for [ʃʲ] and [ʂ] were only statistically different for one of the two Polish speakers studied, and the authors concluded that more speakers were needed to determine whether CoG can reliably distinguish the four Polish sibilants across all speakers.

Spectral peaks. Spectral peaks are also a common measurement used in fricative analysis. Fricatives articulated farther back in the mouth have greater noise at lower frequencies compared to less posterior sounds, such that the longer the anterior cavity, the lower the frequency of the most pronounced spectral peak (Gordon et al. 2002). Jongman et al. (2000) found spectral peak location to consistently differentiate between the English fricatives. In a study of Polish sibilants, Nowak (2006) looked at the "main peak value," or highest-amplitude peak, for each token. For the retroflex fricatives (/ʂ/), he measured values for the *two* highest peaks, since he found that the highest-amplitude peak was "almost equally likely to occur in the vicinity of 3.5 kHz as in the vicinity of 5.5 kHz" (xx).

In addition to high-amplitude peaks, low-frequency peaks can also be useful. Nguyen & Hoole (1993) found /s/ and /ʃ/ to show a clear difference in frequency of the lowest main spectral peak. They also noted the difficulty of locating this peak in many of the spectrograms and emphasized the need for a "more sophisticated method [of precisely identifying fricative spectral peaks] consisting in [sic] combining articulatory/acoustic analyses with modeling" (243). In another study, Dogil (1990) measured the frequencies and intensities of the first *four* peaks in sibilants.

Spectral shape. Some people have argued that overall spectral shape is better for classifying fricatives than the exact positions of spectral peaks (e.g., Evers et al. 1998). According to Fant (1970:26), formant patterns (equivalent to spectral peak patterns in fricatives) are not sufficient for describing consonants, and "the consonant spectrum should in addition be specified by its spectrum envelope," or overall spectral shape. Lindblad (1980) found that spectral shape consistently distinguished Swedish [ʂ] from [ɕ], whereas highest-peak frequencies were not as reliable. Gordon et al. (2002) also found overall spectral shape to be useful for differentiating fricatives. Evers et al. (1998) quantified the overall spectral shape in terms of spectral slope; they used a value they termed "steepness difference" (the spectral slope above 2.5 kHz subtracted from that below 2.5 kHz) to reliably show a contrast between [s] and [ʃ] in English and in languages in which these two sounds are allophones of the same phoneme. Yet another way of looking at the overall spectral shape is through spectral moments analysis.[10] In their study of the usefulness of different acoustic cues for characterizing the English fricatives, Jongman et al. (2000) found all four moments to be robust cues.

Formant transitions. Some researchers have recently begun to look at formant transitions in neighboring vowels for fricative classification, but there is no consensus in the literature about the usefulness of vocalic cues in fricative identification. According to Hamann (2003b), fricative turbulence makes it difficult to detect formant trajectories. Jongman et al. (2000) looked at transition information, but found that F2 transition properties were not consistently able to distinguish all fricatives. In general, researchers have found that internal fricatives cues are sufficient in themselves and that transitions are thus unnecessary. Behrens & Blumstein (1988) suggest that the fricative itself, "irrespective of where the frication noise is measured," is sufficient for deriving patterns of spectral properties (xx). Similarly, Nowak (2006) found that isolated fricatives had sufficient cues in themselves for Polish speakers to accurately identify them. Evers et al. (1998) interpreted the results of a perception experiment by Heinz & Stevens (1961) as an indication that "differentiation of [s] and [ʃ] is accomplished primarily on the basis of cues contained in the frication noise itself," as opposed to vowel transitions (348). It is clear, however, that adjacent vowels have strong coarticulatory effects on fricatives. Soli (1981) found that the high vowels [i] and [u] were especially perceivable in the fricative spectrums.

2.3.5 Measurements for the/ʃ/ – /ʂ/ merger

According to Hamann (2003a), postalveolar [ʃ] and retroflex [ʂ] are very similar acoustically, especially when compared to fricatives articulated in the alveolar region.[11] When the

[10] The four spectral moments are variance (range of spectrum), kurtosis (peakedness of the distribution—clearly defined peaks versus a relatively flat spectrum), skewness (tilt/slant of spectrum), and mean (or CoG).

[11] These sounds have the same degree of similarity—if not more so—in terms of their articulation. As discussed in §1.3.3, retroflex fricatives do not have the same degree of backward bend in the tongue as retroflex

postalveolar fricative is rounded (which it is in Norwegian), the similarity increases. Despite the fact that [ʃ] and [ʂ] may be extremely similar acoustically, studies have shown that spectral peaks of [ʂ] are lower than those of [ʃ]. According to Ladefoged and Maddieson (1996), the retroflex [ʂ] has the lowest cut-off frequency and lowest range of the sibilants, which should translate into the lowest CoG. And Żygis (2003) found similar results for CoG values in Polish; in general, CoG values of [ʃ] were higher than those of [ʂ]. In addition, Gordon et al. (2002), though they did not find CoG to be as reliable, found that the "lower edge of the peak noise band" was lower in frequency for [ʂ] than for [s] or [ʃ].

In the pilot experiment, tokens of traditionally retroflex /ʂ/ (eight underlying tokens from within single morphemes plus eight tokens assimilated across morpheme/word boundaries) were compared to eight tokens of /ʃ/ (in both word-initial and intervocalic positions), as well as to eight tokens of /s/ before /l/. Not knowing the exact pronunciation of the derived sibilant in *sl*-contexts,[12] the fricative in the *sl*-cluster was compared separately to both the postalveolar and the retroflex sibilant. Following the many studies showing CoG to be a reliable acoustic cue for fricatives, the CoG was measured in Praat (Boersma & Weenink 1992/2009) for each sound, with weighting based on the power spectrum ($p = 2$ in Praat). As much of the fricative was selected as possible, excluding the beginning and the end of the sound as well as any other obvious irregularities.

In the follow-up experiment, 20 tokens of postvocalic /ʃ/ and 20 of postvocalic /ʂ/ were collected. All of the /ʂ/ tokens were derived from /rs/ over a morpheme boundary within a single word. The 20 tokens consisted of four tokens from each of five vowel contexts (/i, y, ʉ, u, ɑ/). For this experiment, spectral peak frequencies were measured in addition to the CoG. At least 50 ms from the middle of the frication noise was extracted, and FFT spectra were created from these extracted sounds. The CoG ($p = 2$) was calculated from the raw spectrum of each fricative. After measuring CoG, spectra were converted using LPC smoothing for 10 peaks (with pre-emphasis from 50 Hz). For each LPC-smoothed spectrum, the frequencies of the two lowest-frequency peaks and the two highest-amplitude peaks were measured.

2.3.6 Measurements for the /ʃ/ – /ç/ merger

This merger was only examined as part of the follow-up study. Since the palatal fricative has a more posterior articulation than the postalveolar, we might expect it to have lower

stops. In Norwegian, /ʂ/ is postalveolar for most speakers (e.g. Endresen 1991), so the only difference in the articulation of these two sibilants is apicality—/ʃ/ is laminal and /ʂ/ is apical.

[12] See §1.5.2 for a description of this assimilation rule.

frequencies. This is not the case, however, and seems to be the only exception to the rule. According to Shadle et al. (19xx), the sublingual cavity for [ʃ] is relatively large and increases the size of the anterior cavity, effectively making it sound backer than it really is; this accounts for the higher frequency of [ç] in comparison to [ʃ]. Even though it has been shown that [ç] has higher frequencies that [ʃ], the acoustic differences between these two sounds are not that explicit. The result of Żygis's (2003) crosslinguistic study showed considerable overlap in the CoG values of [ʃ] and [ç], and she concluded that these values are "not able to maintain an optimal perceptual contrast" (208).

In the follow-up experiment, 20 tokens of word-initial /ç/ and 20 of word-initial /ʃ/ were collected. The 20 tokens included four tokens from each of five vowel contexts: /i, y, ʉ, u, ɑ/. In the same manner as described in §2.3.5 for the/ʃ/ – /s̪/ merger, measurements of CoG, first and second spectral peaks, and highest and second-highest intensity peaks were taken for each fricative.

Chapter 3
The /ɭ/ – /l/ merger

The merger of /ɭ/ with /l/ is shown is most of the literature as happening only in certain contexts. What these contexts are, however, varies depending on the source, sometimes varying to the extent of complete contradiction (see §1.5.1). For example, while Vogt (1939) found the neutralization to occur after stressed back vowels, Endresen (1991) described a neutralization in all contexts *except* for after non-high, back vowels. The literature agrees much more on the subject of the merged pronunciation; most sources show the retroflex or apical pronunciation to be taking over for the laminal lateral. The main sources on the /ɭ/ – /l/ merger are specific to Standard Østlandsk, and the merger has not been seen in studies of Trøndersk (Vanvik 1966, Dahl 1981, Endresen 1991). Examples of the different contexts of the merger are shown in (4).[1]

(10)	*lat*	/lɑːt/	[ɭɑːt]	‘lazy’
	lim	/liːm/	[ɭiːm]	‘glue’
	klage	/klɑːgə/	[kɭɑːgə]	‘complain’
	slem	/slɛm/	[ʃɭɛm]	‘mean’
	bolig	/buːli/	[buːɭi]	‘housing’
	bil	biːl	[biː ɭ]	‘car’

Since the literature is so conflicting regarding the status of the /ɭ/ – /l/ merger and the contexts in which it occurs, and since no studies exist that have specifically tested for the presence of the merger in the Trøndersk dialect, a phonetic study was undertaken to determine the status of this merger in Trøndersk.

[1] Each of these contexts has been attested by at least one source. However, not all sources see the merger as happening in all of the contexts in (10).

3.1 Pilot experiment results

The retroflex /ɭ/ was compared to /l/ in three different contexts: postvocalically, word-initially, and in a word-initial *sl*-cluster. Second and third formants (F2, F3) were measured for each token. The data was tested for statistical significance using multivariate analyses of variance (MANOVAs). (See §2.1 and §2.3.3 for details on experimental methods.)

Table 3.1 shows the average F2 and F3 values measured for postvocalic /ɭ/ and /l/, word-initial /l/, and /l/ in a word-initial *sl*-cluster. F3 should be lower in retroflex environments, and the data generally fit with this expectation. For Speaker P1, the average F3 for the retroflex lateral is lower than that of the plain lateral in both postvocalic and word-initial contexts; it is higher than the lateral in the *sl*-cluster, however. This could mean that Speaker P1 has a retroflex pronunciation of *sl*-clusters. Speaker P2's average F3 values were lowest for the retroflex /ɭ/, as expected.

speaker	sound	F2	F3
P1	Vɭ	1484	2655
	Vl	1539	2790
	#l	1467	2688
	#sl	1463	2601
P2	Vɭ	1527	2701
	Vl	1460	2771
	#l	1495	2746
	#sl	1573	2724

Table 3.1: Average values (in Hz) of F2 and F3 for postvocalic /ɭ/, postvocalic /l/, word-initial /l/, and /l/ in a word-initial *sl*-cluster for Speakers P1 and P2.

