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Picture naming in picture context: Semantic interference or semantic facilitation?

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Summary

Glaser and Glaser (1989) reported that naming a target picture takes more time when it is accompanied by a semantically related context picture than when it is accompanied by an unrelated context picture. This finding can be accounted for in current models of language production by assuming that at a lexical level the names of the two pictures compete for selection. In this article we argue that there are reasons to doubt the generalizability of Glaser and Glaser's finding. Most importantly, results of recent picture-naming and word-translation studies strongly suggest that context pictures do not automatically activate their names. In Experiment 1 we replicated Glaser and Glaser's semantic interference effect, but also obtained some evidence that this finding is due to the erroneous selection of the context picture. In Experiment 2, in which measures were taken to ease the selection of the target picture, a small semantic facilitation effect was obtained. Implications of this finding for models of language production are discussed.

Key words: Picture naming, semantic context effects, language production, stroop interference

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Semantic interference and semantic facilitation in picture naming

In what way is object naming affected by a semantically related nonverbal context? Somewhat surprisingly, the language production literature does not provide a clear answer to this question. This is remarkable, because the answer has important implications for models of lexical access. In this article we first discuss current models of language production and show that most of them predict that picture naming will take longer in the context of a semantically related picture then in the context of an unrelated picture. Next, we will show that this prediction is only supported by the results of one experiment (Glaser & Glaser, 1989, Experiment 6) and that there are reasons to believe that this finding is not representative for object naming in context. Next, two experiments are reported. In Experiment 1 Glaser and Glaser's semantic interference effect is replicated, but it is argued that this effect may be due to a number of special characteristics of the authors' methodology. In Experiment 2 conditions are created that are more similar to the tasks commonly used in the language production literature. This experiment does not show semantic interference. In fact, a small but significant semantic facilitation effect is obtained. This finding is completely in line with recent observations obtained in other language production paradigms (Bloem & La Heij, 2003; Damian and Bowers, 2003; La Heij, Hooglander, Kerling & van der Velden, 1996). We interpret our finding as converging evidence that – in contrast to the assumption of current models of lexical access - nonverbal context stimuli do not automatically activate their names at the lexical level.

All current models of lexical access in picture naming (e.g., Glaser & Glaser, 1989; Humphreys, Lloyd-Jones & Fias, 1995; Levelt, Roelofs & Meyer, 1999; Starreveld & La Heij, 1996) make a distinction between a conceptual (or semantic) level and a lexical level of processing. Three important additional assumptions are made. First, objects or pictures have a fast access to their conceptual representations and words have a fast access to their lexical representations. Second, at the conceptual level activation spreads between semantically related concepts. Third, all activated concepts activate the corresponding names at the lexical level. Glaser and Glaser (1989) argued that this architecture provides a relatively simple explanation for the semantic interference effect observed in the picture-word interference task. In this task, the target picture strongly activates its conceptual representation and the accompanying distractor word strongly activates its lexical representation. Retrieval of the picture's name is delayed because of the competition at the lexical level between the picture's name and the distractor word. When the target picture and the distractor word are semantically related (e.g., the picture of a horse with the distractor word DOG), the lexical representation of the distractor word receives additional activation due to the spread of activation from the picture's concept (horse) to the distractor word's concept (dog) and from there to the word DOG. The semantic interference effect reflects the time needed to overcome the resulting increase in competition at the lexical level.

Computer simulations of similar models by Roelofs (1992) and Starreveld and La Heij (1996) confirmed Glaser and Glaser's (1989) analysis. Important for our present discussion is that when these models are modified to simulate picture naming with picture context they also produce semantic interference (see Roelofs, 1992, p. 122). The reason is again that the target concept spreads activation to the name of a semantically related context picture, which results in a stronger competition at the lexical level.

The prediction of semantic interference in a picture-naming task with picture context is in accordance with an experimental finding reported by Glaser and Glaser (1989; Experiment 6). In the relevant experiment, Glaser and Glaser used four context conditions: semantically related (e.g., the target picture of an eye with the context picture of a mouth), semantically unrelated (e.g., eye - chair), identical (e.g., eye - eye), and neutral (e.g., the target picture of an eye accompanied by a neutral picture: a rectangle). In addition, stimulus onset asynchrony (SOA) was manipulated: the time intervals between the presentation of the two pictures were -300 ms, -200 ms, -100 ms, -75 ms, -50 ms, 50 ms, 100 ms, 200 ms, and 300 ms (a negative value indicates that the context picture was presented first, a positive value that the target was presented first). For our present purposes, the most important result was a semantic interference effect that was significant within the SOA range of -75 ms up to +100 ms.

