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Liquid Dissimilation as Listener Hypocorrection

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Introduction

The listener misperception hypothesis of sound change (Ohala 1981, 1993a,b) has been a fruitful area of inquiry over the past several years, in part because it makes testable predictions. According to this line of inquiry, phonological rules arise due to mechanical or physical constraints inherent to speech production and perception. Cross-linguistic tendencies in grammars are thus conceptualized as the phonologization of intrinsic, universal phonetic biases.

Liquid (or lateral) dissimilation is a widely attested co-occurrence restriction on identical [lateral] features within a phonological domain (usually a word). One prediction made in Ohala (1993a) is that long-distance processes such as liquid dissimilation should have their origins in listener *hypercorrection* of liquid coarticulation—that is, misattributing to coarticulation a feature that is intrinsic to the target.

The present study focuses on understanding the origins of liquid dissimilation by testing listener identification of targets along an /r/-/l/ continuum to explore perceptual compensation for co-occurring liquids, which have been shown to have robust long-range coarticulatory effects (Tunley 1999; Heid and Hawkins 2000; West 1999a, 2000). Section 1 gives background on liquid dissimilation in languages, the phonetics of liquids and their coarticulatory properties, as well as how listener hypercorrection is predicted be the mechanism behind liquid dissimilation under Ohala's (1993b) assumptions. Section 2 introduces a perceptual experiment designed to test for listener perceptual compensation patterns for co-occurring liquids, with results reported in Section 3. Finally, Section 4 discusses the novel findings and shows that listeners' categorization of co-occurring liquids is more consistent with a *hypocorrection* rather than hypercorrection account.

1 Background

1.1 Liquid dissimilation in language

Phonological dissimilation and assimilation (harmony) are widespread in natural language. Both can be viewed as constraints pertaining to the co-occurrence of some salient feature within some defined boundary, codifying a preference in the language for certain segmental features either to be dissimilar or to agree. These restrictions may appear either as some kind of static avoidance generalization over the lexicon (root-internal or morpheme structure constraints), or as active phonological processes in which one segment or feature ‘triggers’ a change in the underlying ‘target’ to promote or avoid similarity in the surface form.

Languages whose phonemic inventories include both a rhotic and a lateral phoneme often exhibit co-occurrence restrictions on liquids. More specifically, typological surveys of co-occurrence phenomena find that liquid *disagreement* (in static roots) and *dissimilation* (in derived environments) far outnumber the cases of liquid agreement/harmony across languages (Suzuki 1998; Hansson 2010).

Below are two well-known examples of active liquid dissimilation. In each language, dissimilation is triggered when a liquid-containing morpheme is suffixed to a root containing an identical liquid. Non-dissimilating cases are shown in the (a-b) examples, and dissimilation is shown in (c-d).

(1) Latin: /l/ → [r] / l..._
   a. /nav-alis/ → [navalis] ‘naval’
   b. /episcop-alis/ → [episcopalis] ‘episcopal’
   c. /sol-alis/ → [solaris] ‘solar’
   d. /lun-alis/ → [lunaris] ‘lunar’

(2) Georgian: /r/ → [l] / r..._
   a. /phizik-uri/ → [phizikuri] ‘physical’
   b. /kimi-uri/ → [kimiuri] ‘chemical’
   c. /reakti-uri/ → [reaktiuli] ‘reactive’
   d. /phrang-uri/ → [phranguli] ‘French’

The cases of Latin and Georgian typify many of the facts about liquid dissimilation across languages. Liquid dissimilation is usually found in languages which include one lateral and one rhotic in their phonemic inventory, tends to be triggered non-locally rather than by adjacent segments, and is generally unbounded and cannot be blocked by non-liquids, though it can be blocked by intervening liquids (Suzuki 1998; Walsh Dickey 1997). Notably, while in Latin an underlying /l...l/ sequence triggers dissimilation on the surface, in Georgian there is a restriction against /r...r/ sequences surfacing; both types appear equally prevalent in languages.