Despite generally having a lower average F3 in the results, retroflex /ɭ/ may not be *statistically* distinct from the plain lateral, and this would indicate that a merger has occurred. The postvocalic retroflex /ɭ/ was compared separately to any of the three historically non-retroflex groups to see if a merger had happened in each of these contexts. The MANOVA results are given in Table 3.2. Results showed that for both speakers, /ɭ/ had merged with /l/ in all three contexts. The case nearest to statistical significance was /ɭ/ and postvocalic /l/ for Speaker 1 ($p = 0.0615$). In this case, since the p-value was so close to significance, it cannot be definitively concluded that the speaker has the merger without more data.[2]

[2] All MANOVA, ANOVA, and t-tests used throughout this study were conducted under the same null hypothesis, which states that the sounds are not statistically different—or that the sounds are merged in the speech of the speaker. For results with p-values less than 0.05, the data gave sufficient evidence to definitively reject the null hypothesis and conclude that the sounds were distinct and that there was clearly no merger. For p-values between 0.05 and 0.10, the results were too close to significance to definitively accept or reject

Speaker	comparison	MANOVA	p-value	merger?
P1	Vɭ v. Vl	$F(2,28) = 3.08$	0.0615	?
	Vɭ v. #l	$F(2,20) = 0.25$	0.7814	✓
	Vɭ v. #sl	$F(2,20) = 0.39$	0.6800	✓
P2	Vɭ v. Vl	$F(2,30) = 1.42$	0.2565	✓
	Vɭ v. #l	$F(2,22) = 0.66$	0.5275	✓
	Vɭ v. #sl	$F(2,22) = 0.25$	0.7797	✓

Table 3.2: MANOVA results for testing for /ɭ/ – /l/ merger for Speakers P1 and P2.

3.2 Follow-up experiment results

In the follow-up experiment, the postvocalic /ɭ/ derived by the retroflex rule across morpheme boundaries was compared to postvocalic /l/, word-initial /l/, and /l/ in a word-initial *sl*-cluster. While Jahr (1981) maintains that /ɭ/ has merged with /l/ both word-initially and in postvocalic positions in back vowel contexts and in for speakers in front vowel contexts as well, Endresen (1991) argues that the merger has happened everywhere except for after non-high, back vowels. To look more closely at the claims made about the contexts of this merger, laterals in this study were also compared separately by vowel context, to see if the merger has happened in back vowel contexts (before or after /ɑ, u/) or in non-back vowel contexts (before or after /i, y, ʉ/). In addition to the formants of the lateral itself, the formant transitions in the preceding vowels were measured as well (only in postvocalic contexts). F2 transitions were calculated by subtracting the F2 value at the end of the vowel from the F2 value in the middle of the vowel, and F3 transitions were calculated analogously, so that a positive transition indicated raising of the formant into the following consonant and a negative transition indicates lowering.

All tokens of retroflex /ɭ/ for the follow-up experiment were derived across morpheme boundaries by the retroflex rule (see §1.3). However, in some cases the speakers did not pronounce a retroflex lateral but instead articulated the alveolar tap and lateral separately

the null hypothesis. Thus, we concluded that there was possibly no merger, and that more data was needed to clarify. For p-values above 0.10, we must assume the null hypothesis to be true and conclude that the sounds are statistically indistinguishable, or that the two sounds have merged, based on the acoustic properties measured. The table below shows the criteria used for interpreting p-values.

p-value	accept H_0?	merger?	denotation
$p < 0.05$	reject	no	–
$0.05 \leq p < 0.10$	marginal	possibly	?
$p \geq 0.10$	accept	yes	✓

([ɾl]).[3] If the alveolar tap was pronounced, the retroflex rule clearly did not apply (since it involves coalescence), and the token was thrown out. For some speakers, this happened more often than was expected, and it may have been due to the fact that their speech was elicited from wordlists and therefore wasn't as casual or rapid as natural speech might be. Despite several requests that he speak more naturally, Speaker 7 gave the impression of making efforts to enunciate clearly, and all but 4 of his retroflex laterals had to be dropped. For this reason, Speaker 7's data could not be used for the /ɭ/ – /l/ merger.

The data is summarized for each speaker in Tables 3.3–3.7. Listed are average F2

speaker	sound	F2	F3	ΔF2	ΔF3
	iɭ	1549	2349	−393	−162
1	il	1578	2458	−236	−110
	#li	1585	2429		
	iɭ	1823	2837	−95	−192
2	il	1754	2779	−104	−109
	#li	1938	2873		
	iɭ	1498	2211	−25	−166
3	il	1512	2555	−142	−40
	#li	1576	2524		
	iɭ	1861	2744	−271	−175
4	il	1816	2776	−181	−220
	#li	1878	2837		
	iɭ	1304	2564	−263	27
5	il	1212	2628	−354	63
	#li	1483	2689		
	iɭ	1622	2686	−244	−35
6	il	1603	2672	−241	−51
	#li	1767	2689		
	iɭ	1526	2462	−155	−106
8	il	1562	2739	−142	−91
	#li	1766	2671		

Table 3.3: Average values (in Hz) of F2, F3, F2 transitions (ΔF2) and F3 transitions (ΔF3) for pronunciations of postvocalic /ɭ/, postvocalic /l/, and word-initial /l/, all in non-back vowel contexts (/i, y, ʉ/) for Speakers 1–6 and 8.

and F3 measurements for the lateral itself, in addition to F2 and F3 transition (ΔF2, ΔF3) measurements on the preceding vowel in postvocalic contexts. Table 3.3 shows averages

[3] According to Bradley (2002), the retroflex rule is obligatory across morpheme boundaries in Standard Østlandsk. Results from our speakers cause us to question this assumption. While it is possible that the rule wouldn't apply without exception in unnaturally slow or careful speech, at least some of the speakers did not seem to have a problem with speaking naturally, and all of the speakers used [ɾl] instead of [ɭ] at least a few times.

for tokens from non-back vowel contexts ("i" is used here to represent the non-back vowels /i, y, ʉ/). For all speakers except for Speaker 2 and Speaker 6, the average F3 for the retroflex lateral is lower than that of the plain lateral in both postvocalic and word-initial contexts, as we would expect. For Speaker 2, while the average F3 of the plain postvocalic lateral was slightly lower than F3 for the retroflex, ΔF3 showed much more lowering of F3 before the retroflex than before the plain lateral. For Speaker 6, F3 was essentially the same for postvocalic /ɭ/, postvocalic /l/, and word-initial /l/, with a variation of only 14 Hz. As in the pilot experiment, MANOVA tests were run individually by speaker to see if the group means were statistically the same or not. Shown in Table 3.4 are MANOVA results for non-back vowel contexts.[4] As can be seen in the MANOVA results shown in 3.4, nearly all

speaker	comparison	MANOVA	*p*-value	merger?
1	iɭ v. il	$F(4,15) = 1.46$	0.2626	✓
	iɭ v. #li	$F(2,17) = 2.60$	0.1036	✓
2	iɭ v. il	$F(4,17) = 0.42$	0.7922	✓
	iɭ v. #li	$F(2,19) = 1.66$	0.2163	✓
3	iɭ v. il	$F(4,15) = 5.72$	0.0053	–
	iɭ v. #li	$F(2,18) = 3.20$	0.0646	?
4	iɭ v. il	$F(4,13) = 1.12$	0.3892	✓
	iɭ v. #li	$F(2,15) = 2.01$	0.1689	✓
5	iɭ v. il	$F(4,11) = 1.06$	0.4207	✓
	iɭ v. #li	$F(2,15) = 9.27$	0.0024	–
6	iɭ v. il	$F(4,18) = 0.12$	0.9736	✓
	iɭ v. #li	$F(2,20) = 4.23$	0.0294	–
8	iɭ v. il	$F(4,14) = 2.16$	0.1275	✓
	iɭ v. #li	$F(2,15) = 11.40$	0.0010	–

Table 3.4: Results of per-speaker MANOVA for data in Table 3.3, testing for merger in pronunciations of /ɭ/ after non-back vowels with /l/ after non-back vowels and word-initial /l/ before non-back vowels.

speakers merged /ɭ/ and /l/ postvocalically in non-back vowel contexts. The only speaker who did not have the merger after non-back vowels was Speaker 3 ($p = 0.0053$). We also see fewer speakers merging word-initially than postvocalically. Speakers 5, 6, and 8 did not have a merger word-initially ($p = 0.0024$, $p = 0.0294$ and $p = 0.0010$, respectively), and Speaker 3 also had possibly no merger word-initially ($p = 0.0646$).

Table 3.5 shows averages for tokens in back vowel contexts ("u" is used here to represent the back vowels /u, ɑ/). The data shows that for Speakers 1, 2, 3, and 5, average

[4] Following the MANOVAs with significant results, dependent variables were also tested individually to look for significant effects for each separate measurement. Results from post-hoc ANOVAsthe results were inconsistent and showed no general pattern across speakers.

F3 and ΔF3 values were lowest for the retroflex lateral, as expected. For Speakers 4, 6, and 8, the retroflex did not have the lowest internal F3 but did have the lowest ΔF3. Shown in

speaker	sound	F2	F3	ΔF2	ΔF3
	uɭ	1272	2239	228	−115
1	ul	1091	2332	114	0.53
	#lu	1279	2361		
	uɭ	1544	2586	263	−140
2	ul	1459	2714	160	23
	#lu	1673	2707		
	uɭ	1386	2170	196	−296
3	ul	1034	2414	66	3.5
	#lu	1299	2465		
	uɭ	1805	2761	565	−66
4	ul	1378	2592	213	45
	#lu	1654	2689		
	uɭ	1213	2497	116	−48
5	ul	1048	2652	150	45
	#lu	1059	2681		
	uɭ	1335	2555	164	−9.7
6	ul	1208	2515	201	127
	#lu	1407	2835		
	uɭ	1346	2624	208	−75
8	ul	1184	2356	86	-67
	#lu	1453	2619		

Table 3.5: Average values (in Hz) of F2, F3, F2 transitions (ΔF2) and F3 transitions (ΔF3) for pronunciations of postvocalic /ɭ/, postvocalic /l/, and word-initial /l/, all in back vowel contexts (/u, ɑ/) for Speakers 1–6 and 8.