However, Glaser and Glaser's (1989) semantic interference effect is a rather isolated finding and there are reasons to doubt its generalizability. The main reason is that their experiment differs in important respects from the usual picture-word interference task. First, in Glaser and Glaser's (1989) experiment the target picture and context picture were randomly presented above or below a central fixation point and the selection of the target had to be based on the order of presentation of the two stimuli in the display (the so-called "sequential discrimination task"). Especially in conditions with SOA values as small as 50 ms or 100 ms, the participants may have had difficulty in determining which of the two pictures was the one to be named.

Second, in contrast to most picture-word studies, Glaser and Glaser (1989) used only nine target pictures selected from only three different semantic categories. Moreover, these pictures were used both as targets and as context stimuli. These characteristics may have had important consequences. First, strong sequential effects may occur (e.g., participants have to name the picture of an eye in one trial but have to ignore that same picture in the next trial). Second, the large number of repetitions of the nine pictures and the small number of semantic categories will probably reduce or even eliminate a possible facilitation effect of semantically related context pictures on target identification (as observed, for instance, in the semantic priming tasks reported by Carr, McCauley, Sperber & Parmelee, 1982, and Henderson, 1992). Third, the names of the nine target pictures will become highly activated during the experiment, which may render it more likely that – upon incorrect selections - context pictures activate their names.

There are other reasons to believe that Glaser and Glaser's (1989) finding cannot be generalized to all language production tasks in which context pictures are used. First, Humphreys et al. (1995) failed to find a semantic interference effect when participants were asked to name a green picture that was accompanied by a red context picture. Semantic interference was only obtained in a task in which participants were instructed to covertly name both pictures and to produce the name of one of them on the basis of a cue presented after stimulus offset (the "post-cue naming procedure").

Second, recently, Damian and Bowers (2003) failed to replicate Glaser and Glaser's (1989) semantic interference effect in a task in which the target and context pictures differed in size. Third, using a word translation task (a task that is generally assumed to be similar to picture naming in that it is conceptually mediated; see Jescheniak and Levelt, 1993, and La Heij, de Bruijn, et al., 1990), La Heij et al. (1996) and Bloem and La Heij (2003) reported that Dutch-English bilinguals took less time to translate an English word (e.g., HORSE) into the Dutch equivalent when it was accompanied by a semantically related context picture (e.g., of a dog) than when accompanied by an unrelated context picture (e.g., of a bottle).

In conclusion, there are reasons to doubt the generalizability of Glaser and Glaser's (1989) semantic interference effect in a word production task with picture context. As noted above, Glaser and Glaser's experiment was deviant in a number of aspects, like the use of a very small number of targets and semantic categories, the use of pictures as targets and context stimuli and the use of the sequential discrimination task. In addition, no evidence of semantic interference (and sometimes even semantic facilitation) was obtained in a number of other studies that examined the effects of picture context in language production tasks.

In Experiment 1 we first attempt to replicate the semantic interference effect in an experiment that is as similar as possible to Glaser and Glaser's (1989) Experiment 6. To test our conjecture that selection in Glaser and Glaser's sequential discrimination task is relatively difficult, we also measured the frequency with which the context picture was named instead of the target. Next, in Experiment 2, using the same SOA values, conditions were created that were more similar to those in the usual picture-word interference task. In that experiment a small semantic facilitation effect was observed. Although the two experiments do not allow us to pinpoint the exact cause of the discrepancy (in fact, it seems likely that many factors play a role in the reversal from semantic interference into semantic facilitation, see Bloem and La Heij, 2003), the important conclusion is that context pictures do not necessarily induce semantic interference in picture naming and that models of language production should be able to account for such a finding.

Experiment 1

In this experiment the main characteristics of Glaser and Glaser's Experiment 6 were adopted. First, nine target pictures were selected from three semantic categories (with one exception the objects were the same as the ones used by Glaser and Glaser). Second, these pictures were used both as targets and as context stimuli. Third, four context conditions were used: semantically related, unrelated, neutral (a rectangle), and identical. Fourth, the sequential discrimination task was used. That is, in trial blocks with positive SOA values (the target is followed by the context) participants were instructed to name the first picture that appeared on the screen (above or below the central fixation point), and in trial blocks with negative SOA values (the context precedes the target) participants were instructed to name the second picture that appeared on the screen. Finally, a range of SOA values was used: -300 ms, -50 ms, +50 ms, and +100 ms.

