Journal of Experimental Psychology: Human Perception and Performance

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Online First Publication, April 3, 2017. http://dx.doi.org/10.1037/xhp0000352

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0096-1523/17/$12.00 http://dx.doi.org/10.1037/xhp0000352

Words We Do Not Say—Context Effects on the Phonological Activation of Lexical Alternatives in Speech Production

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There is compelling evidence that context strongly influences our choice of words (e.g., whether we refer to a particular animal with the basic-level name "bird" or the subordinate-level name "duck"). However, little is known about whether the context already affects the degree to which the alternative words are activated. In this study, we explored the effect of a preceding linguistic context on the phonological activation of alternative picture names. In Experiments 1 to 3, the context was established by a request produced by an imaginary interlocutor. These requests either constrained the naming response to the subordinate level on pragmatic grounds (e.g., "name the bird!") or not (e.g., "name the object!"). In Experiment 4, the context was established by the speaker's own previous naming response. Participants named the pictures with their subordinate-level names and the phonological activation of the basic-level names was assessed with distractor words phonologically related versus unrelated to that name (e.g., "birch" vs. "lamp"). In all experiments, we consistently found that distractor words phonologically related to the basic-level name interfered with the naming response more strongly than unrelated distractor words. Moreover, this effect was of comparable size for nonconstraining and constraining contexts indicating that the alternative name was phonologically activated and competed for selection, even when it was not an appropriate lexical option. Our results suggest that the speech production system is limited in its ability of flexibly adjusting and fine-tuning the lexical activation patterns of words (among which to choose from) as a function of pragmatic constraints.

Public Significance Statement

This study shows that when we plan an utterance, multiple words that we could alternatively use (e.g., to refer to a certain object we see) are simultaneously activated in our mental lexicon. This is even the case when a preceding context renders use of one of these words inappropriate. This finding thus shows that the early processes in word selection run in a highly automatic and context independent fashion.

Keywords: speech production, word production, lexical access, context effects, phonological activation

Imagine you see a particular object, say a duck, and another person asks you to describe what kind of bird you see. Most likely you would respond with a sentence like "I see a duck." Responding with "I see a bird" would be considered odd and would, thus, hardly ever occur. This would be different, however, had the interlocutor asked you to describe what kind of object you see. Similarly, if you were to name a set of objects and had just produced the word "stork" in response to a particular bird, you would hardly use the word "bird" in response to the next object from that semantic category. Rather, if available you would use a more specific term, such as "duck." These examples illustrate that a preceding linguistic context—provided by an interlocutor or by a speaker her/himself—strongly constrains our choice of words. In linguistics, pragmatic theory deals with phenomena like this. It describes how speakers ought to shape their utterances in order to engage in successful communication. In a seminal article, Grice introduced the cooperative principle stating that as a speaker you should try to "make your conversational contribution such as is required, at the stage at which it occurs, by the accepted purpose or direction of the talk exchange in which you are engaged" (Grice,

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Our research was supported by the German Research Council (DFG JE229/11-1). We thank Ismail Ayoub, Mirjam Feldt, and Fabienne Greiner for assistance in data collection.

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1975, p. 41). A speaker using the word “bird” (rather than “duck”) in the examples mentioned above, would violate the maxim of quantity (which is, among other maxims, derived from the cooperation principle). This is the case because the choice of that term would not make the speaker’s contribution as informative as needed for the current exchange—the unambiguous identification of a particular kind of bird. The present study investigated the effect of such pragmatic constraints on lexical retrieval in speaking. It addressed the question of whether these constraints can already exclude inappropriate words from the set of candidates that become lexically activated and then compete for selection. Pragmatic theory is silent with respect to this issue. But an answer to this question is important from a cognitive perspective, because it provides information about the flexibility of the conceptual-lexical processing system involved in speaking.

Context Effects in Language Processing

Context effects of various kinds are widely found and well documented in the domain of language processing, both in comprehension and production. For example, in a seminal study Reicher (1969) observed letters to be better recognized when embedded in meaningful words as opposed to meaningless letter strings or no context (see also McClelland & Rumelhart, 1981; Rumelhart & McClelland, 1982). Other comprehension studies have shown that a preceding linguistic context can effectively bias the activation of the different semantic interpretations of homonyms (Tabossi, 1988), bias a particular syntactic analysis (Altmann & Steedman, 1988), or affect processes of semantic-pragmatic integration (Nieuwland & van Berkum, 2006; Van Berkum, 2008). In all of these comprehension studies, the context was shown to have a direct impact on the degree to which a particular semantic or syntactic representation is activated and preferentially processed. The finding of such context effects is theoretically important as it informs us about the interactive (rather than modular or autonomous) nature of processing in the respective domains.

In the domain of language production, context effects are also documented. First, distractor words affect picture naming, showing semantic interference and phonological facilitation (e.g., Damian & Martin, 1999; Glaser & Düngelhoff, 1984; Hantsch, Jescheniak, & Schriefers, 2009; Schriefers, Meyer, & Levelt, 1990); the former effect is often interpreted as reflecting competition during word selection at an abstract lexical level (e.g., Levelt, Roelofs, & Meyer, 1999; Roelofs, 1992). Second, naming performance is deteriorated when participants repeatedly name pictures blocked by semantic category (rather than presented intermixed) in the cyclic naming task (Belke, Meyer, & Damian, 2005; Damian & Als, 2005; Damian, Vigliocco, & Levelt, 2001; Kroll & Stewart, 1994; Schnur, Schwartz, Brecher, & Hodgson, 2006; Vigliocco, Vinson, Damian, & Levelt, 2002) or when participants repeatedly name different pictures from a particular category, even when the critical pictures are interspersed in a set of unrelated pictures in the continuous naming task (Brown, 1981; Howard, Nickels, Coltheart, & Cole-Virtue, 2006). These effects have also been attributed to lexical competition or, alternatively, incremental learning (Oppenheim, Dell, & Schwartz, 2010). Yet other picture naming studies employed semantically biasing lead-in-sentence fragments or word distractors bearing a combined semantic-phonological relation to the target to explore the possible interaction between processing levels (Damian & Martin, 1999; Griffin & Bock, 1998; Starreveld & La Heij, 1995).

Many of these production studies used these context manipulations to explore the question of whether lexical processing at an abstract lexical level is a competitive process (and the results led many researchers to conclude that it is). However, none of these studies addressed the question of whether the activation and processing of possible competitors may be attenuated (or even be suppressed completely) in certain—constraining—contexts.[1] In line with this state of affairs, evidence concerning potential effects of pragmatic contexts on the activation of mental representations involved in speech planning is scarce. There is ample evidence that a concurrent visual context constrains the eventual choice among lexical alternatives (e.g., Brennan & Clark, 1996; Brown-Schmidt & Tanenhaus, 2006; Horton & Keysar, 1996; Nadig & Sedivy, 2002; Olson, 1970) as does a preceding linguistic context (e.g., Van Der Wege, 2009; Yoon & Brown-Schmidt, 2013). But little is known about whether these factors also have an impact on the degree to which alternative lexical representations are activated and processed prior to selection. This is possibly due to the fact that (implicitly) word retrieval is often assumed to be a rather static process, driven by the activation flow in a hard-wired conceptual-lexical network. Within such a static system, lexical activation patterns should evolve in a largely autonomous way, independent of contextual factors (for exceptions see the swinging lexical network model by Abdel Rahman & Melinger, 2009, or the incremental learning model by Oppenheim et al., 2010). A more dynamic perspective, by contrast, would assume that contextual factors can selectively affect parts of the conceptual-lexical network, in that they temporarily enhance or attenuate the activation of certain representations or the strength of the links between them.

