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An articulatory account of nasal place assimilation in Italian

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INTRODUCTION

A critical issue for the phonological treatment of place assimilation is the amount of **variability** that an increasing body of experimental investigations has repeatedly shown to characterize the phonetic output of assimilation

(e.g., Local 1992, Ellis & Hardcastle 2002, Stephenson & Harrington 2002, Kochetov & Pouplier 2008).

Variability takes the shape of:

• **Optionality** of the rule: cross-subject & within-subject variation

• **Gradience** in phonetic output: Intermediate forms between unassimilated and assimilated consonants demonstrate that assimilation processes may be incomplete and that articulatory gestures may be only partially assimilated or reduced.

BACKGROUND

Italian Nasal place assimilation in consonant clusters is context-induced and allophonic: Ns are said to categorically assimilate their PoA to that of the following consonant, both within and across words. In /nk/ and /ng/ clusters, the N is generally held to be velar; a velar N does not exist as a phoneme; non-homorganic clusters tend to be avoided.

Articulatory evidence

Farnetani & Busà (1994), EPG study: assimilation appears to be **categorical** in Italian, i.e. complete in all its occurrences and for all the subjects (3).

Calamai & Ricci (2010 in press), acoustic and EPG study of temporal / spatial reduction as a function of speech rate variation in Italian /n(#)t, n(#)d, n(#)k, n(#)g/ clusters: N-to-V clusters are **almost categorically** homorganic, with only a few “unusual patterns” in the fast speech of one of the subjects.

English differs structurally and articulatorily from Italian, inasmuch as it opposes an obligatory rule of place homorganicity in lexical clusters (e.g., e[nt]er, a[mb]er, pra[n]k) to an optional process of place assimilation in post-lexical contexts (e.g., gree[nb]ox ~ gree[mb]ox or gree[nk]ard ~ gree[nk]ard).

Several EPG studies have shown that postlexical assimilation is variable across speakers as well as in the speech of individual speakers, and can be gradually implemented (residual alveolar gestures in partially assimilated clusters) (Barry 1991, Stephenson & Harrington 2002, Ellis & Hardcastle 2002).

AIMS

In this study, we aim at verifying whether sources of variability may be found in Italian lingual gestural patterns involved in N-to-V assimilation, as a consequence of contextual and stylistic variables such as *speech rate* variations and presence/absence of a *word boundary*.

Predictions:

✓ normal speech should exhibit a higher degree of assimilation compared to slow careful speech, since intrinsic duration of segments and gestural integrity are reduced when speech rate is higher

✓ word-internal clusters should exhibit a higher degree of assimilation compared to postlexical clusters, insofar as an intervening boundary is expected to disfavor segments coarticulation

✓ can variability be explained within a *dynamic picture of the gestural organization* across the cluster, beyond strict monodirectionality of assimilation?

