Resolving semantic picture-word interference requires attention

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The semantic picture-word interference effect, in which subjects are slower to name a picture while ignoring a semantically related than an unrelated distractor word, has been attributed to increased competition during lemma selection [1] or the increased difficulty of excluding the distractor word from a pre-articulatory response buffer [2]. These accounts were challenged by [3] (see also [4]; but see [5]), which suggested that semantic picture-word interference affects an early, automatic stage of picture naming that precedes lemma selection. If true, this finding imposes a significant, unsatisfied constraint on models of word production. An alternative interpretation is that lemma selection is an automatic process, which would also be surprising [6]. We conducted two dual-task experiments to determine whether lemma selection (Experiment 1) and picture-word interference (Experiment 2) require attentional resources.

In Experiment 1, 40 subjects were presented first with a tone and then a picture on 188 trials. Their task was to categorize the pitch of the tone and to subsequently name the picture, which was presented either 100 ms (short SOA) or 1000 ms (long SOA) after the tone. Critical pictures comprised semantically related sets across the experiment; e.g., *donkey*, *pig*, *horse*, *sheep* and *cow*. Previous work has shown that subjects' naming latencies slow progressively for each additional category member; all accounts agree that this cumulative semantic interference manifests in the increased difficulty of lemma selection [7,8]. According to the logic of dual-task experiments, if lemma selection is automatic, cumulative interference should be present when pictures are presented at a long SOA, but not at a short SOA. Instead, the effect emerged at both SOAs (Figure 1). Thus, lemma selection requires attention.

This contrasts with the disappearance of semantic picture-word interference at a short SOA [3]. However, it may be important that picture-word interference involves word reading. Orthographic processing can be performed automatically [9,10]. Dual-task research has shown that competition between automatic and attention-demanding processing can be reduced at short SOAs [11]. If picture-word interference affects lemma selection, distractor effects might be reduced because lemma selection – but not word reading – is delayed. This would be equivalent to presenting the distractor before the picture (i.e., at a negative SOA), which reduces interference [12].

Experiment 2 tested this hypothesis. Forty-eight subjects categorized a tone and then named a picture on 162 trials. Pictures were accompanied by semantically related or unrelated distractors that were visually presented either simultaneously with, or – in the crucial condition – 250 ms after the picture. If the disappearance of semantic interference is due to the uncoupling of distractor and picture processing, delaying distractor presentation should cause it to co-occur with lemma selection, re-introducing semantic interference at the shortest task SOA.

It does (Figure 2). Replicating [3], when the picture and distractor were presented simultaneously, semantic interference was present at SOAs of 350 and 1000 ms, but absent at 100 ms. In contrast, when the distractor was presented 250 ms after the picture, semantic

interference was absent at SOAs of 350 and 1000 ms, but emerged at 100 ms. Reassuringly for existing models of word production, these results confirm that resolving picture-word interference requires attention and does not precede lemma selection.

