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Selection by competition in word production: Rejoinder to Janssen (2013)

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Roelofs, Piai, and Schriefers argue that several findings on the effect of distractor words and pictures in producing words support a selection-by-competition account and challenge a non-competitive response-exclusion account. Janssen argues that the findings do not challenge response exclusion, and he conjectures that both competitive and non-competitive mechanisms underlie word selection. Here, we maintain that the findings do challenge the response-exclusion account and support the assumption of a single competitive mechanism underlying word selection.

Keywords: Cognitive control; Competition; Distractor effects; Word production.

Competition has long been assumed to be a central principle underlying psychological processes in general and language processes in particular (e.g., Levelt, 2013). Competition explains, for example, why contextual influences on response time (RT) in word production often manifest as interference. In our target article (Roelofs, Piai, & Schriefers, 2013), we presented a critique of the response-exclusion account of interference effects in word production. The response-exclusion account holds that words are selected upon exceeding an activation threshold rather than by competition, and that interference arises later in an articulatory buffer (e.g., Finkbeiner & Caramazza, 2006). Previous discussions of the relative merits of the competition and response-exclusion accounts were centred around findings on the effect of distractor words in picture naming. In our target article, we evaluated the two accounts with respect to their ability to explain five findings on distractor effects of pictures and words in simple word reading, generating gender-marked noun phrases in response to words and word categorising. We concluded that the findings from these tasks provide evidence in favour of competition and against response exclusion. In his comment, Janssen (2013) argues that the findings do not challenge the response-exclusion account, and he conjectures that both competitive and non-competitive mechanisms underlie word selection. We address these claims in turn in the following sections.

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DISTRACTOR EFFECTS IN RESPONDING TO WORDS

According to Janssen, our five findings on responding to words (see Table 1 of our target article) do not pose problems for the response-exclusion account. He starts discussing the Findings 2 and 3 on our list: Distractor words yield general interference (i.e., RT unrelated distractor > RT neutral distractor) and identity facilitation (RT identical < RT neutral) but not a semantic effect (RT semantic = RT unrelated) in simple word reading (Finding 2) and in generating noun phrases (Finding 3). For example, compared to a series of Xs as distractor (neutral), saying "kat" ("cat") or "de kat" ("the cat") in Dutch to the word KAT (CAT) is slower with the distractor word PIN (PIN, unrelated) and faster with the distractor word KAT (identical), whereas there is no difference in effect between the distractor words PIN (unrelated) and HOND (DOG, semantically related). To explain the absence of a semantic effect, Janssen cites the claim of Finkbeiner and Caramazza (2006) that target words overwrite responses to distractor words in the articulatory buffer. Consequently, response exclusion does not have to take place and a semantic effect will not occur. In our target article, we took this explanation as our starting point for evaluating the response-exclusion account (also citing Finkbeiner & Caramazza, 2006), and we argued that the explanation is at odds with other findings on our list. To explain the general interference of distractor words in word reading and noun phrase production, Janssen proposes that the effect occurs because distractor words "capture the articulators". However, this account fails to explain why distractor pictures yield no effect in word reading (Finding 1), but yield general interference and semantic effects in generating noun phrases in response to words (Finding 4) and in word categorising (Finding 5). Perhaps the general interference of pictures in noun phrase production and word categorising may be explained by assuming that distractor pictures also capture the articulators. However, this would predict general interference from distractor pictures in simple word reading, unlike what is empirically observed (Finding 1). To conclude, the general interference of distractor words and pictures remains problematic for the response-exclusion account, even when assuming that distractor words capture the articulators.

In addition to yielding general interference in generating noun phrases in response to words, distractor pictures yield semantic facilitation (Finding 4), whereas distractor words yield no semantic effect (Finding 3). Janssen argues that semantic facilitation effects pose problems for the competition account, whereas they are easily explained by the response-exclusion account. However, he does not indicate how the response-exclusion account explains the difference in semantic effect between distractor pictures and words. Moreover, the claim that semantic facilitation effects pose difficulty for the competition account is problematic. As indicated in our target article, it has been demonstrated through computer simulations that the competition account explains semantic facilitation effects in word production tasks (e.g., Roelofs, 2003, 2006, 2008; Roelofs, Dijkstra, & Gerakaki, 2012). We refer to Piai, Roelofs, and Schriefers (2012) for an extensive discussion of the conditions under which semantic interference and facilitation effects are obtained.

To conclude, most of the findings on our list challenge the response-exclusion account, even with the assumption that distractor words capture the articulators. In our view, Janssen (2013) presents no convincing counterarguments.