MATERIALS AND METHODS

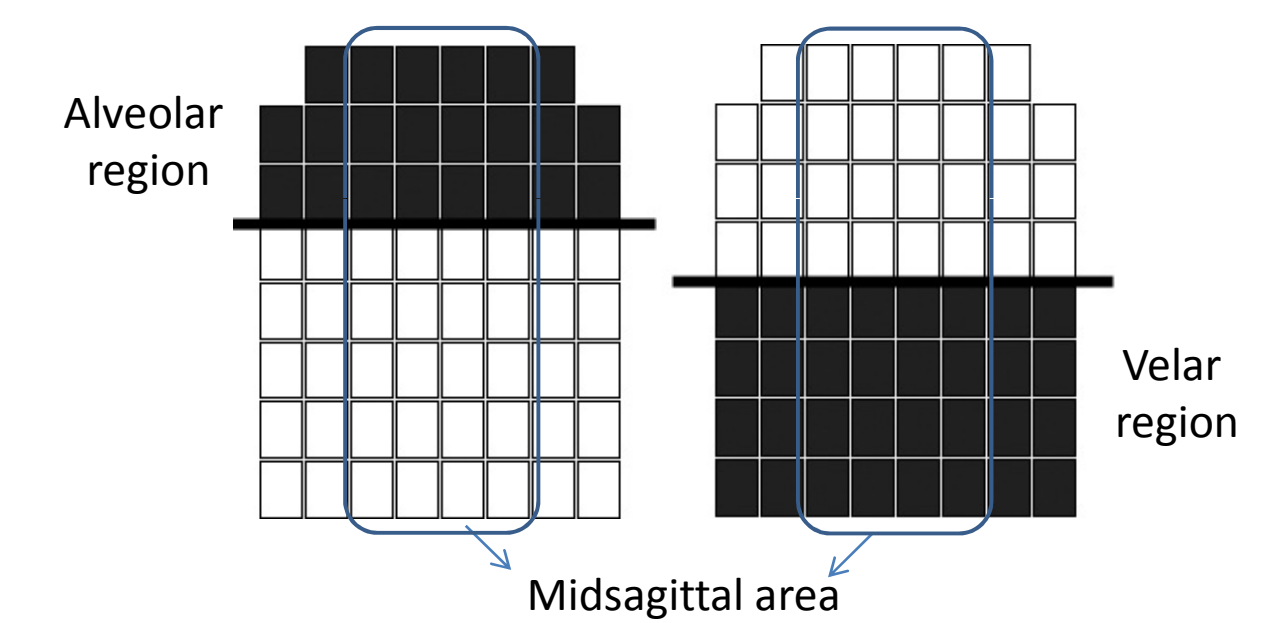
Sixteen meaningful Italian words containing a N-to-V cluster were embedded in short isosyllabic frame sentences (e.g., *ho mancato davvero*). PostN stops could either be voiced (/n(#)g/) or voiceless (/n(#)k/). Target words were selected in order to preserve an invariable vowel context (/ànCa/ or /anCà/). Clusters could be either in word internal position, or across a word boundary (e.g. *mancato* vs. *fan caso*).

Subjects: Five native Italian speakers with no reported speech, language or hearing pathology, aged 30-35, speaking a Tuscan variety of Italian, were recorded separately in an anechoic chamber. Simultaneous EPG and acoustic data were recorded.

Experimental sentences were randomized and participants were asked to produce 20 repetitions of each sentence, 10 at a *normal* and 10 at a *slow* speech rate.

The classificatory criteria used to identify the realizations of the nasal stop were inspired by the method developed by Hardcastle (1994, and subsequent work), with the following adaptation for the purposes of the present analysis:

we individuated an *alveolar region* spanning over rows 1 to 3, and a *velar region* spanning over rows 5 to 8 (see Fig. 1a and b).