Figure 1

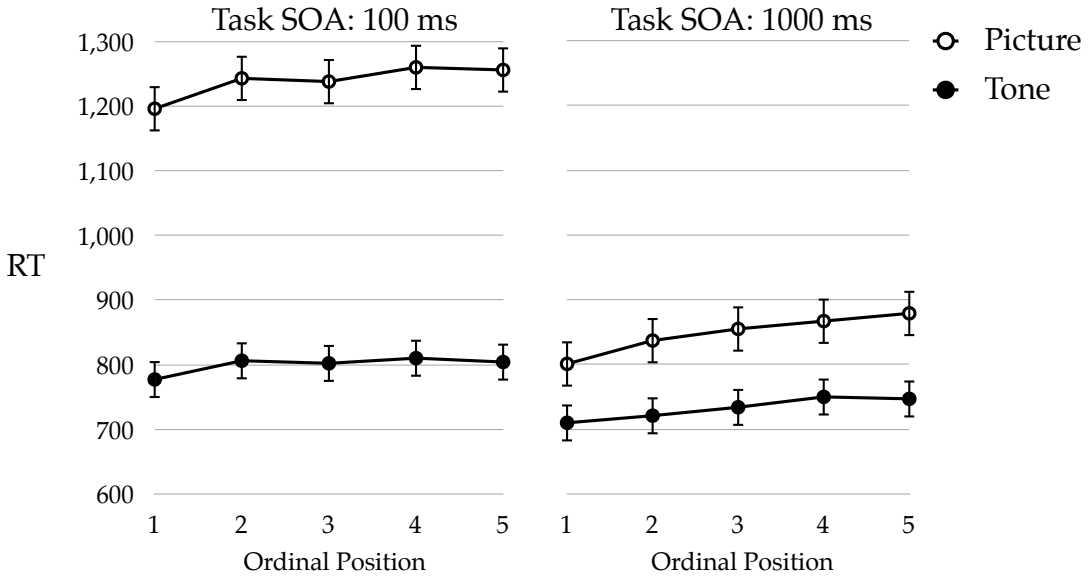
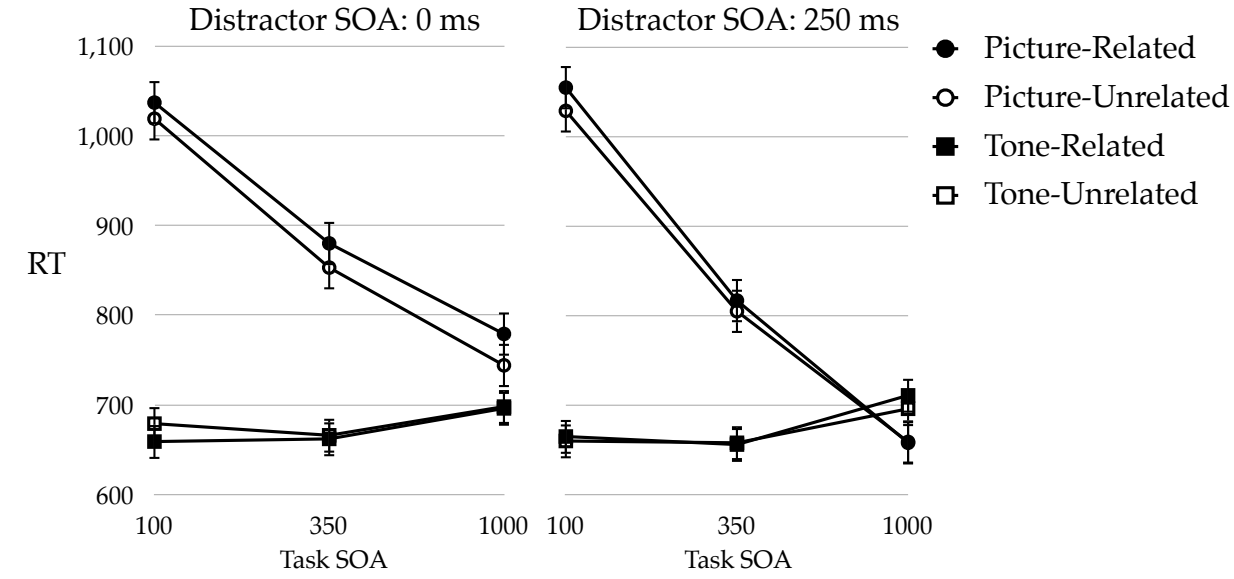


Figure 2



Error bars represent 95% confidence intervals.

[1] Levelt et al. (1999). *BBS*.
[2] Mahon et al. (2007). *JEP:LMC*.
[3] Dell'Acqua et al. (2007). *PB&R*.
[4] Ayora et al. (2011). *Frontiers*.
[5] Schnur & Martin (2010). *Psychonomics poster*.
[6] Ferreira & Pashler (2002). *JEP:LMC*.
[7] Howard et al. (2006). *Cog*.
[8] Oppenheim et al. (2010). *Cog*.
[9] Reynolds & Besner (2006). *JEP:HPP*.
[10] O'Malley et al. (2008). *JEP:LMC*.
[11] Besner et al. (2009). *QJEP*.
[12] Glaser & Düngelhoff (1984). *JEP:HPP*.