WORD-LEVEL PROMINENCE AND "STRESS DEAFNESS" IN MALTESE-ENGLISH BILINGUALS

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ABSTRACT

This study investigates "stress deafness" in bilingual speakers of Maltese and Maltese English. Although both reportedly have lexical stress, the acoustic cues to prominence appear to be relatively weak. Further, word-initial pitch peaks make pitch an unreliable cue to lexical stress, which can be elsewhere in the word. In a sequence recall task, we show that speakers dominant in Maltese exhibit a classic "stress deafness" effect, similar to speakers of French. Speakers who identify as balanced or Maltese English dominant have more diverse results and do not show such a strong tendency towards "stress deafness". These speakers may rely on their exposure to other varieties of English to identify (and recall) word prominences. This study suggests that the nature of stress in Maltese might need to be revisited.

Keywords: stress, prominence, perception, Maltese, Maltese English, sequence recall

1. INTRODUCTION

The difficulty of processing prominence contrasts at a more abstract level under high cognitive load has been the subject of research yielding the somewhat controversial "stress deafness" (SD) phenomenon [e.g. 1-9]. There is consensus that the perceptual (in)sensitivity to prominence contrasts differs as a function of the presence or absence of lexical stress, or some form of word-level prominence, in the native language. Specifically, speakers of languages that lack lexical stress (under other accounts, languages that lack contrastive or have unpredictable lexical stress [4;5]), are expected to perform worse on recalling sequences of stimuli with prosodic prominence contrasts compared to speakers of languages with stress. For example, native speakers of French, Indonesian, and Persian form a cluster of populations exhibiting the SD effect in contrast to Dutch and Japanese listeners who exhibit better performance [6].

This study is concerned with "stress deafness" in Maltese-English bilinguals differing in language dominance. Maltese and English co-exist in the repertoire of most Maltese, in a context shaped by historical events and demographic shifts which have resulted in a rich and complex linguistic landscape [10]. Thus, Maltese/English language contact as well as the prosodic characteristics of the two languages make Maltese and Maltese English (hereafter, MaltE) interesting test cases for the distinction between "stress deafness" and stress sensitivity in speakers/listeners of different languages.

Maltese and MaltE are both reported to have weight-sensitive lexical stress [11;12]. In fact, although MaltE prioritises weight over other factors when assigning stress, there is also a strong tendency to avoid stress falling earlier than on the penultimate syllable, e.g. in compounds, making stress placement more regular than in mainstream varieties.

To date, there has been no full-scale empirical study examining the phonetic cues to lexical stress in Maltese. The few studies on Maltese stress report an inconsistent relationship between stress and vowel duration [13;14]. They also report that neither Maltese nor MaltE reduce the quality of unstressed vowels [12;15;16]. Thus, in both Maltese and MaltE the cues to stress appear to be relatively weak. This does not seem to be compensated for by pitch. Although Maltese and MaltE are intonational languages that have regular pitch accents [17], they commonly exhibit additional initial peaks on unstressed syllables [18-21], making the location of a pitch peak an unreliable cue to stress too. It appears that words in both Maltese and MaltE can have more than one type of prominence: lexical stress prominence and pitch prominence on the initial syllable. The existence of these different types of prominence raises questions about the perceptual status of word prominence for Maltese-English bilingual speakers as well as about their ability to process it at a more abstract level.

The main question we put forward in this study is whether Maltese listeners are sensitive to varying locations of word prominence. Secondly, given the bilingual situation in Malta, we ask whether language dominance (Maltese vs. English) affects listeners' sensitivity and consequently their processing of word prominence at a more abstract level. In the local Maltese context, most bilingual Maltese-English speakers operate in both languages on a daily basis. Whilst the notion of *balanced* bilingual persists, it is more likely that many of these bilinguals will be more dominant in one of their two languages than in the other [22;23]. The construct of language dominance, although increasingly invoked in the literature, is not easy to define or operationalise [23]. It nevertheless continues to feature as important in research involving bilinguals since there is clear evidence that it impacts on participants' performance in different tasks [24]. A number of studies on Maltese bilinguals [e.g. 25] acknowledge that bilinguals' choices in language use are as important to determining dominance as is proficiency, perceived or actual [23]. To this end, we hypothesize that given the weak and competing cues to word prominence, Maltese listeners will exhibit a SD effect. Yet, we expect the degree of SD to covary with the nature of the individual's bilingual profile, with more English dominant bilinguals possibly being more sensitive to stress-related prominence, in the absence of competing prosodic enhancement, than more Maltese dominant bilinguals. This is related to the likelihood for speakers who make more use of MaltE to have greater exposure to other varieties of English, in which the acoustic cues to lexical stress are stronger.

