Expectation effects on listening effort in speech processing: Evidence from pupillometry

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Research using pupillometry as a measure of cognitive effort has shown that, even when speech is accurately understood, the listening effort required for successful comprehension varies based on listener- and speech-based factors. Recent work also demonstrates that talker-based factors such as accent influence listening effort [1, 2]. Findings show, for instance, that listeners demonstrate greater cognitive effort (as indicated through greater pupil dilation) when listening to foreign-accented versus L1-accented speech. Other work has shown that L2 speakers of a language show greater pupil dilation when listening to L2 versus L1 speech [3]. These findings align with models proposing that listening effort increases when the mapping between acoustic input and stored phonological categories is strained. While such bottom-up perceptual processes are well documented, far less is known about how top-down social information shapes listening effort. Although prior work shows that listeners' social expectations can modulate speech perception [e.g., 4], it is unclear how such expectations influence *real-time* speech processing and how these effects interact with listeners' linguistic backgrounds.

We seek to answer these questions by incorporating a social priming element into the pupillometry paradigm used in previous work [1,2]. Listeners from two language backgrounds (L1-Southern British English speakers and L2-English Mandarin Chinese speakers) heard 60 sentences produced by speakers of Southern-British or Mandarin Chinese-accented English. While participants heard the accented sentences, we tracked changes in pupil size compared to a resting baseline period measured before sentence onset. Participants were then asked to repeat the sentence they heard to ensure accurate comprehension. Half of the participants were in the *priming* condition, in which they saw a socially meaningful word related to the accent they heard ("British" or "Chinese"), and half were in the *non-priming* condition in which they saw a socially neutral word ("Speech").

Analysis of preliminary results (n=34) show significant differences in how British and Chinese listeners responded to the stimuli. British listeners showed greater pupil dilation when exposed to Chinese-accented compared to Southern British speech (p=0.002; in keeping with the results of [2]), though Chinese listeners showed a similar degree of pupil dilation regardless of accent. The effects of the prime also showed differences between listener groups. British listeners showed a priming effect in the expected direction, in which pupil dilation was lower in the *priming* condition compared to the *non-priming* condition (though this did not reach significance; p>0.05). In contrast, Chinese listeners showed the opposite effect (p=0.048), whereby listeners who saw the socially meaningful prime showed much higher pupil dilation (p=0.047).

The current work demonstrates how pupillometry can be a useful tool in addressing sociophonetic questions, by measuring automatic physiological responses over which a listener has little control. Notably, these results present evidence against the hypothesis that L2 speakers show greater listening effort listening to L2 speech [3]. Further, the priming results present evidence that social priming effects may not occur among L2 listeners.

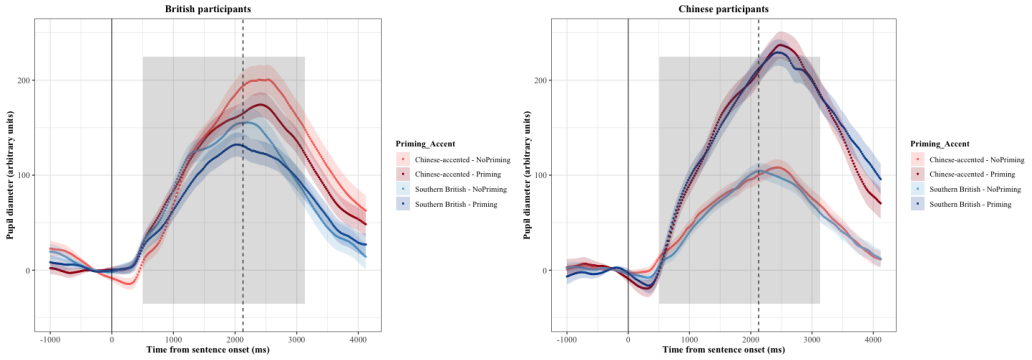

Figure 1. Mean pupil dilation response across British (left) and Chinese (right) participants when processing speech by accent and condition. On the Time axis, 0ms corresponds to sentence onset and the vertical dotted line at 2344ms to average sentence offset. In grey is the area of interest from which data were fed into the statistical models.

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