In one study which did investigate context effects on lexical activation patterns (Jescheniak et al., 2005), participants saw displays showing a target object and a context object that were either drawn from the same basic-level category (e.g., duck–stork) or from different basic-level categories (e.g., duck–palm tree). In the former condition, only the subordinate-level name was appropriate for naming one of the pictures unambiguously (constraining context), while in the latter condition both subordinate-level and basic-level names were appropriate (nonconstraining context). The target was marked by a visual cue (a frame around the picture) and participants named it with its subordinate-level name (e.g., “duck”) while auditory distractors that were phonologically related versus unrelated to the basic-level name alternative tapped the phonological activation of that basic-level name alternative. Related distractors were found to slow down naming latencies compared with unrelated distractors, suggesting that the basic-level name alternative was processed up to a phonological level. Crucially, the effect was similar-sized for nonconstraining and constraining contexts, even though the basic-level name was not a contextually appropriate lexical option in the constraining context (and was, in fact, never produced in a control experiment in which participants were free in choosing the subordinate-level or the basic-level name).

[1] Yet another difference to the present study is that most of these studies were specifically concerned with lexical-semantic processing while the focus of the present study is on phonological processing.

This pattern suggested that lexical activation occurs in an autonomous and context-independent way and that contextual constraints are effective only relatively late, when competing phonological representations have become available and one of them is selected (for similar evidence regarding the phonological coactivation of near-synonyms see Jescheniak & Schriefers, 1998; Peterson & Savoy, 1998).

However, this pattern could also be due to the way the contextual constraint was implemented in that study. The salient cuing of the target might have effectively drawn the participants' attention to this picture that was then processed with priority. The (peripherally perceived) context picture, by contrast, might have been processed to a lesser extent. If so, it would not be surprising that the visual context did not affect the initial activation of the lexical alternatives.[2]

Moreover, there is some evidence that a preceding linguistic context (e.g., "the large green triangle," produced by a different speaker or the same speaker) affects how speakers shape a target utterance (e.g., "the large RED triangle," with the new or contrasting information being accented), while a simultaneous visual context (presence of a large green triangle) does not have any effect (Bögels, 2011; Krahmer & Swerts, 2001; Pechmann, 1984; Swerts, Krahmer, & Avesani, 2002). It thus seems that—at least with respect to accentuation of new information—a preceding linguistic context is more powerful in affecting the production of an utterance than a simultaneous visual context. This is where the present study comes in. It investigated the effect of a preceding linguistic context that pragmatically constrains the set of appropriate words on the lexical activation of these words.

Outline of the Experiments

We present four picture–word interference experiments which explored the effect of a preceding linguistic context on the activation of name alternatives that were either locally appropriate (nonconstraining context) or not (constraining context). Participants always named pictures with their subordinate-level names (e.g., the picture of a duck with the name "duck" and not with the basic-level name "bird"). We implemented two manipulations.

First, we manipulated the context (nonconstraining vs. constraining). This was done by means of requests that came in two forms and preceded the pictures. In one condition, the request was "name the object!" (Experiments 1 and 2; this was changed into "describe the object!" in Experiment 3). In this situation, the possible choice of alternative names for the picture to be subsequently named was not constrained on pragmatic grounds. That is, the subordinate-level name (e.g., duck) as well as the basic-level name (e.g., bird) would be appropriate (nonconstraining context). In another condition, the request was "name the x!" with x being the name of a basic-level category (Experiments 1 and 2; this was changed into "describe the y!" with y being a subordinate-level name in Experiment 3). In this situation, the basic-level name was no longer appropriate (constraining context). In a final experiment, the pragmatic context manipulation resulted from the speaker's own preceding utterance. Just before the critical picture, s/he either named an object from a different category (nonconstraining context) or from the same category (constraining context; Experiment 4).

Second, to assess the phonological activation of the basic-level name, we presented, together with the pictures, auditory distractor words that were either phonologically related or unrelated to the basic-level name (e.g., Jescheniak, Hahne, & Schriefers, 2003; Jescheniak & Schriefers, 1998; see also Levelt et al., 1991). We predicted that in the nonconstraining context a related distractor would interfere more strongly with the picture naming response than an unrelated distractor. This effect can be explained as follows. In the related distractor condition, the distractor activates the phonological form of the (eventually not produced) basic-level name that is, at the same time, also activated by the picture, that is, there is convergence of activation from two sources on a nontarget representation. By contrast, in the unrelated distractor condition, there is no such convergence, because the distractor only activates the phonological form of words that do not receive any activation from the picture name. Thus, a related distractor reduces the difference in activation between the phonological form of the target and a (basic-level name) competitor, rendering target selection more difficult. Put differently, with all other factors being controlled and when the same distractors are used in the related and unrelated condition, an interference effect from related distractors can only arise when the alternative basic-level name is phonologically activated by the picture. If, for some reason, the activation flow from the picture to the phonological form of the basic-level name is disrupted, related and unrelated distractors should affect the naming response in the same way. Hence, if the pragmatic context constraint is capable of flexibly adjusting and fine-tuning the lexical activation pattern, that is, if it can reduce or even disrupt the flow of activation from the picture to the inappropriate basic-level name, the interference effect should be attenuated or absent.

In all experiments, sample size was identical and determined in advance on the basis of related experiments and the number of experimental lists (so that each list was used equally often). We report all data exclusions (if any), all manipulations, and all measures implemented (Simmons, Nelson, & Simonsohn, 2012).

Experiment 1

In Experiment 1, participants named pictures with their subordinate-level names (e.g., "Ente" [duck]). Each picture was preceded by a request which either rendered the basic-level name (e.g., "Vogel" [bird]) an appropriate lexical option ("Benenne das Objekt!" [name the object!]; nonconstraining context) or excluded it as a locally appropriate lexical option (e.g., "Benenne den Vogel!" [name the bird!]; constraining context). Auditory distractors starting simultaneously with picture onset were phonologically related or unrelated to the pictures' basic-level names and assessed whether the (actually not produced) basic-level name alternative was phonologically coactivated. We predicted interference from related distractors in the nonconstraining context condition (indexing coactivation of the basic-level name). The critical question was whether this effect would be attenuated or absent in the constraining context condition (suggesting that the context in

[2] In this scenario, the finding that the context did have an effect on lexical choice would be attributed to later control processes (i.e., monitoring, Levelt, 1989) at a point in time at which the context object has been sufficiently processed.

part or fully prevented the phonological activation of a locally nonappropriate lexical candidate).

Method

Participants. Thirty-two participants, most of them students from Leipzig University (27 female, mean age: 24.3 years, *SD* = 4.9) were tested. Three of them were replaced because of high error rates (>15% on the experimental trials). In all experiments reported here, the participants were native speakers of German with normal or corrected-to-normal vision. They received either course credit or were paid 6 €.

