

Individual differences in top-down lexical processing linked to cognitive inhibition

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While perceiving and understanding speech, people implement both top-down and bottom-up processing [1]. Previous work established that some people seem to be more influenced by top-down processing than others and that this may be a stable perceptual style – individual degree of lexical influence was correlated across two tasks [2]. Older adults tend to show larger effects of top-down lexical information than younger adults [3] and this has previously been posited to relate to deficits in cognitive control [4]. Differences in cognitive control may also influence use of top-down knowledge in younger adults [5]. In this study we examined whether individual differences in top-down lexical processing in young adults are mediated by individual differences in inhibition-related functions. A second goal was to examine whether the locus of the lexical effects is early in perceptual processing [6,7] or occurs later at the decisional stage [8]. We did this by including two cognitive control tasks that are thought to tap these two stages respectively.

Methods: We measured top-down lexical processing with two tasks, a *Ganong task* (2AFC on vowel continua from ‘dish-desh’ or ‘vest-vist’) and a discrimination task with locally time reversed speech (*LTRS* as in [2]) in which listeners hear a word and similar non-word spoken by two different people and must decide if they match or not. One of the two is degraded by LTRS and top-down lexical effects are expected to ‘restore’ the signal better in words than non-words. We also measured inhibition with two tasks, the *flanker task* that is thought to measure early-stage inhibition, or resistance to competitors, and the *go/no-go task* that is thought to measuring late-stage inhibition, or resistance to pre-potent responses [8].

Participants were 32 young adults (ages = 18-30, $M = 21.8$) who completed all four tasks in counter-balanced order, alternating between lexical and inhibition tasks. To assess whether lexical effects in tasks were related, we measured the size of the lexical effect in each of the lexical tasks (proportion of ‘word’ responses in *Ganong*, difference in d' when the LTRS item was a word or a nonword for *LTRS*) to use as individual level predictors in the other lexical task. We measured median correct log RT for both inhibition tasks as well as d prime in *go/no-go* and the RT difference between congruent and incongruent stimuli for *flanker*. Mixed effects models were built for each lexical task and the individual difference measures (3 inhibition measures and the other lexical measure) were included as predictors. RT for *go-no-go* was not included as it was most correlated with the other measures.

Results: As in [2] we found that some listeners were more susceptible to top-down lexical effects than others, and this correlated across tasks (Pearson $R = 0.50$, Figure 1) supporting previous work with a new lexical task (*Ganong*). Second, we found evidence that a stronger lexical effect in the *LTRS* task was related to weaker performance in 2 of 3 inhibition tasks (slower responses in the *flanker* task, $\beta = 0.10$, $p < 0.001$; and smaller *go/no-go* d' , $\beta = 0.16$, $p < 0.001$). The cognitive tasks did not predict performance on the *Ganong* task.

Conclusion: The amount that individuals use top-down lexical information during speech perception seems to be stable across different tasks. We found evidence that these individual differences may be related to aspects of cognitive control, specifically inhibition. Our different

inhibition measures were partly correlated with each other and both tasks predicted degree of lexical effect, so top down effects could be due to either competition from forms supported by the lexicon or a tendency to respond with words (a pre-potent response).

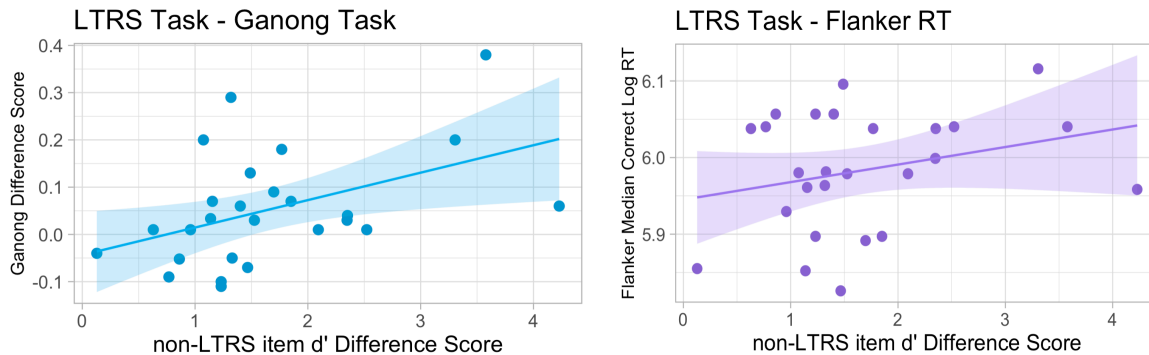


Figure 1: Left - Individual scores on the two lexical tasks. Right – Individual scores on one lexical task and one inhibition task.

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