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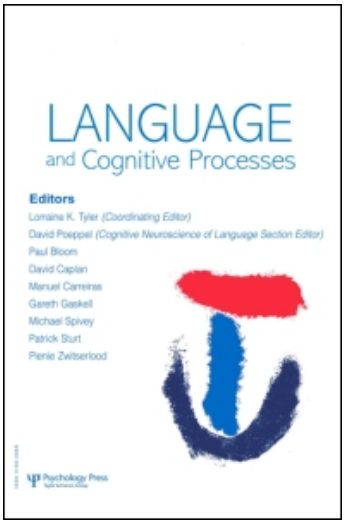

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Why does lexical selection have to be so hard? Comment on Abdel Rahman and Melinger's swinging lexical network proposal

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Why does lexical selection have to be so hard? Comment on Abdel Rahman and Melinger's swinging lexical network proposal

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The semantic interference effect, in the picture-word interference paradigm, has played an important role in the development of certain models of lexical selection. However, and aside from the semantic interference effect, the typical pattern that is observed when contrasting semantically related and unrelated distractors in the picture-word paradigm is facilitation. We have argued that semantic facilitation, and not semantic interference, is informative about the dynamics of lexical selection. Semantic interference in the picture-word interference paradigm arises at a post-lexical level of processing. Abdel Rahman and Melinger (2009 this issue) defend the hypothesis of lexical-selection-by-competition and argue that when the hypothesis is supplemented with additional assumptions, it can be reconciled with findings that are otherwise difficult to explain. Here we explore Abdel Rahman and Melinger's proposal. We argue that it is not clear that the authors have in fact succeeded in explaining the findings they set out to explain. In conclusion, we suggest that the liabilities of retaining the hypothesis of lexical-selection-by-competition outweigh the explanatory scope of that view.

Keywords: Lexical competition; picture-word interference paradigm; response exclusion hypothesis; semantic interference; semantic facilitation.

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INTRODUCTION

The semantic interference effect (SIE) refers to the observation that participants are slower to name pictures of objects (e.g., horse) in the context of semantic category coordinate distractor words (e.g., whale) compared with unrelated distractors (e.g., truck). It has been argued that the SIE arises due to increased competition for selection of the target word in the related compared with the unrelated condition (e.g., La Heij, 1988; Schriefers, Meyer, & Levelt, 1990). The hypothesis of lexical-selection-by-competition (unadorned) thus predicts that any semantically related distractor word should interfere more than an unrelated distractor word. This prediction follows from current models of semantic and lexical processing in which activation spreads among semantic representations in proportion to their semantic similarity (Bloem & La Heij, 2003; Caramazza, 1997; Collins & Loftus, 1975; Dell, Oppenheim, & Kittredge, 2008; Roelofs, 1992). However, and aside from the semantic interference effect, the typical pattern that is observed in the picture-word paradigm when comparing semantically related and unrelated distractor words is not interference: the typical pattern is semantic facilitation (see Mahon, Costa, Peterson, Vargas, & Caramazza, 2007 for review and discussion). We have thus argued for a model of lexical selection that takes semantic facilitation effects, in the picture-word interference paradigm, to be the critical empirical phenomenon that must be explained.

Distractor words, compared with pictures (or ink colours in the Stroop task) have a privileged relationship to articulatory processes. Thus, in order to produce the picture name, the articulators must first be disengaged from the distractor word. Excluding the distractor word as a candidate for articulation costs time, and when a distractor word shares criteria that must be satisfied by a correct response, it costs more time. The SIE, on this view, arises at a post-lexical level of processing and is not informative about the dynamics of lexical retrieval processes (Finkbeiner & Caramazza, 2006; Janssen, Schirm, Mahon, & Caramazza, 2008; Mahon et al., 2007; Miozzo and Caramazza, 2003; for review of earlier, related but not identical, proposals see Glaser & Düngelhoff, 1984). We refer to this account as the Response Exclusion Hypothesis.

The Response Exclusion Hypothesis predicts that if semantic category coordinate distractors are prevented from having privileged access to the articulators then no SIE should be observed; if anything, such distractors should lead to semantic facilitation. The Response Exclusion Hypothesis also predicts (all else equal) that if distractor words are slowed from having access to the articulators, then they will take longer to be excluded as potential responses; under those circumstances, the empirical prediction is made that naming latencies will be longer. Another prediction that follows

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from this view is that it should be possible to observe the SIE when naming latencies are no longer constrained by the bottleneck at lexical selection. All three predictions have been confirmed (Prediction 1: Damian & Bowers, 2003; Finkbeiner & Caramazza, 2006; La Heij, Heikoop, Akerboom, & Bloem, 2003; Navarrete & Costa, 2005; Prediction 2: Abdel Rahman & Melinger, 2007[1]; Burt, 2002; Miozzo & Caramazza, 2003; Prediction 3: Janssen et al., 2008; for review and discussion see Mahon et al., 2007).