Table 3.6 are MANOVA results for back vowel contexts. Compared to front vowel contexts, there was less merging in back vowel contexts, especially word-initially. Speakers 1 and 8 had the merger both word-initially and postvocalically in back vowel contexts. Speaker 2 also had the merger postvocalically after back vowels and a questionable merger word-initially. Speakers 5 and 6 also had a questionable merger postvocalically after back vowels. All other speakers and contexts showed no merger.

Table 3.7 shows averages for /ɭ/ and the lateral in an *sl*-cluster for all vowel contexts. For comparison between the retroflex /ɭ/ and the lateral in an *sl*-cluster , separate comparisons for different vowel contexts were not made, since none of the literature suggested that this *sl*-lateral was pronounced differently based on vowel context. In Table 3.8 are MANOVA results by speaker. As the MANOVA results show, retroflex /ɭ/ is pronounced the same as the lateral in *sl*-clusters for all speakers except for Speaker 4 ($p = 0.0175$).

speaker	vowel context	MANOVA	p-value	merger?
1	uɭ v. ul	$F(4,11) = 0.85$	0.5235	✓
	uɭ v. #lu	$F(2,13) = 1.04$	0.3817	✓
2	uɭ v. ul	$F(4,11) = 1.57$	0.2489	✓
	uɭ v. #lu	$F(2,13) = 2.77$	0.0992	?
3	uɭ v. ul	$F(4,11) = 18.97$	0.0001	–
	uɭ v. #lu	$F(2,13) = 5.69$	0.0168	–
4	uɭ v. ul	$F(4,11) = 6.13$	0.0076	–
	uɭ v. #lu	$F(2,13) = 5.57$	0.0179	–
5	uɭ v. ul	$F(4,13) = 2.84$	0.0678	?
	uɭ v. #lu	$F(2,13) = 4.67$	0.0297	–
6	uɭ v. ul	$F(4,11) = 3.21$	0.0563	?
	uɭ v. #lu	$F(2,13) = 4.08$	0.0420	–
8	uɭ v. ul	$F(4,7) = 2.31$	0.1571	✓
	uɭ v. #lu	$F(2,10) = 0.83$	0.4646	✓

Table 3.6: Results of per-speaker MANOVA for data in Table 3.5, testing for merger in pronunciations of /ɭ/ after back vowels with /l/ after back vowels and word-initial /l/ before back vowels.

speaker	sound	F2	F3
1	Vɭ	1410	2294
	#sl	1376	2306
2	Vɭ	1699	2725
	#sl	1781	2707
3	Vɭ	1445	2192
	#sl	1415	2256
4	Vɭ	1829	2754
	#sl	1636	2673
5	Vɭ	1255	2528
	#sl	1320	2435
6	Vɭ	1501	2631
	#sl	1560	2624
8	Vɭ	1451	2529
	#sl	1459	2477

Table 3.7: Average values (in Hz) of F2 and F3 for pronunciations of postvocalic /ɭ/ and/l/ in a word-initial *sl*-cluster in all vowel contexts for Speakers 1–6 and 8.

speaker	MANOVA	p-value	merger?
1	$F(2,23) = 0.22$	0.8073	✓
2	$F(2,24) = 1.46$	0.2514	✓
3	$F(2,24) = 0.49$	0.6187	✓
4	$F(2,21) = 4.94$	0.0175	–
5	$F(2,21) = 1.18$	0.3266	✓
6	$F(2,26) = 0.35$	0.7067	✓
8	$F(2,19) = 0.12$	0.8891	✓

Table 3.8: Results of per-speaker MANOVA for data in Table 4.4, testing for merger in pronunciations of postvocalic /ɭ/ and /l/ in word-initial *sl*-cluster.

3.3 Discussion

Results of this study have shown a large amount of interspeaker variation in the pronunciation of /ɭ/ and /l/, revealing the /ɭ/ – /l/ merger to be in transitional stages in Trøndersk. Speaker 1, for example, has a completed merger in all vowel contexts, both word-initially and postvocalically, while for the other speakers, complete neutralization has only happened in some contexts.[5] The fact that neutralization is happening at all calls into question Vanvik's (1966), Dahl's (1981), and Endresen's (1991) analyses of Trøndersk in which they show no merger.

Results also reveal other interesting trends. In general, more speakers merged in postvocalic contexts than in word-initial contexts, and more speakers merged in non-back vowel contexts than in back vowel contexts. Word-initally, only three speakers (i.e., 43%) had the merger in back vowel contexts, and four speakers (57%) merged in non-back vowel contexts. Postvocalically, five speakers (71%) had the merger after back vowels, and six speakers (86%) had the merger after non-back vowels (11).

(11)

	−bk	+bk
V__	86%	71%
#__V	57%	43%

The table in (11) clearly displays some interesting trends, from which we can make a few generalizations regarding the merger. Since all contexts are being affected, we see a general pressure to merge the two laterals. This is expected because of the perceptual

[5] Since the follow-up experiment provided more informative data regarding vowel contexts of the merger, we will focus our discussion on these results.

closeness of these two sounds. Languages prefer sounds to be perceptually distinct, and if they are not distinct enough, there would be pressure to merge them (or make more perceptually distinct).

Furthermore, the fact that /ɭ/ and /l/ were merged by more speakers in non-back vowel contexts than in back vowel contexts is unsurprising. Recall from §1.3.3 that retroflex consonants require retraction of the tongue body, so they are difficult to pronounce in non-back vowel contexts. The pronunciation of the plain /l/, on the other hand, doesn't require any particular position for the tongue body, so it is articulatorily compatible with both back and non-back vowels. This means that the contrast between the two laterals is more likely to be reduced in non-back vowel contexts due to the articulatory difficulty such contexts create for the retroflex lateral. This results in additional pressure to merge in these contexts, beyond the general acoustic pressure.

Finally, we see postvocalic contexts showing more merger of /ɭ/ and /l/ than word-initial contexts, a fact that is also easy to account for. Certain phonological positions are well-known to be "psycholinguistically prioritised or perceptually prominent" (Beckman 1997:xx). These privileged positions, which include word-initial positions, frequently maintain underlying contrasts on the surface and therefore resist merger (Beckman 1995, 1997, 1998).

It is difficult to determine from the results of this study what exactly the merged pronunciation is. Because we saw an additional pressure to merge in non-back vowel contexts due to articulatory difficulty of retroflexes in such contexts, we must assume that the merged pronunciation—at least in non-back vowel contexts—is less retroflex than the underlying retroflex. Perhaps a less retroflex pronunciation means an alveolar place of articulation instead of post-alveolar or apical tongue contact instead of subapical, or laminal tongue contact instead of apical. It may vary from speaker to speaker. It is also important to keep in mind that the merged pronunciation may vary depending on the context. For example, Vogt (1939) observed that the two sounds were merging to a laminal articulation after front vowels and to a retroflex articulation after back vowels. This may well still be the case, but it is important that articulatory, not acoustic, research be done to determine the merged pronunciation.

In addition, future research should study the behavior of the merger in more specific vowel contexts. Instead of dividing between back and non-back vowel contexts (based on the articulatory difficulty of retroflexion that coincides with non-back vowels /i, y, ʉ/), it may be more helpful to look at each vowel context individually instead of grouped. This could potentially avoid overlooking other patterns in the vowel contexts of the merger. For example, some of the literature has suggested that the merger is happening after back vowels excluding /ɑ/ (Papazian 1977), or that it is happening everywhere except in front high vowel contexts (Jahr 1981), and these claims, which were made based on the writers' own articulations and/or on their impressionistic perception of the articulation of others, should be rigorously tested.

Finally, while this study did not go outside the scope of the Trøndersk dialect, it is important that future research use acoustic or articulatory analysis to study this merger in Standard Østlandsk, due to the unusually large amount of conflicting literature on the subject. For example, while one source might show the merger to be happening after back vowels (Vogt 1939), the next source might maintain that the only place it *is not* happening is after back vowels (Endresen 1991). It is difficult to know which sources are most accurate, since no previous studies that I know of have analyzed this merger using acoustic tools. Further research could clarify some of the disagreements in the literature.

Chapter 4
The /ʂ/ – /ʃ/ merger

The merger of post-alveolar /ʃ/ (orthographically, *sj*, *skj*, and *sk*) with retroflex /ʂ/ (orthographically, *rs*) is recognized in some of the literature as being a completed merger, while other researchers still show the sounds to be two separate phonemes (see §1.5.2 for more details and sources). Christiansen (1976) finds a merger in some East Norwegian dialects but does not specify whether this includes Trøndersk. Sivertsen (1967) writes that younger speakers are more likely to have the merger. Vanvik (1966) implies a completed merger in Trøndersk by transcribing both sounds as [ʃ], though he doesn't specifically mention it. The majority of researchers (though not all) transcribe the merged pronunciation as [ʂ]. Data in (12) show the merger.

(12)	*skip*	/ʃiːp/	[ʂiːp]	'ocean'
	hesje	/hɛʃə/	[hɛʂə]	'to harvest'
	Lars	/lɑːʂ/	[lɑːʂ]	'Lars (name)'
	far sin	/fɑr sin/	[fɑːʂin]	'Dad's'

4.1 Pilot experiment results

In the pilot experiment, the center of gravity (CoG) of traditionally retroflex /ʂ/ was compared to that of /ʃ/. In addition, both /ʂ/ and /ʃ/ were compared separately to the first sound in an *sl*-cluster, since the literature does not agree on whether this is a post-alveolar or a retroflex sound.[1] See §2.1 and §2.3.5 for a more detailed description of experimental methods for the pilot experiment.

[1] Recall the phonological rule described in §1.3 in which /s/ is pronounced as [ʂ] (or [ʃ]) before the lateral. We would expect the sibilant and the lateral in an *sl*-cluster to be pronounced with the same place of articulation, either both apically or both laminally. Therefore, the pronunciation of the fricative in an *sl*-cluster may depend on whether or not the speaker has a completed /ɭ/ – /l/ merger, and if so, what the merged pronunciation is.

For each speaker, CoG measurements of /ʂ/, /ʃ/ and the *sl*-sibilant were tested using an analysis of variance (ANOVA) test to see if the means of the three groups were statistically different. Significant ANOVAs were followed up with Tukey-Kramer pairwise comparison tests to find out which of the three possible pairs of sounds were statistically different. As with the /ɭ/ – /l/ merger, the null hypothesis was that the mean CoG values are statistically the same, i.e., that /ʂ/ and /ʃ/ are merged.