1.1.1 Exploring the perceptual origins of liquid dissimilation

Why do identical liquids co-occurring at a distance tend to trigger dissimilation? As Alderete and Frisch (2007) note, co-occurrence phenomena have become significant empirical domain for several different research paradigms in linguistics over the past several years, including the listener misperception hypothesis. The present paper approaches this question with a perceptual account in view, using American English as a case study. While American English lacks a liquid dissimilation rule, there is evidence that speakers are sensitive to co-occurring liquids: In some (rhotic) dialects, /r...r/ may optionally surface as [∅...r] or [l...r] in casual speech (cf. *ape(r)ture, flustrated*); see Hall (2007) for documentation. Furthermore, not having a rule against identical co-occurring liquids means that speaker-listeners should not be phonotactically biased against surface /r...r/ or /l...l/ sequences.

1.2 The phonetics of English liquids

As in many languages with multiple liquids, the rhotic and lateral in English are considered minimally different according to their [lateral] feature specification. Acoustically, the first and second formants of American English /r/ closely approximate those of a “canonical central vowel,” with the primary acoustic cue of a dramatically lowered third formant; F3 closely approximates the frequency of F2 (Espy-Wilson et al. 2000). The spectrum above F3 is also marked by a diminution of intensity. Meanwhile, the lateral is marked by not only changes in formant frequencies, but also changes in glottal source amplitude and spectrum, as well as in the amplitudes of peaks at the transition out of the consonant (Prahler 1998).

English /l/ and /r/ exhibit significant influence on the acoustic signal of neighboring syllables (Heid and Hawkins 2000; West 1999a,b; Tunley 1999; Espy-Wilson et al. 2000; West 2000). /r/ is distinguished most prominently by a markedly low second and third formant, the effects of which persist for at least its neighboring segments and, it appears, even further away. Meanwhile, the lateral causes F2 and F3 to raise for neighboring segments (Heid and Hawkins 2000). For American /r/ and /l/, found strong coarticulatory effects both from vowel to liquid and liquid to vowel in local contexts have been found (Lehman and Swartz 2000; Hashi et al. 2003).

Studies of longer-distance (non-adjacent) liquid coarticulation in American English is lacking. For British English, whose /r/ and /l/ formant frequencies are generally comparable to those in American English (Kelly and Local 1986), initial and intervocalic /l/ and /r/ can affect formant frequencies as many as five syllables before, and the effects can “pass through” up to two stressed syllables (Heid and Hawkins 2000). West (1999a) also found articulatory evidence of liquid influence on vowels several syllables preceding for a speaker of British English.

Finally, there is evidence that speaker-listeners have perceptual access to liquid coarticulation (West 1999b; Tunley 1999; Heid and Hawkins 2000; Coleman 2003; Hawkins and Nguyen 2004). Tunley's (1999) thesis showed that incorporating articulatory variation in synthetic /ərVCə/ sequences increased intelligibility by as much as 28%. English speakers are also able to correctly anticipate the liquid in upcoming word and identify a liquid partially embedded in noise based on surrounding contextual cues (West 2000).

1.3 Predictions made by Ohala (1993b)

Ohala (1981, 1993a) not only recognized the implications of perceptual compensation for sound change, but posited such compensation—or more specifically, the imperfect application thereof—as a primary mechanism of sound change. While listeners normally perceptually reduce or factor out the effects of coarticulation on the target sound, failing to adjust or attribute these effects to their contextual source sometimes could lead listeners to perceive variation as intrinsic to the target (what Ohala has termed *hypocorrection*). In other cases, listeners accustomed to adjusting for variation might be led to *over*compensate, misattributing a feature that is actually intrinsic to the target to coarticulation (*hypercorrection*).

It is hypercorrection that Ohala (1993a) hypothesized to be responsible for non-local phonological phenomena like liquid dissimilation, since the temporally long cues of liquids would "create an ambiguity as to where the feature is distinctive and where fortuitous" (Ohala 1993:251). Listeners hearing two identical liquids within a phonological domain (usually a word) may misattribute the perceived occurrence of one liquid to the resonance effects of the other, and begin to adjust their mental representations of the underlying sounds, possibly leading to an eventual dissimilation rule in the language.

