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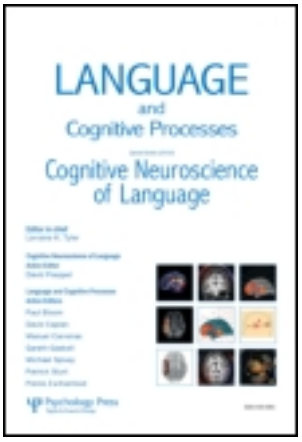


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# A rose by any other name is still a rose: A reinterpretation of Hantsch and Mädebach

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# A rose by any other name is still a rose: A reinterpretation of Hantsch and Mädebach

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The Response Exclusion Hypothesis localises the semantic interference effect as observed in the picture–word paradigm at a postlexical level of processing. An important aspect of this proposal is that the ease with which distractor words can be excluded from production at the response level is determined by the degree to which they satisfy criteria demanded of a correct response. This proposal predicts that naming a picture of a "rose" with the response "flower" will be slower with the distractor "rose" than a distractor word that would not be appropriate for the picture (e.g., "tulip"). Hantsch and Mädebach report evidence consistent with this expectation; however, the authors argue that the results are problematic for the Response Exclusion Hypothesis. Here we unpack Hantsch and Mädebach's arguments about why their finding is (putatively) problematic for the Response Exclusion Hypothesis. We conclude that the pattern of effects that the authors report are not only in line with what would be expected by the Response Exclusion Hypothesis, but are difficult to reconcile with Hantsch and Mädebach's preferred theoretical position.

***Keywords:*** Speech production; Picture–word interference; Lexical selection; Response Exclusion Hypothesis.

## PREVIEW TO OUR RESPONSE

Hantsch and Mädebach (2013) report that participants are slower to name a picture of a "rose" with the response "flower" when the distractor is "rose" (subordinate-identical condition) than when the distractor is "tulip" (subordinate-alternative condition). In discussing how their observation may or may not be problematic for the Response Exclusion Hypothesis the authors write:

> The fact that in the subordinate-identical condition the distractor denotes an appropriate name of the target picture, while in the subordinate-alternative condition it does not, makes the notion of "relevance" intuitively appealing. In fact, our results can be conceived as mirroring the relevance of the distractor word. (p. 696)

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However, the thrust of Hantsch and Mädebach's argument is that their findings are *difficult* to reconcile with the Response Exclusion Hypothesis. In this response we unpack the authors' argument and suggest that, in line with the intuition expressed in the above excerpt, the pattern of findings the authors report fits nicely with the Response Exclusion Hypothesis. The core of our argument is presaged in our previous discussion of this issue (Mahon, Costa, Peterson, Vargas, & Caramazza, 2007, p. 516):

> . . .Hantsch et al. [2005] observed that basic-level naming latencies (e.g., "car") were slowed by correct subordinate-level distractors (Mini) compared with unrelated distractors (e.g., daisy). The pattern of results obtained by Hantsch et al. is what would be expected if semantic interference arises because distractor words from the semantically related condition satisfy a response criterion demanded by the target pictures. In other words, when naming a picture of a Mini, "car" is an appropriate response, whereas "hat" is not; similarly, when naming a picture of a Mini as "car", the distractor Mini is appropriate, whereas the distractor daisy is not. The same situation arises when basic-level names are produced in the context of superordinate-level distractor words; when naming a picture of a dog, "animal" is an appropriate response, whereas "vehicle" is not (Kuipers et al., in press). The observation that semantic interference is observed across levels of categorization (Hantsch et al., 2005; Kuipers et al., in press) reinforces the conclusion that semantic interference is observed when semantically related distractor words satisfy response-relevant criteria demanded by the target pictures that are not satisfied by unrelated distractor words.

Hantsch and Mädebach present a number of arguments that are more or less independent of one another; we respond to those points below in detail. First though, it is important to respond to a theme that runs throughout their manuscript—that the viability of the Response Exclusion Hypothesis is tied up in whether the theory is "merely" an explanation of what is going on in the picture–word paradigm. As the authors correctly note, the Response Exclusion Hypothesis was developed as an account of what happens in tasks where participants must ignore a prepotent linguistic stimulus. The authors then object:

> For a confined mechanism, as originally proposed by the response-exclusion account, that only becomes effective during picture-word experiments such a mechanism appears to be extremely potent. (p. 696)

In other words, Hantsch and Mädebach argue that if the theory can explain findings outside of the picture–word paradigm, then this is a mark against the theory. But why should "potency" be a mark against a theory? "Potency", while maintaining falsifiability, is a strength for a scientific theory. It is important to distinguish between whether a theory is explicitly an account of the cognitive processes that are implicated in a given experimental paradigm, and the claim that those cognitive processes are used only in that paradigm. Our view has never been that the human mind comes equipped with the cognitive machinery behind the Response Exclusion Hypothesis merely so that distractor words could interfere with picture naming. Rather, our view is that the cognitive processes implicated by the Response Exclusion Hypothesis are being "hijacked" by the picture–word paradigm but that they "exist" for more enduring reasons. A position that we initially shied away from, but which has gained some ground as developed by Dhooge and Hartsuiker (2010, 2011a), is that the Response Exclusion Hypothesis may be construed as drawing on the same processes that are involved in speech monitoring. If that were the case, then this would offer a

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new way of testing the Response Exclusion Hypothesis, as well as a new way of conceptualising what is going on in the picture–word paradigm [in this respect, see the recent proposal by Dhooge and Hartsuiker, 2012, about the role of the monitoring system in picture–word interference (PWI) tasks].

