L1 and L2 Speakers' Performance in Receptive Multilingualism

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Introduction: Receptive multilingualism allows speakers to comprehend utterances in a foreign language (e.g., Dutch) using a known language (e.g., English), facilitated by similarities in their vocabulary and pronunciation. However, the development of sound categories in the known language varies between L1 and L2 speakers (Lecumberri et al., 2010). L2 speakers may have less clearly defined or even absent sound categories (Scharenborg & van Os, 2019), leading to less accurate phoneme recognition or auditory word recognition (AWR), particularly in adverse contexts. Consequently, L1 and L2 speakers of the known language may exhibit different levels of comprehension when processing utterances in the foreign language. In this study, we investigate how L1 and L2 speakers process and adapt language to different contexts in receptive multilingualism. We focus on accuracy and reaction time in AWR tasks, exploring the effects of phonological and semantic similarities on the AWR of English words in Dutch-English prime-target pairs. In addition, we examine how the processes differ across various listening conditions. We specifically compare L1 English speakers and L2 English learners with L1 Chinese backgrounds.

Methods: To address the investigation, we conducted web-based experiments on lexical decision tasks in a priming paradigm following that of Kudera et al. (2021). Specifically, to examine priming effects, we introduced four types of word pairs (cognates, false friends, translation equivalents, and fillers) that differ in the degree of similarity in phonological forms and semantics as shown in Figure 1. The contrasts between them aim to determine how the lack of semantic similarity (i.e., false friends vs cognate) and phonological overlap (i.e., translation equivalents vs cognate) impacts AWR. To study the effect of listening conditions, we studied these pairs in five listening conditions including quiet, white noise and babble noise. We had two versions of the experiments differing in the order of conditions as shown in Figure 1. We used *glmer* and *lmer* models in *lme4* and *lmerTest* R packages to study the effects of the treatment-coded contrasts between different prime-target pairs, listening conditions, versions, L1/L2, and their interactions in predicting response correctness and reaction time, respectively as shown in Figure 1.

Results and Conclusion: We recruited 84 L1 speakers and 46 L2 speakers of self-reported intermediate or higher level via Prolific. Figure 2 shows the mean and error bars for accuracy (left panel) and for reaction time of correct responses (right panel). The prediction results showed a significantly lower accuracy of L2 than L1 (β = 0.779023, SE = 0.188443, z = 4.134, $p < 0.0001$) but a null effect of L1/L2 (L1_v_L2) on reaction time (β = -63.222, SE = 57.799, df = 126.805, t = -1.094, p = 0.37837). Also, as expected, L1/L2 showed significant interactions with listening conditions, such as with quiet vs. noise contrast (Q_v_N) for both accuracy and reaction time, suggesting their different performance when noise exists. We found a significant interaction between L1/L2 and cognate vs. false-friend (CG_v_FF) contrasts for accuracy, indicating different effects of lacking semantic similarity between L1 and L2. We also found a significant interaction between L1/L2 and cognate vs. filler (CG_v_FL) contrasts for reaction time, suggesting that L2 speakers appear to be confused with filler words compared to L1 speakers. Note that significance values were corrected based on Benjamini-Hochberg method. Overall, L2 speakers seem to suffer more in more adverse contexts either via listening conditions or linguistic context. Further analyses are necessary to reveal the differences between them.

- Experimental setting:

Listening condition:	1	2	3	4	5
Version 1:	White Noise SNR=0 dB	White Noise SNR=-6 dB	Quiet	Babble Noise SNR=0 dB	Babble Noise SNR=-6 dB
Version 2:	Babble Noise SNR=0 dB	Babble Noise SNR=-6 dB	Quiet	White Noise SNR=0 dB	White Noise SNR=-6 dB

- Stimuli examples:

Type of word pair	Phonological similarity (similar sound)	Semantic similarity (same meaning)	Example	
			Dutch	English
cognate	yes	yes	arm /ɑrm/	arm /ɑːm/
false friend	yes	no	wet /wɛt/ (means *law*)	wet /wɛt/
translation equivalent	no	yes	fiets /fits/	bike /baɪk/
filler	no	no	prent /prɛnt/ (means *print*)	liss /lɪs/