The most direct way to determine whether the SIE reflects lexical-selection-by-competition is to manipulate the within-category semantic distance between distractor words and target pictures. As would be predicted by the view that lexical selection is not by competition, target naming latencies (e.g., horse) are faster in the context of within-category semantically close distractors (e.g., zebra) than in the context of within-category semantically far distractors (e.g., whale) (Mahon et al., 2007; see Ischebeck, 2003, for the same finding with Arabic numeral naming).

The challenge to the assumption of lexical-selection-by-competition is thus two-fold. First, the hypothesis must explain why there are polarity reversals from semantic interference to semantic facilitation. On the account that we have proposed, semantic facilitation effects reflect the dynamics of lexical selection, while the SIE arises at a post-lexical locus. The second challenge to the hypothesis of lexical competition is to explain why naming latencies to target pictures are faster for within-category semantically close distractors compared to within-category semantically far distractors. On the account we have proposed, the within-category distance effect follows from the contrasting effects of facilitation (at the lexical level, due to semantic distance) and interference at the response-level, due to the presence of category coordinate distractors.

In their article 'Semantic context effects in language production: A swinging lexical network proposal and a review', Abdel Rahman and Melinger (2009 this issue; hereafter AR&M) argue that both challenges can be met by a theory of lexical-selection-by-competition. AR&M make

[1] A number of studies have explored the effect on naming latencies of an associative relationship that points from distractor words to target pictures (see Mahon et al., 2007 for review and data). However, only recently (Abdel Rahman & Melinger, 2007) has the effect on naming latencies of having an associative relationship from the target toward the distractor been studied. When the associative relationship goes from the target picture to the distractor word, the hypothesis of lexical competition would predict greater interference for associatively related distractors than unrelated distractors. That prediction is at variance with the facilitatory effect that is empirically observed (Abdel Rahman & Melinger, 2007). That facilitatory effect can be interpreted within the framework of the Response Exclusion Hypothesis, following the same logic used for explaining the distractor frequency effect. Distractor words that are associates of the target pictures are available sooner for exclusion compared with distractor words that are not associates of the targets.

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three principal claims: (1) That the arguments we have developed against the hypothesis of lexical-selection-by-competition fail to appreciate the role played by the number of activated non-target words; (2) There are trade-offs between facilitation at the semantic level and interference at the lexical level; and (3) There are strong biases (or even absolute constraints) on spreading activation in the semantic and lexical systems. Here we explore these three aspects of AR&M's proposal.[2]

COMMENTS ON AR&M'S SWINGING LEXICAL NETWORK PROPOSAL

What determines the amount of lexical competition?

The central claim of AR&M is that naming latencies to target pictures are affected by the level of activation of *all* words within the network: '... we assume that the latency of target lemma selection varies as a function of the state of activation of the entire lexical network, and is proportionally delayed with an increasing number of active competitors' (p. 715). There are at least two ways in which AR&M's proposal may be interpreted. On the one hand, and in the tradition of current models (e.g., Roelofs, 1992), AR&M may be taken to be (merely) emphasising the existing assumption that the (sum) level of activation of all words in the network is critical for determining the amount of competition for selection of the target word. On this interpretation, there is nothing about the 'number' (qua number) of activated words that is important, but only that the (sum) level of activation is computed over *all* words in the system. On the other hand, AR&M also at times seem to accord a special role to the 'number' of non-target words that are activated, without specification of their relative levels of activation. Here we explore both readings of AR&M's proposal. We argue that it is not obvious that either version provides a clear solution to the problems that are faced by the hypothesis of lexical-selection-by-competition. For exposition, we follow AR&M's lead in using the within-category semantic distance effect as the target phenomenon to be explained:

> While the observation of slower naming latencies with increasing semantic distance might be viewed as being contrary to what a single-lexical competitor account would predict, it is in line with the above described trade-off account

[2] AR&M cite unpublished data at several points in their argument; as there is no way to evaluate those findings, we focus here on the relation between the authors' theoretical claims and published findings.