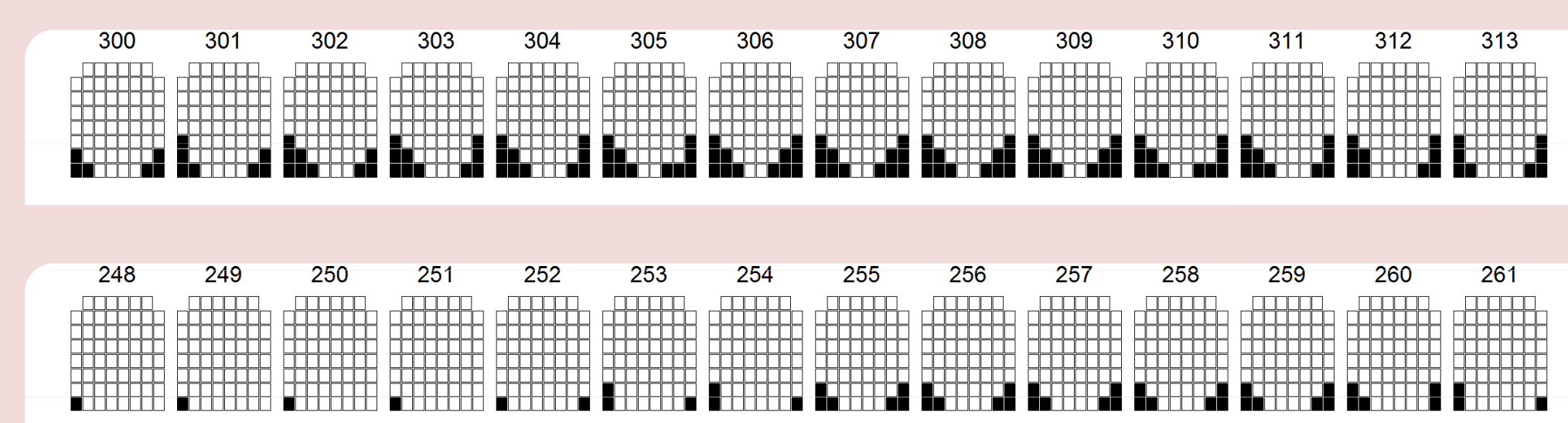


RESULTS

The picture emerging from our data supports a more nuanced view of Italian N place assimilation than previously thought.

The great majority of realizations were **completely assimilated**. Major points:

- a general tendency towards a *progressive approximation of the nasal to the postnasal articulatory pattern*: the articulatory configuration in the production of the N tends to gradually get closer to the MaxC of the cluster articulation.
- the posteriority of the N was subordinated to that of the postN, whose articulatory configuration appeared to be *inherently variable*, although restricted to the velar region.



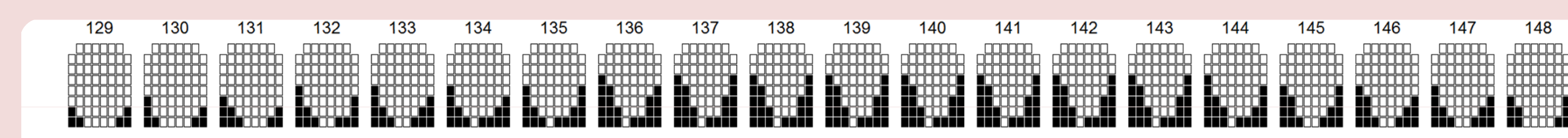
Point **b)** has important consequences for the understanding of N place assimilation, that are likely to have been underestimated in previous experimental accounts:

- if the postN varies, the articulatory target of the assimilating N also varies; and the way to cover the distance from the vocalic aperture to the specific articulatory target will be different all the more so. *Antero-posteriority of the N by itself is not a good predictor of whether and to what extent the N has assimilated to the postN*. Rather, a *proportioned perspective* has to be adopted, in order to correctly evaluate the degree of assimilation of the N.
- target indeterminateness, as attested in our data, complicates the picture to a great extent. Points **a)** and **b)** are both difficult to account within a traditional segmental perspective, because the phonetic details of the “assimilated” consonant are specific to its *assimilation environment*, in terms of the precise closure place.

We propose therefore that N-to-V clusters are to be conceived of as a constituent with one articulatory target and a complex gestural pattern distributed over a relatively extended temporal interval (cf. Local 1992, Nolan 1992, Flemming 2001 for similar observations)

Sporadic cases of **partially or un-assimilated** clusters were also attested in the corpus.

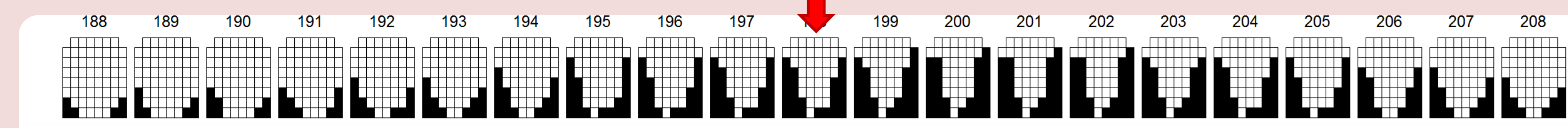
- palatal spreading**, i.e., the contacted area may reach rows 4. Affects slow speech (38 occurrences) more than normal speech (12 occurrences).



- fronting**, i.e., constriction area extends up to the alveolar region (rows 1 to 3). Occurs exclusively in slow speech, and predominantly across a word boundary (7 occurrences in total).