Average CoG values (in Hertz) for Speakers P1 and P2 are shown in Table 4.1. As we would expect, the CoG for the retroflex fricative is lower than that of the post-alveolar. The mean CoG for the *sl*-cluster sibilant is somewhere in between that of /ʂ/ and /ʃ/ for Speaker P1 and very close to that of /ʂ/ for Speaker P2.

	context	example	P1 CoG	P2 CoG
ʂ	rs, r#s	*Lars*	2245	2029
ʃ?	sk, sj, skj	*skip*	3174	2998
?	sl	*slå*	2665	2099

Table 4.1: Average CoG values (in Hz) for pronunciations of /ʃ/, /ʂ/, and /sl/ for Speakers P1 and P2.

The ANOVA test showed significance for both speakers: for Speaker P1, $F(2,20) = 11.24, p = 0.0005$, and for Speaker P2, $F(2,21) = 12.62, p = 0.0003$. The Studentized range statistic q-values from the post-hoc Tukey-Kramer test are shown in Tables 4.2 and 4.3. The critical value of q is approximately 3.578 for Speaker P1 and 3.565 for Speaker P2.[2] Results show that for both speakers, /ʃ/ is statistically different from both /ʂ/ and the sibilant in an *sl*-cluster, while /ʂ/ and the *sl*-sibilant are statistically the same.

comparison	q	significant?	merger?
ʂ v. ʃ	6.6758	✓	–
ʂ v. sl	3.0222	–	✓
ʃ v. sl	3.7819	✓	–

Table 4.2: Studentized range statistic q for Speaker P1, testing for merger in pronunciations of ʂ, ʃ, and sl, with a critical value of 3.578.

[2] The critical value is based on 20 tokens for Speaker P1 and 21 tokens for Speaker P2, for 3 fricative groups, and a confidence interval of $\alpha = 0.05$.

comparison	q	significant?	merger?
ʂ v. ʃ	6.3695	✓	–
ʂ v. sl	0.4606	–	✓
ʃ v. sl	5.9088	✓	–

Table 4.3: Studentized range statistic q for Speaker P2, testing for merger in pronunciations of ʂ, ʃ, and sl, with a critical value of 3.565.

4.2 Follow-up experiment results

In the follow-up experiment, traditionally retroflex sounds (derived across morpheme boundaries by the retroflex rule) were compared to postvocalic post-alveolar sounds. In addition to CoG, spectral peak measurements of the fricatives were also taken in the follow-up experiment. The frequencies of the two lowest-frequency peaks (Pk1, Pk2) and the two highest-amplitude peaks (Hi, Hi2) were recorded. Some tokens were discarded due to distortions in the sound files; in particular, several tokens for Speakers 7 and 8 had to be discarded due to microphone problems.

The data is summarized by speaker in Table 4.4; all values are in Hertz. With the exception of Speakers 3 and 6, CoG measurements were lower for /ʂ/ than /ʃ/, though the difference between the two means varied from 13 Hz to 435 Hz. With the exception of Speaker 5, lowest-frequency peak measurements were on average higher for /ʂ/ than /ʃ/, the difference between the two means varying from 22 Hz to 145 Hz. Highest-intensity peaks of /ʂ/ were higher than /ʃ/ for Speakers 1, 5, and 6, and lower than /ʃ/ for Speakers 2, 3, 4, 7, and 8.

MANOVA tests were run individually by speaker to see if the mean measurements of /ʂ/ were statistically different from the means of /ʃ/. When measurements for each group of sounds were shown to be statistically the same, the null hypothesis was accepted, and it was concluded that the speaker had the /ʂ/ – /ʃ/ merger. Table 4.5 shows the MANOVA results for each speaker. None of the MANOVAs showed significance below the 5% level, showing that in general, there is a /ʂ/ – /ʃ/ merger in Trøndersk. For Speaker 4, however, the p-value was below 0.10, so we can neither definitively accept nor reject the null hypothesis. We can conclude that this speaker possibly has no merger and that more data is needed to make a definitive conclusion about whether this speaker has the merger.

speaker	sound	CoG	Pk1	Pk2	Hi	Hi2
1	Vʂ	3806	3023	5292	3698	5068
	Vʃ	4134	2945	5126	3639	5167
2	Vʂ	4387	3377	4915	3742	4984
	Vʃ	4400	3355	5076	3925	5311
3	Vʂ	3969	2336	4360	3778	4474
	Vʃ	3966	2191	4366	4039	3745
4	Vʂ	4610	3483	4916	3743	4946
	Vʃ	4904	3426	4698	4244	4995
5	Vʂ	3955	2507	4933	5478	3477
	Vʃ	4016	2551	4807	5175	3011
6	Vʂ	3910	2954	4887	2954	5495
	Vʃ	3785	2904	4540	2904	5410
7	Vʂ	3798	2793	3929	2934	3938
	Vʃ	3940	2727	3978	3377	3966
8	Vʂ	2201	2174	3961	2364	3974
	Vʃ	2636	2056	3874	2619	3684

Table 4.4: Average values (in Hz) of center of gravity (CoG), lowest and second-lowest frequency spectral peaks (Pk1, Pk2), and highest and second-highest intensity spectral peaks (Hi1, Hi2) for pronunciations of postvocalic /ʂ/ and /ʃ/ for Speakers 1–8.

speaker	MANOVA	p-value	merger?
1	$F(5,34) = 1.12$	0.3698	✓
2	$F(5,31) = .37$	0.8673	✓
3	$F(5,33) = .50$	0.7712	✓
4	$F(5,29) = 2.08$	0.0965	?
5	$F(5,29) = 2.01$	0.1069	✓
6	$F(4,33) = 0.88$	0.4847	✓
7	$F(5,26) = 0.81$	0.5530	✓
8	$F(5,24) = 0.50$	0.7713	✓

Table 4.5: Results of per-speaker MANOVA for data in Table 4.4, testing for merger in pronunciations of postvocalic /ʂ/ and /ʃ/.

4.3 Discussion

Results of the pilot experiment showed no merger of /ʂ/ and /ʃ/ in Speakers P1 and P2, and also showed the sibilant in an *sl*-cluster to have a retroflex [ʂ] pronunciation. Interestingly, the follow-up experiment yielded results opposite to what was found in the pilot experiment, with seven out of eight speakers clearly having a merger of /ʂ/ and /ʃ/, and Speaker 4 having a possible merger.

Because the methods differed to such a great extent between the two experiments, it is unclear whether these differing results are actually showing a merger in transition (i.e., some speakers have it; others do not) or if they are due to differing methods. In the pilot experiment, only CoG values were used for comparison, whereas in the follow-up experiment, four spectral peak measurements were included along with CoG. It is likely that some of the peak measurements used in the follow-up experiment were highly correlated,[3] which weakens the statistical efficiency of a MANOVA (Hair et al. 1998), possibly enough to produce nonsignificant results where there would have been significant results with fewer variables.

In addition, the follow-up experiment was more controlled than the pilot experiment. In the pilot experiment, not only were fewer tokens of /ʂ/ and /ʃ/ used, but tokens of /ʂ/ came from three different sources: underlying /ʂ/ within a single morpheme, /ʂ/ derived by the retroflex rule across morpheme boundaries, and /ʂ/ derived across word boundaries. In the follow-up experiment, however, only /ʂ/ sounds derived across morpheme boundaries were used. And in the follow-up experiment, all of the /ʃ/ tokens were postvocalic, whereas in the pilot experiment, a few word-initial tokens were included. The post-alveolar /ʃ/ is actually much more common word-initially, and it occurs postvocalically almost exclusively in loan words. If, for example, /ʂ/ and /ʃ/ have merged postvocalically but not word-initially (or vice versa), then the fact that word-initial tokens were included in the pilot but not in the follow-up experiment might account for the difference in results between the two experiments. A follow-up study could also expand here to compare the retroflex /ʂ/ to the post-alveolar /ʃ/ not only in postvocalic contexts but in word-initial contexts as well.

Some people have argued that the underlying retroflex phonemes in Norwegian are articulated differently than the derived ones. Simonsen et al. (19xx) and Moen et al. (19xx), who did not look at underlying retroflexes in their articulatory studies of Norwegian coronals but restricted their work to derived retroflexes, found a large degree of variation in the passive articulator and an articulation that was not always posterior. Bradley (2002) predicts

[3] In fact, for Speaker 6, Pk1 and Hi were exactly the same, such that one variable had to be eliminated completely for the MANOVA.

that these findings are specific to derived retroflexes, and that underlying retroflexes would be more posterior and would show less variation than derived ones. As far as I know, no studies have been done comparing the articulation of underlying retroflex phonemes to that of derived retroflexes in Norwegian. According to Bradley, the derived retroflexes result from a blending of the articulatory characteristics of apicoalveolar /r/ and the following alveolar laminal, and the variation in the contact area seen in the articulatory studies "reflects a gradient compromise between the lexically specified constriction locations of the adjacent tongue tip gestures" (2002:xx). If Bradley's speculation is true that nonderived retroflexes are more posterior than derived retroflexes in Norwegian, the fact that some underlying retroflexes were included in the pilot but none in the follow-up experiment could also account for the different results. In this case, the post-alveolar might be merged with the derived retroflex but not with the phonemic retroflex. However, further research is needed to determine the validity of this theory.

Most notably, however, both pilot speakers (P1 and P2) are from Malvik, as is the only speaker in the follow-up who did not have a clear merger (Speaker 4). When the other variables were eliminated for Speaker 4, and only the CoG was used to test for statistical difference, as had been done for Speakers P1 and P2, results were statistically significant, showing /s̺/ and /ʃ/ to be clearly different (i.e., unmerged) for Speaker 4 ($p < 0.0184$), just like for Speakers P1 and P2. The fact that all and only the three Malvik speakers patterned differently than the others points to an analysis of the merger varying across dialects of Trøndersk.

It is possible that none of the acoustic properties measured are sufficient to reliably detect the slight difference in articulation between a post-alveolar laminal fricative and a post-alveolar apical fricative. Recall in §1.5.2 that Lindblad (1980) argues that we can only differentiate between these two sounds articulatorily but cannot separate them auditorily or acoustically. Also recall in §2.3.4 that acoustic studies of these two sounds in Toda (Gordon et al. 2002) and Polish (Żygis & Hamann 2003) showed that they were not reliably distinguishable across all speakers. While Simonsen et al. (19xx) and Moen et al. (19xx) have done in-depth articulatory studies (using electropalatography and electromagnetic articulography) of the Norwegian stop and lateral consonants, they have not applied these techniques to the Norwegian sibilants. If the articulations of /s̺/ and /ʃ/ are indeed too similar to be distinguished acoustically, it would seem that the most appropriate path for testing for merger in articulation would be articulatory studies as opposed to acoustic ones.