Materials. From a large set of color photographs of objects compiled from various sources, we selected 32 pictures as experimental items. These objects came from 16 basic-level categories, with two pictures per basic-level category (see the Appendix for a list of the materials). Pictures were considered only if there was no phonological or morphological overlap between its basic-level name and its subordinate-level name and the subordinate-level name of the second picture from that basic-level category. Moreover, picture selection was constrained by the results from a series of pretests (with a total of $N = 61$ participants) which controlled that—in the absence of any familiarization, specific instruction, and context—(a) the subordinate-level name was preferred, (b) the basic-level name was available, and (c) both names were considered appropriate responses. For the selected materials, we obtained the following results in these pretests. Participants named the individual pictures with the intended subordinate-level names in 76.6% of cases (*SD* = 14.5%); when multiple pictures were grouped by category, this value even increased to 92.8% (*SD* = 8.2%). Participants categorized individual pictures with the intended basic-level names in 76.7% (*SD* = 23.2) of cases and considered both names as appropriate responses, *M* = 5.0 (*SD* = 0.05) for subordinate-level names and *M* = 4.1 (*SD* = 0.4) for basic-level names (5-point Likert scale; 1 = *not an appropriate name*, 5 = *very appropriate name*).

In addition, we selected 32 pictures from the same source as filler items, drawing two pictures from each of the same 16 basic-level categories as for the critical pictures. Fillers as well as catch trials (see below) were included to discourage participants from strategically preparing one possible response (out of only two) in the constraining context.

For the two pictures from each experimental basic-level category, we selected a word that shared its initial phonological segments with the basic-level name to create the related distractor condition (e.g., "Foto" [photo] for the basic-level name "Vogel" [bird], when the subordinate-level target names were "Ente" [duck] and "Storch" [stork]). To create the unrelated distractor condition, each related distractor word was reassigned to two pictures from a different basic-level category. For each basic-level category, we used a constraining request ("Benenne den/die/das x!" [name the x!], with x denoting that category). In addition, we used a nonconstraining request ("Benenne das Objekt!" [name the object!]). All pictures had their background removed by a masking tool and were sized to roughly fill an imaginary square of 300 × 300 pixels (corresponding to 8.8 cm × 8.8 cm or a visual angle of 8.4° × 8.4° at 60 cm viewing distance). Practice and warm-up trials were created with additional 8 pictures. Distractor words were spoken by a female native speaker of German, recorded at a sampling rate of 48 kHz, and normalized in amplitude. The duration of these words ranged from 663 ms to 850 ms (*M* = 761 ms, *SD* = 57 ms). Requests were spoken by a male native speaker of German and processed in the same way as the distractor words. These sentences had a duration between 1,072 ms and 1,378 ms (*M* = 1,178 ms, *SD* = 71 ms).

Apparatus. Stimuli were presented on a 19 in. TFT-monitor. The experiment was controlled by NESU (MPI for Psycholinguistics). Responses were registered with a microphone and digitally recorded to allow for off-line rechecking, if necessary. Auditory requests and distractors were presented with headphones at a comfortable listening volume.

Design. The repeated-measure design included the two independent variables type of context (nonconstraining vs. constraining) and distractor condition (related vs. unrelated) tested within participants and within items. The sequence of the conditions (per experimental item) was sequentially balanced across subgroups of participants using a Latin square procedure. Each participant received a total of 128 experimental trials (32 items × 4 conditions) and 128 filler trials (32 items × 4 repetitions × 1 condition; in the filler trials, only unrelated distractors were used). Half of these filler trials were catch trials in which a constraining request preceded the target picture but the request did not contain a basic-level name that matched the subsequently presented picture (e.g., "Benenne den Vogel!" [name the bird!] followed by the picture of a palm tree). In the case of catch trials participants were instructed to respond with an utterance like "Ich sehe etwas anderes, nämlich eine Palme" [I see something else, namely a palm]. Overall, this resulted in 37.5% of trials with a nonconstraining context (25% experimental trials, 12.5% filler trials), 37.5% of trials with a valid constraining context (25% experimental trials, 12.5% filler trials), and 25% of trials with an invalid constraining context (catch trials).

We created four lists, each of which was used eight times. Trials within each list were pseudorandomized using the program Mix (Van Casteren & Davis, 2006) with the following restrictions: (a) repetition of a picture was separated by at least eight trials; (b) there were no repetitions of specific picture sequences or (c) pictures from the same basic-level category; pictures which (d) had the same phonological onset or (e) were semantically related did not appear in consecutive trials; (f) the same type of context was not repeated on more than four consecutive trials; and (g) type of distractor condition was not repeated on more than three consecutive trials.

Procedure. Participants were tested individually in a dimly lit room. They were seated comfortably with a viewing distance of about 60 cm to the computer screen. The experimenter was separated from the participants by a partition wall. At the beginning of the experiment, participants received written instructions informing them that they would take part in a pilot experiment for a later study that would explore how well two real speakers can align their utterances in a situation in which they have different visual information available. Participants were informed that their task would be to first listen to a request by an imaginary partner and then to name a picture accordingly as quickly and accurately as possible. Then they received a printed booklet to familiarize themselves with the pictures and their subordinate-level names. In a subsequent practice block, pictures appeared one-by-one on a computer screen and participants named all pictures once. Nonexpected responses were corrected. Next, participants were told that, in the following trials, they would hear a spoken request from the imaginary partner before each picture. The request could either be specific or nonspecific. Participants were asked to respond to each picture by producing a bare noun. If the picture did not match the category mentioned by the imaginary partner, they should inform him with a sentence of the form "Ich sehe etwas anderes, nämlich einen/eine/ein y" [I see something else, namely a y.], with y denoting the specific (i.e., subordinate-level) name of the depicted object. After this practice block (eight trials), the auditory distractor words were introduced in another practice block (16 trials). This was followed by four experimental blocks, each containing 32 experimental and 32 filler trials. There were short breaks between the blocks.

Trials were structured as follows: Pictures were presented at the center of the screen for 1,000 ms on a light gray background (RGB 244 244 244). The spoken requests started 1,700 ms before picture onset. The presentation of pictures and auditory distractors started simultaneously (SOA 0 ms). Responses were recorded in an interval of 3,000 ms starting at picture onset. Each trial lasted for about 5,500 ms.

Results and Discussion

The raw data and data analysis scripts for this and all other experiments reported here are available via the open science framework under this link: https://osf.io/rg8mh/. Observations were coded as erroneous and excluded from the reaction time (RT) analyses whenever no response, a nonexpected response, a disfluency, or a smack was registered, or a technical error occurred (overall 6.7% of the data; technical errors were not included in the error analyses). Observations faster than 200 ms were also discarded. The same was true for observations deviating from a participant's and an item's mean, per context and distractor condition, by more than 2 *SD*; these observations were considered outliers (2.2%). Averaged RTs and error rates were submitted to ANOVAs involving the two-level variables type of context and distractor condition. Table 1 displays mean RTs and error rates broken down by these variables.