Our experiment differed in one important aspect from Glaser and Glaser's study: the experimenter not only noted erroneous responses, but also indicated whether an error was due to the naming of the context picture instead of the target. In this way, we obtained an objective measure of a possible selection problem experienced by the participants.

Method

Participants

Twenty-four students, 10 men and 14 women, of Leiden University participated as paid volunteers. All participants had normal or corrected-to-normal vision.

Materials

Three line drawings were chosen from each of the following semantic categories: parts of the body, furniture, and animals. The verbal labels of these pictures were: eye, hand, mouth, bed, table, chair, cat, horse, and sheep (the corresponding Dutch words are: oog, hand, mond, bed, tafel, stoel, kat, paard, and schaap). With the exception of the concept sheep, these concepts were identical to the ones used by Glaser and Glaser (1989). In the neutral condition the context picture was an empty rectangle. The pictures were scaled and centered in an imaginary square with the dimensions of 4.3 degree x 4.3 degree of visual angle. Each stimulus consisted of two pictures, one located 3.2 degree of visual angle above the central fixation point, and one located 3.2 degree of visual angle below the central fixation point. The inter-contour distance between the two pictures was 2.1 degree of visual angle. The position of the target picture (above or below the central fixation point) was completely balanced across conditions.

The four context conditions were: (a) semantically related, in which the context picture was randomly chosen from the other two pictures in the same category (e.g., target: eye - context: mouth), (b) unrelated, in which the context picture was randomly chosen from the other two categories (e.g., eye - table), (c) neutral, in which the target picture was accompanied by the neutral context picture (e.g., eye - rectangle), and (d) identical, in which two identical pictures were presented (e.g., eye - eye). The following SOA values were used: -300 ms and -50 ms (context first), +50 ms and +100 ms (target first).

Apparatus

The stimuli were presented on a fast display screen (Vector General). Verbal naming latencies were measured by means of a voice key with an accuracy of 1 ms. Presentation of the stimuli and the registration of reaction times (RTs) and errors were controlled by a PDP 11/34 computer.

Procedure

Participants were individually tested in a dimly illuminated room. First, the names of the 9 target pictures were shown to the participants. Next, two practice series were run. The first consisted of 9 trials in which a to-be-named picture was presented randomly above or below the central fixation point. If a naming error occurred, the picture was immediately repeated. The 20 stimuli in the second practice series were randomly selected from the experimental materials. The SOA value used in this series corresponded to the SOA value in the first block of experimental trials. During these practice series incorrect responses were corrected. Next, the participants received 8 series of 36 experimental trials each (9 targets x 4 context conditions). Each of these series started with two warm-up trials, the results of which were not included in the analyses. The 8 series consisted of 4 sets of two blocks, each set corresponding to one specific SOA condition. The order of these four sets (SOA conditions) was balanced across participants with the restriction that half of the participants first received the two negative SOA conditions (-300 ms and -50 ms) and that the other participants first received the two positive SOA conditions (+50 ms and +100 ms). In this way, the instruction (name the first picture that appears on the screen or name the second picture that appears on the screen) only had to be changed once, halfway the experiment.

The participants were instructed to look at the central fixation point and to name the target picture as fast as possible while maintaining accuracy. They were told that the target would appear randomly above or below the point of fixation. Each trial involved the following sequence. A fixation point (an asterisk) appeared in the center of the display for 1 second. Then the first picture appeared. After the SOA value used in that specific block of trials, the second picture was added. The picture-picture combination remained on the screen for

300 ms in the context preexposure conditions, and for 300 ms minus the SOA in the context postexposure conditions. A blank screen was presented until the participant made a vocal response. The experimenter registered whether a response was correct or false (false responses included hesitations and uh-sounds). In case of an error the experimenter indicated whether the participant named the context picture instead of the target. Finally, malfunctioning of the voice key apparatus could also be registered. To reduce the variance in the data, incorrect responses were followed by a filler trial that was randomly selected from the experimental materials. The results of the practice trials, warm-up trials, and filler trials were not included in the analyses.

Results

RTs from incorrect responses and from trials in which the voice key malfunctioned were removed. Also, RTs larger than 2,000 ms were removed. These criteria accounted for 4.6%, 0.2%, and 0.1% of the data, respectively. The remaining RTs were used in the calculation of the means. Table 1 shows the participant means, the overall error percentages, and the percentages of trials in which the participants named the context picture instead of the target ("context-named errors"). Note that information about the context-named errors cannot be provided for the identical condition (naming the context results in a correct response) and that the participants never named the context picture in the control condition (the rectangle).