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> and competition induced by lexical cohorts. First, close distractors should yield stronger priming effects than distant distractors at the conceptual level. Second, one only needs to assume that semantically distant target–distractor pairs co-activate a lexical cohort with numerous different members belonging to this broadly defined category (e.g., animals: not only the target bee and distractor horse, but also other members of this category such as ant, snake, mouse etc., are activated; cf. Figure 1 [AR&M]). In contrast, semantically close target–distractor pairs (bee and fly) co-activate a much more confined and narrow category (e.g., insects: bee, fly, ant; cf. Figure 1 [AR&M]). Such comparatively small semantic categories have fewer members than broad categories. Consequently, close distractors should induce less interference than distant distractors (Abdel Rahman & Melinger, 2008, p. 721; see Figure 1 therein).

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Interpretation 1: What determines the amount of lexical competition is the (sum) level of activation of all words in the system (see e.g., Roelofs, 1992)

AR&M's construal of the activation state of the network in the within-category semantically close and far conditions highlights the point that a broader array of words may be activated in the semantically far than in the semantically close condition. Whether or not this is the case depends entirely on the semantic network architecture that is assumed to mediate how activation spreads among concepts. Is there a plausible semantic architecture that will guarantee that different sized cohorts of words will be activated in the within-category semantically close and far conditions? Perhaps the most straightforward way in which the semantic network might be organised in order to guarantee this (and which AR&M seem to indicate in their discussion – but see Figure 1 [AR&M], and footnote 3 and discussion below) is that distractor words and target pictures in the within-category semantically far condition do not share a common superordinate node. So for instance, the target 'bee' will activate other insects (through its superordinate concept INSECT) and the within-category semantically far distractor 'horse' will activate other animals, by virtue of its superordinate concept. In contrast, in the within-category semantically close condition, the target (bee) and the distractor (fly) will activate only insects, but not other living creatures (horse, snake, etc).

However, a suggestion along those lines would face an important difficulty. The within-category semantically far distractor shows semantic interference compared to the unrelated baseline. This would seem to compel the assumption that there is some common superordinate node that is shared by the target and the distractor in the within-category semantically far condition. This is because, on AR&M's proposal, the presence of semantic interference indicates that activation has converged on a cohort of words.

The potential difficulty faced by AR&M's proposal may, however, even be greater: given that the authors would be compelled to assume that there is a conceptual representation common to the target and distractor in the within-category semantically far condition, it follows that that representation will also be activated by the same items (distractors and targets) when they appear in the within-category semantically close condition.[3] Thus, it is not clear if there would be different sized cohorts of activated words in the within-category semantically close and far conditions.

There is another concern associated with AR&M's characterisation of the semantic network architecture. The authors do not (at least in the current deployment of their theory) consider the influences of other types of semantic relationships (see Figure 1 therein).[4] The onus is on the authors to show how such an impoverished semantic network can explain the range of semantic distance effects that historically, have formed a major impetus for current models of semantic memory (e.g., Collins & Loftus, 1975). For comparison, consider the semantic network in Roelofs (1992) model: there are a number of 'semantic features' (e.g., 'has-a', 'part-of', 'is-a', 'can-do', etc.) that are linked to lexical concepts, and which guarantee that the network will display the dynamic properties as a function of semantic distance that must be explained.

For discussion, it may be supposed that AR&M could adopt the lexical-conceptual space, present in for instance Roelofs (1992; see also Collins & Loftus, 1975). For discussion, one may also grant that there are different sized cohorts of activated words in the within-category semantically close and far conditions. The critical issue is then the relative (sum) levels of activation of those different cohorts. One must compare the activation levels of a relatively narrow cohort of words that is activated in common by both

[3] In Figure 1 (AR&M), the superordinate node ANIMAL is connected to basic level representations of insects (bee, fly, etc.) as well as to basic level representations of mammals (e.g., horse) and other living creatures (e.g., snake). Thus, the superordinate node ANIMAL would be activated in the within-category semantically close condition (target: bee, distractor: fly), and consequently all of the basic level items that are connected to that node would also be activated (e.g., horse, snake, etc.). Following the schematic in AR&M's Figure 1 thus leads also to the same conclusion: it seems that cohorts of the same size will be activated in the within-category semantically close and semantically far conditions, contrary to the authors' gloss in the excerpted passage.

It is also relevant here that in all of the experiments in which we studied within-category semantic distance effects, designs were used in which the same distractor words appeared in the two within-category conditions (close and far). This means that the (structurally fixed) semantic neighbourhoods (including superordinate category nodes) of distractors and targets in the within-category semantically close and far conditions are the same.