Naming responses were faster with a constraining context than with a nonconstraining context, $F_1(1, 31) = 38.539$, $p < .001$, $\eta^2_G = .052$; $F_2(1, 31) = 34.401$, $p < .001$, $\eta^2_G = .077$. Related distractors interfered with the naming response more strongly than unrelated distractors, $F_1(1, 31) = 22.657$, $p < .001$, $\eta^2_G = .016$; $F_2(1, 31) = 14.952$, $p < .001$, $\eta^2_G = .022$. The two variables did not interact, $F_1(1, 31) = 1.515$, $p = .228$, $\eta^2_G = .001$; $F_2(1, 31) = 1.637$, $p = .210$, $\eta^2_G = .002$. In the analysis of error rates, none of the effects was significant, all *p*s > .095.

Table 1
Mean Naming Latencies (in ms) and Error Rates (in %) From Experiment 1, Broken Down by Type of Context and Distractor Condition

	Type of context			
	Nonconstraining		Constraining	
Distractor	ms	%	ms	%
Related	854 (14)	8.0 (1.0)	821 (15)	6.4 (.9)
Unrelated	839 (18)	5.9 (.8)	794 (12)	6.0 (.9)
Difference	15 (8)	2.1 (1.1)	27 (6)	.4 (.9)

Note. Standard errors of the mean are given in parentheses.

The results from Experiment 1 are easily summarized. Responses were faster with a constraining context than with a nonconstraining context, presumably because the constraining context had effectively narrowed down the local response set or because of category priming or both. There was also interference from distractors that were phonologically related to the basic-level name of the target object, suggesting that these name alternatives had been phonologically activated. Importantly, this interference effect was independent of the type of context, suggesting that a preceding request that constrains the set of valid responses could not prevent invalid names from becoming phonologically activated and from competing for selection. This finding with a preceding linguistic context nicely replicates what we found earlier with a simultaneous visual context (Jescheniak et al., 2005).

In Experiment 1, we had used catch trials (i.e., trials in which the request was constraining but the subsequent target picture was drawn from a mismatching basic-level category). Their purpose was to rule out that participants would simply ignore the requests. If our participants had ignored the requests, then the fact that the distractor interference effect was not modulated by a constraining context would not come as a surprise. However, there are two aspects of the results that suggest that our participants did process the requests: First the presence of a context effect (faster responses with constraining requests than with nonconstraining requests; this however, could also result from rather automatic category priming) and second—and more informative—the good performance in catch trials (91.8% correct). Nevertheless, it could still be the case that the relevance of the context was not strong enough to effectively influence the lexical activation pattern. To address this possibility, we carried out Experiment 2.

Experiment 2

In Experiment 2, participants named the same pictures as before, after hearing the same requests. However, this time two pictures (instead of only one) were included in the display (e.g., the picture of a duck and a sandwich) and the constraining request served two functions. First, it identified the target (e.g., "Benenne den Vogel!" [name the bird!]) and, second, as in Experiment 1, it rendered the basic-level name (e.g., "Vogel" [bird]) temporarily inappropriate. We reasoned that this dual function would enhance the relevance of the request, thereby increasing the chance that it could effectively modulate the lexical activation pattern.

Method

Participants. Thirty-two participants, most of them students from Leipzig University (28 female, mean age: 22.2 years, *SD* = 3.4) were tested. Two of them were replaced according to the criterion defined earlier (see Experiment 1). One additional participant was replaced, because s/he had participated in a previous experiment using the same stimuli.

Materials, apparatus, and design. Same as in Experiment 1, with the exception that two pictures (from different basic-level categories) were presented side by side (with a distance of 20 pixels in between the imaginary squares). The two pictures were always semantically, associatively, and phonologically unrelated to each other and the nontarget picture was also unrelated to the basic-level name of the target picture (and unrelated to the two distractors used with the target).

Procedure. Same as in Experiment 1, with the following exceptions. Whenever a request contained a basic-level name (e.g., “Benenne den Vogel!” [name the bird!]), participants were asked to name the picture from that category. If there was no such picture in the display (catch trials), they were instructed to respond with a sentence of the form “Da ist keiner/keine/keins” [there is none]. Whenever a request did not contain a basic-level name (“Benenne das Objekt!” [name the object!]), participants were asked to name the picture that was marked with a cross below it. On trials with a request containing a basic-level name no such marking was present.

Results and Discussion

The raw data were treated as described for Experiment 1. After applying these criteria, 4.5% of the observations were marked as erroneous and 2.1% as outliers. We conducted the same analyses as for Experiment 1. Table 2 displays mean RTs and error rates broken down by type of context and distractor condition.

Naming responses were faster with a constraining context than with a nonconstraining context, $F_1(1, 31) = 24.396$, $p < .001$, $\eta^2_G = .026$; $F_2(1, 31) = 10.202$, $p < .01$, $\eta^2_G = .063$. Related distractors interfered with the naming response, although the effect minimally failed to reach the conventional level of significance in the item analysis, $F_1(1, 31) = 7.297$, $p = .011$, $\eta^2_G = .003$; $F_2(1, 31) = 3.858$, $p = .058$, $\eta^2_G = .008$. The two variables did not interact, Fs < 1. In the error analysis, there was a trend toward fewer errors with a constraining context than with a nonconstraining context, but this effect was only reliable in the item analysis, $F_1(1, 31) = 3.728$, $p = .063$, $\eta^2_G = .035$; $F_2(1, 31) = 10.153$, $p = .003$, $\eta^2_G = .031$.

Experiment 2 replicated the findings from Experiment 1. Again, responses were faster with a constraining context than with a nonconstraining context, presumably because the context had effectively narrowed down the local response set or because of category priming or both. There was also again interference from distractors that were phonologically related to the basic-level name of the target object, suggesting that these name alternatives had been phonologically activated. Importantly, this interference effect was again independent of the type of context, further suggesting that a preceding request that constrains the contextually appropriate naming responses on pragmatic grounds could not prevent nonappropriate names from becoming phonologically activated and, subsequently, from competing for selection.

Before accepting this conclusion, however, one should address one caveat. In both Experiment 1 and 2 the basic-level name whose activation during subordinate-level naming (e.g., “bird” when the target name was “duck”) we traced by means of the distractor words (e.g., related “birch” vs. unrelated “lamp”), had been mentioned in the preceding request in the constraining context condition (e.g., “name the bird!”). Hence, it could be the case that the interference effect in the constraining context condition does not reflect the picture-induced phonological activation of a contextually inappropriate name, but rather some residual trace of lexical-phonological activation of that word resulting from processing of the request. Put differently, it might be that the word “bird” is still phonologically activated to some extent after having been heard during the request, and that exactly this persisting activation led to slower responses with the related distractor “birch” than with the unrelated distractor “lamp.” Experiment 3 was set up to provide a direct test of this alternative explanation for the results of Experiments 1 and 2.

Before turning to this experiment, however, we wish to address another issue. Although the task used in Experiment 1 must be considered less demanding than the task used in the present experiment (as it only required target naming but no target selection), participants responded considerably slower in Experiment 1 than in the present one. We consider this a group effect rather than a true difference. The data for Experiment 1 were collected at a time during the academic year, when the standard population of participants from which we usually sample (undergraduate psychology students who receive mandatory credit for participating in psychological experiments) was not accessible. In fact, many of the participants tested in Experiment 1 entered a psychology laboratory for the first time. Reassuringly, however, only the level of overall performance (in terms of speed) was deteriorated, while the pattern of effects was the same across experiments: The interference effect from related distractors was not reduced in the constraining context condition.