An analysis of variance (ANOVA) was performed on the means per participant per condition, with context conditions and SOA as within-participant variables (*F1*). The same ANOVA was performed using the item means (*F2*). This analysis showed main effects of SOA, $F1(3,69) = 21.6$, $p < .001$, $F2(3,24) = 133.7$, $p < .001$, and context condition, $F1(3,69) = 76.9$, $p < .001$, $F2(3,24) = 147.5$, $p < .001$. The interaction of SOA and context condition was also significant, $F1(9,207) = 10.3$, $p < .001$, $F2(9,72) = 14.6$, $p < .001$.

A separate ANOVA was performed on the data of the semantically related and unrelated conditions. The semantic interference effect of 13 ms appeared significant, $F1(1,23) = 4.3$, $p < .05$, $F2(1,8) = 5.65$, $p < .05$. Also the main effect of SOA reached significance, $F1(3,69) = 22.6$, $p < .001$, $F2(3,24) = 77.8$, $p < .001$. The interaction between these two variables did not reach significance. The semantic interference effects at the SOA values of -300 ms, -50 ms, +50 ms, and +100 ms, were 10 ms, 14 ms, 22 ms, and 6 ms, respectively.

Although the error percentages were relatively small, they were subjected to similar analyses. An ANOVA performed on the numbers of errors with SOA and the two most relevant context conditions (semantically related versus unrelated) as within-participant factors showed a significant main effect of SOA, $F1(3,69) = 10.5$, $p < .001$, $F2(3,24) = 24.3$, $p < .001$. The semantic context effect just failed to reach significance in the analysis by participants, $F1(1,23) = 3.1$, $p < 0.10$, but did reach significance in the analysis by items, $F2(1,8) = 6.2$, $p < .05$. The error percentages were 7.6% and 6.2% in the semantically related and unrelated conditions, respectively.

As shown in Table 1, a relatively large percentage of the errors was due to naming the context picture instead of the target. An ANOVA performed on these context-named errors with SOA and the two relevant context conditions (semantically related and unrelated) showed a significant main effect of SOA, $F1(3,69) = 13.0$, $p < .001$, $F2(3,24) = 23.0$, $p < .001$. The percentages of context-named errors were 0.4%, 8.0%, 6.5% and 2.5% in the SOA conditions -300 ms, -50 ms, +50 ms and +100 ms, respectively. Also the factor context condition reached significance, $F1(1,23) = 5.5$, $p < .05$, $F2(1,8) = 6.8$, $p < .05$. The percentages of context-named errors in the semantically related and unrelated conditions were 5.2% and 3.5%, respectively.

Table 1:
The mean RTs, total percentages of errors, and the percentage of trials in which the context picture was named, in the various conditions of Experiment 1

	SOA condition												
	-300			-50			50			100			Mean
Context condition	RT	%e	%c	RT	%e	%c	RT	%e	%c	RT	%e	%c	RT
Related	613	3.0	0.7	751	10.2	8.3	712	10.5	7.5	625	6.5	3.7	675
Unrelated	603	1.9	0.0	737	11.0	7.7	690	9.1	5.4	619	3.0	1.2	662
Control	601	1.4	0.0	659	3.2	0.0	638	2.8	0.0	602	2.5	0.0	625
Identical	542	2.1	--	581	1.9	--	604	1.9	--	590	2.6	--	579
Semantic interference	10			14			22			6			13

Note. %e = overall error percentage, %c = percentage of trials in which the participants erroneously named the context picture.

Discussion

This experiment nicely replicated the main findings of the time course analysis reported by Glaser and Glaser (1989; Experiment 6). Most importantly, a semantically related context picture induced interference in comparison with an unrelated picture. Also in agreement with Glaser and Glaser's findings the effect was maximal at SOA +50 ms.

In the introduction we suggested that this semantic interference effect may have been due to a number of unusual characteristics of Glaser and Glaser's (1989) experiment: a rather ambiguous selection cue (order of presentation, with delays as small as 50 ms) and the use of a small number of pictures both as targets and as context stimuli. These characteristics may have resulted in the strong activation of the names of the context pictures and even in the erroneous selection of the context picture for naming. This conjecture is supported by the finding that a relatively large percentage of the errors made consisted of context-naming errors, and that these errors were more frequent in the SOA conditions close to zero.

Although in only a very small percentage of the trials the name of the context picture was actually produced, it seems reasonable to assume that in a larger percentage of the trials the name of the context picture was activated, but identified as incorrect at a sufficiently early point in time to allow a (covert) correction. If that is indeed what happened (in our experiment and in the experiment by Glaser and Glaser, 1989, in which the error percentages were also relatively small), in part of the trials a situation is created that is similar to the orthodox picture-word task, in which semantic interference is the usual finding.