[4] In their schematic (Figure 1: AR&M) the authors stipulate the existence of other nodes that mediate how activation flows at the semantic level (e.g., 'associative relation'). It is not clear why such relationships should be afforded the status of a 'semantic node'.

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the target concept and the within-category semantically close distractor, to a broad cohort of words that is diffusely activated by the target and the within-category semantically far distractor. AR&M are in agreement that the individual words within the narrower cohort will be more highly activated than those within the broader cohort. This is because words within the narrow, but not the broad, cohort will receive converging input from both the target and the distractor. It could thus be, and depending on the network parameters that were chosen, that the (sum) level of activation of the narrow cohort is greater than that of the broad cohort. Thus, even granting different sized cohorts of activated words in the two experimental conditions, the relative activation levels of the two cohorts remains unspecified (and in large measure, parameter dependent).

A similar issue arises in explaining the SIE itself in terms of lexical competition. That explanation assumes that in the related condition, a given word (e.g., a non-target coordinate of the distractor) receives activation from two sources (target and distractor); in contrast, in the unrelated condition, a given word (e.g., a coordinate of the distractor) receives activation from a single source (i.e., the distractor). Yet, it must be the case that the (sum) level of activation in the related condition is greater than in the unrelated condition, otherwise AR&M would not be able to explain the basic SIE. In other words, in order to explain the basic SIE, AR&M must assume that the sum level of activation of a relatively narrow cohort of words (in the related condition) is greater than the sum level of activation of a much broader cohort of words (in the unrelated condition). The only way in which this would be the case is if the individual elements that constitute the narrower cohort are more highly activated than the individual elements that constitute the broader cohort.

To this point we have followed AR&M's lead in *not* factoring in the relative levels of activation of words corresponding to the within-category semantically close and far distractors. The authors are in agreement that words corresponding to within-category semantically close distractors will be more highly activated than words corresponding to within-category semantically far distractors. When those activation levels are factored in, will it be the case that the (sum) activation level will be *less* in the within-category close than in the within-category far condition?

Interpretation 2: What determines the amount of lexical competition is the 'number' of activated non-target words

This interpretation of AR&M's claim is not exclusive of the interpretation in terms of (sum) activation levels. However, it is not clear that appealing to the 'number' of activated words, independently of the activation levels of those words, contributes toward explaining the amount of competition that

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is encountered at selection of the target word. It could not be that simply having 'more activated non-target words', independently of their activation levels, leads to more competition for target lexical selection. This is because the hypothesis could not then explain the basic SIE: an unrelated distractor word will activate an *entirely* different cohort of words than is activated by the target concept and the semantic coordinate distractor. Thus, *more* words will be activated in the unrelated than in the related condition. However, it is not the case that, for the SIE '... the latency of target lemma selection ... is proportionally delayed with an increasing number of active competitors' (AR&M, p. 715).[5]

Are there trade-offs between facilitation at the semantic level and interference at the lexical level?

AR&M argue that because the number of activated non-target words is important, there are tradeoffs between facilitation at the conceptual level and interference at the lexical level. In AR&M's terms, in situations of one-to-one competition a target word competes for selection with a single non-target word, while in situations of one-to-many competition, a target word competes for selection with a whole cohort of non-target words. AR&M stipulate that priming from the distractor to the target at the semantic level will be greater than interference at the lexical level in situations of one-to-one competition, but not in situations of one-to-many competition.

It is difficult to evaluate AR&M's proposal because as the authors acknowledge, they do not know '... how large a lexical cohort must be before it can offset a conceptual facilitation effect' (AR&M, p. 728). We also have no way of establishing this. It does seem clear, however, that some fine tuning will be required in order to determine the situations under which such cohorts are assumed to develop within the speech production system. For instance, AR&M argue that such a cohort can develop for contextually related nouns. Presumably, such a cohort should also develop for contextually related words that are not of the same grammatical class. For instance, when naming the picture 'bed' in the context of the distractor verb 'sleep',

[5] Another (conceivable) reading of AR&M's claim is that there is no gradation in the levels of activation of lexical nodes: lexical nodes are either activated (e.g., an activation state of '1') or are not activated (activation state of '0'). On such a theory, it would follow that what would truly matter is the sheer number of activated words, as that would be directly proportional to the amount of competition for selection of the target word. Such an account would be able, in principle, to explain why within-category semantically close distractors 'interfere less' than within-category semantically far distractor words. However, this version of the lexical-selection-by-competition hypothesis would not be able to explain the SIE: there will be more non-target words activated in the unrelated than the related condition. Furthermore, the theory would have no obvious way to implement the construct 'semantic distance'.