Table 2
Mean Naming Latencies (in ms) and Error Rates (in %) From Experiment 2, Broken Down by Type of Context and Distractor Condition

	Type of context			
	Nonconstraining		Constraining	
Distractor	ms	%	ms	%
Related	765 (19)	4.6 (.9)	734 (16)	2.7 (.6)
Unrelated	754 (18)	3.7 (.7)	724 (15)	2.6 (.6)
Difference	11 (6)	.9 (.6)	10 (7)	.1 (.8)

Note. Standard errors of the mean are given in parentheses.

Experiment 3

In Experiment 3, participants named the same pictures as before after hearing constraining or nonconstraining requests. However, this time the constraining requests contained a subordinate-level name (e.g., “Beschreibe die Ente!” [describe the duck!]) and participants described the subsequent picture by producing a noun phrase consisting of a size adjective and a noun (e.g., “kleine Ente” [small duck]). In this situation, any differential effect of distractors phonologically related versus unrelated to the basic-level name (basic-level name: “Vogel” [bird], related distractor: “Foto” [photo]) unrelated distractor: “Brom” [bromine]) cannot result from the preceding request. Thus, if the effect is still present, it needs to be attributed to the phonological coactivation of a contextually inappropriate name alternative that cannot be prevented by the preceding constraining context.

Method

Participants. Thirty-two participants, most of them students from Leipzig University (22 female, mean age: 23.5 years, SD = 3.5) were tested. Two of them were replaced according to the criterion defined earlier (see Experiment 1).

Materials. Same as in Experiment 1 with two exceptions. First, the constraining requests were modified so that they included a subordinate-level name rather than a basic-level name (e.g., "Beschreibe die Ente!" [describe the duck!] in place of "Benenne den Vogel!" [name the bird!]); the nonconstraining requests were also adapted accordingly ("Beschreibe das Objekt!" [describe the object!]). The new requests were again spoken by a male native speaker of German and processed as before. These sentences had a duration between 1,049 ms and 1,575 ms ($M = 1{,}289$ ms, $SD =$ 132 ms). Second, the pictures were prepared in two sizes: half of them were prepared in a small size (200 × 200 pixels, corresponding to 5.9 cm × 5.9 cm or a visual angle of 5.6° at 60 cm viewing distance) and half of them were prepared in a large size (374 × 374 pixels, corresponding to 11.0 cm × 11.0 cm or a visual angle of 10.5° at 60 cm viewing distance; see the Appendix for the assignment of pictures to sizes). The two experimental items from a given basic-level category were prepared in the same size condition, while the two filler items from that category were prepared in the other size condition. In assigning the size to a particular picture, we took care that there was no phonological onset overlap between the size adjective and the picture name. The large and small versions were used in the experimental blocks and a preceding practice block, while their medium-sized versions (from Experiments 1 and 2) were used during familiarization.

Apparatus and design. Same as in Experiment 1.

Procedure. Same as in Experiment 1, except that in the main experiment participants were asked to respond with a size adjective and a noun (e.g., "kleine Ente" [small duck]). Two new practice blocks with filler items and consisting of 8 trials introduced the new utterance format, respectively. Again, catch trials were included in the main experiment and the preceding practice block (same proportion as in Experiment 1). Participants were instructed to respond to them as in Experiment 2 ("Da ist keiner/keine/keins" [there is none]).

Results and Discussion

The raw data were treated as described for Experiment 1. In addition, we also coded an error, whenever participants had used a wrong size adjective. After applying these criteria, 7.6% of the observations were marked as erroneous (including 3.2% in which participants had used the wrong adjective) and 2.0% as outliers. We conducted the same analyses as for Experiment 1. Table 3 displays mean RTs and error rates broken down by type of context and distractor condition.

Naming responses were faster with a constraining context than with a nonconstraining context, $F_1(1, 31) = 120.223$, $p <$ .001, $\eta^2_G = .252$; $F_2(1, 31) = 290.653$, $p < .001$, $\eta^2_G = .544$. Related distractors interfered with the naming response, $F_1(1, 31) = 4.757$, $p = .037$, $\eta^2_G = .004$; $F_2(1, 31) = 5.138$, $p = .031$, $\eta^2_G = .018$. The two variables did not interact, $F_1 < 1$; $F_2(1, 31) = 2.701$, $p = .110$, $\eta^2_G = .005$. In the error analysis, fewer errors were observed with a constraining context than with a nonconstraining context, $F_1(1, 31) = 28.115$, $p < .001$, $\eta^2_G =$ .170; $F_2(1, 31) = 15.313$, $p < .001$, $\eta^2_G = .089$. None of the other effects were significant, Fs < 1.

Table 3
Mean Naming Latencies (in ms) and Error Rates (in %) From Experiment 3, Broken Down by Type of Context and Distractor Condition

	Type of context			
	Nonconstraining		Constraining	
Distractor	ms	%	ms	%
Related	742 (20)	9.8 (1.0)	628 (15)	4.7 (.9)
Unrelated	727 (19)	9.3 (1.0)	621 (14)	5.1 (.8)
Difference	15 (8)	.5 (1.2)	7 (5)	−.4 (1.0)

Note. Standard errors of the mean are given in parentheses.

Experiment 3 replicated the findings from Experiments 1 and 2. Again, responses were faster with a constraining context than with a nonconstraining context. There was also again interference from distractors that were phonologically related to the basic-level name of the target object, suggesting that these name alternatives had been phonologically activated. This interference effect was independent of the type of context. Importantly, in the current situation this distractor effect cannot result from the processing of the preceding request, because that request did not contain the picture's basic-level name. Thus, it must reflect the picture-induced phonological activation of a name that was present even though that name was rendered temporarily inappropriate by the preceding local context.

However—descriptively—the interference effect was only half the size in the constraining condition compared with the nonconstraining condition. This is exactly what one would expect when the pragmatic constraint was powerful enough to affect lexical activation. The descriptive pattern—although not substantiated by the ANOVAs—might thus raise concerns about whether the additivity of context and distractor type effects—in a situation in which the basic-level name is not introduced—would replicate. Moreover, one could also argue that some reduction of the interference effect in the constraining context condition, as seems to be the case in Experiment 3, is to be expected in our experiment, even if the context per se is not effective. This is because after processing the constraining request (e.g., "Beschreibe die Ente!" [describe the duck!]), participants could have fully prepared part of the naming response (i.e., the picture name "Ente" [duck]) even before the target picture appeared. Using this strategy, participants would only have had to retrieve the picture name from some buffer when preparing the full target utterance (adjective + picture name, e.g., "kleine Ente" [small duck]). Consequently, by the time the distractor is presented it would not tap any lexical retrieval process and, thus, no difference between related and unrelated distractors is to be expected. Such a strategy does not seem unlikely, because only in the case of catch trials (25% of all trials), participants would have had to discard the prepared object name. If participants followed such a strategy only on some proportion of the critical trials, the interference effect in the constraining context condition in Experiment 3 would be somewhat reduced, in line with the descriptive pattern.

In view of these considerations, we conducted a final experiment. This experiment was similar to Experiment 3 in that the set of possible picture naming responses was constrained (again rendering the basic-level name locally inappropriate) without introducing the basic-level name. The main goal was a replication of the results from Experiment 3.