## OVERVIEW OF THE THEORETICAL ISSUES AT STAKE

Perhaps the most widely used paradigm to study the dynamics of lexical access during language production using chronometric measures is the PWI paradigm. In the PWI paradigm, participants name a picture while ignoring a distractor word. The time it takes to name the picture is affected (among other things) by the relationship between the picture naming response and the distractor stimulus. One of the most established phenomenon within PWI research is the semantic interference effect (SIE): picture-naming latencies (e.g., "car") are slower in the context of distractor words that are semantic coordinates of the target picture (e.g., truck) than in the context of unrelated distractor words (e.g., table)[1] (e.g., Lupker, 1979; Rosinski, 1977; Schriefers, Meyer, & Levelt, 1990).

### The hypothesis of lexical selection by competition

For the last two decades, the SIE has been interpreted as arising at the lexical level, reflecting lexical selection by competition (e.g., Costa, Miozzo, & Caramazza, 1999; Damian & Bowers, 2003; Damian & Martin, 1999; Hantsch, Jescheniak, & Schriefers, 2005, 2009; Humphreys, Lloyd-Jones, & Fias, 1995; La Heij, 1988; Levelt, Roelofs, & Meyer, 1999; Roelofs, 1992, 1993, 2001, 2003; Schriefers et al., 1990; Starreveld & La Heij, 1995, 1996; Vigliocco, Vinson, Lewis, & Garrett, 2004; Vitkovitch & Tyrrell, 1999). Roelofs (1992), in his now classic implementation of this hypothesis, assumed that lexical selection was a two-step process. In the first step, the level of activation of the target word had to exceed the levels of activation of nontarget words by a parameter dependent amount (the "critical difference"). This first step ensures that the correct target word's identity is never in doubt, but it does not generally contribute to response time effects, such as are observed in the picture–word paradigm. In the second step, the time point at which the target (already defined) is actually selected is a probabilistic function of the ratio between the level of activation of the target and the summed levels of activation of all other words in the system. The greater this ratio the higher the probability of selecting the target lexical node (e.g., Levelt et al., 1999; Roelofs, 1992, 2003). In our previous example, the lexical node corresponding to the semantic coordinate distractor (truck) would be more activated than the lexical node of the unrelated distractor (table), and therefore, the ratio would be lower at any given time point for the distractor truck compared to the distractor table. This means that the distractor truck could be said to compete more for selection of the target than would the distractor table.

The postulated difference in activation levels between a related and unrelated distractor word derives from spreading activation between the semantic system and the lexical system, an assumption shared by almost all models of lexical access (e.g., Caramazza, 1997; Dell, 1986; Levelt et al., 1999; Rapp & Goldrick, 2000, see however

[1] Following conventions in the literature, we use the following notations: picture names and participants' responses appear in quotes (e.g., "bed"), distractor words are underlined (e.g., table), lexical concepts are denoted by capital letters (e.g., BED), and lexical nodes are denoted by italics (e.g., *table*).

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Bloem & La Heij, 2003; Bloem, van den Boogaard, & La Heij, 2004, for a slightly different proposal). As a consequence of spreading activation, the target picture activates the concept CAR which activates the semantically related concept TRUCK which, in turn, spreads activation to the lexical node *truck*. In the unrelated condition, the lexical node *table* is not activated from the target concept. Therefore, while the lexical node *truck* is highly activated because it receives activation from two sources (the target picture and the presentation of the distractor word) the lexical node *table* receives activation from only one source (the presentation of the distractor word).

It is relevant to note that due to spreading activation, activation not only spreads from target representations to the distractor lexical node but also from distractor representations to the target lexical node. The distractor truck activates its corresponding concept TRUCK; this activation spreads to the concept CAR, which in turn propagates activation to the target lexical node *car*. In order to account for the SIE in such a scenario, the hypothesis of selection by competition must assume that the amount of activation that is spread to the target lexical node (*car*) from the distractor (truck) is less than the activation that the distractor lexical node (*truck*) receives from the target concept (CAR).[2] This asymmetry in the amount of activation spread between the distractor and the target will also be important for considering how to best explain the data from Hantsch and Mädebach.

The central prediction made by the hypothesis of lexical selection by competition is that naming latencies will increase as the semantic similarity between distractors and targets increases. That this is the central prediction of the hypothesis is because the theory was engineered to explain the SIE, and the prediction is guaranteed by the assumption that asymmetrical spreading activation will always result in greater target-to-distractor priming than distractor-to-target priming. Therefore, in any semantically related condition, the difference in activation between distractor and target lexical nodes will be reduced compared to an unrelated distractor condition. Because that difference is reduced in the related condition compared to the unrelated condition, the probability of selecting the target at any given time point will be lower, and longer naming latencies are predicted.