- Statistical model formular and coded contrasts:

CG_v_FF * Q_v_N + CG_v_FF * B_v_W + CG_v_FF * Bz_v_Bs + CG_v_FF * Wz_v_Ws + CG_v_TE * Q_v_N + CG_v_TE * B_v_W + CG_v_TE * Bz_v_Bs + CG_v_TE * Wz_v_Ws + CG_v_FL * Q_v_N + CG_v_FL * B_v_W + CG_v_FL * Bz_v_Bs + CG_v_FL * Wz_v_Ws + L1_v_L2 * Q_v_N + L1_v_L2 * B_v_W + L1_v_L2 * Bz_v_Bs + L1_v_L2 * Wz_v_Ws + V1_v_V2 * Q_v_N + V1_v_V2 * B_v_W + V1_v_V2 * Bz_v_Bs + V1_v_V2 * Wz_v_Ws + (1|Participant_id) + (1|audiofile_nr)

Word type	CG_v_FF	CG_v_TE	CG_v_FL
CG	0	0	0
FF	-1	0	0
TE	0	-1	0
FL	0	0	-1

Version	V1_v_V2
V1	0
V2	-1

Language	L1_v_L2
L1	0
L2	-1

Condition	Q_v_N	B_v_W	Bz_v_Bs	Wz_v_Ws
1	-1	-0.5	0	-0.5
2	-1	-0.5	0	0.5
3 (Quiet)	0	0	0	0
4	-1	0.5	-0.5	0
5	-1	0.5	0.5	0

Note. Taking Version 1 as an example.

Figure 1: Experimental setup, examples of stimuli for the four types of words, model formular and the contrasts. Note that the words for English in the fillers are not meaningful, existing words. The variables in the formular are as follows: CG, FF, TE, and FL refer to word types of cognate, false friend, translation equivalent, and filler; Q, N, B, W, Bz, Bs, Wz, and Ws refer to listening conditions of Quiet, Noise, Babble noise, White noise, Babble noise with SNR = 0 dB, Babble noise with SNR = -6 dB, White noise with SNR = 0 dB, and White noise with SNR = -6 dB; V1 and V2 refer to Versions 1 and 2. The contrasts were treatment-coded with cognate, quiet, v1, and L1 as the baselines.

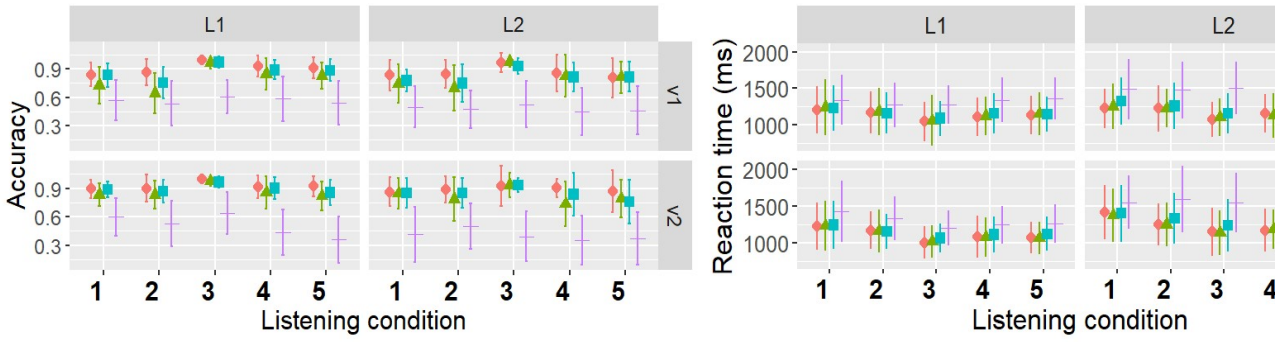

Figure 2: Accuracy (left panel) and reaction time (right panel) plots for the four types of word pairs in five listening conditions. Both L1 and L2 speakers are shown for the two versions of experiments (v1 and v2). The 1-5 on x-axes for v1 (Version 1) and v2 (Version 2) can be found in Figure 1 with 3 refering to the Quiet condition.

References:

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