Experiment 4

In the experiments reported so far, the context constraint was implemented by using different kinds of requests—produced by an imaginary interlocutor—that preceded the target picture. In Experiment 4, by contrast, the context constraint was implemented via the speaker's own naming response to a preceding context picture. Within each trial, participants named four pictures appearing one after another. In one condition, the picture preceding the target picture (henceforth context picture) was drawn from a different category than the target picture (e.g., context: fir–target: duck), which renders the basic-level name *bird* a contextually appropriate response for the target picture (nonconstraining context). In a second condition, the context picture was drawn from the same category as the target picture (e.g., context: stork–target: duck). In this situation, the basic-level name bird was no longer appropriate on pragmatic grounds (constraining context). If pragmatic constraints cannot prevent inappropriate names from becoming phonologically activated and from competing for selection, as the results from Experiments 1–3 suggest, there should again be interference from distractors phonologically related to the basic-level name of the target picture, and the effect should be similar sized for constraining and nonconstraining contexts.

Method

Participants. Thirty-two participants, most of them students from Leipzig University (20 female, mean age: 23.3 years, $SD = 5.4$) were tested. One of them was replaced according to the criterion defined earlier (see Experiment 1).

Materials. Same as in Experiment 1 with the following exceptions. First, the pictures were presented in a slightly smaller size than in Experiments 1 and 2 (250 × 250 pixels, corresponding to 7.3 cm × 7.3 cm or a visual angle of 7.0 × 7.0 at 60 cm viewing distance). Second, there were no requests preceding the pictures.

Apparatus and design. Same as in Experiment 1 with the following exceptions. As there were no preceding requests there were, as a consequence, no catch trials. There were no filler trials either, but filler pictures were used in nontarget positions in the experimental trials. The main experiment thus consisted of 128 trials (32 items × 4 conditions). The target was either the second or the fourth picture in a trial, preceded by the (constraining or nonconstraining) context picture. The combination of context picture and target picture was either followed by two filler pictures or preceded by two filler pictures. Filler pictures were assigned as follows: Filler pictures preceding the context picture and the target picture were (a) from two different basic-level categories that were different from the category of both the context picture and the target picture, and (b) phonologically and semantically unrelated to the target picture. No such constraints applied to filler pictures following the context picture and the target picture. Instead, to detract participants' attention from the (semantically related) context picture–target picture sequences, we presented three or more pictures from the same basic-level category in about 12% of these trials. That is, the target picture was followed by one or two filler pictures from the same basic-level category.

We created 32 pseudorandomized lists with the following restrictions: (a) there was at least one intervening trial between targets from the same basic-level category, (b) the first picture in a trial was always from a different basic-level category than the last picture in the preceding trial, (c) there were no more than three successive trials with the same target position, (d) the same type of context was not repeated on more than three consecutive trials, and (e) type of distractor condition was not repeated on more than three consecutive trials.

Procedure. In each trial, the visual display consisted of four pictures appearing one after another from left to right without temporal overlap. Each of the pictures was named by the participants. Each trial contained only one target that either appeared at second or fourth position.

As in the preceding experiments, participants first received written instructions informing them to name pictures as quickly and as accurately as possible. Then they received a printed booklet to familiarize themselves with the pictures and their subordinate-level names. In a subsequent practice block, pictures appeared one-by-one on a computer screen and participants named all pictures once. Nonexpected responses were corrected. A second instruction informed them that their next task would be to name sequences of four pictures appearing one by one on the screen. Participants started with a short practice block containing four trials and continued with four experimental blocks with 32 trials, each starting with a warm-up trial. There were short pauses between the blocks.

In each trial, four pictures appeared one after another on the screen from left to right at equally spaced and horizontally aligned positions. First, a fixation cross was presented for 2,000 ms at the left side of the screen and was replaced by the first picture. The second, third, and fourth picture were displayed to its right (x-offsets for upper left corner: 95, 375, 655, and 935 at 1,280 × 1,024 pixels screen resolution). All pictures appeared along the horizontal axis in the middle of the screen (constant y-offset for upper left corner: 387). Each picture was presented for 1,000 ms with intervals of 3,000 ms between any two pictures. Simultaneously with the onset of each picture an auditory distractor was presented (i.e., SOA was 0 ms); for the three nontarget pictures in each trial only unrelated distractors were used. Speech onset latency was measured for the target picture, beginning at its onset. One trial lasted for about 14,000 ms.

Results and Discussion

The raw data were treated as described for Experiment 1 with the only difference that observations were also excluded from the RT analyses (but not included in the error analyses) when participants had provided a wrong or no response for the context picture. After applying these criteria, 6.2% of the observations were marked as erroneous and 2.0% as outliers. We conducted the same analyses as for Experiment 1. Table 4 displays mean RTs and error rates broken down by type of context and distractor condition.

Naming responses were faster with a constraining context than with a nonconstraining context, but this effect was only reliable by participants, $F_1(1, 31) = 5.419$, $p = .027$, $\eta^2_G = .003$; $F_2(1, 31) = 2.691$, $p = .111$, $\eta^2_G = .005$. Related distractors interfered with the naming response, $F_1(1, 31) = 11.464$, $p < .01$, $\eta^2_G = .008$; $F_2(1, 31) = 14.499$, $p < .001$, $\eta^2_G = .020$. The two variables did not interact, Fs < 1. In the error analysis, fewer errors were observed with a constraining context than with a nonconstraining context, however, this effect was again only reliable by participants $F_1(1, 31) = 6.369$, $p = .017$, $\eta^2_G = .014$; $F_2(1, 31) = 2.778$, $p = .106$,

Table 4
Mean Naming Latencies (in ms) and Error Rates (in %) From Experiment 4, Broken Down by Type of Context and Distractor Condition

	Type of context			
	Nonconstraining		Constraining	
Distractor	ms	%	ms	%
Related	754 (14)	5.9 (1.1)	744 (16)	4.7 (.8)
Unrelated	737 (19)	4.5 (.6)	729 (16)	3.4 (.8)
Difference	17 (8)	1.4 (1.0)	15 (5)	1.3 (.8)

Note. Standard errors of the mean are given in parentheses.

$\eta^2_G = .011$. Participants tended to make fewer errors with unrelated distractors than with related distractors, $F_1(1, 31) = 3.792$, $p = .061$, $\eta^2_G = .019$; $F_2(1, 31) = 4.054$, $p = .053$, $\eta^2_G = .015$. None of the other effects were significant, Fs < 1.

Experiment 4 replicated the findings from Experiments 1–3. Again, responses tended to be faster with a constraining context than with a nonconstraining context, this time presumably reflecting category priming.[3] There was, once more, interference from distractors that were phonologically related to the basic-level name of the target object, suggesting that these name alternatives had been phonologically activated. This interference effect was clearly independent of the type of context, both in terms of inferential statistics and descriptive statistics. As in Experiment 3, this distractor effect cannot result from having processed the basic-level category name before, because there were no requests preceding the pictures and participants never used or perceived basic-level picture names. In contrast to Experiment 3, the effect was also descriptively of the same size across the context conditions, suggesting that the pragmatic context constraint did not impact the lexical activation pattern.