In Experiment 2, participants again had to name target pictures that were accompanied by context pictures, using the same SOA values as in Experiment 1. However, Experiment 2 was in many respects more similar to the usual picture-word task. If present models of language production are correct, also in Experiment 2 semantic interference should be obtained.

Experiment 2

Experiment 2 differed in the following characteristics from Experiment 1. First, instead of nine pictures selected from three semantic categories, 40 semantically related picture pairs were chosen from many different semantic categories. Second, for each pair, one picture was selected as the target and the other as the context stimulus. Third, the display characteristics were changed to facilitate the selection of the target picture for naming. Pilot experiments revealed that this could most easily be achieved by reducing the display duration of the context picture to 50 ms, a duration at which the pictures could still easily be identified. Exposure time of the target stimulus remained 300 ms. In this way, in addition to relative onset, display duration could be used as a selection cue. The same SOA values were used as in Experiment 1: -300 ms, -50 ms, +50 ms, and +100 ms.

Method

Participants

Twenty-four students, 11 men and 13 women, of Leiden University served as paid participants. All had normal or corrected-to-normal vision. None of them participated in Experiment 1.

Materials

Forty semantically related target-context picture pairs were selected. Care was taken to select pictures that were easily recognized and named. These pairs were divided into two sets that were similar with respect to (a) the mean language frequency of the names of the target pictures, and (b) the mean length of the names of the target pictures. Within each set, target pictures and context pictures were rearranged to form 20 unrelated pairs. Appendix A shows all target-context combinations used. In the neutral condition the context picture was an empty rectangle. The dimensions of the pictures and their positions in the display were identical to those in Experiment 1.

Apparatus

The apparatus was identical to the one in Experiment 1.

Procedure

With the following exceptions, the procedure was identical to the one in Experiment 1. The first practice series contained 40 trials in which all target pictures were presented once, either above or below the central fixation point. During this series, incorrect responses were corrected and the corresponding picture was repeated immediately. Then four blocks of 80 experimental trials were presented, each of which was preceded by a block of seven practice trials, randomly selected from the experimental materials. In addition, each SOA block started with two randomly chosen warm-up trials. The participants received four blocks of trials, corresponding with the four SOA conditions. In a block, the 20 target pictures from Set 1 or the 20 target pictures from Set 2 were presented in each of the four context conditions, yielding a total of 80 trials per block. For each participant, stimuli in the four blocks of trials were alternatingly drawn from the two stimulus Sets 1 and 2. This measure was taken to reduce the number of repetitions of each target picture in the experiment (cf. La Heij & Van den Hof, 1995). To reduce the variance in the data, incorrect responses were followed by a filler trial that was randomly selected from the experimental materials. The results of the practice trials, warm-up trials, and filler trials were not included in the analyses.

Each trial involved the following sequence. A fixation point (an asterisk) was presented in the middle of the screen for 1 second. Then the first picture appeared, followed by the second picture after 50 ms, 100 ms, or 300 ms. The target remained on the screen for 300 ms, the context picture for 50 ms.

Results

RTs of incorrect responses, RTs of trials in which the voice key malfunctioned and RTs larger than 2,000 ms were removed. These criteria accounted for 1.2%, 0.6%, and 0.0% of the data, respectively. The remaining RTs were used to calculate the means per participant and per item for each of the experimental conditions. Table 2 shows per SOA condition and context condition the participants' mean RTs, the percentage of errors, and the percentage of trials in which the participants named the context picture instead of the target. Note that the latter information cannot be provided for the identical condition (naming the context results in a correct response) and that the participants never named the context in the control condition (the rectangle).

An overall ANOVA was performed on the mean RTs per participant and per item. This analysis showed a main effect of context condition, $F1(3,69) = 98.5$, $p < .001$, $F2(3,117) = 140.9$, $p < .001$. The main effect of SOA did not reach significance in the analysis by participants (p>.10), but did reach significance in the analysis by items, $F2(3,117) = 22.6$, $p < .001$. The interaction of SOA and context conditions was significant, $F1(9,207) = 6.3$, $p < .001$, $F2(9,351) = 14.2$, $p < .001$.