2. METHODOLOGY

This study is concerned with understanding the perceptual status of word prominence in Maltese using the Sequence Recall Task (SRT) developed by [1]. In this task participants are required to learn to associate two words representing a phonetic difference (segmental or prosodic) with a specific key on the keyboard. Once the association is established, participants are presented with sequences of varying lengths (in past studies ranging from 2 to 6) made up of contrasting words and asked to reproduce the order of the words in the sequence by pressing the relevant keys. To allow for a direct comparison with SD (e.g. Indonesian, Persian and French) and non-SD (e.g. Dutch, Japanese) reference group listeners, we replicate the design of [6] using the same experimental setup including the exact acoustic stimuli and experimental details such as inter-stimulus interval and sequence orders. The only change we made was implementing it to run in OpenSesame [26].

2.1. Experiment

2.1.1. Stimuli

Two sets of minimal pairs consisting of pseudowords are used as stimuli in the task: the segmental pair /ˈmuku/~/ˈmunu/ which tests the ability to discern a segmental contrast, and the prosodic pair /ˈnumi/~/nuˈmi/ which tests a prominence contrast. The minimal pairs are produced by 2 Dutch and 2 Persian speakers (1 male, 1 female in each language group). The realisation of the prosodic minimal pair varies in terms of phonetic cues (duration/pitch/vowel quality for the Dutch stimuli, and pitch only for the Persian stimuli, cf. [6]). Each speaker produced three instantiations per pseudoword and all tokens were time-compressed to 450ms for comparable duration.

2.1.2. Experimental procedure

The recall tasks (segmental/prosodic) were presented in a counterbalanced order across participants. Each task consisted of 4 parts: word presentation, word identification, practice SRT (2 words), main SRT (3 to 5 words) (for additional information see [6]). At the end of each sequence in the main SRT, the word "OK" was played to flush acoustic memory. The response key for /ˈmuku/ and /ˈnumi/" was "1", for /ˈmunu/ and /nuˈmi/ it was "2". In the main SRT 5 different patterns were presented per sequence length (e.g. for length 3: 122, 121, 122, 211, 212), yielding a total of 15 test items (3 lengths x 5 items), repeated twice, once for each stimulus language. The resulting 30 test items were presented in random order, and speaker (male/female) and acoustic token combinations were determined randomly. In total this yielded 60 items per experiment (30 for each SRT, segmental/prosodic). The entire experiment lasted ca. 35 minutes.

2.1.3. Participants and exclusion criteria

64 Maltese native speakers (age range: 18-28; 29-40; 41-60; > 61, with the majority, 47 out of 64, falling into the 18-28 range) were recruited for this study. Participants were divided into two groups according to their language use choices [23], specifically, as to their choice of language when speaking to close friends and family. The two resulting groups were a Maltese dominant (*N*=32) and a balanced/MaltE dominant group (*N*=32). 9 participants were excluded from the analysis, 4 due to complex linguistic background (e.g. exposure to multiple other languages at home), and 5 due to technical issues. We additionally decided on a cut-off minimum performance in the segmental SRT in order to exclude participants who apparently failed to concentrate on the task: we excluded 4 participants who scored correctly on fewer than 10 (i.e. 33%) of the sequences in the segmental task. Following this criterion for the joint analysis with data from [6] (see section 3.2), we also excluded 1 French participant reported on in [6] as scoring < 10. After the above exclusions, we are

able to report on results from a total of 25 Maltese dominant and 26 MaltE dominant participants.

2.2. Analysis and statistics

The response variable is binary i.e. is a correct response given for an item. We ran binary logistic regression models with *glmer()* [27] in R [28] with main effects for: TASK (segmental/prosodic), LENGTH (3/4/5), SPEAKER (Dutch-f/Dutch-m/Persian-f/Persian-m), and listener GROUP (Maltese/MaltE dominant, M and ME below). Scripts and data are available at https://osf.io/62nc3/ on the OSF platform.