This hypothesis depends largely on at least two things: First, for Ohala's type of hypothesis to be able to account for attested phenomena like liquid dissimilation, we must look for acoustic-auditory cues (like long-distance resonances) that could plausibly support observed phonological behaviors, which was demonstrated in Section 1.2. Second, it must also be the case that listeners indeed engage in a sort of ongoing "normalization" process in the way that Ohala postulates. Research has shown convincingly that despite the speech signal being extremely variable and complex, listeners not only compensate for variation, but also show at least partial access and control over fine-grained, sub-phonological details of the speech string (Whalen (1990); Kingston and Diehl (1994); Gaskell and Marslen-Wilson (1997); Beddor et al. (2007); Tilsen (2007); Sonderegger and Yu (2010), among others). While we know that listeners are aware of contextual variation induced by the presence of /l/ or /r/ in a speech signal, for liquid dissimilation, what we now also want to know is both *whether* and *how* listeners use that information to compensate for liquid-to-liquid coarticulation within a prosodic word.

2 A perceptual experiment

A perceptual phonetic study was conducted to test listener compensation when two liquids were present, to find how perception of a synthesized segment on a continuum between /r/ and /l/ might be affected by the presence of a second, conditioning liquid consonant (either /r/ or /l/). As a control, listeners also categorized ambiguous liquids without another liquid in the word. /d/ was used because of its relatively small, much less enduring coarticulatory effect on formant transitions; it serves as a baseline for comparison with the liquid-condition results.

2.1 Hypotheses

Given the task of categorizing an ambiguous target liquid in the context of an unambiguous liquid trigger, how will listeners tend to categorize the target? If hypercorrection is the correct explanation, then the story is something like this: The presence of a conditioning /r/ in a word should cause the category space to narrow for /r/ in the target position. This is because listeners, sensitive to the coarticulatory effects of /l/ on its surrounding environment, would filter out the contextual variation brought on by conditioning /r/ (for instance, its tendency to lower F3 in surrounding syllables). Thus, listeners encountering an ambiguous liquid in the target position would be more likely to identify it as /l/ than they would in a 'neutral' environment. The listener misperception hypothesis predicts that at least some of the time, this sensitivity would work against the listener, in effect causing him or her to overestimate the effects of coarticulation vs. cues intrinsic to the target.

Finally, since either /r...r/ or /l...l/ may trigger liquid dissimilation in languages, we also expect that the reverse of the above should be true for the effect of conditioning /l/. These hypotheses are summarized in (3) and (4):

(3) *Hypothesis A:* When the conditioning consonant is /r/, listeners will be more likely to hear the continuum consonant as /l/ (the category space of /l/ will widen).

(4) *Hypothesis B:* When the conditioning consonant is /l/, listeners will be more likely to hear the continuum consonant as /r/ than in the control (/d/) condition (the category space of /r/ will widen).

The experimental design can also shed light on whether a directionality bias exists for perceptual compensation of co-occurring liquids. Phonological dissimilation rules do not seem to show a cross-linguistic preference for right-to-left or left-to-right processes; however, West (1999a, 2000), and Heid and Hawkins (2000) all claim to find stronger anticipatory coarticulation in small-scale studies, so if a phonetic bias exists, it will be useful to know how listeners make use of this information. In addition, both onset (intervocalic) and coda (pre-nasal) conditioning consonants will be tested, since listeners show sensitivity to acoustic differences between pre-vocalic and pre-consonantal liquids (Kochetov 2004) and differences in strength of effect might be observed based on the prosodic position of the conditioning consonant.

2.2 Stimuli

Using Praat (Boersma and Weenink 2010), a phonetically trained native speaker of American English was first recorded at a sampling rate of 48 kHz uttering the speech strings [ˈɑrɑ] and [ˈɑlɑ]. The flanking vowels were closely matched for pitch, intensity, and first three formant frequencies so that the strings differed by consonant only. Stress was consistently on the vowel preceding the target segment to control for any effects of stress correlates (intensity, duration) on perceptual salience.