## Lexical selection by activation

More or less independently of the literature on PWI is a rich tradition of modelling speech production processes using error data, both errors in normal speech and in brain damaged patients. Whereas the emphasis of models based on chronometric effects has been on modelling temporal uncertainty about *when* the target word is produced,[3]

[2] This asymmetrical activation can be explained either in terms of the number of links that must be traversed or attentional biases. If modeled in terms of the number of links that must be traversed, the following logic can be used: To reach the target lexical node from the distractor word, activation passes 3 nodes (truck -> TRUCK -> CAR -> *car*); while in order to reach the distractor lexical node from the target concept, activation passes 2 nodes (CAR -> TRUCK -> *truck*). More activation is transmitted in the last case than in the first because there are fewer steps (e.g., Levelt et al., 1999; Roelofs, 1992). Other formulations postulate the relevance of attentional factors as a possible origin of the asymmetrical spreading activation between target and distractor stimuli in PWI and picture-picture interference tasks (Roelofs, 2008, Roelofs, Piai, & Schriefers, 2011).

[3] That uncertainty is modeled with respect to *when* the target is produced (and not *what* the target will be) is guaranteed by the first step in lexical selection under the standard implementation (e.g., Roelofs, 1992). That first step consists in checking that the level of activation of the target is greater by a 'critical difference' than the levels of activation of nontargets—thus, if the target is not the most highly activated word at the lexical level, then the Luce ratio is never computed.

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models based on error data have been concerned with modelling uncertainty about the identity of the target word. Within that class of models, the target word is that which is the most highly activated, and the time to select the target is not affected by the levels of activation of nontarget words (Caramazza, 1997; Dell, 1986; Rapp & Goldrick, 2000), assuming an error is not made. According to those models, errors occur when a nontarget word is the most highly activated.

### Adjudicating among theories

Aside from the SIE which stands out as the exception rather the rule, decreasing semantic distance between distractor words and target pictures leads to faster naming latencies (for review, see Mahon et al., 2007). Semantic facilitation effects cannot be explained by the hypothesis of lexical selection by competition, unless the account makes additional assumptions. Recent discussions have emphasised ways in which the hypothesis of lexical selection by competition may be adorned (e.g., Abdel Rahman & Melinger, 2009a; Bloem & La Heij, 2003; Bloem et al., 2004). There is also independent evidence showing that the SIE arises at a postlexical level of processing as suggested by the Response Exclusion Hypothesis (Janssen, Schirm, Mahon, & Caramazza, 2008; for similar findings with the distractor frequency effect see Dhooge & Hartsuiker, 2010, 2011b). This fact effectively removes the only motivation that there was for assuming lexical selection by competition, since the SIE was the only semantic effect that led to interference and not facilitation (but see Mädebach, Oppermann, Hantsch, Curda & Jescheniak, 2011; Piai, Roelofs & Schriefers, 2011; Roelofs, et al., 2011; for additional relevant findings, see e.g., Aristei, Melinger, & Abdel Rahman, 2010; Costa, Strijkers, Martin, and Thierry, 2009; Hutson, Damian, & Spalek, 2013).

The Response Exclusion Hypothesis (Finkbeiner & Caramazza, 2006; Janssen et al., 2008; Mahon et al., 2007; Miozzo & Caramazza, 2003) draws on early accounts of the source of interference effects in the picture–word, and related, paradigms (e.g., Glaser & Glaser, 1989; La Heij, 1988; Lupker, 1979; Lupker & Katz, 1981; Simon & Sudalaimuthu, 1979). There are two basic components of the Response Exclusion Hypothesis: (1) distractor words have privileged access to a very late stage in speech production, which is the level at which speech becomes a single channel; because that level of processing is a single channel, the target word can be produced only when the distractor has been "purged"; (2) if the distractor satisfies response criteria demanded of the target, it is more difficult to exclude at the response level.

Although the Response Exclusion Hypothesis was originally formulated to account for the SIE in the PWI task, there is no reason in principle why it cannot be extended to explain SIEs that arise from other types of semantic relationships between distractors and targets. It is in this area of research where the study of Hantsch and Mädebach (2013) is located. In particular, they explored whether the Response Exclusion Hypothesis can account for semantic interference across levels of categorisation. They have two bottom-line conclusions. First, the Response Exclusion Hypothesis cannot account for their results; second, the selection by competition hypothesis can account for their results. Here we explore each claim in detail.

## THE EMPIRICAL PREDICTIONS OF HANTSCH AND MÄDEBACH

In the PWI study conducted by Hantsch and Mädebach (2013), participants were instructed to name object pictures at the basic level whose preferential name was at the

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subordinate-level (75–100% preferences for naming at the subordinate level). For example, for the picture of a "rose" people spontaneously refer to it as "rose", but were instructed to call the picture by its basic level name "flower". Each picture was presented with four distractors: the word corresponding to the preferred response (i.e., rose; the subordinate-identical condition); a semantically related subordinate-level exemplar (i.e., tulip; the subordinate-alternative condition); and two unrelated subordinate-level words (i.e., villa, jeep; the subordinate-identical unrelated and the subordinate-alternative unrelated conditions). In comparison to their respective unrelated baseline conditions, naming latencies were slower in the subordinate-identical condition (rose) but not in the subordinate-alternative condition (tulip). Further analyses showed that pictures were named slower in the subordinate-identical condition (rose) than in the subordinate-alternative condition (tulip).