A separate ANOVA was performed to examine the effect of a semantically related context picture in comparison with an unrelated context picture. This difference (a semantic facilitation effect of 17 ms) appeared significant, $F1(1,23) = 27.3$, $p < .001$, $F2(1,39) = 9.4$, $p < .005$. The main effect of SOA only reached significance in the analysis by items, $F2(3,117) = 26.4$, $p < .001$. The semantic facilitation effects in the SOA conditions -300 ms, -50 ms, +50 ms, and +100 ms, were 19 ms, 14 ms, 26 ms, and 11 ms, respectively.

The overall error percentages were too small to allow a useful analysis. However, it is important to note that the measures taken to reduce the assumed selection problem in Experiment 1 appeared to be successful. In the related and unrelated conditions of Experiment 1 in which the target and context pictures were presented in close temporal proximity (SOA's of -50 and +50 ms), 7.2% of the trials resulted in the erroneous naming of the context picture. In the present experiment, this number was reduced to 0.6%.

Table 2:
The mean RTs, total percentages of errors, and the percentage of trials in which the context picture was named, in the various conditions of Experiment 2

	SOA condition												
	-300			-50			50			100			Mean
Context condition	RT	%e	%c	RT	%e	%c	RT	%e	%c	RT	%e	%c	RT
Related	643	1.2	0.0	697	0.4	0.2	636	2.3	1.0	638	2.5	0.4	654
Unrelated	662	2.7	0.0	711	1.3	0.0	662	2.9	1.0	649	2.1	0.8	671
Control	627	0.8	0.0	657	0.8	0.0	613	1.3	0.0	633	3.1	0.0	633
Identical	515	2.5	--	596	1.9	--	587	0.8	--	596	1.5	--	574
Semantic facilitation	19			14			26			11			17

Note. %e = overall error percentage, %c = percentage of trials in which the participants erroneously named the context picture.

Discussion

The most important observation in this experiment is that picture naming was facilitated by semantically related context pictures in comparison to unrelated context pictures. This change in the direction of the effect of semantic similarity in comparison to Experiment 1 is accompanied by a change in the number of context-named errors. Whereas in Experiment 1 the context picture was erroneously named in 7.2% of the trials in the two SOA conditions close to zero (-50 ms and +50 ms), these errors were almost completely absent in the present experiment. This finding suggests that our measures to facilitate target selection were successful. It also suggests that the ease of target selection is at least one of the factors that contributed to the reversal from semantic interference in Experiment 1 into semantic facilitation in Experiment 2.

General Discussion

Glaser and Glaser (1989) reported that picture naming is more difficult in the context of semantically related pictures than in the context of unrelated pictures. Although Glaser and Glaser’s finding is an isolated finding, it is of great importance because it supports the assumption - shared by almost all models of language production - that context pictures automatically activate their names at the lexical level (see e.g., Roelofs, 1992). Because the names of semantically related context pictures receive additional activation from the conceptual system (due to spreading activation), lexical competition increases in comparison to the unrelated condition[2].

[2] Note that the models also predict semantic interference when the participant would prefer a different name for the context picture in a confrontation-naming task (e.g., JACKET instead of COAT). The only requirement is that the context picture activates a semantically related concept that can easily be named.

In the introduction, we argued that there are reasons to doubt whether Glaser and Glaser's (1989) finding is representative for all conditions in which pictures are named in nonverbal contexts. Two points were discussed. First, other studies in which the effect of picture context was examined either failed to find semantic interference (Damian & Bowers, 2003; Humphreys et al., 1995) or even reported semantic facilitation (Bloem and La Heij, 2003). Second, Glaser and Glaser's (1989) experiment had a number of unusual characteristics that may have been responsible for the result obtained: the use of only nine target pictures from only three semantic categories, the use of these pictures both as targets and as context stimuli and the use of an ambiguous selection cue.

In Experiment 1 we replicated the semantic interference effect reported by Glaser and Glaser (1989), but also observed that the context picture was erroneously named in a substantial number of trials, especially when the temporal separation between target and context was small (SOA or -50 ms and +50 ms). We interpreted this latter finding as an indication that in part of the trials the participants erroneously selected the context picture for naming. If this indeed occurred, the situation in these trials was similar to the picture-word task, in which semantic interference can be expected.

If context pictures always activate their names, semantic interference should not be confined to the situation in Glaser and Glaser's (1989) Experiment 6 and our Experiment 1, but should also be observed in an experiment in which more target pictures are selected from a larger number of semantic categories, in which the context pictures are not used as targets and the selection of the target is fairly easy. This hypothesis was tested in Experiment 2. In that experiment forty target pictures were selected from a large number of semantic categories. In addition, target selection was facilitated by reducing the exposure duration of the context picture. In this way, exposure duration could be used as an additional selection cue. The results showed that virtually no context-naming errors occurred, which confirms that target selection was easier than in Experiment 1. Most importantly, the experiment did not show semantic interference, as predicted by models of language production, but semantic facilitation.

