1 Background
Written or spoken word recognition involves activation of, and selection among, multiple candidates which share similar sensory (visual, auditory), phonological or semantic properties (e.g. Marslen-Wilson, 1987). Various neural models have claimed that competition and selection processes are a function of the left inferior frontal gyrus (LIFG, e.g. Thompson-Schill et al. 2005), or a bilateral frontal control system (Bozic et al. 2010). However, rarely have these studies differentiated selection of a target word from competition among multiple candidates, although behavioral research in speech production suggests that they are separable processes (Mahon et al. 2007).

The present experiment used fMRI to investigate the contribution of left and right frontal control systems as a function of different levels of control processes (e.g. competition and selection). The hierarchical hypothesis suggests that bilateral IFG might be involved in low-level competition process, whereas higher-level selection processes tax mainly LIFG. To test this hypothesis, we manipulated the strength of selection, as represented by cue-target similarity, as well as the strength of competition, as represented by cue-distractor similarity. Moreover, we were interested in whether frontal recruitment is domain-general or influenced by characteristics of the stimulus. To test this, we manipulated selection and competition demands across perceptual, phonological, and semantic tasks.

2 Methods
Participants
20 healthy, right-handed, native English speakers (8 male, age range = 19-34, mean = 23.7) participated in this experiment.

Stimuli & Task
• There were three conditions: phonological, semantic and perceptually related triplets, with 165 triplets per condition.
• Participants selected the item that best matched the cue.
• Selection demands were manipulated by cue-target similarity.
• Competition demands were manipulated by cue-distractor similarity.
• Both measures were confirmed with similarity ratings from a separate group of participants.

fMRI Results
When the distractor shared more phonemes with the cue, there was greater activation in bilateral IFG. When the target shared fewer phonemes with the cue, there was greater activation in LIFG only.

3 Results
Behavioral results
We correlated competition and selection measures with a combined measure of behavioral performance (RT divided by accuracy) to estimate decision efficiency. These item-wise correlations were plotted and shown below:

<table>
<thead>
<tr>
<th>phonological &gt; null events</th>
<th>phonological &gt; dots</th>
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<tr>
<td>semantic &gt; null events</td>
<td>semantic &gt; dots</td>
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<tr>
<td>semantic &gt; null events</td>
<td>semantic &gt; dots</td>
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RT (weighted by accuracy) became higher with increasing competition and selection demands in all three conditions (except phonological competition effect).

fMRI results
We first compared all phonological and semantic trials against null events (blank screen) and against the perceptual condition. Then we explored competition and selection effects in each task.

4 Summary & Conclusions
• Behavioral measures revealed that RT (weighted by accuracy) increased with higher competition and selection demands across conditions (except phonological competition effect).
• Increasing competition produced greater activation in bilateral IFG, while increasing selection generated more activation in LIFG only, in both the phonological and semantic conditions.
• Patterns of competition and selection effects were constant across linguistic items.
• A hierarchical cognitive control system was observed in bilateral IFG, with LIFG and RIFG equally involved in easy, low-level competition process, i.e., detecting, monitoring competition among candidates, while LIFG was engaged in high-level selection process, i.e., selecting among multiple candidates the one which best matches sensory inputs.
• The null results for the perceptual dots condition may indicate that non-linguistic competition and selection processes operate differently from linguistic competition and selection.

5 References

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