Frequency information and reduction in second-language perception of multi-word sequences[1]

David Tizón-Couto[1], David Lorenz[2]
[1]Universidade de Vigo, Spain
[2]Lunds universitet, Sweden

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Abstract

Entrenchment of multi-word sequences is known to shape native language competence, but there is debate about how (much) it affects L2 speakers. We investigate advanced English learners' receptive processing of multi-word sequences with a word-monitoring experiment. The effect of reduction on recognition of the word *to* was tested in English V-*to*-V_{inf} constructions of varying surface frequencies and transitional probabilities. Results show that high frequency facilitates recognition of both full and reduced forms. Unlike with native speakers, there is no chunking effect of high-frequency reduced forms, and no facilitating effect of transitional probability. The findings suggest that advanced L2 learners draw on basic frequency information, but do not make use of the full range of probabilistic cues available to native speakers.

Keywords: multi-word sequences, second language processing, phonetic reduction

Introduction

Effects of frequency and *entrenchment* of multi-word sequences are well-attested in the native language (see Blumenthal-Dramé 2018; Arnon & Snider 2010). The cognitive entrenchment of frequently occurring sequences comes in the form of 'chunking' (accessing the sequence as a single unit) and of 'procedure strengthening' (predicting the next step in a sequence) (see Siyanova-Chanturia 2015). Entrenchment effects of frequent collocations have also been found in speakers' second language (L2; Ellis et al. 2016; Supasiraprapa 2019). But how do they play out in connection with phonetic reduction, given that reduction is especially challenging in L2 speech perception (Ernestus et al. 2017)?

This study investigates advanced English learners' receptive processing of multi-word sequences, using a word-monitoring experiment. Recognition time of the element *to* in V-*to*-V_{inf} constructions (e.g. *need to go*, *prefer to stay*) was tested for full and reduced renderings ([tʊ] vs [ɾə]), conditioned by the general frequency of the V-*to* sequence and the transitional probability (TP) of *to* given the verb (V > *to*). The experiment replicates a study with native speakers (Lorenz & Tizón-Couto 2019), so the results can be compared directly.

The crucial question is how frequency information and reduction interact in L2 perception. Do second language learners rely on probabilistic information in the receptive processing of multi-word sequences? How do frequency-based

expectations affect their recognition of reduced forms? To what extent do they process frequent collocations as holistic units (*chunks*) or predictable sequences?

We assume recognition time of an item in a sequence (such as *to* in V-*to*-V_{inf}) to be indicative of the perception of the input. A faster recognition signals that the element was predictable based on high bigram frequency or transitional probability. Such predictability can also mitigate the perceptual difficulty posed by reduced forms. When recognition is slow, the item may have been unexpected due to low bigram frequency or transitional probability. However, a delayed recognition of an element in a high-frequency collocation can also be an effect of chunking, as the holistic perception initially hinders the recognition of the individual element (Sosa & MacFarlane 2002; Kapatsinski & Radicke 2009). Thus, the entrenched access routes of sequential or holistic processing ('procedure strengthening' or 'chunking') can be distinguished by their different outcomes in the word-monitoring experiment.

Experiment design

The participants were 44 Spanish learners of English with a certified C1-C2 level of proficiency. In the experiment, they listened to recorded sentences and reacted to hearing the word *to*. The input items are 126 sentences, of which one third each are target, control and distractor items. Target items contain *to* within a V-*to*-V_{inf} construction (*If the camel's sick we have to give him his medicine*), control items contain *to* in a different context (*When the monkeys are friendly to you they don't mean it.*), and distractors do not include *to*. Participants were to hit the space bar immediately upon hearing the word *to*; another button when *to* was absent from the sentence. The response and reaction time (from onset of *to*) were recorded.

Each participant heard half of the target items with a full pronunciation [tʊ], the other half with a reduced *to* [ɾə]. One group heard, e.g., *need* [tʊ] and *forget* [ɾə], and the other heard *need* [ɾə] and *forget* [tʊ]. Apart from this condition, the items were the same. The stimuli were presented in random order.