We conclude that the semantic interference effect observed by Glaser and Glaser (1989) in a picture-naming task with picture context does not generalize to other language production tasks with picture context. Probably, Glaser and Glaser's finding is restricted to situations in which a small number of pictures is repeatedly presented for naming, the same pictures are used as targets and context and selection is relatively difficult. If these rather unusual characteristics are eliminated, no semantic effect or semantic facilitation is obtained. It is important to note that the semantic facilitation effect in Experiment 2 is not an isolated finding. In the Introduction we discussed recent findings that the translation of a word (a task that – like picture naming - is thought to be conceptually mediated) is also facilitated by a semantically related context picture (Bloem & La Heij, 2003; Bloem, van den Boogaard & La Heij, 2003; La Heij et al., 1996). Our finding in Experiment 2 is important because it provides converging evidence in favor of Bloem and La Heij's conclusion that in language production tasks a nonverbal context induces semantic facilitation.

Why is this conclusion of importance? An analysis of the behavior of the models of lexical access, proposed by Roelofs (1992) and Starreveld and La Heij (1996) reveals that these and related models have great difficulty in simulating semantic facilitation effects in general. This is due to the assumption in these models that not only the target concept, but also all other activated concepts activate their names at the lexical level. As a consequence, spreading activation at the conceptual level in combination with a strong activation of the target concept, always leads to a relatively strong increase in activation of competing words at the lexical level. This is not only true for the situation in which target and context are presented simultaneously, but also when the context (or prime) precedes the target in time. To account for semantic facilitation effects, Bloem and La Heij (submitted) proposed the following modifications.

First, in line with Levelt's (1989) original proposal, we assumed that only one concept (or better, a "preverbal message") is lexicalized. That is, activated concepts outside the preverbal message, that may have become activated by non-target objects in the visual field or by spreading activation, are not involved in lexical access. As a consequence, semantically related nonverbal stimuli facilitate target identification at the conceptual level, without inducing interference at the lexical level. Second, to account for semantic interference, semantic errors and blends of semantically related words, the additional assumption was made that the preverbal message activates a cohort of semantically related words.

Although this account for semantic context effects in picture naming and word translation is tentative and in need of further experimental support, it is in line with a number of other observations in the literature. First, in variants of the Stroop task, Glaser and Glaser (1982) showed that incongruent colors do not hamper word reading, even when preexposed by several hundreds of ms (the lack of a "reversed Stroop effect"). This finding could also be interpreted as evidence that the identified context colors did not activate their names at the lexical level. In fact, this was the interpretation that was originally proposed by Neumann (1980). Second, La Heij, Helaha and van den Hof (1993) have shown that in a variant of the Stroop task color naming is not hampered by an incongruent color patch, provided that the selection of the target color is easy.

In conclusion, we have shown that Glaser and Glaser's (1989) semantic interference effect in a picture-naming task with picture context can be replicated, but is not representative for all picture naming in picture context. The semantic facilitation effect observed in Experiment 2 provides converging evidence that context pictures induce semantic facilitation; a finding that suggests that they are not automatically processed up to the lexical level.

References

1. Bloem, I., & La Heij, W. (2003). Semantic facilitation and semantic interference in word translation: Implications for models of lexical access in language production. Journal of Memory and Language, 48, 468-488.
2. Bloem, I., van den Boogaard, S., & La Heij, W. (2003). Semantic facilitation and semantic interference in language production. Further evidence for the Conceptual Selection Model of lexical access. Paper submitted for publication.
3. Carr, T.H., McCauley, C., Sperber, R.D., & Parmelee, C.M. (1982). Words, pictures, and priming: On semantic activation, conscious identification, and the automaticity of information processing. Journal of Experimental Psychology: Human Perception and Performance, 8, 757-777.
4. Damian, M.F., & Bowers, J.S. (2003). Locus of semantic interference in picture-word interference tasks. Psychonomic Bulletin & Review, 10, 111-117.
5. Glaser, M.O., & Glaser, W.R., (1982). Time course analysis of the Stroop phenomenon. Journal of Experimental Psychology: Human Perception and Performance, 8, 875-894.
6. Glaser, W.R., & Glaser, M.O. (1989). Context effects on Stroop-like word and picture processing. Journal of Experimental Psychology: General, 118, 13-42.