Two typologies:

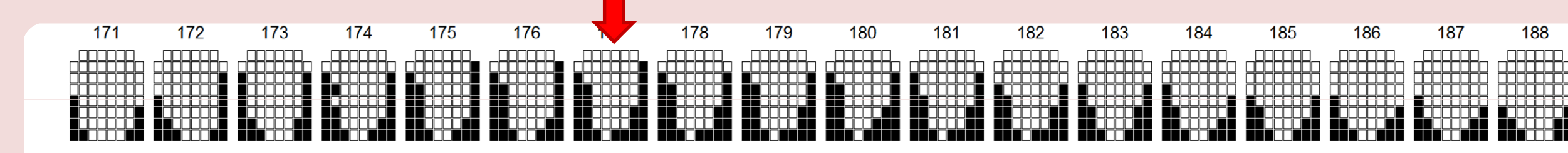
Type 1 - the fronted configuration spreads to the postN: MaxC is situated in the production of the PostN, which therefore appears to be a fronted (i.e., palatalized) velar. (4 occurrences).



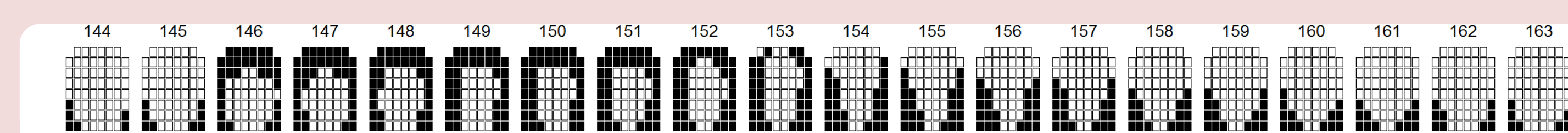
It is possible to hypothesize that similar palatalized realizations of the postN, preceded by anteriorized N, are the product of a gestural *blending* strategy by which two adjacent consonants result into a compromise articulatory outcome at an intermediate constriction location (Browman and Goldstein, 1989).

Type 2 - the fronted configuration is confined to the N: MaxC is situated in the production of the N. (3 occurrences)-

We consider this kind of realization as an example of **partially assimilated cluster**, where the constriction place of the N shows residual contacts in the alveolar region (see Ellis & Hardcastle 2002 for English).



- totally unassimilated** clusters, i.e., the N shows a full alveolar stop closure with row 1 and 2 completely contacted, while the postN is produced with a fully back constriction. 2 occurrences in slow speech, across a word-boundary.



The difference between the two types of cluster fronting lies therefore in the relative position of MaxC with respect to cluster execution: Type 2 cluster anteriority appears to parallel to a great extent the configurations of incomplete assimilation with residual alveolar gesture found for English /n#k/ clusters (Ellis & Hardcastle 2002), while Type 1 cluster anteriority can be seen as obtained through a production strategy distinct from (partial) assimilation, i.e., blending. **Blending** is traditionally said to be favored in clusters where both the first and the second consonant are relatively unconstrained and in this sense it represents an alternative mechanism to assimilation, which is expected to take place when the second consonant is more highly constrained than the first (Recasens 2008). If the interpretation of Type 1 cluster anteriority as the result of gestural blending is correct, blending and gradual assimilation would behave *substantially the same*, except for relative timing of gesture organization.

CONCLUSIONS

This study confirms that Italian N-to-V assimilation process tends to be categorical and pre-velar Ns are fully assimilated to the following stop. Deviations from this general pattern appear to be marginal in quantitative terms.

• However, EPG examination shows that speakers’ gestural control may vary as a function of communicative and grammatical context, with a tendency for **categorical** assimilation to emerge when the level of gestural control is lower (normal/casual speech) and for **gradience** to become visible when gestural control is higher (slow/careful speech).

• In both cases of total and partial assimilations, the two segments within the cluster appear to interact in a nearly deterministic manner.

Bi-directional effects in place specifications for nasal-to-velar assimilations demonstrate that nasal and velar gestural targets accommodate each other in a two-way (instead of merely anticipatory) interaction and require the assimilated cluster to be considered as a single gestural unit.

A realistic account of nasal place assimilations should not be limited to a description in terms of relative antero-posteriority of the two segments; instead, it entails a dynamic picture of the gestural organization across the cluster and the relative timing of back/front lingual movements.

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