

The phonological perception of voicing assimilation in Emilian dialects

Background. The way speech is perceived is strongly influenced by language-specific phonological knowledge (Dupoux *et al.* 1999). Whereas earlier work focussed mostly on the influence of phonotactic restrictions, recent studies take into consideration the role of phonological processes in speech perception. For instance, Durvasula & Kahng (2015, 2018) show that Korean and Mandarin speakers perceive different illusory vowels depending on the phonological context as well as on the phonological processes of their native phonological systems. These recent studies share a shortcoming with earlier experimental work in as far as they fail to provide an explicit formalization of the phonological knowledge in speech perception. In the present study, we provide such a formalization by using the *Bidirectional Phonetics and Phonology* model (Boersma 2007; henceforth: BiPhon), where the same set of phonotactic constraints that trigger phonological processes in production also apply in speech perception. Crucially, this model allows for an explicit formalization of how phonological restrictions and auditory cues interact in the process of speech perception.

Empirical domain. Our study addresses regressive voicing assimilation (RVA) in the consonant clusters of the Emilian dialects spoken in Parma, Modena, Bologna and Ferrara. As a consequence of syncope, these dialects display consonant clusters, which agree in voicing. This is shown by the Bolognese data in (1):

(1)	a)	[⟨a⟩ 'paɪz]	'(I) weight'	-	[⟨b⟩zɛ:r]	'to weight'
		[⟨a⟩ 'saɪg]	'(I) sew'	-	[⟨z⟩gɛ:r]	'to sew'
	b)	[⟨b⟩aka]	'mouth'	-	[⟨p⟩kæŋ]	'mouthful'
		[⟨v⟩etʃ]	'old'	-	[⟨f⟩tʃats]	'old geezer'

The forms in (1) are morphologically related, which suggests that in the varieties under consideration RVA is a synchronic process.

Methodology. We tested whether RVA a) systematically applies in production and b) influences native speakers' perception of non-assimilated clusters. We checked the former by means of an elicitation task (translation of morphologically correlated forms displaying vowel-∅ alternation), and the latter by employing a forced-choice segment detection task (Zimmerer & Reetz 2014). We tested whether our participants detect a [p] followed by a voiced obstruent, e.g. in nonce words such as [apda], as such (thus, hear a [p]), or whether they apply their knowledge of RVA in perception and perceive this obstruent as assimilated (thus, hear a [b]). The hypothesis is that, in the case RVA is part of the phonological competence of the speakers, consonant clusters whose segments display opposite voicing specification are misperceived as showing the same voicing specification. We tested 13 participants from Parma, Modena, Bologna and Ferrara, who were native speakers of the regional dialects. They were first interviewed and recorded, and then had to perform the perception experiment.

Results. In the production study, the participants applied RVA on average in 86% of the cases; four speakers always applied RVA. This finding experimentally supports what was suggested in the literature, namely that RVA represents a robust process in Emilian dialects. In the segment detection experiment, participants reported to have perceived 'b' in [apda]-words in 58% of the cases. Control words with prevocalic [p] in initial or medial position (e.g. [pafa] and [sapə]) triggered 'b'-responses only in 4% of the cases. These results support

our hypothesis that RVA influences perception. Interestingly, the percentage of ‘b’-responses to [apda]-words is lower than to stimuli containing a [b] (85%). This is because the speakers’ phonological knowledge influences speech perception, but does not necessarily override the auditory cues given in the acoustic signal: the two types of information are conflicting, and participants’ responses vary accordingly.

Formal analysis. The observed results can be adequately formalized in BiPhon. As shown in (2), RVA in production results from the interaction of the phonological constraints AGREE (violated by a non-agreeing consonant cluster), SYNCOPÉ (causing the deletion of prestressed vowels), IDENT(voice)C₂ (ensuring identity of the voicing feature in the second consonant of a cluster), and IDENT(voice).

(2)	pV+dV	AGREE	SYNCOPÉ	IDENT(voice)C ₂	IDENT(voice)
	/pVdV/		*!		
	/pdV/	*!			
☞	/bdV/				*
	/ptV/			*!	*

In perception, the influence of RVA results from the interaction of the same phonological constraint AGREE with several CUE constraints: *[_]/+voice/ (violated by a silent closure in the auditory form being mapped onto a voiced plosive in the surface form), *[_]/–voice/ (violated by a voiced closure being mapped onto a voiceless plosive), and *[^d]/–voice/ (violated by a voiced alveolar release being mapped onto a voiceless alveolar plosive). Note that a cluster of a voiceless and a voiced plosive contains a silent closure followed by a voiced closure.

(3)	[a [~] _ ^d a]	*[_]/–voice/	*[_]/+voice/	*[^d]/–voice/	AGREE
	☞ /ap.da./				*
	☞ /ab.da./		*		
	/ab.ta./	*(!)		*(!)	

The evaluation results in two winning candidates, the first not assimilated, the second with regressive assimilation, mirroring the two possible answers the participants provided in our perception experiment. In the presentation, we show that the observed individual variation in perception can be modelled by implementing a stochastic evaluation of speaker/listener-specific rankings.

References. Boersma P. (2007). Some listener-oriented accounts of h-aspiré in French. *Lingua* 117:1989–2054; Dupoux E., Kaheki K., Hirose Y., Pallier C. & Mehler J. (1999). Epenthetic vowels in Japanese: a perceptual illusion. *Journal of Experimental Psychology: Human Perception and Performance* 25:1568–1578; Durvasula K., Huang H., Uehara S., Luo Q. & Lin Y. (2018). Phonology modulates the illusory vowels in perceptual illusions: Evidence from Mandarin and English. *Laboratory Phonology* 9: paper 7; Durvasula K. & Kahng J. (2015). Illusory vowels in perceptual epenthesis: the role of phonological alternations. *Phonology* 32: 385–416; Zimmerer F. & Reetz H. (2014). Do listeners recover “deleted” final /t/ in German? *Frontiers in Psychology* 5: Article 735.