Results

The analysis of response times concerns only correct responses to target items. After removing individual outliers (by-subject z-score > 2.5), the final data set comprises 1,372 data points. We analyzed the results with a mixed-effects generalized additive model (Wood, 2017) on the logarithmized response times. The main predictor variables are (logarithmized) bigram frequency (V + *to*) and transitional probability (V > *to*), moderated by 'condition' (full or reduced *to*). Random effects and control variables were included to ensure the reliability of the model; see Lorenz & Tizón-Couto (2019: 760–761) and Tizón-Couto & Lorenz (2024: Section 2.3) for the modelling procedure.

Both L1 and L2 speakers' recognition of reduced items is slower compared to full forms (see Figure 1). For advanced learners, this is mitigated when the

sequence has a high frequency (lower left panel), while TP has no such effect (lower right panel). Thus, advanced learners seem to profit from frequency-based expectations in speech perception when the input is reduced. Native speakers show a more diverse pattern when reduction is present, most notably including a chunking effect of delayed recognition of reduced high-frequency strings (upper left panel) and a facilitating effect of TP (upper right panel).

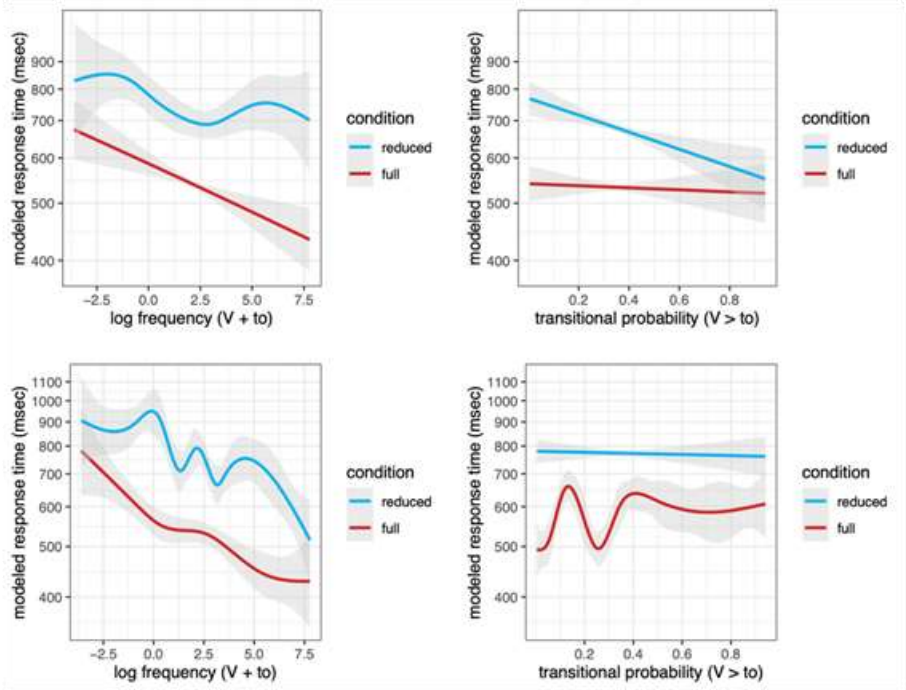

Figure 1. Response times to full and reduced items by FREQUENCY (left panels) and TP (right panels). Native speakers (upper panels) vs. advanced learners (lower panels).[2]

Discussion

We conclude that, firstly, (advanced) learners' access to linguistic structures is more compositional than native speakers'. Secondly, they do take recourse to entrenched sequences to recover reduced input forms, but do not seem to derive expectations from transitional probabilities; as TP is more complex than surface frequency, it may require more and richer usage experience to become part of a language user's intuitive perception. Consequently, reduction implies a greater setback for advanced learners, who rely less on statistical information and compensation strategies generally available to native speakers (cf. Baese-Berke et al. 2018). Overall, advanced learners show sensitivity to frequency information in their speech processing, but the range of it is more limited than

in native speakers (cf. Ellis, Wulff 2020). We attribute these findings to learners' lesser experience with spontaneous speech and phonetic reduction.

Notes

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2. See Figure 4 in Lorenz & Tizón-Couto (2019) and Figure 2 in Tizón-Couto & Lorenz (2024).

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