

Practical challenges in polylexical metronome synchronisation

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Abstract

A metronome synchronisation paradigm was used to investigate possible interaction between P(erceptual)-centre location and initial mutation in Irish (Gaelic). A pilot study returned promising results in a subset of stimuli. Data later collected using only these stimuli differed from those of the pilot: participants exclusively synchronised metronome beats with the possessive particle preceding main lexical targets. In the pilot task, monosyllables as the minimal target, as opposed to exclusively disyllabic two-word possessive phrases in the modified task, may have focussed participants on these. This conditioning has been reinstated in a third version of the task by preceding target phrases with a dummy monosyllable.

Keywords: Methodology, P-centre, metronome synchronisation

Introduction and background

This paper discusses a problem arising with participant treatment of a metronome synchronisation task. Relevant context and background are presented briefly below. The problem itself is then detailed, and its speculated provenance is discussed. A solution to the issue for future work is sketched. This is followed by a summary and conclusion.

Background on P(erceptual)-centres and initial mutation in Irish

The present matter arose as part of doctoral research involving the relationship between prosody and morphophonology in Irish (Gaelic). Part of this work is concerned with *P-centres* (the perceptual ‘downbeat’ of a syllable; Morton *et al.* 1976) and one of two *initial mutations* which characterise Irish lexical morphology.

P-centres and metronome synchronisation

P-centres are the moment of perceptual occurrence of a syllable (Morton *et al.* 1976). There has been considerable investigation of acoustic correlates of the P-centre (Marcus 1981; Barbosa *et al.* 2005; Villing *et al.* 2011, *inter alia*) and environmental influences on its location (Marcus 1981; Fowler and Tassinari 1981; Cooper *et al.* 1986; Fox and Lehiste 1987; Šturm and Volín 2016). P-centre movement has been described in response to onset complexity (Fowler and Tassinari 1981), as well as number of syllables in a target (Lehiste 1987). There has also been limited investigation of morphophonological influences on

P-centre location. Franich (2018) reports a significant effect of item derivation status on P-centre location in Medumba, a Bantu language with morphological prenasalisation of initial consonants.

There are numerous methods for estimating P-centre location (for an overview of existing methods, see Villing *et al.* 2011). For investigation of higher-level influences on P-centre location *metronome synchronisation* is popular, as it is easy to implement and straightforward in analysis (Fowler and Tassinary 1981; Fox and Lehiste 1987; Šturm and Volín 2016; Franich 2018). In this method, participants are instructed to repeat target stimuli ‘in time’ with an audible metronome beat (MB); the P-centre is estimated as the point with which participants align MBs.

Initial mutation

Initial mutation refers to a family of phenomena which alter the segmental character of a lexical item’s left edge for morphosyntactic purposes. Two such mutations exist in Irish: historically spirantising ‘lenition’ (or *séimhiú*) and historically nasalising ‘eclipsis’ (or *urú*). These are variously used to signal tense, phrasal relationships, and grammatical gender and number. Eclipsis was selected for study in the present work, as its character and implementation were more amenable to controls relevant to the phenomenon under examination.

The relationship between mutated lexical items and their ‘underlying’ forms is a matter of interest in the literature, both in terms of production (Falc’hun 1950; Scully 1973; Ball and Müller 1993; Welby *et al.* 2016) and perception (Usishkin *et al.* 2017). This study investigated whether P-centre locations varied between mutated and unmutated members of homophone pairs (e.g. *a bpá* ‘their pay’ and *a bá* ‘her sympathy’, both /ə bʲɑː/).

Two metronome synchronisation tasks

A metronome synchronisation task was designed to investigate the relationship between eclipsis and P-centre location. In a pilot study, a large list of stimuli was prepared. Target monosyllables containing a long vowel were presented: in isolation (e.g. *pá* ‘pay’), following the possessive particle *a* with or without eclipsis (e.g. *a (b)pá* ‘her/their pay’), or in one of two three-word prepositional phrases (e.g. *ar a (b)pá* ‘on their/her pay’ or *ar an bpá* ‘on the pay’). Additionally, target lexical items could have either a singleton or cluster onset. Each of these conditions had a particular reason for inclusion at the time of design, relating to previous work on P-centres.

Three native speakers of the Waterford sub-variety of Munster Irish were recruited for the pilot study. Stimuli were presented on a desktop monitor while participants heard a 60 beats-per-minute MB over headphones. When a new stimulus was presented, they were instructed to repeat the word/phrase ‘in time’ with the MB until it was changed. Two of three participants treated the

task in the intended way. Results for these two participants showed that, for simple possessive phrases with singleton-onset main lexical targets, estimated P-centre location within onsets corresponded strikingly between lexical matches (e.g. *a pá* ‘her pay’ – *a bpá* ‘their pay’), rather than between homophones (e.g. *a bá* ‘her sympathy’ – *a bpá* ‘their pay’). The third participant did not show this correspondence, but did robustly differentiate between mutated items and their unmutated homophones.

For main data collection, the metronome task itself was unchanged. Stimuli, however, were now restricted to simple possessive phrases with singleton onsets. These represent the overlap of the simplest environment for eclipsis (possession) and maximal segmental control (possessive *a* + bilabial consonant + /ɑ:/), allowing presence/absence of mutation to be the only substantial variable. 7 native speakers of Waterford Irish took part in the first round of data collection. Instructions were modified to prevent the task interpretation shown by the third pilot participant.

Results were extremely uniform, but completely unlike those of the pilot. Instead of showing any clustering of P-centre location by condition (whether by lexical {*pá* – *bpá*, *bá* – *mbá*} or homophonic {*bá* – *bpá*, *mbá* – *meá*} pairing), MBs consistently fell roughly 150ms before target lexical item onset. This was not merely inconvenient, it was inconsistent with the psychoacoustic basis of the P-centre. P-centres are well-documented to move as a function of onset characteristics. Participants seem to have synchronised MBs not with the target lexical items, but with the initial possessive particle *a*. The latter’s invariance across all conditions is consistent with the uniform placement of MBs. In the pilot study, the inclusion of target items in isolation, alongside phrasal contexts, may have unintentionally, but helpfully, guided participants’ attention.

Going forward, all target phrases will be preceded by a dummy monosyllable *tá* to be repeated in alternation with the target itself (e.g. *tá* – *a pá*). This will serve to reinforce participant focus on the lexical items of interest, rather than on whole phrases with initial *a* as synchronisation target.

Conclusion

In the absence of guidance, participants in a metronome synchronisation task may align MBs with the wrong part of a stimulus. This is a challenge for the collection of data on P-centre location in polylexical contexts, as in the study of Irish initial mutation described above, the nature of which required the use of phrasal stimuli with the items of interest in non-initial position.

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