# The Role Of Inhibition In Older And Younger Adults' Lexical Competition

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## 1 Introduction

With age, uncertainty becomes more pronounced in speech perception; it becomes harder to recognize words in noise [1] and to inhibit similar sounding high-frequency lexical competitors [2]. Similar to [3], we contrast lexical competition and speech perception, but in older and younger adults, because older adults have weaker encoding of some phonetic contrasts [4, 5] and greater lexical effects than younger adults [2, 6]. The lexical bias found in older adults [6] could be indicative of decreased lexical inhibition, which would result in increased activation among lexical competitors. Indeed, [7] found that older adults had greater difficulty than younger adults recognizing words with many semantic neighbours, suggesting that older adults exhibit difficulty inhibiting competitors.

We manipulated voice onset time (VOT) and present a phonological competitor to the target word to investigate the role of phonetic sensitivity and lexical competition in resolving spoken word recognition. To investigate the influence of domain-general inhibition in resolving lexical competition, all participants completed a Simon task [8]. Given the previous lexical and inhibitory results, we expected older adults to have more difficulty inhibiting lexical competitors, especially as speech becomes increasingly ambiguous.

## 2 Method

### 2.1 Participants

All younger (n=27, $M_{age}$=21.6) and older adult (n=27, $M_{age}$=68.1) participants underwent an audiological screening and none had a Pure Tone Average (PTA) threshold of greater than 25 dB HL. All participants were native speakers of English, although some had beginner to intermediate knowledge of a second language.

### 2.2 Stimuli

A female native speaker of English recorded the target minimal pairs and distractor items in a carrier sentence in a sound-attenuated booth. There were six /p/-/b/ minimal pairs (peach-beach, pear-bear, pin-bin, etc.). We also included an equal number of /ʃ/- and /l/- initial distractors. We manipulated VOT by cross-splicing to create a 9-step continuum for each minimal pair.

### 2.3 Procedure

Participants were seated in a sound-attenuated booth approximately 550 mm away from the display screen. Our eyetracking task used a four-picture visual world paradigm. Each display included a /p/-/b/ minimal pair, one /ʃ/- and one /l/-initial image. Each target stimulus was presented 10 times, with an equal number of distractor trials (/l/ or /ʃ/ initial target) for a total of 1080 trials (6 minimal pairs x 9 steps x 10 repetitions = 540 test trials + 540 distractor trials). Each trial began with a 500 ms preview of the display. Participants were instructed to click on the image that best matched the word played over headphones. Participants completed the first half of the eyetracking task, followed by the Simon task, and then the second half of the eyetracking task. Our Simon task [8] was comprised of 40 congruent, 40 incongruent, and 40 neutral trials (120 trials total). Participants were presented with a coloured circle (blue or red) on a screen and asked to respond with one of two keys on a keyboard depending on the colour of the circle (left Shift key-red circle, right Shift key-blue circle). Congruent trials presented the coloured circle on the side of the screen corresponding to its response side (e.g., blue circle on the right side), while incongruent trials presented the coloured circle on the opposing side (e.g., blue circle on the left side). Neutral trials presented the circle in the center of the screen. The session took approximately two hours.

## 3 Results

### 3.1 Data processing and analysis

We calculated the proportion fixation to each image for the 2000 ms following the stimulus word onset, and then calculated a discrimination score as the difference between looks to the target image and looks to the competitor [9]. Thus, a discrimination score approaching one indicates almost all looks were to the target, while a score close to zero indicates participants looked about equally to both. Following [3], we fit a series of logistic regressions to the mouse click responses to find the category boundary for each participant and continuum. These category boundaries were used to set the 'correct' response for each auditory stimulus and to standardized the continuum steps (Relative continuum step) such that the category boundary was set to zero for each participant and continuum. Only trials where the correct image was selected were included in our analysis. We ran a mixed-effects linear regression on discrimination score with Relative continuum step, Age group, and Simon score as predictors. Simon score was calculated as the average difference between response time

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in incongruent and neutral trials, thus a higher Simon score corresponds to poorer inhibitory skill. To include both sides of the continuum in one model, we used absolute distance from the category boundary. Age group and Simon score were rescaled and centered on zero.

## 3.2 Model results

Table 1 presents the results from our mixed-effects linear regression. As expected, we find that tokens from the clear end of the continua are easier to discriminate than those near a category boundary (β=0.11, t=10.35, p<0.001), and that younger adults are better at discriminating regardless of the ambiguity of the token (Figure 1A; β=0.04, t=2.23, p=0.03). We find a main effect of Simon score (β=0.07, t=2.02, p=0.06), suggesting that those with poorer inhibition show better discrimination. This is qualified, however, by a two-way interaction involving Simon score. We find that younger adults with poorer inhibition discriminate better than those with better inhibition (Figure 1B; Age Group x Simon score: β=0.12, t=2.13, p=0.04).

**Table 1:** Fixed effects estimates from mixed-effects linear regression of discrimination score.

| Fixed Effect | β Estimate | Std. Error | t Value | p | |
|---|---|---|---|---|---|
| Intercept | 0.53 | 0.02 | 26.93 | <0.001 | *** |
| Continuum step | 0.11 | 0.01 | 10.35 | <0.001 | *** |
| Age group | 0.04 | 0.02 | 2.23 | 0.03 | * |
| Simon score | 0.07 | 0.03 | 2.02 | 0.05 | * |
| Con. step x Age group | -0.003 | 0.02 | -0.16 | 0.88 | |
| Con. step x Simon score | 0.02 | 0.03 | 0.86 | 0.39 | |
| Age group x Simon score | 0.14 | 0.07 | 2.19 | 0.03 | * |
| Con. step x Age gr. x Simon | 0.08 | 0.06 | 1.35 | 0.18 | |

# 4 Discussion

We find that, overall, younger adults are better at discriminating targets from competitors, especially younger adults with poorer inhibitory skill. We suspect that these younger adults are not distracted by poor competitors (i.e., when targets are clear and far from the category boundary), but are especially distracted by strong competitors (when targets are close to the category boundary). This is supported by the direction of the non-significant trend between Continuum step, Age group, and Simon score.

Despite our initial predictions, we found no strong relationship between inhibition and discriminatory ability in the older adults. This could be because we have a relatively strong group of older adults who mostly are performing close to the mean (see Older Adult panel of Figure 1B). We may also have found different results if we had chosen a linguistic measure of inhibition, rather than the domain-general Simon task. We do find that older adults have more difficulty discriminating targets from competitors, regardless of the clarity of the stimuli, which suggests older adults do have more difficulty inhibiting lexical competitors compared to younger adults. This behaviour, however, is not predicted by our measure of inhibitory ability.

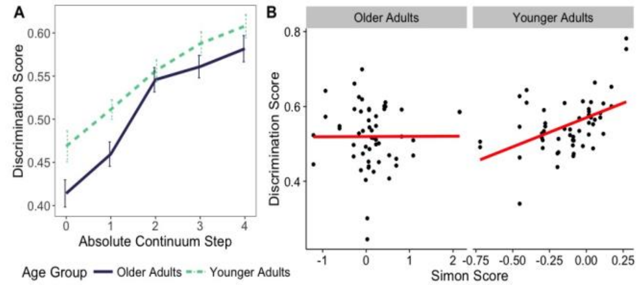


**Figure 1:** Discrimination score (proportion targets looks – proportion competitor looks) by (A) age group and absolute relative continuum step, and (B) age group and simon score.

# 5 Conclusion

Our results provide evidence that older and younger adults employ different strategies when resolving lexical competition, as evidenced by the different role played by inhibitory ability across the two age groups.

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