Hantsch and Mädebach make two critical predictions. The first prediction they make is that the Response Exclusion Hypothesis would predict the same interference in the two semantically related conditions (subordinate-identical and subordinate-alternative), compared to the unrelated baselines. The second prediction is that the hypothesis of selection by competition predicts more interference in the subordinate-identical condition than in the subordinate-alternative condition. There are thus three pairwise comparisons between experimental conditions that are of theoretical significance: (1) subordinate-identical versus subordinate-alternative, (2) subordinate-identical versus subordinate-unrelated, and (3) subordinate-alternative versus subordinate-unrelated. Below we consider, in the context of each contrast, the effects that were observed, the coherence of Hantsch and Mädebach's predictions, and our own interpretation of their findings.

## Subordinate-identical (rose) versus subordinate-alternative (tulip)

According to Hantsch and Mädebach, both hypotheses postulate a semantic priming effect from the related distractors (rose and tulip) to the target. The difference between the two hypotheses concerns the effect on response times of priming from the target to the distractor. The authors argue that, according to the hypothesis of lexical selection by competition, the lexical node corresponding to the subordinate-identical distractor (*rose*) would receive more activation from the target than would the lexical node corresponding to the subordinate-alternative distractor (*tulip*). This generates the prediction of slower latencies for subordinate-identical distractors than for subordinate-alternative distractors, consistent with the observed pattern.[4]

With respect to the Response Exclusion Hypothesis, Hantsch and Mädebach argued that the same amount of interference is expected from both related conditions (rose and tulip). They based that prediction on the argument that rose and tulip are both at the subordinate-level of categorisation, and that, according to their reading of the Response Exclusion Hypothesis, it will require the same amount of time to reject rose and tulip from the output buffer when the response is located at a basic level of categorisation ("flower"). As they reason:

> . . . the subordinate-identical condition and the subordinate-alternative condition did not differ with regard to the semantic relation between the related distractor words (subordinate-level names) and the target utterances (basic-level names). Thus, the related

[4] However, and as discussed above, the hypothesis predicts (and for the same reasons) that the distractor tulip, while interfering less than the distractor rose, should nevertheless interfere more than an unrelated distractor (e.g., jeep), contrary to what was observed (see prediction 3 below).

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> distractor words in both conditions should be considered equally relevant for the responses in the experiment. Following this logic, the response-exclusion hypothesis would predict similar levels of interference in both conditions – contrary to what we found. (p. 695)

There is a problem with the authors' gloss of what is occurring—it is inconsistent with their argument that the lexical node *rose* will receive more activation from the target concept than will the lexical node *tulip*. The reason why the authors argued (in the context of the selection by competition hypothesis) that *rose* is primed more by a picture of a rose than is *tulip* is because the former *is the same concept as the target* while the latter is not. In other words, the semantic relationship between the distractor rose and the response "flower" to *a picture of a rose* is not the same as the relation between the distractor tulip and the response "flower" to *a picture of a rose*. The relation between rose and tulip and the response "flower" would be the same if the underlying picture was of a daffodil—but that is not the situation. The response "flower" is not given in a vacuum—it is retrieved from a conceptual representation which was itself selected upon presentation of a picture. It seems difficult for the authors to disagree with this, since it is very motivation for the derivation of their prediction with respect to the hypothesis of lexical competition, as for instance they argued:

> (i.e., the subordinate-level name of the target picture that supposedly receives substantial activation via the picture) gets further activated by the distractor word, whereas in the subordinate-alternative condition a somewhat weaker competitor (i.e., the name of a different exemplar of the same basic-level category that supposedly received less activation via the picture) gets activated by the distractor word. (p. 687)

So there is no reason to presume that the distractor rose does not satisfy criteria demanded of the target picture, since the target picture is one of a rose. In other words, rose is response relevant in a way that tulip is not: the reason is that participants are struggling not to say the word rose.[5]

## Subordinate-identical (rose) versus subordinate-unrelated (villa)

Following Hantsch and Mädebach, both hypotheses (lexical competition and Response Exclusion) predict that rose should interfere more than a subordinate-unrelated distractor (villa). We agree with their assessment. According to the selection by competition account: (1) the distractor rose primes the target lexical node (*flower*) while the distractor villa does not, and (2) the distractor lexical node *rose* will be more

[5] There is plenty of evidence as well that telling somebody: "don't do it" produces the reverse effect (e.g., Wardlow Lane, Groisman, & Ferreira, 2006; Wegner, 2009). Why should we think the situation is any different when you give someone a picture that has a clear name and you tell them to not name it as such, and then, in addition, to ignore the name they are supposed to not use? By analogy, it would be as if a life long friend changed his name from Frank to Alex, and Alex (formally Frank) absolutely insisted that you call him by his new name. That might present a challenge at first, but would be doable. But then, imagine that Alex (formally Frank) went around wearing a t-shirt with the name 'FRANK printed in big letters. This would make it even more difficult to refer to Alex correctly. And if Alex (formally Frank) then took umbrage when you made a mistake and called him 'Frank, one would be inclined to say: "But why couldn't you wear a t-shirt with some irrelevant name on it, such as Paul, or Daniel or Sam? That would make it much easier for me to concentrate on what your new name is and not be distracted by what I 'want' to call you."

