

Allotonic variants are not stored in the lexicon: evidence from a Ganong experiment with allotonic gaps

Stephen Politzer-Ahles¹

¹University of Kansas (USA)

Introduction. Because of phonological alternations, there are some productions that occur as surface realizations of other lexical items, even though these productions don't correspond to the citation form of any word on their own. For example, in Mandarin there is no morpheme whose canonical pronunciation is ka^2 , but the syllable ka^2 nevertheless occurs as a potential allomorph of the existing morpheme ka^3 , the tone of which changes from Tone 3 to Tone 2 in certain phonological contexts.

The goal of the present study was to examine whether such productions (hereafter referred to as "allotonic gaps") are processed like real words (because listeners do have experience hearing them) or like pseudowords (because they are not the canonical form of any word). Episodic accounts of lexical representation would predict these stimuli to pattern like words, whereas abstractionist accounts would predict them to pattern like pseudowords. We test this question using a Ganong paradigm [3], which is known to distinguish between real words and pseudowords, and which has been successfully applied to tonal continua such as those used in the present study [2, 6, 8].

The present experiment is a follow-up from two initial attempts to test this question. The first attempt (N=100) observed a standard Ganong effect, but the critical continua involving allotonic gaps patterned like neither words nor nonwords, which prevented us from making any clear conclusions. The second attempt (N=100) failed to elicit a Ganong effect at all. Thus, the present study is a new attempt to address this question, using newly selected and recorded stimuli.

Methods. We selected stimuli to form Tone-1-biased continua, Tone-2-biased continua, and critical continua involving allotonic gaps. The design is shown in Table 1. T1-biased continua are expected to yield more T1 responses than T2-biased continua (the Ganong effect). If allotonic gaps are processed like pseudowords, then continua contrasting T1 real words with T2 allotonic gaps ("T1-T2[?]" continua) do) should also be T1-biased, and thus should elicit more T1 responses than T2-biased continua. On the other hand, if allotonic gaps are processed like real words, then continua contrasting T1 pseudowords with T2 allotonic gaps ("T1*-T2[?]" continua) should be T2-biased, and thus should elicit fewer T1 responses than T1-biased continua do.

We recorded natural tokens of each item in both T1 and T2, and for each item we used Tandem-STRAIGHT [4] to create a 20-step continuum between these endpoints. We selected seven steps to use in the experiment, including the two endpoints and five steps near the categorical boundary estimated by several Mandarin speakers we consulted.

Data were collected from 61 native Mandarin speakers online using the Gorilla experiment control platform (www.gorilla.sc) [1]. Each participant heard 5 repetitions of each token, yielding 29,890 observations (5 repetitions * 7 steps * 14 continua * 61 participants).