LEXICAL SELECTION: COMPETITIVE, NON-COMPETITIVE OR BOTH?

While distractor words yield general interference but not a semantic effect in word reading (Finding 2), distractor words yield general interference and a semantic

interference effect in picture naming. A critical difference between the competition and response-exclusion accounts of semantic interference concerns the time course of the effect. The response-exclusion account maintains that semantic interference arises close to articulation onset, when a response to the distractor word is removed from the articulatory buffer. In contrast, the competition account maintains that semantic interference arises during lexical selection, much closer to picture onset. According to an influential estimate of the onsets of word planning stages (e.g., Indefrey, 2011), lexical selection starts around 200–250 ms after picture onset and lasts until about 350 ms post-picture onset, whereas the articulatory buffer is reached no earlier than about 145 ms before articulation onset. In an ERP study of picture–word interference, Piai, Roelofs, and Van der Meij (2012) obtained evidence that brain activity reflected the semantic interference between about 230 and 370 ms after picture onset, which corresponds to the estimated time window for lexical selection (Indefrey, 2011). The corresponding mean naming RT was around 800 ms, which implies that the onset of the semantic effect was about 570 ms before articulation onset. This is much earlier than predicted by the response-exclusion account (i.e., 145 ms before articulation onset).

Other evidence also specifically supports the lexical competition account. For example, Aristei, Zwitserlood, and Abdel Rahman (2012) observed semantic interference during compound production in a picture–picture experiment, which is readily explained by the competition account but challenges the response-exclusion account.

In his comment, Janssen (2013) advances the new conjecture that two mechanisms underlie lexical selection, a competitive and a non-competitive mechanism. He states that "a competitive mechanism of selection is only invoked under circumstances when the default [noncompetitive] mechanism does not produce satisfactory results". According to him, "word production involves a general mechanism of cognitive control that is external to the language system", as proposed, for example, by Thompson-Schill, D'Esposito, Aguirre, and Farah (1997). Whether the competitive mechanism is needed is assessed by cognitive control mechanisms that "monitor word retrieval processes, and adjust such processes under situations where performance deteriorates" (e.g., Botvinick, Braver, Barch, Carter, & Cohen 2001). Moreover, Janssen states, "the implementation of control in WEAVER++ (Roelofs, 2003) is different from the idea of control discussed here .... the function of cognitive control here is based on the literature of conflict monitoring (Botvinick et al., 2001), and refers to a mechanism that monitors and modulates the word retrieval processes".

A problem with this new proposal of two selection mechanisms is that no evidence is presented that both competitive and non-competitive mechanisms underlie word selection. Janssen refers to Thompson-Schill et al. (1997) and Snyder, Banich, and Munakata (2011) for evidence that word production engages cognitive control mechanisms outside the language system (see also Roelofs, 2003; Roelofs & Hagoort, 2002; Roelofs & Piai, 2011). However, these authors do not distinguish between competitive and non-competitive selection mechanisms. Without evidence for such a distinction, a single mechanism is to be preferred (Ockham's razor). Moreover, unlike what Janssen suggests, Botvinick et al. (2001) and Thompson-Schill et al. (1997) maintain that the presence of competing response alternatives is the trigger for, rather than the result of, the engagement of cognitive control processes. Elsewhere, we proposed that cognitive control is engaged to the extent that words compete for selection (e.g., Roelofs, 2003, 2008; Roelofs & Hagoort, 2002) in line with Botvinick et al. (2001) and Thompson-Schill et al. (1997). Moreover, we provided evidence that

cognitive control is engaged not only to the degree that selection is difficult or easy (Roelofs, Van Turennout, & Coles, 2006) but also that control is adjusted when selection is expected to become difficult or easy, leading to more strict or lenient control settings, respectively (e.g., Aarts, Roelofs, & Van Turennout, 2008; Lamers & Roelofs, 2011). This challenges the claim of Janssen that cognitive control is invoked only under adverse selection circumstances. Finally, we note that cognitive control in WEAVER++ does involve monitoring and modulation of word retrieval (e.g., Lamers & Roelofs, 2011; Roelofs, 2004).

CONCLUSION

Janssen (2013) argues that findings on the effect of distractor pictures and words in responding to words do not challenge response exclusion, and he conjectures that both competitive and non-competitive mechanisms underlie word selection. Contrary to these claims, we showed that the findings do challenge response exclusion and support a single competitive mechanism underlying word selection.

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