General Discussion

In a series of four experiments, in which participants named pictures with their subordinate-level names, we investigated whether a pragmatic context that constrains the set of appropriate picture name alternatives affects the activation level of the respective lexical candidates. Across the experiments, we consistently obtained the following results. First, a constraining context led to faster naming responses than a nonconstraining context, likely because of a reduction of the response set or because of category priming. Second, distractors that were phonologically related to a nontarget name alternative (i.e., a picture's basic-level name) interfered with the naming response more strongly than unrelated distractors. This suggests that the alternative name was activated at a phonological level of representation. Third, the strength of the interference effect did not depend on whether the context rendered the basic-level name appropriate or inappropriate. This suggests that the pragmatic context manipulation had no effect on the activation strength of lexical candidates that compete for selection at the phonological level.

The consistency of the result pattern from the individual experiments is also corroborated in a joint analysis on all data. This analysis revealed a main effect of type of context, $F_1(1, 124) = 183.612$, $p < .001$, $\eta^2_G = .064$; $F_2(1, 31) = 106.253$, $p < .001$, $\eta^2_G = .132$, a main effect of distractor condition, $F_1(1, 124) = 41.395$, $p < .001$, $\eta^2_G = .006$; $F_2(1, 31) = 19.005$, $p < .001$, $\eta^2_G = .017$, but—critically—no interaction of type of context and distractor condition, Fs < 1, and no interaction of type of context, distractor condition, and experiment, Fs < 1.001. We additionally evaluated these two nonsignificant interactions using a Bayesian approach (Masson, 2011; Wagenmakers, 2007). With respect to the interaction of type of context and distractor condition, we found positive evidence for the null hypothesis being true (analysis over participants: $p(H_0|D) = .919$; analysis over items: $p(H_0|D) = .849$). With respect to the interaction of type of context, distractor condition, and experiment, we found strong evidence in the analysis over participants and very strong evidence in the analysis over items for the null hypothesis being true (analysis over participants: $p(H_0|D) = .977$; analysis over items: $p(H_0|D) = .991$). These analyses thus show that the null hypothesis is to be preferred with respect to the two interactions, leading to the conclusion that the constraining context did not modulate the distractor interference effect we observed. The same conclusion is also reached when limiting the joint analysis to Experiments 3 and 4 in which the interference effect in the constraining context condition—unlike in Experiments 1 and 2—cannot be attributed to some residual trace of lexical-phonological activation of the basic-level name, resulting from processing of the request. With respect to the interaction of type of context and distractor condition, these analyses yielded positive evidence for the null hypothesis being true (analysis over participants: $p(H_0|D) = .857$; analysis over items: $p(H_0|D) = .822$). With respect to the interaction of type of context, distractor condition, and experiment, they yielded positive evidence in the analysis over participants and very strong evidence in the analysis over items for the null hypothesis being true (analysis over participants: $p(H_0|D) = .879$; analysis over items: $p(H_0|D) = .991$).

Thus, there is no evidence that a (pragmatically) constraining context can attenuate or suppress the phonological coactivation of contextually inappropriate lexical representations in word production, replicating and extending what we found earlier with a constraining simultaneous visual context (Jescheniak et al., 2005). Interestingly, this situation closely resembles the state of affairs that has emerged in the domain of bilingual lexical processing in the past years. There is clear evidence for parallel lexical activation across languages (e.g., of the words "duck" and "Ente" in bilingual English-German language users) during production (and comprehension), even when only one language is targeted for use. A question that has attracted a lot of attention is whether the presence of certain contexts can reduce this cross-language coactivation. Results from these studies typically support the idea that cross-language lexical activation is relatively insensitive to the presence of contextual variables (although semantic

[3] In some other paradigms, such as cyclic naming and continuous naming, repeated retrieval from a given semantic category has been shown to deteriorate naming performance (see Introduction). Note, however, that in our study the experimental trials followed familiarization and practice, during which the pictures were repeatedly processed, so that effects of repeated category access might have been washed out. Also, at least in cyclic naming, it takes more than two name retrievals from a category to yield interference. In fact, sometimes no effect or even facilitation is observed in the first cycle (i.e., when all pictures drawn from a category [often in the range of about five] are named for the first time within a block, see Abdel Rahman & Melinger, 2007).

constraints do seem to be somewhat effective in at least some circumstances; for a review see, e.g., Kroll, Gullifer, & Rossi, 2013; see also Lagrou, Hartsuiker, & Duyck, 2013; Schwartz & Kroll, 2006; Titone, Libben, Mercier, Whitford, & Pivneva, 2011).[4]

Related to this point is the fact that the participants we tested all had some knowledge in a second language. Given the German educational system (all of our participants were native speakers of German and went through the German school system for 12 or 13 years before entering University) we can safely assume that all of them had knowledge of one foreign language (most likely English) at the level of B1 according to the Common European Framework of Reference for Languages (Council of Europe, 2001) or better and at least some basic knowledge in one other language. At the same time the materials we tested included a number of German words that are cognates with English (and other languages). One cannot exclude with certainty that these facts may have influenced our results. Note, however, that in all experimental conditions the same picture names were produced and the same distractor words were processed. Thus, differential effects to the experimental conditions are unlikely. Still, the second language background of our speakers (and the presence of cognates) could have affected first language processing (as is the case in a vast number of studies with native speakers of a given language).

Returning to the present experiments, the obvious question is why there was no trace of an effect of pragmatic constraints (implemented in different ways) on the phonological activation of locally inappropriate lexical candidates. A possible answer could be that in speaking there is a trade-off between the need for quick and error-free selection of an appropriate target word at a given point in time (calling for an effective mechanism that inhibits locally inappropriate name alternatives) and the option of lexical flexibility as speaking continues (demanding a high availability of different name alternatives). In spontaneous speech, speakers quite often strive for alternating labels as they continue talking about a particular entity (e.g., “I would really like to own a 911. The Porsche is so great. With such a car, a true icon, I could impress all of my friends, that’s for sure” vs. “I would really like to own a 911. The 911 is so great. With a 911, a true 911, I could impress all of my friends, that’s for sure”). In such a situation, actively inhibiting alternative—and thus likely competing—words (such as “Porsche”, “car,” and “icon,” when producing “911”) might be more harmful for switching to these lexical alternatives further downstream than temporarily dealing with competition resulting from the coactivation of these words. Clearly, our data show that despite robust and substantial lexical-phonological coactivation and competition, as indexed by the interference effect we observed, speakers are fairly effective in dealing with this state of affairs, as evidenced by only very few cases in which a nonappropriate name was produced in our experiments.

Of course, our findings do not prove that the activation of lexical candidates in speech production is generally insensitive to all kinds of pragmatic or other contextual constraints. For example, in our experiments, there was no real interlocutor involved. Possibly, context effects are more likely to become visible in a situation involving two real speakers in which a joint goal can only be reached when appropriate object names are very quickly and accurately communicated. Also, discarding competing words might take more experience such that phonological coactivation effects are only diminished when speakers learn over time that certain words are not appropriate responses in a given (experimental) situation. Last but not least, it could be that a possibly rather subtle effect of context on the accessibility of the basic-level name is wiped out by a potentially much larger effect of the distractor such that the effect of the former does not become visible in the RT measurement. If so, the use of more continuous measures such as ERPs might provide further insight into the fine-grained development of lexical activation patterns that is not easily tapped with RTs. In fact, we are currently preparing corresponding behavioral and electrophysiological experiments.