The results of this study have shown that the dialect of Trøndersk has the /s̺/ – /ʃ/ merger, according to the acoustic properties measured, but not necessarily across all regional dialects or all speakers. More research needs to be done to find out which acoustic measurements are most accurate in differentiating among acoustically similar sibilants. Without knowledge of such measurements, articulatory methods might be more appropriate for testing for this merger. In addition, since the Malvik Trøndersk speakers appeared to be patterning differently from the other speakers, more data should be collected from Malvik speakers to see if they do consistently avoid the merger of /ʂ/ – /ʃ/ seen in the other Trøndersk dialects.

Chapter 5
The /ʃ/ – /ç/ merger

The /ʃ/ – /ç/ merger[1] was first noticed in 1964 among youth in Bergen (Sandøy 2002) and is still considered to be restricted to younger speakers. The merger has appeared in all of the large cities in the southern half of Norway, which includes Trondheim (e.g., Skjekkeland 2005, Kristoffersen 2000). Examples of the merger are shown in (13). See §1.5.3 for more details on the /ʃ/ – /ç/ merger. This merger was not a part of the pilot experiment and was only examined in the follow-up experiment.

(13)	*kyssen*	/çʏsːn̩/	[ʃʏsːn̩]	'kiss'
	skyssen	/ʃʏsːn̩/	[ʃʏsːn̩]	'ride'
	kjære	/çæɾə/	[ʃæɾə]	'dear'
	skjære	/ʃæɾə/	[ʃæɾə]	'to cut'

5.1 Results

For each token of /ʃ/ and /ç/, the center of gravity (CoG) was measured in addition to the frequencies of the two lowest-frequency peaks (Pk1, Pk2) and the two highest-intensity peaks (Hi, Hi2). Some tokens were discarded due to distortions in the sound files. (See §2.2 and §2.3.6 for more details on experimental methods.) The data for Speakers 1–8 is summarized in Table 5.1. The mean CoG of /ʃ/ was higher than that of /ç/ for Speakers 1, 3, 4, 5, and 8, and lower than /ç/ for Speakers 2, 6, and 7. The mean lowest-frequency peak of /ʃ/ was lower than that of /ç/ for all speakers; the difference between the two means ranged from to 243 Hz to 1345 Hz. The mean highest-amplitude peak for /ʃ/ was lower than that of /ç/ for all speakers except Speakers 3 and 5, for whom it was much higher.

[1] This could also be referred to as the /ʂ/ – /ç/ merger, if we assume a completed /ʂ/ – /ʃ/ merger with a merged pronunciation of /ʂ/.

speaker	sound	CoG	Pk1	Pk2	Hi	Hi2
1	#ʃ	4039	2882	5196	3367	5445
	#ç	3770	3204	5504	3583	5862
2	#ʃ	4322	3374	5090	3483	5679
	#ç	4572	3617	4849	4467	4736
3	#ʃ	4123	2185	4463	4522	3219
	#ç	3115	2745	4461	2869	4337
4	#ʃ	4914	3447	4732	4427	4488
	#ç	4813	3706	4819	4734	4653
5	#ʃ	3762	2568	4962	5147	3966
	#ç	3748	2954	4323	2954	5278
6	#ʃ	3703	2891	4452	2891	5362
	#ç	4260	3286	4445	3784	4065
7	#ʃ	3776	2716	3919	2716	3992
	#ç	4884	3695	5058	4367	5470
8	#ʃ	2350	2261	4453	2311	4732
	#ç	2281	3606	8032	3606	8032

Table 5.1: Average values (in Hz) of center of gravity (CoG), lowest and second-lowest frequency spectral peaks (Pk1, Pk2), and highest and second-highest intensity spectral peaks (Hi1, Hi2) for pronunciations of word-initial /ʃ/ and /ç/ for Speakers 1–8.

MANOVA tests were run individually by speaker to see if the two sound groups were statistically the same or not. The null hypothesis was that there was no statistical difference in means. MANOVA results for each speaker are shown in Table 5.2. Results showed the means of /ʃ/ and /ç/ to be statistically different for all speakers except Speaker 4. For half of the speakers, the significance level was less than 0.0001.

speaker	MANOVA	p-value	merger?
1	$F(5,32) = 3.88$	0.0073	–
2	$F(5,32) = 5.53$	0.0009	–
3	$F(5,31) = 23.19$	< 0.0001	–
4	$F(5,31) = 2.01$	0.1053	✓
5	$F(5,28) = 22.22$	< 0.0001	–
6	$F(5,31) = 7.50$	0.0001	–
7	$F(5,32) = 97.69$	< 0.0001	–
8	$F(5,29) = 24.23$	< 0.0001	–

Table 5.2: Results of per-speaker MANOVA for data in Table 5.1, testing for merger in pronunciations of word-initial /ʃ/ and /ç/.

5.2 Discussion

The results of this experiment show that only one of the eight Trøndersk speakers has the /ʃ/ – /ç/ merger, indicating that this merger is perhaps just starting to take root in the Trøndersk dialect. Since MANOVA results for Speaker 4 did not show statistical significance ($p < 0.1053$), we can conclude that this speaker does not reliably pronounce /ʃ/ and /ç/ differently. Recall that Speaker 4 is from Malvik, an area east of the city of Trondheim. If indeed this speaker does have the /ʃ/ – /ç/ merger, it may indicate that the merger has started spreading outwards from Trondheim, where its presence has been attested (Dalbakken 1997). Since the merger has until now been identified as a large city phenomenon (e.g. Skjekkeland 2005), this could be evidence that this designation needs to be changed.

Another consideration to keep in mind when interpreting the results is that of the three mergers in this study, the /ʃ/ – /ç/ merger is the only one that most non-linguist Norwegians are consciously aware of, and, not surprisingly, disapprove of. Papazian points to an article published in 1992 in the Oslo newspaper *Aftenposten* entitled "En skilo skjøttdeig?" ('a kilogram of ground beef'), which mimics people's incorrect pronunciation of /ç/ (the correct spelling would be *en kilo kjøttdeig*). Pronouncing /ç/ as [ʃ] is considered a speech error and is usually attributed to laziness (see §1.5.3 for more discussion). It is possible that speakers who did not show a merger in the artificial setting of the recording session might have a merger in casual conversation. Since the speakers were obviously aware that they were being recorded as they read the wordlists and that their speech was going to be analyzed in a linguistic study, they may have been more careful in their pronunciation of /ç/ than they would normally be, in order to avoid the stigmatized [ʃ] pronunciation.

Another interesting result of this study was the variability in the pronunciation of /ç/. Recall from §2.3.6 that because the sublingual cavity present in [ʃ] increases the size of the anterior cavity, [ʃ] has a predictably lower frequency than the palatal [ç]. However, as seen in the CoG values in Table 5.1, this was not the case for all speakers in this study. Not only was the average CoG of /ç/ often lower than that of /ʃ/, CoG also had a much greater degree of variation for /ç/ than /ʃ/. For example, Speaker 5's individual CoG values ranged from 1073 to 4575 Hz for /ç/ (a range of over 3500 Hz!), but only from 3071 to 4572 Hz for /ʃ/ (a range of only about 1500 Hz). Moreover, this variability is not due to vowel context, with front, back, low, and high vowel contexts all showing a similar degree of variation. This lower CoG seems to reflect a backer pronunciation, perhaps a velar one. Indeed, these differences in acoustics are clearly audible; those tokens of /ç/ that have unusually low CoG frequencies do not sound like palatal fricatives at all, but impressionistically sound much more like velar fricatives. This pronunciation may be a result of the articulatory difficulty of the palatal fricative (similar to the [ʃ] pronunciation). It could also just be an attempt to better distinguish the palatal fricative from the relatively similar post-alveolar. However, this alternative back pronunciation of /ç/ is not accounted for anywhere in the literature, though a *fronted* allophone of [ç] has been attested. Recall from §1.5.3 that the pronunciation of /ç/ as an alveolo-palatal [ɕ] has been growing more and more common in the past few decades. But to my knowledge, no one has yet documented a backer allophone of /ç/. The fact that it does not seem to have any predictable coarticulatory causes is also unusual. It would seem strange that this would not have been noticed previously in the many studies of Standard Østlandsk, so perhaps this is a trait specific to the Trøndersk dialect. Clearly, more research is needed.

Finally, results for the /ʃ/ – /ç/ merger show speakers from the Malvik municipality to be once again patterning differently from other Trøndersk speakers. As discussed in Chapter 4, the Malvik dialect appears to be exceptional for Trøndersk in not having the /s̺/ – /ʃ/ merger. If this is true, and if Malvik speakers do indeed have the /ʃ/ – /ç/ merger (as Speaker 4's results here indicate), we may be seeing two ways of resolving the perceptual crowding of a three-way fricative contrast between /s̺/, /ʃ/, and /ç/. According to Żygis (2003:xx), acoustics and perception play an important role in the determination of sibilant systems: "the improvement of perceptual contrast essentially contributes to creating new sibilant inventories by i) changing the place of articulation of the existing phonemes ii) merging sibilants that are perceptually very close or iii) deleting them." In Norwegian, there is acoustic pressure to reduce the three-way contrast to a two-way contrast by merging two of the fricatives, and while most Trøndersk speakers seem to be merging the two fronter fricatives (/s̺/ and /ʃ/) and keeping them distinct from the palatal /ç/, Malvik Trøndersk speakers seem to be merging the two backer fricatives (/ʃ/ and /ç/) and keeping them distinct from the retroflex /s̺/. However, no data for the /ʃ/ – /ç/ merger was collected from the other Malvik speakers (P1 and P2), so more data is needed to verify this theory.

5.3 Excursus on variables used for fricative analysis

As discussed in §2.3.4, researchers have so far been unable to find a single acoustic measurement that can classify fricative place of articulation consistently and accurately. While CoG is by far the most common measurement used in acoustic analysis of fricatives, some studies have shown that it cannot reliably distinguish acoustically similar fricatives (e.g., Żygis & Hamann 2003). Since I found no data on the acoustic differences between Norwegian fricatives /s̺/, /ʃ/, and /ç/, I took four spectral peak measurements in addition to CoG and used MANOVAs to compare the fricatives based on the five measurements combined.

However, since MANOVAs do not show significant effects for each individual dependent variable, follow-up tests were needed after significant MANOVAs to determine which of the five measurements were most crucial for distinguishing the sounds. For speakers whose results showed omnibus multivariate effects, post-hoc univariate ANOVAs were run with each dependent variable individually to look for significant effects on separate measurements. Results of these analyses of individual variables can be found in Table 5.3.