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activated than the distractor lexical node *villa*. Critically, the difference between the level of activation of the target lexical node and the distractor lexical node is smaller in the subordinate-identical condition than in the unrelated condition, and therefore, slower naming latencies are predicted. With respect to the Response Exclusion Hypothesis, the interference arises because when naming the picture of a rose as "flower", the distractor rose satisfies criteria demanded of the picture, whereas the distractor villa does not. The results are therefore congruent with both hypotheses, and so that effect does not distinguish the two theories.

As detailed by Hantsch and Mädebach, both hypotheses predict slower naming latencies when (1) the distractor corresponds to the name of the target picture itself, and (2) the response utterance is located at a different level of categorisation, in comparison to an unrelated distractor. Hantsch and Mädebach's (2013) current investigation is not the first to explore this prediction. Table 1 summarises studies that have explored "identity across levels" effects with subordinate, basic, and superordinate naming responses. For simplicity, Table 1 reports the effects (identity – unrelated) for the stimulus onset asynchrony (SOA) condition in which target and

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TABLE 1

Summary of the "identity across levels" studies. In the identity condition the distractor word (e.g., rose) corresponds to the identity of the picture target ("rose") and the response is located at a different level of categorisation (e.g., "flower"). In the unrelated condition the distractor word (e.g., car) is semantically unrelated to the target picture. The reported data corresponds to the condition SOA = 0 ms, see main text for details. Effect size corresponds to $RTs_{Identity\ condition}$ *minus* $RTs_{Unrelated\ condition}$

| *Task* | *Target (preferred name)* | *Response* | *Identity condition* | *Unrelated condition* | *Effect size (ms)* | *Study* |
|---|---|---|---|---|---|---|
| Categorisation | Flower | "Plant" | Flower | $Car_{(active\ category)}$ | −13 | Lupker & Katz (1981) Exp.2 |
| Categorisation | Flower | "Plant" | Flower | $Car_{(inactive\ category)}$ | −12 | Lupker & Katz (1981) Exp.2 |
| Categorisation | Flower | "Plant" | Flower | Car | 16 | Glaser & Düngelhoff (1984) Exp.2 |
| Subordinate | Rose | "Rose" | Flower | Car | −45 | Vitkovitch & Tyrrel (1999) Exp.2 |
| Basic | $Flower_{(picture\ of\ a\ rose)}$ | "Flower" | Rose | Jeep | 42 | Hantsch et al. (2005) Exp.1 |
| Basic | $Flower_{(picture\ of\ a\ rose)}$ | "Flower" | Rose | Jeep | 39 | Hantsch et al. (2005) Exp.2 |
| Subordinate | $Flower_{(picture\ of\ a\ rose)}$ | "Rose" | Flower | Car | 28 | Hantsch et al. (2005) Exp.3 |
| Subordinate | $Flower_{(picture\ of\ a\ rose)}$ | "Rose" | Flower | Car | 18 | Hantsch et al. (2009) Exp.1 |
| Subordinate | $Flower_{(picture\ of\ a\ rose)}$ | "Rose" | Flower | Car | 25 | Hantsch et al. (2009) Exp.2 |
| Subordinate | $Flower_{(picture\ of\ a\ rose)}$ | "Rose" | Flower | Car | 2 | Hantsch et al. (2009) Exp.3 |
| Subordinate | $Flower_{(picture\ of\ a\ rose)}$ | "Rose" | Flower | Car | −14 | Hantsch et al. (2009) Exp.4 |
| Basic | Rose | "Flower" | Rose | Jeep | 14 | Hantsch & Madebach (2013) |

distractor are presented simultaneously (i.e., SOA = 0 ms). However, as some studies did manipulate SOA parametrically, a more complete table with effects by SOA for all studies is provided in the Supplemental Online Materials (see Table S1). Collapsing across the effects listed in Table 1, naming latencies for identity across level distractors are 8 ms slower than in the unrelated baseline with a standard error of the mean (SEM) of 7 ms (see below for further discussion). Thus, Hantsch and Mädebach's findings (2013) are in accordance with previous work on the topic.

