Effects of Segmental Inventory on Speech Sound Processing

Introduction: It is well-established that the phoneme inventory of a speaker's native language impacts their discrimination of speech sounds (e.g., Werker and Tees, 1984a,b). However, it is unclear whether the presence of a sound in a speaker's L1 phoneme inventory is enough to facilitate the processing of that sound. To investigate this question, this study examines the processing of aspirated and unaspirated stops by speakers of Thai, in which aspiration is contrastive, and Spanish, whose inventory contains only unaspirated stops. While the Spanish inventory may bias the Spanish speakers to process unaspirated stops more easily, the acoustics of the stops predict that it is the aspirated stops that will be easier to process, as these are said to be more perceptually salient (e.g., Wright et al., 2004). Results are reported from an immediate serial recall (ISR) experiment (Experiment 1) and an artificial language learning (ALL) experiment (Experiment 2), both of which tested the processing of aspirated and unaspirated stops by 20 native speakers of Spanish and 19 native speakers of Thai.

Experiment 1: Speakers were presented with sequences of 6 /TV/ syllables. Stops were either all aspirated (e.g., /k^ha k^ha t^ha p^ha t^ha k^ha/) or all unaspirated (e.g., /ka ka ta pa ta ka/). Participants heard each sequence and were asked to repeat it after a brief pause. The repeated sequences were recorded and coded auditorily for accuracy of recalled stop place of articulation. Speakers of both Spanish and Thai remembered syllables with aspirated stops better than those with unaspirated stops ($p = 0.0166$; Figure 1), suggesting that regardless of the phoneme inventory of the participant's language, sounds that are more acoustically salient are easier to recall.

Experiment 2: Speakers learned words in an artificial language by seeing images of objects on a laptop screen and simultaneously hearing the name of each object in the language. Words in the language were disyllabic with a constant vowel and either two aspirated stops (e.g., /t^hik^hi/) or two unaspirated stops (e.g., /tiki/). After the training round, participants saw each image again and heard two words sequentially: one was the correct corresponding name and the other was a distractor word, the name for a different image. Distractors matched the target word in vowel and aspiration (e.g., target: /p^hit^hi/, distractor: /k^hip^hi/). Participants pressed the 1 key if the first word was the correct name for the image on the screen and the 2 key if the second word was correct. The order of the correct and incorrect words was counterbalanced across trials. Results showed neither a main effect of word type nor a significant interaction between L1 and word type. Therefore, acoustic salience was not a predictor of processing in this experiment. Additionally, the presence of one stop type but not the other in the Spanish inventory was shown not to impact word learning results.

Implications: The results of the ISR task provide experimental evidence for the impact of acoustic salience on speech sound processing; across all speakers, the more acoustically salient sound was recalled with higher accuracy. In the ALL task, this effect of acoustic salience was absent. Furthermore, it was shown that the absence of aspirated stops in the Spanish phoneme inventory was not enough to create a significant difference in word learning between words with aspirated stops and those with unaspirated stops. It may also be the case that the absence of an L1 effect is due to the subsegmental nature of aspiration, which may have implications for theories of segmental structure. Taken together, these results provide clear evidence for the impact of acoustic salience on speech sound processing, but show that salience impacts processing only in a recall task, which involved short-term memory and repetition, and not in a word learning task, which involved longer-term memory and phonological learning.

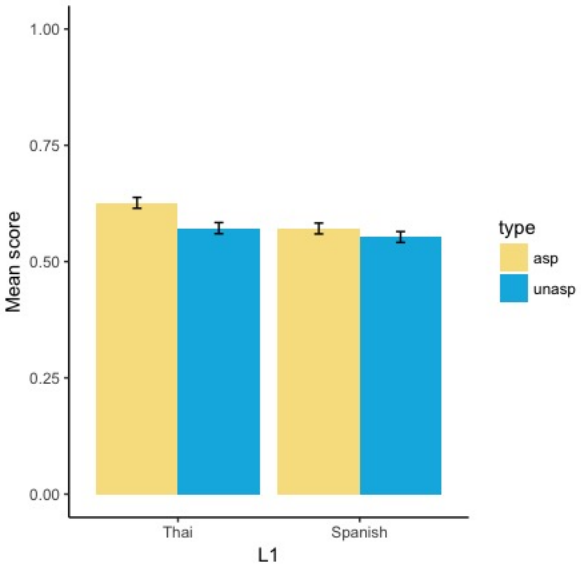

Figure 1: Mean score per syllable, Experiment 1

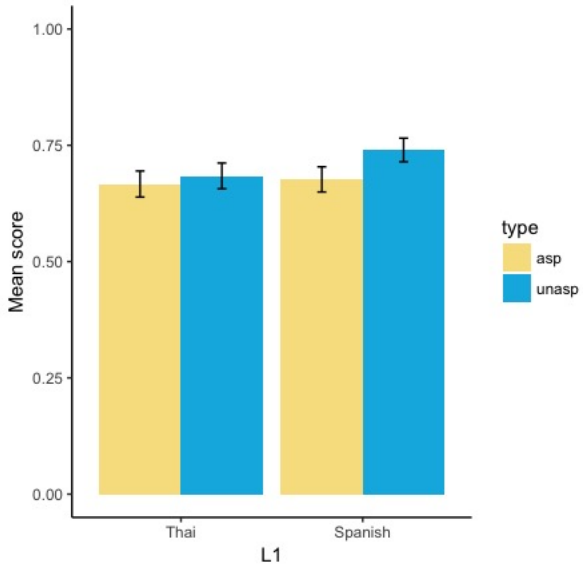

Figure 2: Mean score, Experiment 2

References

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