Using [ɑrɑ] and [ɑlɑ] as endpoints, a 7-step continuum was synthesized. A script[1] determined the formant structure of the two speech signals using an LPC algorithm with 9 linear-prediction parameters, then calculated the formants at intervals of 5 ms with an analysis window of 50 ms. The sound was then reverse-filtered using the calculated formants, giving a source. At each time step, the script calculated new formant values at 7 intervals between the original /r/ and /l/ values. The source was then filtered through the new formants to produce seven synthesized /ɑXɑ/ sequences (where X = a step on the continuum between /r/ and /l/). Table 1 gives the calculated F2 and F3 values for each continuum step.

Table 1: Formant values for target (synthesized) consonants.

Continuum step	F2 (Hz)	F3 (Hz)
1 /r/	1407	1969
2	1317	2106
3	1416	2363
4	1452	2626
5	1412	2801
6	1403	3020
7 /l/	1331	3314

Finally, each of the seven sequences was spliced into twelve different conditioning environments (see Table 2), also recorded by the phonetically trained native speaker. These varied by conditioning consonant (CONDC = l, r, or d), whether the conditioning consonant was an onset or coda (CODA = y or n), and whether the

[1] Thanks to Ed King in the UChicago Phonology Lab for writing and providing the Praat script.

target preceded or followed the conditioning consonant (TARGET POSITION = 1 or 2), resulting in a total of 84 unique stimuli.

Table 2: Conditioning environments (stimulus types).

	TP=1		TP=2	
CONDC	CODA=n	CODA=y	CODA=n	CODA=y
/d/	aXada	aXadna	adaXa	adnaXa
/l/	aXala	aXalna	alaXa	alnaXa
/r/	aXara	aXarna	araXa	arnaXa

2.3 Participants

Sixteen native speakers of American English between 18 and 23 years of age (11 females, 5 males) participated in the study. None reported any known history of speech or hearing disorders. All participants were compensated either with course credit or nominal cash upon completion of the one-session experiment.

2.4 Task

The experiment consisted of four blocks. There were two main *trial blocks* divided by TARGET POSITION; half the subjects completed the blocks in one order and half in the reverse. Each block consisted of 42 stimuli presented 10 times each for a total of 420 trials per block, in randomized order, with a break between blocks. In a soundproof booth, subjects were instructed to listen to the entire word and then respond as quickly as possible using a manual response box to indicate whether they heard /l/ or /r/ (forced-choice) in the target position. For each trial, a visual reminder of the task appeared on a monitor. As soon as a response was registered, the next stimulus was immediately presented, and so on until the end of that block.

Each trial block was preceded by a *training block*. During the training, 12 stimuli were presented, but only unambiguous /r/ and /l/ were used as target consonants. At least 80% of the targets had to be correctly identified to complete the training; if not, subjects were given one more chance to score over 80% or else be determined ineligible to complete the study. No one was ultimately disqualified by the training.

Although not incorporated into the analysis of the data, reaction time was recorded as a way to ensure that subjects listened to both the target and conditioning consonant before responding. All listener responses with reaction times which were shorter than the duration of the stimulus were excluded. Results were then statistically analyzed using linear mixed-effects modeling.

3 Results

The model began by including four fixed-effect predictors, which were TARGET (continuum step), CONDITIONING CONSONANT, CODA, and TARGET POSITION. Non-significant factors were successively eliminated from the model, resulting in just the significant two-way and main effects shown in the results below. To allow for listener-specific and stimulus-specific variation, as well as to control for the possibility of subject fatigue over the course of the experiment, random intercepts of TRIAL, SUBJECT, TRIAL:SUBJECT and STIMULUS were also included. Table 3 shows the significant fixed-effects results of the model.