## Subordinate-alternative (tulip) versus subordinate-unrelated (jeep)

Hantsch and Mädebachs' treatment of the predictions that follow for this comparison were not as complete as their treatment of the other comparisons. The authors contended that, whether the hypothesis of lexical selection by competition predicts interference or facilitation depends on a delicate trade-off between distractor-to-target and target-to-distractor priming. Facilitation emerges, the authors claim, when there is greater distractor-to-target priming than target-to-distractor priming. But, to be consistent, and following the same assumptions that guarantee a prediction of interference for the classic SIE (see also the immediately preceding section), the hypothesis of selection by competition predicts more interference for tulip than for jeep when naming a picture of a rose as "flower". The reason is that the lexical node corresponding to *tulip* will receive activation from two sources (picture and word) while the word corresponding to the lexical node *jeep* will receive activation from only one source (word). Thus, because the difference in activation levels between the target lexical node and the distractor lexical node in the semantically related condition will be less than the difference in the unrelated condition, slower naming latencies are predicted in the semantically related than in the unrelated condition (for detailed discussion of the assumptions that lead to this prediction, see Hantsch et al., 2005, 2009). The data, which show no interference effect, are at odds with the hypothesis of lexical selection by competition.

According to Hantsch and Mädebach, the Response Exclusion Hypothesis makes the prediction that the same amount of interference effect should be observed as in the comparison between the subordinate-identical versus the subordinate-unrelated conditions. The reason why, the authors argue, is because the distractor tulip and the distractor rose are located at the same level of categorisation in relation to the response "flower". We have already discussed above why this reasoning is problematic.

If anything, the Response Exclusion Hypothesis predicts a semantic facilitation effect: neither of the two distractors (tulip or jeep) is appropriate to name the picture of a rose as "flower", and therefore, it should take the same time to reject the two distractors as possible responses. However, tulip and jeep differ in terms of distractor-to-target priming: the related distractor tulip will prime the target response more than jeep. Thus, if anything, the Response Exclusion Hypothesis predicts a semantic facilitation effect, with faster naming latencies in the subordinate-alternative condition than in the unrelated condition. Positive evidence in this direction was reported by Costa, Mahon, Savova, and Caramazza (2003). In Experiment 1 of that study, participants named target pictures (e.g., "axe") at the superordinate level ("tool") while ignoring coordinate-related (hammer) or unrelated (carrot) distractors. Naming latencies were facilitated by 56 ms in the coordinate-related condition compared to the unrelated condition (see also Kuipers, La Heij, & Costa, 2006, for further evidence for facilitation). Hantsch and Mädebach (2013) failed to replicate the semantic facilitation

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effect reported by Costa et al. (2003), although it is noteworthy that their effect goes in the right direction by subjects, $F(1, 31) = 2.55$, $MSE = 596.61$, $p = .12$. Perhaps the most plausible conclusion is then that Hantsch and Mädebach's experiment was underpowered.

Table 2 summarises the studies that have included a "coordinate across levels" of categorisation condition. As in Table 1, we focus for simplicity on the SOA = 0 condition with a complete list of all data by SOA for the available studies reported in Supplemental Table S2. As can be see in Table 2, when distractor words (e.g., tulip) are semantically related to the target picture ("rose") and the response is located at a different level of categorisation ("flower"), naming latencies tend to be faster in comparison to unrelated distractors. Collapsing across studies, the coordinate condition is 8 ms faster than the unrelated condition ($SEM = 7$ ms).

## Identity-across levels interference, except for superordinate categorisation responses

Table 1 shows that there is a consistent pattern of interference when the distractor word corresponds to the picture's name and the picture is named at a different level of categorisation, compared to an unrelated condition (see the *Identity across level*

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TABLE 2
Summary of the "coordinate across levels" studies. In the coordinate condition the distractor word (e.g., tulip) is semantically related to the picture target ("rose") and the response is located at a different level of categorisation (e.g., "flower"). In the unrelated condition the distractor (e.g., car) is semantically unrelated to the target picture. The reported data corresponds to the condition SOA = 0 ms, see main text for details. Effect size corresponds to $RTs_{\text{Coordinate condition}}$ *minus* $RTs_{\text{Unrelated condition}}$

| *Task* | *Target (preferred name)* | *Response* | *Coordinate condition* | *Unrelated condition* | *Effect size (ms)* | *Study* |
|---|---|---|---|---|---|---|
| Categorisation | Flower | "Plant" | Tree | $Car_{(active\ category)}$ | −11 | Lupker & Katz (1981) Exp.2 |
| Categorisation | Flower | "Plant" | Tree | $Car_{(inactive\ category)}$ | −10 | Lupker & Katz (1981) Exp.2 |
| Categorisation | Flower | "Plant" | Tree | Car | 0 | Glaser & Dungelhoff (1984) Exp.2 |
| Basic | Flower | "Flower" | Plant | Vehicle | 1 | Roelofs (1992) |
| Basic | Flower | "Flower" | Tulip | Jeep | 5 | Roelofs (1992) |
| Subordinate | Rose | "Rose" | Tree | Car | −19 | Vitkovitch & Tyrrel (1999) Exp.2 |
| Basic | Rose | "Flower" | Tulip | Car | −56 | Costa et al. (2003) Exp.1 |
| Basic | Flower | "Flower" | Petal | Wheel | −23 | Costa, Alario, & Caramazza (2005) Exp.1 |
| Basic | Flower | "Flower" | Petal | Wheel | −15 | Costa et al. (2005) Exp.2 |
| Categorisation | Flower | "Flower" | Plant | Vehicle | 47 | Kuipers et al. (2006) Exp.1a |
| Basic | Rose | "Flower" | Tulip | Jeep | −6 | Hantsch & Madebach (2013) |

condition in Figure 1). A distractor word that corresponds to the preferred name of a picture satisfies response-relevant criteria when the picture is named with a nonpreferred name. In other words, distractor words that increase response uncertainty slow down naming latencies, in line with the main claim of the Response Exclusion Hypothesis. The increase in response uncertainty is created by ambiguity in whether the production ready representation corresponding to the distractor word is the target response or should be rejected as not being appropriate for the given task.