As can be seen in Table 5.3, there was no measurement that was consistently significant for all speakers. For Speaker 1, the only variable that showed significant between-subject effects was the lowest-frequency peak (Pk1). For Speaker 2, both the highest-amplitude peak (Hi) and the second highest-amplitude peak (Hi2) were significant; the former was the most significant by far. Post-hoc ANOVAs for Speaker 3's data showed main effects for all the dependent variables except for the second lowest-frequency peak (Pk2). Most significant was the center of gravity (CoG) and the lowest-frequency peak (Pk1). For Speaker 5, all measurements except for CoG showed significant effects, with highest-amplitude peak (Hi) the most significant. All measurements for Speaker 6 except second-lowest frequency peak (Pk2) were significant, with highest-amplitude peak (Hi) having the largest effect. Follow-up ANOVAs for Speaker 7 showed highly significant effects for every dependent variable. For Speaker 8, CoG measurements had no effect, but all of the spectral peak measurements had highly significant effects, with Pk1 and Hi the highest.

Table 5.4 summarizes significant results on dependent variables individually by speaker. Surprisingly, CoG was shown to be one of the least informative measurements in differentiating between /ʃ/ and /ç/. Even in cases that had highly significant MANOVA results (e.g., Speaker 7; $p < 0.0001$), CoG was not a reliable distinguishing property,[2] which contradicts much of the literature. Conversely, the lowest-frequency peak (Pk1) and two highest-amplitude peaks (Hi, Hi2) were much more consistent, each showing significant effects for all but one speaker. In every case, however, the highest peak had a much larger effect than the second highest peak. It would seem, then, that at least for acoustically distinguishing between the palatal and the post-alveolar fricative in Norwegian, the first (or lowest-frequency) peak (Pk1) and the largest (or highest-amplitude) peak (Hi) are the most important measurements.

It is important to note that the distinguishing properties are not consistent from speaker to speaker. Whereas Pk1 was the only significant variable for Speaker 1, Hi and Hi2 were the only significant variables for Speaker 2. Ideally, we would be able to find one or two measurements that could reliably differentiate among all phonemic fricatives across all

[2] The fact that CoG was not a valuable acoustic cue for differentiating the palatal fricative from the post-alveolar might be explained by the variation in articulation of /ç/ discussed in palataldiscuss.

speaker	variable	F	p-value	significant?
1	CoG	1.82	0.1855	–
	Pk1	4.90	0.0333	✓
	Pk2	0.63	0.4334	–
	Hi	0.36	0.5500	–
	Hi2	0.61	0.4390	–
2	CoG	1.29	0.2643	–
	Pk1	1.32	0.2581	–
	Pk2	0.72	0.4008	–
	Hi	19.33	0.0001	✓
	Hi2	4.96	0.0323	✓
3	CoG	36.90	<0.0001	✓
	Pk1	47.11	<0.0001	✓
	Pk2	0.00	0.9961	–
	Hi	17.67	0.0002	✓
	Hi2	8.37	0.0065	✓
5	CoG	0.00	0.9542	–
	Pk1	6.63	0.0147	✓
	Pk2	4.34	0.0451	✓
	Hi	103.83	<0.0001	✓
	Hi2	5.73	0.0226	✓
6	CoG	5.92	0.0202	✓
	Pk1	6.83	0.0131	✓
	Pk2	0.00	0.9849	–
	Hi	17.84	0.0002	✓
	Hi2	12.41	0.0012	✓
7	CoG	198.47	<0.0001	✓
	Pk1	79.41	<0.0001	✓
	Pk2	37.67	<0.0001	✓
	Hi	64.86	<0.0001	✓
	Hi2	84.79	<0.0001	✓
8	CoG	0.08	0.7810	–
	Pk1	101.57	<0.0001	✓
	Pk2	18.93	0.0001	✓
	Hi	82.39	<0.0001	✓
	Hi2	15.69	0.0003	✓

Table 5.3: Results of post-hoc univariate ANOVAs for the /ʃ/ – /ç/ merger by variable for Speakers 1–3 and 5–8.

	1	2	3	5	6	7	8
CoG	–	–	✓	–	✓	✓	
Pk1	✓	–	✓	✓	✓	✓	✓
Pk2	–	–	–	✓	–	✓	✓
Hi	–	✓	✓	✓	✓	✓	✓
Hi2	–	✓	✓	✓	✓	✓	✓

Table 5.4: Statistically significant results of post-hoc univariate ANOVAs on dependent variables individually, for Speakers 1–3 and 5–8.

speakers. From this study, it seems that both lowest-frequency peak and highest-amplitude peak should be used in conjunction, but whether this applies for other fricative contrasts needs to be examined in future research.

Chapter 6
Conclusion

Results of this acoustic study show the /ɭ/ – /l/ merger to be in transition in Trøndersk, the /ʂ̹/ – /ʃ/ merger to be present in almost all speakers, and the /ʃ/ – /ç/ merger to be present in almost no speakers.

The /ɭ/ – /l/ merger was found to be present to varying degrees in all speakers. Whereas Speaker 1 has a completed merger in all vowel contexts, both word-initially and postvocalically, the other speakers had complete neutralization only in some contexts. The fact that the merger is found in all contexts—postvocalically after back non-back vowels, postvocalically after back vowels, word-initially before back vowels, and word-initially before non-back vowels—reflects a general acoustic pressure to merge. However, trends indicate that additional pressure to merge is applied in non-back vowel contexts, which we can infer is due to the articulatory difficulty of retroflexion in such contexts. Moreover, we see a tendency for word-initial contexts to resist the merger. The existence of the merger in Trøndersk contradicts previous studies of the dialect (e.g., Vanvik 1966, Dahl 1976), and it is possible that this merger has only recently appeared in the dialect.

While results for the /ʂ̹/ – /ʃ/ merger from the follow-up experiment indicate a completed merger, the fact that the follow-up experiment yielded results opposite to those of the pilot suggests a need for further research. In order to clarify whether or not the opposite results were based on methodological differences, another follow-up experiment should be undertaken that uses the methods of the second experiment with the speakers of the pilot experiment (P1 and P2). Alternatively, there is the possibility that the three Malvik speakers are showing a dialectal difference regarding this specific merger.

As for the /ʃ/ – /ç/ merger, that one Malvik speaker is found to have this merger may mean that it has started to spread outwards from the city of Trondheim, where its existence has been attested (Dalbakken 1997). This would mean that it can no longer be classified as a large city phenomenon as it has been until now (e.g., Kristoffersen 2000, Skjekkeland 2005). The results of this study also show that for comparison of these two phonemes, CoG is not a sufficient measurement. Rather, highest-intensity or first peak frequencies are more useful and accurate, and both should be used in conjunction for best results. Since CoG is by far the most standard measurement used in fricative analyses, the results of this study show that it should be seriously reconsidered. I would highly advise against using solely CoG in a study of two acoustically similar fricatives.

Future research on Trøndersk can improve upon this study by looking at a more widespread collection of speakers. While the speakers in this study represented at least 5 different subdialects of Trøndersk: Nordmørsmål, Fosenmål, Northeast Trøndersk, Southeast Trøndersk, and the city dialect of Trondheim, all of the speakers came from areas within 50 miles of Trondheim, which is the intersection of these five dialects. Without more research, I would not assume that speakers from the outer edges of these dialect regions would show the same results. Dialects spoken in areas more inland are usually more antiquated or conservative than both city dialects and coastal dialects (Jahr 1990) and would be less likely to be patterning with the Trondheim dialect. In addition, no speakers of West or East Namdalsk were included in this study, and a more comprehensive study of Trøndersk should include these subdialects as well.

A more diverse array of speakers would not only include geographical variation, but would also incorporate speakers from different generations. Sivertsen's (1967) claim that older speakers are more likely than younger speakers to maintain the contrast between /ʂ/ and /ʃ/ is a valid one and can apply to the other mergers as well. Since this study only looked at speakers between the ages of 19 and 28, we cannot safely generalize our results to include all generations. The disappearance of dialect traits in the speech of youth is a common phenomenon in Norwegian. It is not unlikely, then, that a study including older generations of speakers would show different results, with fewer speakers merging. It is even possible that we could distinguish different stages if the /ɭ/ – /l/ merger in terms of context. In general, the older literature describes a more limited context for the merger than the recent literature. It would interesting to see if an intermediate stage of the merger was restricted to postvocalic contexts, or non-back vowel contexts. And because the /ʃ/ – /ç/ merger is so recent, future studies should also include even *younger* speakers. Dalbakken's (1997) showed a good deal of merging in 12- and 16-year-old speakers from Trondheim; this study, however, did not include any speakers younger than 19. It is possible that the merger has already spread much farther than Trondheim but only among speakers younger than the one in this study.

In addition to collecting data from more speakers, it would also be valuable to collect more tokens per speaker, if time constraints allow. Because of the fact that some tokens had to be thrown out due to sound distortions, or in the case of the retroflexes, non-assimilation via the retroflex rule, there were fewer tokens than had been anticipated. Obviously, the more tokens collected per sound, the more reliable the results of the statistical analyses. However, it should not be necessary to go overboard, as long as enough extra tokens are collected to compensate for unexpected loss of data.

Another way of possibly improving upon the methodology of this study would be by looking into different methods of eliciting speech. The fact that many speakers did not assimilate all underlying clusters of /rl/ to [ɭ] when reading from the wordlists[1] paired with the fact that they were more likely to assimilate to the retroflex in the second half of the wordlist than in the first half suggests that they were not speaking in the most natural register.[2] This is not surprising, since there is little that can be considered natural about reading wordlists into a microphone. A less-than-natural speech register could affect the results for any of the three mergers, but especially the /ç/ as /ʃ/ merger. This is the only of the three sound changes that Norwegian speakers are cognizant of, and it is usually attributed to indolence on the part of the speaker. The possibility exists that more of our speakers might pronounce /ç/ as /ʃ/ in natural speech, but were careful to pronounce it correctly because they were being recorded. Replacing the wordlists with a more casual (recorded) conversation might generate more accurate data. It would also eliminate any unwanted effects of orthography, especially since there is no written form of Trøndersk and Bokmål, which most closely resembles the Østlandsk dialect, was used.

Also, as discussed in §4.3, it would be interesting to do a follow-up study comparing the derived retroflexes with the nonderived retroflexes. This is applicable to both the /ɭ/ – /l̻/ and the /ʂ/ – /ʃ/ mergers.[3] If Bradley's (2002) claim that underlying retroflexes should be more posterior and show less variation than derived ones is true, it might be the case that the postalveolar /ʃ/ has merged with the derived retroflex /ʂ/ but not with the nonderived retroflex, or in the case of the laterals, that the laminal /l̻/ has merged with the derived retroflex /ɭ/ but not with the underlying retroflex. Further research could compare the nonretroflex consonants to underlying retroflexes and derived retroflexes separately.