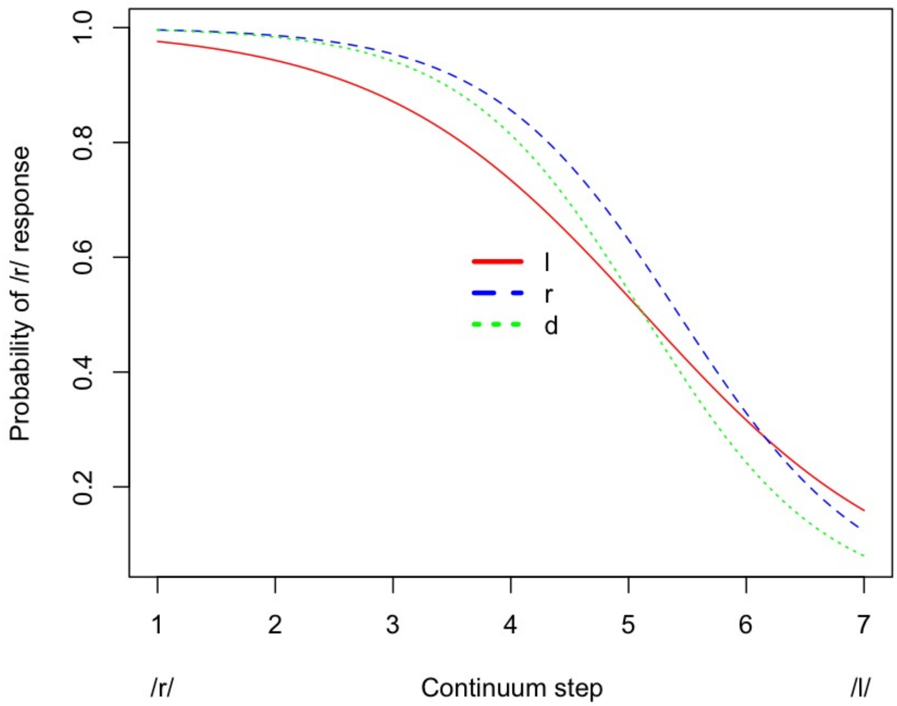
Table 3: Estimates for significant fixed-effect predictors in the mixed-effect model.

	Estimate	Std. Error	z value	Pr($>|z|$)
(Intercept)	6.294596	0.513587	12.256	$<2e^{-16}$ ***
CONDC=l	-1.477787	0.616761	-2.396	0.0166 *
TARGET	-1.170735	0.099006	-11.825	$<2e^{-16}$ ***
CONDC=l:TARGET	0.284985	0.135777	2.099	0.0358 *
- - -				
Signif. codes:	0 ‘***’	0.001 ‘**’	0.01 ‘*’	0.05 ‘.’ ‘ ’ 1

Neither TARGET POSITION nor CODA were found to be significant predictors of listener RESPONSE. Turning to the factors which directly relate to the main Hypotheses A and B, TARGET was a significant factor ($p < .001$), confirming that listener response to the perceptual judgment task differed based on the quality (i.e., continuum step) of the target consonant. We also find a significant main effect of conditioning /l/ on RESPONSE. Meanwhile, /r/ as a conditioning consonant did not significantly affect RESPONSE, either as a single predictor or in any interaction effects. The effect of /l/ is also seen in the interaction effect between TARGET and CONDC=l ($p < .05$).

Figure 1 plots partial effects of a mixed-effects model fit, with predicted RESPONSE as a function of TARGET and CONDITIONING CONSONANT. As expected, the control conditioning environment, /d/, shows virtually 100% /r/ responses at the /r/ end of the continuum, and near-zero /r/ (high /l/ response) at the /l/ end of the continuum. When /r/ is the conditioning consonant, results are similar, with at-ceiling /r/ responses for the /r/-end of the continuum and near-zero /r/ responses at the opposite end. Although the boundary shift along the /r/-/l/ continuum appears to occur later when CONDC=/r/ than when CONDC=/d/, which would suggest an assimilatory effect, the regression model failed to find significance in the interaction

Figure 1: Predicted RESPONSE as a function of TARGET and CONDITIONINGC



between CONDC=r x TARGET. This will be discussed further in Section 4.

In summary, significant effects are found when the conditioning consonant in the word is /l/ versus when there was no second liquid in the word. The probability plot illustrates that overall, listeners are more likely to judge the target consonant to be /l/ when there is another /l/ in the word, meaning that listeners perceptually assimilate the target to the trigger. The presence of /l/ causes continuum liquids to be identified as /l/ more often than in the control condition.