7. Henderson, J.M. (1992). Identifying objects across saccades: Effects of extrafoveal preview and flanker object context. Journal of Experimental Psychology: Learning, Memory, and Cognition, 18, 521-530.
8. Humphreys, G.W., Lloyd-Jones, T.J., & Fias, W. (1995). Semantic interference effects on naming using a postcue procedure: Tapping the links between semantics and phonology with pictures and words. Journal of Experimental Psychology: Learning, Memory, and Cognition, 21, 961-980.
9. Jescheniak, J. D., & Levelt, W. J. M. (1994). Word frequency effects in speech production: Retrieval of syntactic information and of phonological form. Journal of Experimental Psychology: Learning, Memory, and Cognition, 20, 824-843.
10. La Heij, W., de Bruyn, E., Elens, E., Hartsuiker, R., Helaha, D., & van Schelven, L. (1990). Orthographic facilitation and categorical interference in a word-translation variant of the Stroop task. Canadian Journal of Psychology, 44, 76-83.
11. La Heij, W., Helaha, D., & van den Hof, E. (1993). Why does blue hamper the naming of red? Color-color interference and the role of locational (un)certainty. Acta Psychologica, 83, 159-177.
12. La Heij, W., Hooglander, A., Kerling, R., & van der Velden, E. (1996). Nonverbal context effects in forward and backward word translation: Evidence for concept mediation. Journal of Memory and Language, 35, 648-665.
13. La Heij, W., & Van den Hof, E. (1993). Picture word interference increases with target set size. Psychological Research, 58, 119-133.
14. Levelt, W. J. M., Roelofs, A., & Meyer, A. S. (1999). A theory of lexical access in speech production. Behavioral and Brain Sciences, 22, 1-75.
15. Neumann, O. (1980). Informationsselektion und Handlungssteuerung [Selection of information and action control]. Unpublished doctoral dissertation, University of Bochum.
16. Roelofs, A. (1992). A spreading-activation theory of lemma retrieval in speaking. Cognition, 42, 107-142.
17. Starreveld, P.A., & La Heij, W. (1996). Time-course analysis of semantic and orthographic context effects in picture naming. Journal of Experimental Psychology: Learning, Memory, and Cognition, 22, 896-918.

Appendix A

Picture-picture combinations used in Experiment 2

Set 1 Target	Related Context	Unrelated Context
ARM arm	BEEN leg	RAAM
BANAAN banana	APPEL apple	GLAS
BROEK trousers	TRUI sweater	HARP
DEUR door	RAAM window	SJAAL
FLES bottle	GLAS glass	HOMMEL
GIETER watering-can	HARK rake	OOR
HAND hand	VINGER finger	BEITEL
HOED hat	SJAAL scarf	APPEL
HUIS house	KERK church	BEEN

Set 1 Target	Related Context	Unrelated Context
KAARS candle	LAMP lamp	HARK
KAST cupboard	BED bed	VINGER
KWAST brush	PENSEEL paint-brush	FORNUIS
NEUS nose	OOR ear	KETTING
PAN pan	FORNUIS stove	KERK
PIANO piano	HARP harp	HANGSLOT
RING ring	KETTING necklace	STOEL
SLEUTEL key	SLOT padlock	TRUI
TAFEL table	STOEL chair	PENSEEL
VLIEG fly	HOMMEL bumble-bee	BED
ZAAG saw	BEITEL chisel	LAMP

Appendix A (continued)

Set 2 Target	Related Context	Unrelated Context
AUTO car	TRUCK truck	DOLK
BOEK book	KRANT paper	MES
BOOM tree	CACTUS cactus	PISTOOL
EEKHOORN squirrel	KONIJN rabbit	TROMPET
GITAAR guitar	TROMPET trumpet	MOND
HAMER hammer	TANG pliers	CACTUS
HENGEL fishing-rod	DOBBER float	KAT
HOND dog	KAT cat	DOBBER
HORLOGE watch	KLOK clock	KERS
KAM cam	BORSTEL brush	TRUCK
KANON canon	PISTOOL pistol	SCHAAP
KOFFER suitcase	TAS bag	BALLON
OOG eye	MOND mouth	KLOK
PAARD horse	SCHAAP sheep	TANG
PEER pear	KERS cherry	KRANT
PIJP pipe	SIGAAR cigar	NIETMACHINE
SCHAAR scissors	NIETMACHINE stapling-machine	KONIJN
VLIEGER kite	BALLON balloon	SIGAAR
VORK fork	MES knife	TAS
ZWAARD sword	DOLK dagger	BORSTEL