How do the present findings tie in with current models of word production? It is commonly assumed that during word production multiple candidates become activated at an abstract lexical level (coined lexical node level, Dell, 1986, or lemma level, Levelt, 1989) by the conceptual input (see, e.g., Dell, 1986; Levelt, 1989; Levelt et al., 1999; Starreveld & La Heij, 1995). Many researchers also assume that these coactivated candidates then compete for selection (in the sense that strongly coactivated competitors hamper selection of the eventually produced word, e.g., Bloem & La Heij, 2003; Levelt et al., 1999, 1991; Roelofs, 1992; but see Finkbeiner & Caramazza, 2006). Research in the past years has also revealed insight into how activation flows from the abstract lexical level to the phonological level. While some researchers originally maintained that only those lexical nodes that are selected transmit activation to the phonological level (Levelt et al., 1991), this position has been challenged by subsequent studies. These studies revealed that not all activated lexical nodes substantially activate their phonological representations (to an extent that is measurable with available experimental techniques). Rather, phonological coactivation has been repeatedly observed for near-synonyms (Jescheniak & Schriefers, 1998; Peterson & Savoy, 1998) and hierarchically related terms (Jescheniak, Hantsch, & Schriefers, 2005; and the present study) but not for category coordinates (Levelt et al., 1991; see also Jescheniak, Hahne, Hoffmann, & Wagner, 2006; Jescheniak et al., 2003; Peterson & Savoy, 1998, for replications; see also Dell & O’Seaghdha, 1991, 1992, for a theoretical argument based on computational simulations; however, such an effect has later been found in young speakers about age 7, see Jescheniak et al., 2006). This pattern clearly shows that the information flow in the conceptual-lexical system is constrained (for an overview, see, e.g., Goldrick, 2006). Therefore, a theory of word production has to distinguish between those factors that modulate the information flow and those factors that do not. The findings on near-synonyms, hierarchically related words and category coordinates can be explained by modulating factors inherent to the network structure of the conceptual-lexical system, with semantic similarity being the driving force (see Dell & O’Seaghdha, 1991, 1992 for a computational account). These findings can be accommodated by models in which lexical processing is viewed as a rather static process of activation flow along hard-wired connections between representations (such as in the models developed by Dell, 1986, or Roelofs, 1992). Lately, however, models have been proposed such as the swinging lexical network model by Abdel Rahman and Melinger (2009) or the incremental learning model by Oppenheim et al. (2010) that view lexical processing as more dynamic and, in principle, allow for changes in lexical activation as a function of context (including previous productions in the Oppenheim et al., 2010 model or [re]configurations in the lexical cohort in the Abdel Rahman & Melinger, 2009 model). The present study also sought for factors, specifically pragmatic constraints, outside the

[4] We thank an anonymous reviewer for bringing this parallelism to our attention.

conceptual-lexical network proper that may affect the information flow within the conceptual-lexical system. Specifically, we tested whether such constraints allow for a reduction or elimination of competition at the phonological level. For the time being, however, we conclude that the pragmatic constraints tested in the present study are no such factor.

Conclusion

The findings from four experiments implementing different kinds of pragmatic context constraints suggest that the speech production system is rather limited in its ability of flexibly adjusting and fine-tuning the lexical activation patterns of candidate words as a function of such constraints. It seems that lexical activation processes largely run in an autonomous and context-independent way and that contextual constraints do only become effective relatively late, when competing phonological representations have become available and these contextual constraints prevent the ultimate selection and production of an inappropriate response.

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(*Appendix follows*)

Appendix

List of the Experimental Pictures and Distractors Used in Experiments 1–3

Subordinate-level name	Basic-level name alternative	Related distractor	Unrelated distractor
$Palme_s$ [palm tree]	Baum [tree]	Bauer [farmer]	Foto [photograph]
$Tanne_s$ [fir]	Baum [tree]	Bauer [farmer]	Foto [photograph]
$Rose_s$ [rose]	Blume [flower]	Bluse [blouse]	Pumpe [pump]
$Tulpe_s$ [tulip]	Blume [flower]	Bluse [blouse]	Pumpe [pump]
Hai_l [shark]	Fisch [fish]	Filter [filter]	Bauer [farmer]
Aal_l [eel]	Fisch [fish]	Filter [filter]	Bauer [farmer]
$Jeans_s$ [jeans]	Hose [trousers]	Hobel [plane]	Nutria [nutria]
$Leggings_s$ [leggings]	Hose [trousers]	Hobel [plane]	Nutria [nutria]
$Dackel_l$ [dachshund]	Hund [dog]	Humpen [beaker]	Käfig [cage]
$Pudel_l$ [poodle]	Hund [dog]	Humpen [beaker]	Käfig [cage]
$Barbie_l$ [barbie]	Puppe [doll]	Pumpe [pump]	Karren [barrow]
$Matroschka_l$ [matryoshka]	Puppe [doll]	Pumpe [pump]	Karren [barrow]
$F\ddot{u}ller_l$ [fountain pen]	Stift [pen]	Stirn [forehead]	Bluse [blouse]
$Kuli_l$ [ballpoint pen]	Stift [pen]	Stirn [forehead]	Bluse [blouse]
$Ente_s$ [duck]	Vogel [bird]	Foto [photograph]	Brom [bromine]
$Storch_s$ [stork]	Vogel [bird]	Foto [photograph]	Brom [bromine]
$Toast_s$ [toast]	Brot [bread]	Brom [bromine]	Auge [eye]
$Sandwich_s$ [sandwich]	Brot [bread]	Brom [bromine]	Auge [eye]
$Atlas_l$ [atlas]	Buch [book]	Bude [shack]	Stirn [forehead]
$Duden_l$ [dictionary]	Buch [book]	Bude [shack]	Stirn [forehead]
$Boxer_s$ [boxer]	Sportler [athlete]	Sporn [spur]	Humpen [beaker]
$Golfer_s$ [golfer]	Sportler [athlete]	Sporn [spur]	Humpen [beaker]
Ass_l [ace]	Karte [card]	Karren [barrow]	Sporn [spur]
$Joker_l$ [joker]	Karte [card]	Karren [barrow]	Sporn [spur]
$Flipflop_s$ [flipflop]	Schuh [shoe]	Schule [school]	Bude [shack]
$Sandale_s$ [sandal]	Schuh [shoe]	Schule [school]	Bude [shack]
$Trabi_l$ [Trabant]	Auto [car]	Auge [eye]	Schule [school]
$Smart_l$ [Smart]	Auto [car]	Auge [eye]	Schule [school]
$Mozzarella_l$ [mozzarella]	Käse [cheese]	Käfig [cage]	Filter [filter]
$Parmesan_l$ [parmesan]	Käse [cheese]	Käfig [cage]	Filter [filter]
$Spaghetti_s$ [spaghetti]	Nudeln [noodles]	Nutria [nutria]	Hobel [plane]
$Tortellini_s$ [tortellini]	Nudeln [noodles]	Nutria [nutria]	Hobel [plane]

Note. English translations are given in brackets. The subscript following the subordinate-level name specifies the object size in Experiment 3; s = small size; l = large size.

Received January 27, 2016
Revision received November 4, 2016
Accepted November 4, 2016 ■