We ran one model on the full dataset from both SRTs, which included interactions for TASK with SPEAKER and TASK with GROUP, and an interaction between SPEAKER and GROUP. The random effects structure included an intercept for participant and a random slope for by-task variation in performance across participants. Following the observation that there were no GROUP differences on the segmental SRT, we continued the analysis with a model that exclusively ran on the prosodic SRT (dropping the main effect of TASK and its possible interactions), allowing the inclusion of by-listener random slopes for SPEAKER. Estimates and SEs were generated with the package *emmeans* [29], with Tukey correction for multiple comparisons. *p*-values were generated through LRTs between full and null models for the predictors tested. Predicted probabilities and 95% CIs were also from *emmeans*.

3. RESULTS

3.1 Maltese versus MaltE dominant speakers

Mean model predictions (back transformed from the logit scale), for the segmental contrast, were the following: sequences of length3 had a probability of a correct answer of 0.87 (ME) / 0.83 (M), dropping to 0.60 (ME) / 0.52 (M) for sequence length5. For the prosodic contrast, the mean probabilities of a correct response for sequences of length3 and length5 were 0.69 (ME) / 0.60 (M) and 0.33 (ME) / 0.25 (M), respectively. The model showed a main effect of LENGTH ($\chi^2(2)$ = 224.97, p<0.0001, and all pairwise significant at p<0.0001: length3-logit = 1.17, SE = 0.13; length4-logit = 0.49, SE = 0.12; length5-logit = −0.34, SE = 0.12). There was also a main effect of TASK with higher scores on the segmental task (prosodic-logit = −0.12, SE = 0.11; segmental-logit = 1.01, SE = 0.12, p<0.0001), but no interaction between GROUP and SPEAKER, nor main effects.

For subsequent analysis we ran models on the prosodic SRT separately. Predicted mean correct scores and 95% CIs on the prosodic task are shown in Figure 1, with separate estimates for the different stimulus speakers. Performance on the prosodic task again showed an effect of sequence LENGTH ($\chi^2(2)$ = 93.21, p<0.0001, all pairwise significant at p<0.01: length3-logit = 0.49, SE = 0.20; length4-logit = −0.02, SE = 0.20; length5-logit = −0.94; SE = 0.20). There were no group differences but there was a SPEAKER effect: the Dutch female speaker's stimuli yielded more incorrect responses than the Persian male speaker's (p<0.05: Dutch-f-logit = −0.45, SE = 0.21; Persian-m-logit = 0.12, SE = 0.20).

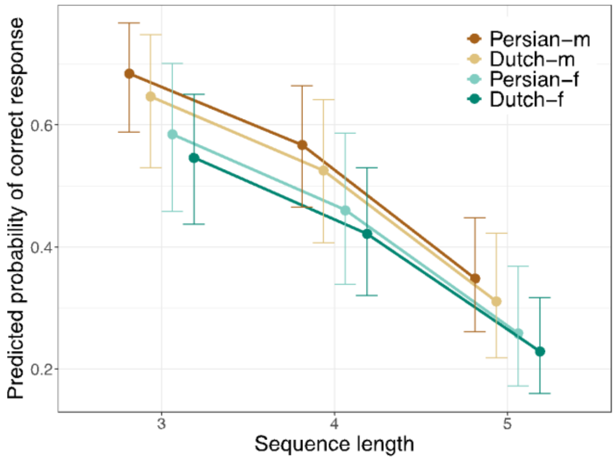

Figure 1: Predicted probability and 95% CIs for a correct response on the prosodic SRT, pooled across listener groups and separated by stimulus speaker (Persian/Dutch, m/f).

3.2. Comparison with results from [6]

For the purpose of a direct comparison with the SD and non-SD groups in [6], we ran a model on the joint prosodic data from the present experiment, and the original raw data from [6]. Model specification is identical to the prosodic model from 2.2, with the exception of the change from stimulus SPEAKER to stimulus LANGUAGE (speaker is not available for the data from [6]). Predicted probability of a correct response is shown in Figure 2.

The scores of the Maltese dominant group are similar to those of the SD groups from [6] (Indonesian, French, Persian), while the MaltE dominant group performs better. Model comparisons on the GROUP level confirm that: i) the known "non-stress deaf" Dutch and Japanese groups perform significantly better (all comparisons are significant at p<0.05) than the known "stress deaf" groups Indonesian, French, and Persian (confirming the analysis from [6] with a different statistical implementation); ii) the Maltese dominant group performs significantly worse than the "non-stress deaf" groups, but not different from the known "stress deaf" groups; iii) the MaltE group does not differ significantly from any other group, including the Maltese dominant one.

