

Long-distance effects caused by length contrast

Giuseppina Turco¹ and Bettina Braun²

¹University of Stuttgart, ²University of Konstanz

When sounds are produced in connected speech, their physical realization is highly influenced by segmental context (i.e. coarticulation), among other factors. Local effects on adjacent sounds have been deeply researched in phonetics and phonology. The anticipation of the properties of an upcoming segment on previous sounds has shown that segments are planned well in advance rather than one at a time, as shown by studies on English voicing contrast (Hawkins & Nguyen 2004). Long-distance effect, sometimes referred to as (vowel or consonant) ‘harmony’ (Hansson 2010), defines a phenomenon by which non-adjacent segments within a certain domain (syllable, foot, word, etc.) tend to be similar with respect to some dimensions. Well attested in many world languages, harmony phenomena often involve feature-based contrasts (e.g. the feature [nasal], [round], [high]) reflecting their basic defining articulatory properties. Comparatively little is known on long-distance effects induced by a skeleton-based contrast, i.e. a contrast related to the temporal properties of the sound.

This study investigates long-distance temporal effects before an upcoming length contrast. We therefore compared the temporal properties of sounds preceding the upcoming length contrast in Italian words with word-medial geminate and singleton consonants (e.g., [p] in [*palla*] “ball” vs. [*pala*] “shovel”).

Like in many world languages, Italian has a lexical contrast between geminate and singleton consonants. Phonologically, the syllabic parsings of geminate and singleton consonants are distinguished by their association to one vs. two skeletal positions. Italian phonologists assume a heterosyllabic representation of geminates (e.g., [*pan.na*], see Bertinetto, 1981; for empirical evidence, see Gili Fivela & Zmarich, 2005), resulting in an initial closed syllable, which is different from an open syllable in words with a medial singleton consonant (e.g., [*pa.ne*] “bread”). Phonetically, the distinction between the two consonants is carried primarily by duration: geminates are systematically longer than their singleton counterparts (see, for instance, Esposito & Di Benedetto, 1999); or, by the duration ratio between the geminate consonant and the preceding vowel (e.g. Pickett, Blumstein, & Burton, 1999).

The goal of this study is to investigate long-distance effects triggered by word-medial geminate consonants and examine whether the enhancing gestures associated with phonemic length contrast are also foreshadowed in preceding sounds (e.g., in the Italian [*palla*], the effect of the liquid geminate [ll] goes not only on the immediately preceding vowel but also affects the rhythmic properties of preceding sounds, e.g. the word-initial [p]). To test this hypothesis, two production studies were designed. In Experiment 1, we compared the temporal properties of the word-initial consonant in minimal pairs that differed in the length of the word medial consonant (e.g., *palla* vs. *pala*). In order to have comparable syllable structures, in Experiment 2, we additionally compared temporal properties of the initial consonants in word-medial geminate consonants to cohort competitors with a word-medial consonant cluster (e.g., *panna* vs. *panda*). These two production studies were conducted with 8 and 9 Italian speakers, respectively. Participants read sentences containing experimental minimal pairs starting with stop consonants (e.g., *The word <target> this is what I am saying*). To normalize segment durations for speech rate, we measured the duration of the initial consonant (C1) of the minimal pairs and divided it by the duration of the preceding word (*parola* “word” in Italian, (see Pickett, Blumstein, & Burton, 1999, for a similar procedure in Italian)). These C1-ratios were subjected to linear mixed effects regression models with TYPE (Experiment 1: singleton vs. geminate; Experiment 2: cluster vs. geminate) as a fixed factor and SPEAKERS and ITEMS as crossed-random factors (the model allowed for random intercepts and slopes for within group fixed factors, cf. Barr, Levy, Scheepers, & Tily, 2013). Results showed a main effect of TYPE on the C1-ratios (Experiment 1: $\beta = .031$, $SE = .001$, $t = 2.18$, $p < .05$ - Experiment 2: $\beta = .030$, $SE = .008$, $t = 3.79$, $p < .001$), see Figure 1 (similar results are obtained with raw durations).

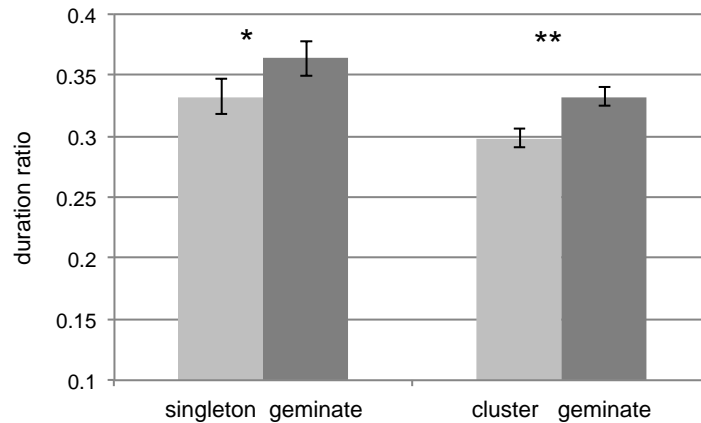


Figure 1: Duration of the initial consonant (normalized for the duration of the preceding word) in Italian singleton-geminate pairs (Experiment 1) and cluster-geminate pairs (Experiment 2). Whiskers represent standard errors.

We argue that these duration ratio differences anticipate the upcoming length contrast (Experiment 1), and are independent of syllable structure (Experiment 2). The existence and nature of such long-distance effects may raise questions of the utmost theoretical interest that concern the organization of phonological systems, their phonetic realization and speech planning processes.

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