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High-variability distributions increase perceptual uncertainty during acoustic cue acquisition

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Much statistical learning research has focused on effects of the number of peaks in input distributions. Recent research has examined how *statistical variance* in acoustic cue distributions affects perceptual uncertainty in native speech perception (Clayards, Tanenhaus, Aslin & Jacobs, 2008; Nixon, van Rij, Mok, Baayen & Chen, 2016). The present study investigates how statistical variance affects acquisition of a *non-native* cue, namely tone.

In a visual world eyetracking experiment, participants saw four pictures of common objects and heard a Cantonese word. Auditory stimuli consisted of a 12-step continuum of increasing pitch, presented in a bimodal distribution. Distribution peaks corresponded to prototypical high and mid tones, respectively. Statistical variance (the width of the distribution) varied between participants: high- vs. low-variance.

Eye movements (Euclidean distance from target) were analysed with generalised additive mixed models (GAMMs). Models showed a significant condition-by-pitch nonlinear interaction over time ($p < 0.001$); and a significant condition-by-pitch nonlinear interaction over the experiment (i.e. trial; $p < 0.001$). Over the course of the experiment, and over the trial, fixations became closer to the target in the low-variance condition.

With more distinctive pitch cues in the low-variance condition, participants were better able to distinguish between tones. In early trials, distance from target was actually larger in the low-variance condition, especially for the high tone. However, by the second half of the experiment, participants were already closer to the target than those in the high-variance condition. These results provide evidence that in implicit statistical learning of new acoustic dimensions, within-category acoustic variation hinders acquisition; learning is enhanced by low within-category variability.

References: • Clayards, M. et al. (2008): Perception of speech reflects optimal use of probabilistic speech cues. *Cognition*. 108(3), 804–809. • Nixon, J.S., van Rij, J., Mok, P., Baayen, R.H. and Chen, Y. (2016): The temporal dynamics of perceptual uncertainty: eye movement evidence from Cantonese segment and tone perception. *Journal of Memory and Language*. 90, 103–125.