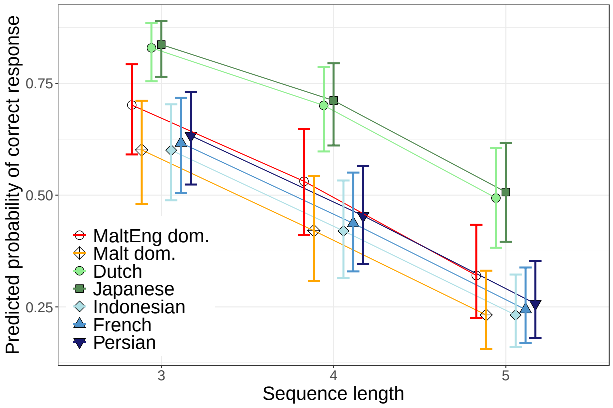

Figure 2: Predicted probability and 95% CIs for a correct response on the prosodic SRT for the combined Maltese data and [6], per participant group, averaged across stimulus language.

4. DISCUSSION

4.1. A "stress deafness" effect

The above results provide clear evidence that native Maltese speakers who are dominant in Maltese pattern with the known SD groups. In contrast, native Maltese speakers who are balanced users of Maltese and MaltE or dominant in the latter, exhibit more varied behaviour. Whereas these speakers behave no differently from Maltese dominant speakers (section 3.1), in a larger comparison with known SD and non-SD groups (section 3.2), they additionally perform neither better nor worse than any other group. The result is that they straddle the SD vs. non-SD dichotomy that exists between the other groups.

In contrast to most previous studies, we did not aggregate response scores across participants prior to statistical analysis, yielding more insight into within-group variation in performance. The large overlap in CIs between the MaltE and SD groups suggests that the MaltE group is tendentially more SD-like, although this sample did not perform significantly worse than non-SD groups. Future work is planned to seek the individual-level factors that yield better performance and model Maltese/MaltE dominance as a continuous factor to investigate whether there is a degree of English dominance that serves as a threshold for "non-stress deaf" performance.

4.2. Acoustic properties of stimuli

In section 3.1. we discussed a SPEAKER effect: the stimuli spoken by the Dutch female speaker yielded lower performance than those from the Persian male speaker (the speaker yielding the highest correct scores). In an earlier replication of [6], [9] reported a similar effect for Tashlhiyt Berber and Moroccan Arabic participants. The stimulus effect was explained with reference to the phonetic details of the stimuli spoken by the Dutch-f speaker, which diverged considerably from the productions of the other three speakers. Firstly, no durational difference is found between the initial syllables of the two pseudowords as a function of stress (i.e. stress in these tokens is not actually cued by durational differences). Secondly, the fundamental frequency (f0) patterns for all tokens of this speaker's renderings of /nuˈmi/ terminate high as opposed to low (as in the tokens produced by the other speakers). These diverging realisations could potentially result in conflicting prominence cues, affecting participants' performance by hindering a straightforward identification of one of the two syllables as the most prominent one. Although this is a limitation of the study, which we were aware of from the outset [cf. 9], we retained the stimuli from the original study [6] for the purposes of direct comparison across studies [6; 9].

5. CONCLUSION

With a sequence recall task replicating the design of [6] we showed that Maltese speakers, if they are dominant in Maltese, exhibit a classic "stress deafness" effect. Maltese listeners who are balanced bilinguals or dominant in English, in contrast, do not exhibit the effect to the same extent, as their performance falls between that of known "stress deaf" and "non-stress deaf" groups.

Maltese dominant speakers do not appear to process word-level prominence in the same way as speakers of languages with Germanic-type stress or Japanese pitch accent. We argue that this can be explained with reference to the prosody of Maltese and MaltE, in which lexical stress and prosodic enhancement are not straightforwardly linked. First, weak cues to stress in their native language might prevent them from being fully attuned to the prosodic contrast tested here. Second, they can only make limited use of pitch prominence, which is not exclusively reserved to mark the syntagmatic contrast of lexical stress, since it can often occur on an initial (unstressed) syllable.

The situation might be somewhat different for speakers identifying as Maltese-English dominant or *balanced*. Their performance in recalling stress patterns might be enhanced through greater exposure to mainstream varieties of English, which often lack pitch prominence on unstressed syllables and instead overwhelmingly place pitch prominence on, or in the vicinity of, lexical stress. This could lead them to more easily relate the location of prosodic prominence to that of lexical stress, allowing them to recall the prosodic contrast as an unequivocal categorical contrast.

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