At the far right end of the continuum only, when the target was most clearly /l/-like, the predicted trajectory in Figure 1 seems to show that listeners were more likely to identify the target as /r/ when the trigger was /l/ than in the baseline condition. Thus, in a limited number of cases, /l/ caused listeners to perceptually dissimilate.

4 Discussion

4.1 Listener (mis)perception patterns of liquid-to-liquid coarticulation

The experimental findings, especially the interaction effect of CONDITIONINGC=/d/ x TARGET, at least partially support the general expectation under the assumptions of the listener-misperception paradigm, that the presence of two liquids within a word should cause perceptual boundaries to shirt. However, the results ultimately contradict the original hypotheses (see Section 2.1, (3) and (4)) stemming from the hypercorrection account in a number of important ways. The prediction that the presence of /r/ should effect a higher rate of /l/-identification for the target liquid in Hypothesis A was not borne out, as conditioning /r/ did not have a significant effect for this study.

Meanwhile, Hypothesis B predicted that the occurrence of /l/ should cause listeners' /r/-/l/ category boundary to shift toward more responses of /r/ in identifying the continuum liquid. A significant effect of conditioning /l/ was found, but the empirical data supports the opposite of what was expected. The fixed-effects results of the linear model demonstrate that having a conditioning liquid of /l/ makes a significant difference on listener phonological judgment of the target liquid when compared with the baseline (CONDC=d). The probability plot above further illustrates what kind of difference it makes: a clear instance of /l/ was present in the word, listeners in general were more likely to identify a continuum liquid as /l/ than in the condition where two liquids did not co-occur, thus widening the category space of /l/ and perceptually assimilating.

It is surprising that /l/ causes perceptual *assimilation* of continuum liquids (particularly those towards the left on the /r/-/l/ continuum; x-axis in Figure 1). Previous research on fricative-vowel coarticulation (Mann and Repp 1980), vowel-to-vowel coarticulation (Tilsen 2007), and vowel-nasal coarticulation (Beddor and Krakow 1999), among other phenomena, has fairly consistently found that listeners deal with contextual variation by perceptually "undoing" the effects of coarticulation in identification tasks. In the present study, which used an established experimental paradigm (identification task for a synthetic continuum spliced into various contexts) to shed light on a previously untested phenomenon (liquid-to-liquid coarticulation), listener perceptual patterns did not filter out coarticulation. Instead, listeners' identification of the continuum liquid was altered by the presence of conditioning /l/ by *strengthening* rather than undoing the effect of coarticulation, whereby /l/ causes the continuum liquid to be perceived as /l/-like more of the time.

4.2 A hypocorrection account for liquid dissimilation?

Recall the results predicted by the listener misperception account for liquid dissimilation, as given in Section 2.1. The predictions were based on the assumptions that liquid coarticulatory influence is long-ranging, robust, and available to listeners. It also assumes that listeners will normally filter out coarticulatory noise, and that the nonlocal nature of liquid coarticulation would make listeners prone to hypercorrective perceptual errors, misperceiving intended acoustic cues as contextual residue.

The most significant finding suggested by the results of this study is that if dissimilation indeed has its origins in listener (mis)perception of coarticulation, the data are more consistent with a *hypocorrection* rather than a *hypercorrection* account. Hypocorrection and hypercorrection have often been defined in terms of perceptual compensation as "undoing" coarticulation; however, the current results suggest that for liquid-to-liquid coarticulation, listener compensation involves perceptually assimilating, rather than dissimilating, co-occurring liquids, at least when there is an /l/ present in the word.

While several studies have found experimental evidence for the perceptual motivations of assimilatory processes in phonologies, such as place assimilation (Ohala 1990), to date there is a dearth of work showing that the origins of dissimilation are also perceptual. Furthermore, a convincing empirical case showing dissimilation to result from hypercorrection has not yet been made. The results of this study indicate that hypercorrection is not a viable explanation for the perceptual data we find. Since listeners are shown not to normally correct for the effects of liquid coarticulation, it does not follow that listeners' perceptual errors would be prone towards hypercorrecting for coarticulation. Furthermore, conceptualizing hypercorrection in a more general as over-application of usual perceptual tendencies, whatever they might be, would still logically result in liquid *assimilation*, which is only rarely attested among languages.