On the whole, follow-up articulatory studies that make use of techniques such as EPG and EMA would shed light on the results of this acoustic study. For example, such assessments could determine the articulation of the merged pronunciation of the lateral, about which the literature disagrees. While our results indicate that the merged pronunciation

[1] This was unexpected, since the retroflex rule is supposed to be obligatory across morpheme boundaries (e.g. Bradley 2002).

[2] !!According to Kris, the only time it is common for people to speak like this is in stage language.!!

[3] And according to Kristoffersen (2000) and others, who see the /ʂ/ – /ʃ/ merger as complete, it is also possibly applicable to the /ʃ/ – /ç/, which is considered to be a /ʂ/ – /ç/ merger by Kristoffersen.

in non-back vowel contexts is not retroflex, it is unclear whether it is apical or laminal, and it could likely vary from speaker to speaker. Results are even less clear as to the merged pronunciation of the lateral in back vowel contexts, since no articulatory difficulty exists that would allow us to assume the sounds were merging away from a retroflex pronunciation. Future research would ideally analyze the articulation of the merged lateral in all contexts. Regarding the /ʂ/ – /ʃ/ merger, articulatory studies could confirm that this acoustic merger is reflecting a merger in articulation. If Lindblad's (1980) claim is valid, then it is possible for there to be a clear difference in articulation of these two fricatives (i.e., apical versus laminal) that is not discernible auditorily or acoustically, and acoustic analysis alone would be insufficient. In addition, future articulatory research could look more closely at the alternative back pronunciation of the palatal /ç/ that was seen in several speakers. While it sounded like a velar or velarized fricative, a backer pronunciation is not accounted for anywhere in the literature, and it is possible that it was due to microphone problems or other factors.

conclusion: while the spreading of traits from dialect to dialect is common in Norwegian, these mergers need not necessarily be a matter of dialect change via spreading. (this seems to be the case for merger 3, but for the other two mergers... Acoustic similarity between the two sounds is enough pressure for independent merger from within the dialect as well,

Appendix A

Figure A-1: County (*fylke*) map of Norway (adapted from Wikipedia).

Figure A-2: Municipality (*kommune*) map of North and South Trøndelag (adapted from Wikipedia).

Appendix B

This appendix contains the written materials that were read aloud by the speakers during the recording sessions. This includes the two separate recording sessions of the pilot experiment as well as the single session for the follow-up experiment.

Sentences used in first session of pilot experiment, along with translations.

1	Æ søv med lyset av.	I sleep with the light off.
	Det går itj nå bra på TV.	There's nothing good on TV.
	Det e et stort skip.	That's a big ship.
	Det e helt stilt i huset.	It's completely quiet in the house.
	Hu slit med smerte i foten.	She struggles with pain in her foot.
	Man blir fort sliten av å spring.	One gets tired quickly from running.
	Dem bor i andre etasje.	They live on the second floor.
2	Æ må ha mæ en Cola.	I need a Coke.
	Det e itj lett å finn en jobb i den byen her.	It's not easy to find a job in this city.
	I Hallingdal tenke dem høyt.	They think out loud in Hallingdal.
	Vi ska kos oss med pizza og TV i kveld.	We're going to have a nice time with pizza and TV tonight.
	Mor dytte maten ned i søpla.	Mom is pushing the food down in the garbage.
	Han ska kjøp fler hodepinetabletta.	He's going to buy several pills for headaches.
	Finnes det ål ned i brønnen?	Are there eels down in the well?
3	Du bodd i Oslo første gangen æ møtt dæ.	You lived in Oslo when I first met you.
	Æ kan kom i mårra.	I can come tomorrow.
	Den bilen e ber enn Far sin.	That car is better than Dad's.
	Vi ska fær sjette juli.	We're going to leave on July 6th.
	Vi ska bare en liten tur på butikken.	We're just making a short trip to the store.
	Kan du slett det?	Can you delete that?
	Hunden har bæsja i gården.	The dog pooped in the yard.

4	Kongen sin hær ligne en gjeng med speidera.	The King's army looks like a gang of spies.
	Vi ska te syden i sommer sammen med Elise.	We're traveling south this summer with Elise.
	Gul ska vær en fin farge, har æ hørt.	I've heard that yellow's supposed to be a pretty color.
	Hu har nå i lomma si.	She has something in her pocket.
	Æ har lyst te å fortsett å jobb med unga.	I want to continue to work with children.
	Hu like å sol sæ utpå verandaen.	She likes to lay out on the porch.
	Han får ligg der så leng han vil.	He can lie there as long as he wants to.
5	Vi prøvd å ring Lars i går.	We tried to call Lars yesterday.
	Kan du gi mæ ei fyrstikk?	Can you give me a match?
	Vart du invitert i bryllupet demmers?	Were you invited to their wedding?
	Har du sett sjalet mitt?	Have you seen my shawl?
	Æ e redd for å se en slange.	I'm afraid of seeing a snake.
	Æ hørt at nånn hadd kræsja.	I heard that someone crashed.
	Men ellers har han det bra.	But otherwise he's doing well.
6	Han kjæm itj te å hæl det å spis krabba.	He won't be able to stand eating crabs.
	Vi ska lur Torstein te å spis fiskebolla.	We're going to trick Torstein into eating fishballs.
	Hu beherske språket sitt ber enn dem fleste.	She has a better command of her language than most.
	Far tok Mormor te banken i går.	Dad took Grandma to the bank yesterday.
	Skygge og sol danse på taket.	Shadow and sunlight are dancing on the roof.
	År etter år nyte dem det gode været i Grimstad.	Year after year they enjoy the good weather in Grimstad.
	En hæl lar dæ stå stødig.	A heel helps you stand steadily.
7	Han ska lær sæ å stå på ski.	She's going to learn how to ski.
	Hu fikk et stort sjokk da det skjedd.	It was a big shock for her when it happened.
	Han kan slå hardt.	He can hit hard.
	Rosenborg vant serien trur æ.	Rosenborg won the series, I think.
	Det e bare to uka te vi ska hesj.	There are only two weeks until we harvest.
	Det å forsk e itj en leik.	Doing research is not a game.
	Hu sjer sæ alltid i speilet før hu fær.	She always looks in the mirror before leaving.
8	En kur som virke på alt og alle.	A cure that works for everything and everyone.
	Han ska mal når det blir lyst.	He's going to paint when it gets light out.
	Oddgeir får sokka fra mæ te jul.	Oddgeir is getting socks from me for Christmas.
	Det hadd vært fint å vit når dokker kjæm.	It would be nice to know when you are coming.
	Kan du mål lengden på det bordet?	Can you measure the length of that table?
	Ska æ lær dæ å bruk programmet?	Shall I teach you how to use the program?
	Kan du skjul ti stykka under det teppet?	Can you hide ten of them under that blanket?

Wordlist from first session of pilot experiment, along with translations.[4]

1	hadde	pels	malte	slå	broren	sopp
2	skapet	plomme	tårn	kul	dele	kunne
3	mottatt	sølv	hørte	låt	kålen	høre
4	neste	slo	Jarl	plukke	hel	angripe
5	sendte	føle	målte	skilt	læreren	sent
6	jobbe	lomme	kurs	slure	klemme	kjøkken
7	kjappe	Køhl	skjært	file	kulen	arbeid
8	ønsket	byll	Kurt	slette	Gerd	tilbud
9	Bente	klør	gult	pil	faren	pris
10	andre	hyle	fordi	hals	lek	vinter
11	navn	sløv	varte	flire	pølen	ansvar
12	tema	pryl	barn	hale	stolt	sang
13	hode	løk	sølte	slite	våren	mat
14	mange	flytte	perle	Dahl	Ståle	måtte
15	tegn	Olga	sårt	lite	hælen	fikk
16	kano	slynge	Lars	glane	Pål	noen
17	kaste	Olav	gammelt	full	luren	fint
18	ung	lys	fart	slanke	blå	besøk
19	gangen	menthol	lurt	ulik	dalen	uka

1	had	fur	painted	to hit	the brother	mushroom
2	the closet	plum	tower	cool	to share	could
3	received	silver	heard	tune	the cabbage	to hear
4	next	hit (v.)	Jarl	to pluck	whole	to attack
5	sent	to feel	measured	sign	the teacher	late
6	to work	pocket	course	to glide	to squeeze	kitchen
7	quick	Køhl	cut (v.)	to file	the bump	work
8	wished	boil (n.)	Kurt	to delete	Gerd	offer
9	Bente	itches	yellow	arrow	the father	price
10	other	to scream	because	neck	game	winter
11	name	dull	lasted	to laugh	puddle	responsibility
12	topic	spanking	child	tail	proud	song
13	head	onion	spilled	to struggle	the spring	food
14	many	to move	pearl	Dahl	Ståle	had to
15	sign	Olga	sore (a.)	few	the heel	got
16	canoe	to sling	Lars	to stare	Paul	some
17	to throw	Olav	old	full	the lyre	beautiful
18	young	light	speed	to slim down	blue	visit
19	the time	menthol	tricked	unlike	the valley	the week

[4] Since the translations for the wordlists are one-word translations, in some cases they are only approximate. For the majority of words it was possible to find precise synonyms, but there are several exceptions for which it was impossible to convey the exact meaning in a single word, so an appropriate substitute was chosen. This applies to all wordlist translations, including those for the follow-up experiment materials.

Sentences used in second session of pilot experiment, along with translations.

1	Æ lure på kor han kan vær.	I wonder where he might be.
	Dem ska kom sjette mai.	They are coming on May 6th.
	Kongenes dal ligg sør i Egypt.	The Valley of the Kings lies in the south of Egypt.
	Hun ska lær sæ å skriv med venstre hånd.	She is going to teach herself to write with her left hand.
	Mor læst den boka i fjor tror æ.	Mom read that book last year, I think.
	Gul liste oppdateres hver måned.	The Yellow Pages are updated every month.
	Dette va første gangen æ har gjort det.	This was the first time I've done that.
2	Den bygningen har fler etasja.	That building has several storeys.
	Vi besøkt Den store mur like etter vi dro fra Beijing.	We visited the Great Wall right after we left Beijing.
	Det e et hull litt nedenfor den kanten.	There is a hole just below that ledge.
	Æ ska slå dæ hvis du gjør det igjen.	I will hit you if you do that again.
	Far like å grill året rundt.	Dad likes to grill all year long.
	Det bli masse sol lørdagen etter han kjæm.	There's going to be a lot of sun the Saturday after he comes.
	Æ kan hør Lise i stua.	I can hear Lise in the living room.