There is an interesting exception to the general pattern of interference that is evident in the data summarised in Table 1 (see also Table S1): When the naming response is at the superordinate level, distractor words corresponding to the correct basic level name of the picture facilitate naming latencies compared to unrelated distractor words. There are several possible explanations for this pattern, all of which are ad hoc, pending future empirical work.

One possibility is that the "facilitation" effect could be due as much to slowing down in the unrelated condition as speeding up in the related condition. It has been proposed (Lupker & Katz, 1981; Simon & Sudalaimuthu, 1979; for discussion, see Glaser and Glaser, 1989; Mahon et al., 2007) that the task performed over the target stimulus is applied as well over the distractor—termed, "logical recoding" by Simon and Sudalaimuthu (1979) and Glaser and Glaser (1989). Thus, if the target picture is categorised at the superordinate level (e.g., flower → plant) then the distractor is categorised as well (related: flower → plant; unrelated: car → vehicle). The related distractor condition would thus involve response congruency between the target

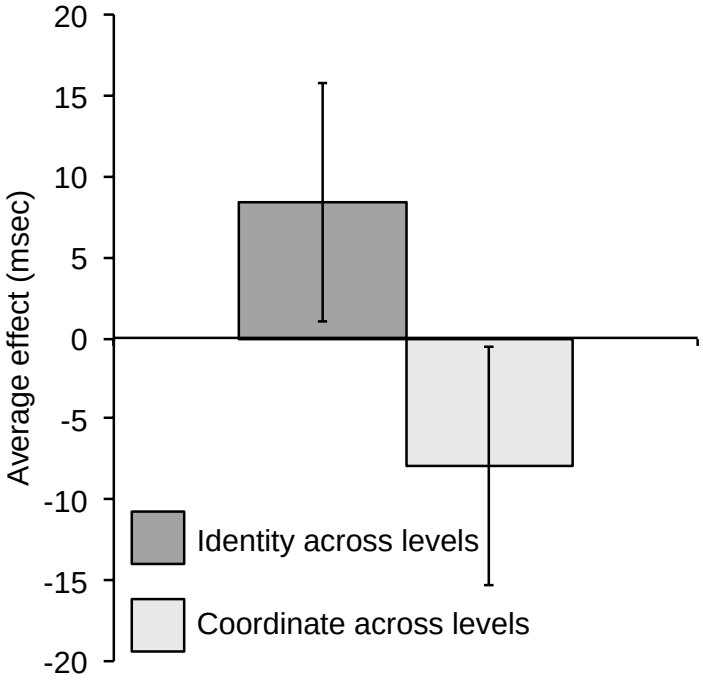


**Figure 1.** Effect size in milliseconds for *Identity across levels* (in Table 1) and *Coordinate across levels* (in Table 2) studies. Positive values reflect a semantic interference effect and negative values a semantic facilitation effect.

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response and the response engendered by the distractor, while the unrelated would involve response incongruency (see also Kuipers et al., 2006; Kuipers & La Heij, 2008).[6]

Another possibility, albeit less well defined, may be related to the well-known phenomenon that the preferred level of categorisation at which subjects name objects is the basic level (Jolicoeur, Glucks, & Kosslyn, 1984; Murphy & Wisniewski, 1989; Rosch, Mervis, Gray, Johnson, & Boyes-Braem, 1976). While stimuli may be selected that have their preferred (or, "natural") response at the subordinate (e.g., see Hantsch and Mädebach, 2013) or basic level, single stimuli cannot (probably) be chosen whose preferred name is at the superordinate level. Thus, in a superordinate level naming task, the response deviates from anything that would otherwise be acceptable for the stimulus, rendering subordinate and basic level names irrelevant (for some hints toward such an account, see Costa et al., 2003, Experiments 2 and 4).

Regardless of what proves to be the correct interpretation of the fact that distractor words denoting the target picture facilitate target superordinate categorisation, what is relevant in the context of Hantsch and Mädebach is that in the specific manipulation of their experiment (i.e., naming at the basic level while ignoring subordinate-identical distractor), the general pattern is the same as observed by the authors, that is, interference.

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## Can distractor-to-target priming lead to semantic facilitation according to the hypothesis of lexical selection by competition?