However, it may be possible to conceive of liquid dissimilation as perceptually motivated, but by a special kind of hypocorrection instead. Hypocorrection may not merely be a failure to under coarticulation, but rather a failure or avoidance of listeners' usual perceptual patterns for a given coarticulatory phenomenon. With such an understanding, the story would be this: For co-occurring liquids, listeners are shown to usually "compensate" in an assimilatory direction. Therefore, a hypocorrective failure to do so should result in dissimilation—the phenomenon we seek to explain.

What remains a puzzle for now is that the plotted curves suggest that for the most /l/-like point of the continuum (step 7), we actually find a small probability that listeners will categorize this liquid as /r/, and at a higher probability than in the baseline condition. If this were the trend throughout more of the continuum, we might be led to a different interpretation of the results, since it would indicate that listeners are adjusting for /l/ coarticulation by perceiving a second /l/ less often. Yet oddly, this effect shows up only for the final continuum step, reversing the pattern for the majority of the curve. Prior to the experiment, phonetically trained researchers assessed the resynthesized sounds and found them to be a good /r/-/l/ continuum with clear phonemic endpoints and gradually more ambiguous sounds towards the middle; however, perhaps the final continuum step was not sufficiently /l/-like as to be unambiguous for listeners.

4.3 Other issues

Since TARGET POSITION was not a significant predictor of RESPONSE, it does not appear that the relative positions of the target and conditioning consonant affect listener compensation. On one hand, this is unproblematic from the standpoint of observed phonologies; both regressive and progressive dissimilation is found in languages. On the other hand, given the greater robustness of regressive coarticulation found by Heid and Hawkins (2000) and West (1999a) in comparison to progressive effects, we might have expected that listeners would make use of that information. However, both of these studies used only one (British) speaker to collect data, yet we know that wide interspeaker variability in both anticipatory and perseverative coarticulation has often been observed (Magen (1997); see also Newman et al. (2001) for more on interspeaker variability in producing acoustic cues). Collecting production and perception data from a larger subject pool might show that anticipatory and perseverative coarticulation are equally strong for liquids.

The experimental results give rise to the question of why the presence of /l/ significantly influences listener identification of a continuum liquid while /r/ does not, especially since /r/ has been reported to have just as strong resonances as /l/. Interestingly, Heid and Hawkins (2000) have speculated that rather than a simple gradient effect as the distance from the liquid grows, there are two distinct effects occurring, a long-range effect and a more local one. Indeed, in many languages with liquid dissimilation, quite a bit of phonetic material intervenes between the liquids, not just a single segment. For instance, with optional /r/-dissimilation in American English, the dissimilating (target) /r/ tends to be consonant-adjacent and is often further than one segment away from the triggering /r/ (Hall 2007). The presence of /r/ may have a more significant effect if stimuli with more intervening syllables are used in follow-up studies, and also with the target consonant in different prosodic positions (rather than onset-only, as in the present study). Another factor to consider is that perceptual (non)resistance to coarticulation, as well as coarticulatory influence exerted in production, varies by dialect and speaker (Bladon and Al-Bamerni 1976; Tunley 1999). More language- and dialect-specific work still needs to be done on listener perception patterns, and on larger groups of speakers.

5 Conclusion

Listeners have long been known to have perceptual access to the fine-grained acoustic details that accompany coarticulation, and to use these acoustic cues in phoneme discrimination. A novel aspect of this study is that, while past studies have generally found listeners to perceptually undo the acoustic effects of coarticulation, the results here suggest that for liquids, listeners adjust their perception in the same direction as coarticulation, strengthening rather than undoing the effect. American English speaker-listeners engage in perceptual compensation for coarticulatory effects of liquids in a way that causes the category space of /l/ to widen when another /l/ is in the word compared to a baseline, thus perceptually assimilating the co-occurring liquids. Since a hypercorrection account assumes that listeners would normally perceptually dissimilate, it cannot adequately explain the origins of liquid dissimilation. Meanwhile, in the case of liquids, dissimilation could actually result from a failure to compensate in the usual direction, suggesting dissimilation may be a special case of hypocorrection.

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