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there is a clear set of items that should receive convergent activation (pillow, dream, mattress, etc.). Contrary to what AR&M's cohort account would predict however, facilitation and not interference is observed for semantically related verbs in noun naming (Mahon et al., 2007). Similar questions arise with respect to the facilitatory effect of distractor words that name parts of the target objects (Costa, Alario, & Caramazza, 2005; see also discussion below).

The arguments outlined in the preceding section about the relevance of the variable 'number of activated words' may undermine the notions of one-to-many and one-to-one competition. However, and independently of those arguments, it is not obvious that trade-offs, even as stipulated by AR&M, can explain polarity reversals from semantic interference to facilitation. Consider AR&M's explanation of the part-whole effect (Costa et al., 2005): Participants are faster to name objects when the distractors name a (non-visible) part of the object than when the distractor is unrelated. According to the network developed in Roelofs (1992), the presence of 'part-of' nodes (and their respective connections) will result in higher levels of activation for lexical nodes in the related than in the unrelated condition. It would then have to be argued on AR&M's account, that distractor-to-target priming facilitates target conceptual selection *more* than target words are slowed down due to competition at the lexical level.

Does such an explanation work? AR&M adopt the use of the Luce ratio as a means for determining when the target word will be selected (see Roelofs, 1992). The Luce ratio is a proportion that generates the probability (at each time step) of selecting the target word. The value of the Luce ratio is determined by dividing the level of activation of the target word by the (sum) level of activation of all words within the system, *including the target node.* Because the level of activation of the target word is included in the denominator of the Luce ratio, it must also be assumed that more activation spreads from the target representation to the distractor than from the distractor representation to the target. Critically, that asymmetry in spreading activation must be large enough to ensure that distractor-to-target priming *does not* outweigh the competition for selection of the target word. It is thus not obvious, that the trade-off account of AR&M, even as stipulated, can explain polarity reversals from semantic interference to facilitation.

Is spreading activation biased?

AR&M's suggestion of biases on spreading activation builds on previous proposals (e.g., Bloem & La Heij, 2003; see also discussion immediately above regarding asymmetries on spreading activation between targets and distractors). For instance, Bloem and La Heij (2003) proposed that activated concepts do not automatically spread activation to their corresponding

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lexical nodes, in order to explain why distractor pictures facilitate the translation of words that are semantic category coordinates. AR&M have not specified (e.g., as did Bloem & La Heij, 2003) the conditions that must obtain for such biases on spreading activation to be realised. The authors discuss the influence of contextual factors, such as the other items with which a given item is presented, and/or task-related instructions. Understood in that way, the idea of contextually induced 'biases' on the spreading of activation is not new: if a set of related concepts are co-activated, those concepts will tend to mutually activate one another. Furthermore, and as discussed by the authors, a new 'category' of items could be established by strongly activating those items within a specific task context.

A much more radical notion of biases on the spreading of activation could stipulate the presence of structural constraints that guarantee that only a subset of words are in fact activated, compared to the entire set of nodes that would otherwise be activated. For instance, it may be argued that lexical nodes corresponding to distractor words become activated only if those distractors are category coordinates of the target concepts. In this way, the proposal would redefine the construct of a 'lexical competitor' to only include words that are coordinates of the target concept. The motivation for such a revision is not clear. It is also not clear how such a constraint would be implemented, at either the semantic or lexical levels. Furthermore, the within-category semantic distance effect would remain to be explained.

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'Semantic interference' is not synonymous with 'lexical competition'

A number of authors, including AR&M, have argued that 'semantic interference' effects observed in other naming paradigms constitute support for the assumption of lexical competition (Damian, Vigliocco, & Levelt, 2001; Belke, Meyer, & Damian, 2005; Kroll & Stewart, 1994). For instance, Brown (1981; see also Kroll & Stewart, 1994; Damian et al., 2001) observed that naming latencies to target pictures are slower if the pictures are blocked by semantic category than if they are intermixed with unrelated pictures. Damian and Als (2005) subsequently showed that naming latencies for target pictures from the same semantic category, all appearing in the same block, are slower even when unrelated picture naming trials are interspersed throughout the block. Similar to Damian and Als' observation, Howard, Nickels, Coltheart, and Cole-Virtue (2006; see also Brown, 1981) observed that naming latencies to each subsequently named within-category picture increase, independently of the number of intervening items from other categories (we refer to this as the Cumulative Within Category Cost; Navarrete, Mahon, and Caramazza, 2008).