Wordlist used in second session of pilot experiment, along with translations.

1	norsk	nærlys	firlinger	morløs	kunnskap
2	artikkel	syrlig	forlis	rørlegger	ansikt
3	gjennom	sørland	snarlig	dyrlegge	vindu
4	herse	forlag	nordlys	Irland	opphold

1	Norwegian (a.)	headlights	quadruplets	motherless	knowledge
2	article	sour	shipwreck	plumber	face
3	through	the South	soon	veterinarian	window
4	to order around	publishing house	northern lights	Ireland	residence

Wordlist used in follow-up experiment, along with translations.[5]

1	stedet	hyle	lat	skyte	brosje	teknisk
2	betyr	alarm	prestisje	luke	kirsebær	vitenskap
3	fordi	juli	lutefisk	lam	plage	høyskole
4	vente	kjole	tjue	file	konturløs	senere
5	etter	lue	familie	forse	lim	forsvant
6	saken	kjip	kino	anlagt	kynisk	virkning
7	fremdeles	lyse	stakkars	styrløs	sju	åtte
8	kvinne	slovak	farløs	loff	sjofel	gjøre
9	skrive	adlyde	dyrlege	ulykke	sjuk	kamera
10	måten	myrsig	sjikane	erle	sjal	august
11	dørlås	farsdag	molekyl	stasjon	laget	nummer
12	region	mosjon	irlending	bluse	tjukk	regne
13	tredje	sjy	lite	festlig	slalåm	parti
14	student	prosjekt	kyle	tjue	fisjon	nivå
15	rike	lo	ski	klima	lyge	høyre
16	ordfører	plysj	nordlending	perle	skurlag	skritt
17	arbeid	mars	papirløs	bagasje	fyrstikk	medisin
18	hennes	tirsdag	morløs	lure	snarlig	mange
19	jernbane	urspråk	pysj	mulighet	skjule	tema
20	dårlig	lade	klarsynt	sjiraff	eventyrstil	rekke
21	stasjon	solusjon	sjalu	tusje	kiming	strekning

1	the place	to scream	lazy	to shoot	brooch	technical
2	means (v.)	alarm	prestige	hatch	cherries	science
3	because	July	lyed cod	lame	to annoy	college
4	to wait	dress	twenty	to file	contourless	later
5	after	hat	family	strength	glue	disappeared
6	the issue	unfortunate	cinema	anlagt	cynical	effect
7	still (adv.)	to light up	‘poor thing’	uncontrollable	seven	eight
8	woman	Slovak	fatherless	white bread	infamous	to do
9	to write	to obey	veterinarian	accident	sick	camera
10	the way	bog	sjikane	sparrow	shawl	August
11	door lock	Father’s day	molecule	station	the team	number
12	region	motion	Irishman	blouse	fat	to calculate
13	third	gravy	a little	festive	slalom	batch
14	student	project	to fling	twenty	fission	level
15	rich	laughed	skis	climate	to lie	right
16	mayor	plush	northerner	pearl	skurlag	step
17	work	March	paper-less	luggage	match	medicine
18	hers	Tuesday	motherless	to trick	rapid	many
19	railroad	urspråk	p.j.’s	opportunity	to hide	topic
20	bad	to load	clear-sighted	giraffe	fairytale style	row
21	station	solution	jealous	to color	kiming	distance

[5] Written materials used in the experiment consisted of a single wordlist of 42 sets of six words; the wordlist has been divided up here for typographical clarity.

22	utenfor	klisje	fjorsommer	skjorte	sluhet	åpne
23	kommune	sluke	dusje	sjy	slim	beste
24	opptatt	Olav	sly	kjole	hvile	fredag
25	område	ulik	skip	naturlig	firlinger	utgave
26	punktum	korsang	kjortel	kjole	morse	radio
27	Rita	kjase	slag	sjokolade	kynisk	sende
28	musikk	glo	ansvarsområde	fusjon	sky	brann
29	eldste	syrlig	girstang	rysj	lom	ferdig
30	aviser	lide	firseter	slyete	morsmelk	biskop
31	hoved	slire	blyant	barlind	murstein	bygge
32	kontor	bolig	gasje	brystlomme	lyn	senere
33	ansatt	nordlys	losje	visjon	utstyrsfilm	bygning
34	mindre	forsvarlig	hirse	kjapp	ordspill	roman
35	andre	skjule	kjos	skjorte	sirlig	datter
36	bygdene	kjake	kyr	lyd	fyrlykt	drikken
37	ordbok	kultursyn	massasje	hale	hysje	artist
38	eksempel	storlig	pilot	slo	karse	grense
39	kongen	jarl	asyl	pryle	kjakebein	side
40	styre	kilo	sursild	galakse	logo	menneske
41	kriger	tjukk	irsk	sal	like	jente
42	under	noenlunde	nylig	burloft	karl	hæren

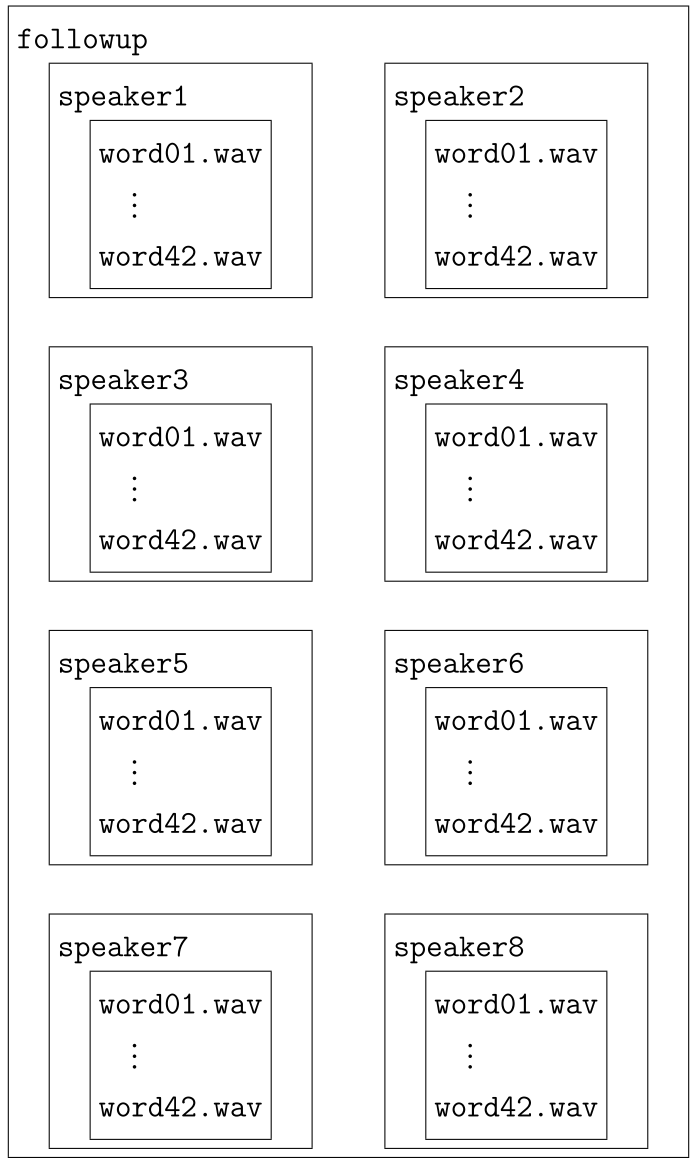
22	outside	cliché	last summer	shirt	guile	to open
23	municipality	to devour	to shower	gravy	slime	best
24	busy	Olav	slimy fluid?	dress	to rest	Friday
25	area	distinct	ship	natural	quadruplets	edition
26	period	choir song	tunic	dress	Morse	radio
27	Rita	to toil	blow	chocolate	cynical	to send
28	music	ember	responsibility?	fusion	cloud	fire
29	oldest	acidulous	gear stick	frill	loon	done
30	newspapers	to suffer	four-seater	slyete	mother's milk	bishop
31	main	scabbard	pencil	yew	brick	to build
32	office	housing	wage	breast pocket	lightning	later
33	employed	northern lights	losje	vision	utstyrsfilm	building
34	less	justifiable	millet	quick	pun	novel
35	other	to hide	kjos	shirt	elegant	daughter
36	the villages	jaw	cows	noise	fyrlykt	the drink
37	dictionary	culture view	massage	tail	to hush	artist
38	example	greatly	pilot	hit	garden kress	border
39	the king	earl	asylum	to smite	jawbone	side
40	management	kilogram	sour herring	galaxy	logo	human
41	warrior	fat	Irish	room	to like	girl
42	under	relatively	recently	cage	man	the army

Appendix C

Included with this thesis is a DVD burned with audio files from the recording sessions. The sound files are organized into two main folders, **pilot** and **followup**, for the pilot and follow-up experiments, respectively. Each of these main folders contains subfolders for the relevant speakers, **speakerP1** and **speakerP2** for the pilot experiment, and **speaker1** through **speaker8** for the follow-up experiment.

For the pilot experiment, each individual speaker folder contains the speaker's audio files, **pilot1-sent01.wav** through **pilot1-sent08.wav** and **pilot1-word01.wav** through **pilot1-word19.wav** for the sentences and wordlists from the first session, and **pilot2-sent01.wav**, **pilot2-sent02.wav**, and **pilot2-word01.wav** through **pilot2-word04.wav** for the sentences and wordlists from the second session. For the follow-up experiment, each individual speaker folder contains the speaker's audio files, **word01.wav** through **word42.wav**. All sentence and wordlist audio files match the lists in Appendix B in both numbering and content. The organization of the DVD is schematized below:

- pilot
  - speakerP1
    - pilot1-sent01.wav
    - ⋮
    - pilot1-sent08.wav
    - pilot1-word01.wav
    - ⋮
    - pilot1-word19.wav
    - pilot2-sent01.wav
    - pilot2-sent02.wav
    - pilot2-word01.wav
    - ⋮
    - pilot2-word04.wav
  - speakerP2
    - pilot1-sent01.wav
    - ⋮
    - pilot1-sent08.wav
    - pilot1-word01.wav
    - ⋮
    - pilot1-word19.wav
    - pilot2-sent01.wav
    - pilot2-sent02.wav
    - pilot2-word01.wav
    - ⋮
    - pilot2-word04.wav


followup
speaker1
word01.wav
word42.wav
speaker2
word01.wav
word42.wav
speaker3
word01.wav
word42.wav
speaker4
word01.wav
word42.wav
speaker5
word01.wav
word42.wav
speaker6
word01.wav
word42.wav
speaker7
word01.wav
word42.wav
speaker8
word01.wav
word42.wav

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