An important part of Hantsch and Mädebachs' claims (2013) is the discussion of semantic facilitation effects in the context of PWI tasks. Current models of speech production assume that activation between the conceptual system and the lexical level spreads freely (see above). As a consequence, all models assume an activated concept will spread activation to related concepts, and nearly all models (but see Bloem & La Heij, 2003) assume that activated concepts therefore spread activation to lexical nodes corresponding to semantically related concepts. Thus, independent of the stimulus format (word or picture) and stimulus status (target or distractor), the presentation of a stimulus in the PWI task leads to activation of the corresponding conceptual and lexical representations as well as related concepts and their corresponding lexical nodes. But, and as discussed above, all explanations of the SIE in terms of lexical selection by competition have to assume that more activation spreads from the target to the distractor word's lexical node than from the distractor to the target lexical node. It is this aspect of the theory that makes observations of semantic facilitation (see e.g., Table 2 and Table S2, see also Mahon et al., 2007) particularly difficult to reconcile with the hypothesis of lexical selection by competition. Hantsch and Mädebach do not take this into account in their discussion, as they write:

[6]This type of an interpretation of the difference between the related and unrelated conditions in superordinate categorization is of the same form as can be applied to the so-called gender interference effect in the picture-word paradigm. That effect, first described by Schriefers (1993) refers to the observation that participants are slower to name target pictures with a determiner + noun phrase when the (unrelated) distractor word is of a different grammatical gender as the target compared to the same grammatical gender as the target. Critically, the gender interference effect is observed only when the determiner that would be appropriate for the distractor word is of a different form as that which is required by the target response (Schiller & Caramazza, 2003).

> It should be noted that the effect of subordinate-identical distractor words as well as subordinate-alternative distractor words will reflect the interplay of the facilitative and the interfering component according to both types of models. Therefore the net effect of both distractor types in relation to unrelated distractor words might either be semantic facilitation or semantic interference (or a null effect), depending on the relative size of the facilitative or interfering component. (p. 688)

This kind of reasoning is not tenable if the authors also want to be able to explain the SIE using the hypothesis of selection by competition. It is the relative level of activation of the target in relation to the competitors that determines when lexical selection occurs. Thus, it is not a valid argument, unless the authors have a new model of selection by competition, to claim that the more activation is received by the target, the faster the target will be produced. This is because as the priming over the target lexical node increases, the priming over the distractor node increases even more, and as a consequence the amount of competition increases and selection is delayed (for discussion see also Abdel Rahman & Melinger, 2009a, 2009b; Mahon & Caramazza, 2009).

In contrast, on a model of lexical selection according to which selection of the target word does not depend on the levels of activation of nontarget words, it is a viable explanation of semantic facilitation to invoke distractor-to-target priming. We feel that it is important to be consistent on these issues, as they are the critical empirically motivated issues on which the viability of the hypothesis of lexical selection by competition depends. Because the Response Exclusion Hypothesis is built upon a model of lexical selection in which the activation levels of nontarget words are irrelevant for the timing of target selection, it is able to accommodate semantic facilitation effects.

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## CONCLUSION

Hantsch and Mädebach present a set of findings, that while perhaps not novel (see Tables 1 and 2) are very exciting and constraining for extant models of the PWI paradigm. We have argued that the authors interpretations of those data face two principal problems. First, it is incorrect to suppose that rose is not more response relevant than tulip when naming a picture of a rose as "flower". Second, it is incorrect to claim that the hypothesis of selection by competition does not predict more interference in saying "flower" to a picture of a rose when the distractor is tulip compared to when the distractor is jeep.

Our conclusion is that the findings of Hantsch and Mädebach are consistent with the Response Exclusion Hypothesis, and because they are difficult to reconcile with lexical selection by competition, the authors have provided positive support for the Response Exclusion Hypothesis. This conclusion is underlined by the fact that the results summarised in Table 2 suggest that the reason why Hantsch and Mädebach may not have observed reliable semantic facilitation is because their experiment was underpowered.

The weight of the evidence, including the new evidence that the authors report, suggests that the enterprise of exploring how the Response Exclusion Hypothesis may be further developed is worth pursuing. An issue noted above, and which figures prominently in Hantsch and Mädebach's evaluation of the Response Exclusion Hypothesis, is whether it would be a mark against the theory if it were no longer *only* about the picture–word paradigm. As Hantsch and Mädebach write, pursuing the

development of the Response Exclusion Hypothesis in the context of theories of speech monitoring would *fundamentally change the conception of the response-exclusion hypothesis. Instead of providing merely an explanation for semantic interference effects in Stroop-like experimental tasks it would turn into a fully equipped general monitoring system* (p. 697). While this was not the original thinking behind the view, it was certainly never claimed that the human mind comes equipped with the cognitive machinery behind the Response Exclusion Hypothesis for the sole purpose of having distractor words interfere with picture naming. Presumably, that experimental paradigm is "hijacking" a series of cognitive processes that are in the mind for other reasons. What those other reasons are remains to be demonstrated, but the idea that a system for monitoring speech may be the machinery behind the Response Exclusion Hypothesis has a lot of appeal and recent empirical evidence behind it (Dhooge & Hartsuiker, 2010, 2011a; see also Hartsuiker, Pickering, & de Jong, 2005). We consider that direction of development of the account as an exciting avenue for future work.

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