As discussed by Damian and Als (2005; see also discussion in Dell et al., 2008; Howard et al., 2006) it is unlikely that either the semantic blocking effect or the related Cumulative Within Category Cost can be explained only by reference to (positive) spreading activation. As discussed by various authors, possible accounts may be developed in terms of a learning mechanism (Damian & Als, 2005; Dell et al., 2008), and/or memory related processes (Brown, Whiteman, Cattoi, & Bradley, 1985; see also Norman, Newman, & Detre, 2007), and/or a combination of excitatory and inhibitory connections (Dell et al., 2008; Howard et al., 2006). Regardless of the view that is adopted, it follows that those 'semantic interference effects' do not constitute evidence, either for or against, the hypothesis of lexical-selection-by-competition. Those phenomena also do not constitute evidence, either for or against, the Response Exclusion Hypothesis.[6]

In contrast, semantic facilitation effects are directly relevant for evaluating the dynamical principles that govern lexical retrieval processes. Belke and colleagues (2005; see also Damian et al., 2005) showed that semantic facilitation, and not semantic interference, is observed in the first presentation of items within a block. Abdel Rahman and Melinger (2007) found semantic facilitation (instead of semantic interference) for the first entire block. Such semantic facilitation effects are difficult to accommodate on the view that lexical selection is by competition. In contrast, on the model we have outlined, the 'normal' effect of semantic context on correct lexical selection events should be facilitatory. The pattern of how facilitation changes to interference is informative of the (perhaps, non-language relevant) processes that lead to interference (e.g., a learning mechanism, a memory related explanation, etc.).

CONCLUSION

The hypothesis of lexical-selection-by-competition faces two challenges: (1) to explain polarity reversals from semantic interference to facilitation in the picture-word naming task; and (2) to explain the facilitatory effect of

[6] In our first attempt to synthesise the various effects of semantic context on naming latencies in speech production (Mahon et al., 2007), we highlighted the similarity between the semantic blocking paradigm and the semantic interference effect in the picture-word interference paradigm. In both paradigms, semantic interference is induced by contextual stimuli that are semantic category coordinates of the target. We noted that '[p]reviously named pictures will be available as potential responses' (Mahon et al., 2007, p. 516). We no longer believe that aspect of the paradigm to be an integral part of a viable account of the semantic blocking phenomenon (see Navarrete et al., 2008). Regardless, the explanatory status of cumulative semantic effects is independent of the role of the Response Exclusion Hypothesis in explaining semantic interference in the picture-word paradigm.

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decreasing semantic distance between distractors and targets. We have argued that AR&M's proposal does not succeed with respect to either challenge. Further assumptions can always be envisioned that would help to overcome these difficulties. Computational simulations can also be envisioned in which the parameter space might be searched in order to fit models to specific effects – our argument has not been that there is, in principle, no possible set of parameters that can explain specific findings that have been argued to be problematic for lexical-selection-by-competition. However, the additional assumptions that would be required in order to 'save' the assumption of lexical-selection-by-competition have their motivation only in that purpose. Is the assumption of lexical competition worth saving at *any* cost?

As AR&M acknowledge, their review of the experimental literature is selective, and the explanatory scope of the Swinging Lexical Network Proposal is even more restricted than the authors' review. For instance, the proposal does not address the findings that (1) SIE is observed in a delayed naming task (Janssen et al., 2008); (2) low frequency distractors interfere more than high frequency distractors (Burt, 2002; Miozzo & Caramazza, 2003); (3) either no SIE, or semantic facilitation is observed for picture distractors in picture naming (Damian & Bowers, 2003; La Heij et al., 2003; Navarrete & Costa, 2005); or (4) that masked semantic category coordinate distractors facilitate target naming compared with masked unrelated distractors (Finkbeiner & Caramazza, 2006).

Adopting the account that we have outlined would shift the focus of study in several different directions. For instance, one issue that becomes prominent concerns the dynamics of spreading activation at the semantic level, and how spreading activation facilitates processes involved in lexical access. Another change in focus concerns what the picture-word interference paradigm itself can tell us about language production: The Response Exclusion Hypothesis is, above all, a proposal about how conflicts that are induced by the picture-word (and Stroop) task are resolved within the speech production system. Thus, the issue arises of how the picture-word paradigm can be used to study the mechanisms of control that mediate the production of response-level representations.

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