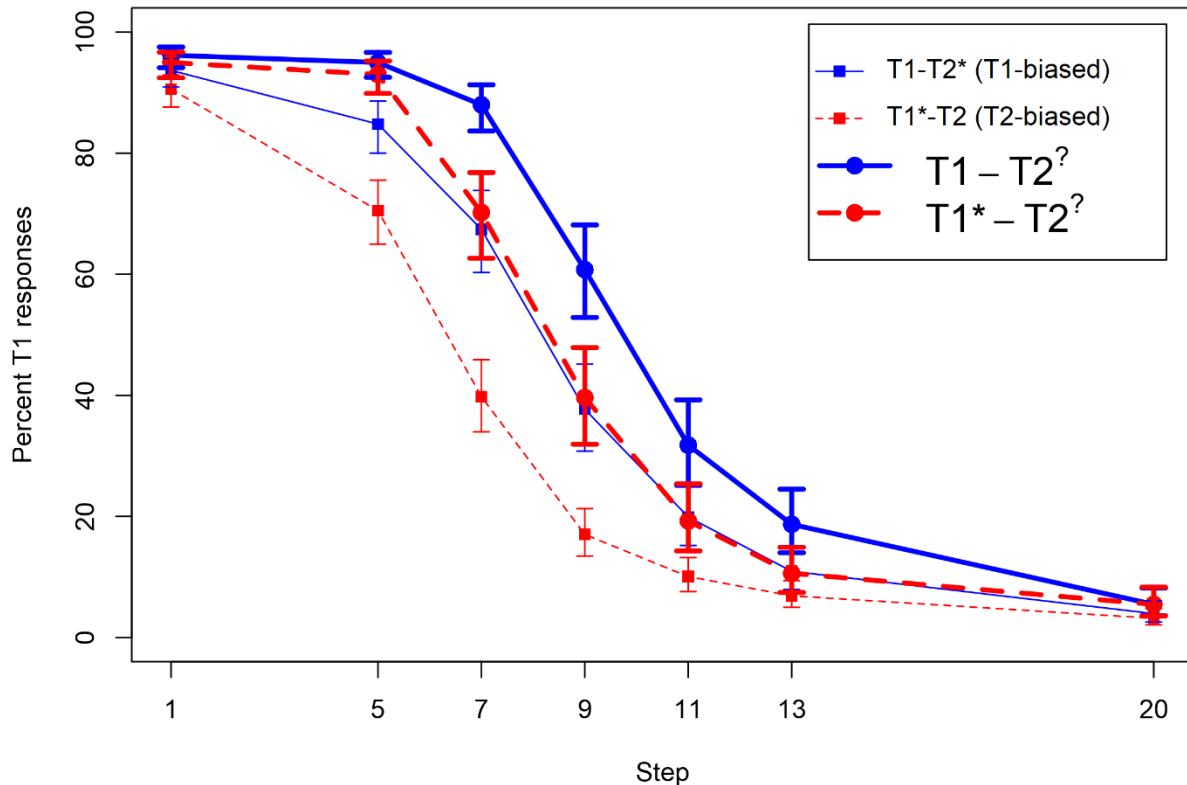
Results. Results are shown in Figure 1. T1-biased continua elicited more T1 responses than T2-biased continua, as expected; this confirms that the present experiment was able to elicit a Ganong effect. More importantly, T1-T2[?] continua also elicited more T1 responses than T2-biased continua did. This is what would be expected if allotonic gaps are processed as nonwords (such that a T1-T2[?] continuum is processed like a T1-T2*, i.e. T1-biased, continuum). Furthermore, T1*-T2[?] continua did *not* elicit fewer T1 responses than T2-biased continua did; this result is *not* what would be expected if allotonic gaps are processed as real words.

Discussion. Overall, the results suggest that allotonic gaps are processed as if they are not real words. Even though people *do* hear these syllables in actual language use and they are meaningful, they are not represented in the lexicon. This finding is consistent with abstractionist views of the lexicon, in which surface detail is stripped away from at least some aspects of lexical representation.

The inconsistency of the Ganong effect in the experiments that preceded this one also raise questions about the robustness of the Ganong effect for tone continua. We do not yet have a satisfactory explanation for this and further study is needed, but the inconsistency may be related to the markedness of T1 and T2 in Mandarin, or to the general low information load and high mutability of tones in Mandarin lexical processing [5, 7]. We thank anonymous reviewers for suggesting these explanations.

Table 1. Continua used in the experiment

Condition label	Description	Syllables used
T1-T2*	Existing word in T1 but pseudoword in T2	<i>diu, sai, yue</i>
T1*-T2	Pseudoword in T1 but existing word in T2	<i>huai, lai, ni</i>
T1-T2 [?]	Existing word in T1 and T3, but allotonic gap in T2	<i>biao, jian, kai</i>
T1*-T2 [?]	Existing word in T3, but not in T1. Allotonic gap in T2	<i>gei, nuan, nü</i>

**Fig. 2.** Results. The standard Ganong conditions are shown in thin lines, and the critical conditions involving allotonic gaps are shown in thick lines.**References**

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