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Focus and Context: How Speakers Create Alternative Sets

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1 Introduction: Theoretical Background on Focus

In our daily conversations, highlighting information is one important aspect of communication. One main strategy to highlight information in intonation languages such as English or German is by using focus marking, e.g., contrastive prosodic pitch accents (see Krifka, 2007; Hartmann, 2008). Contrastive pitch accents usually carry a high pitch on the stressed syllable that is preceded by a low tone (L+H*) (for more on the relation of L+H*-accent and contrastive meaning, see Pierrehumbert & Hirschberg, 1990, for English, and Grice & Baumann, 2002, for German)[1]. In terms of processing, listeners make use of the information signalled by different types of pitch accents. The function of focus is to establish a set of alternatives to a focused element (e.g., Rooth 1985, 1992; Krifka 2007). In (1), with contrastive intonation on *monkeys* (the focused element), possible alternatives could be other animals that can be seen and photographed in a zoo (e.g., elephants or tigers). However, thinking more broadly, alternatives to the focused element *monkeys* in the given sentence might also include other things that one can photograph in a zoo such as a bench, trees, zookeepers, or visitors.

According to Rooth's (1985, 1992) Alternative Semantics, focus adds a second semantic value to an utterance. The first value – the ordinary semantic value – is the utterance's meaning derived by compositional semantics (2a). Focus adds a second meaning representation, the focus-semantic value (2b). This focus-semantic value is needed to interpret focus correctly because it provides a set of alternatives to the focused element. Following the theory of Alternative Semantics, focus alternatives are of the same semantic type as the focused element, and thus, are replacements to the focused element in the utterance. Example (2b) shows such a set of possible focus alternatives leading to the alternative propositions of (1), schematically illustrated in (2b): 'Sarah photographed zebras.' and 'Sarah photographed donkeys.'.

(1) Sarah photographed MONKEYS in the zoo.

(2) a. ordinary semantic value:
{photographed (Sarah, monkeys)}

b. focus semantic value providing a set of alternatives:
{photographed (Sarah, x) | x ∈ *E*}

including {photographed (Sarah, zebras), photographed (Sarah, monkeys), photographed (Sarah, donkeys)}

(based on Rooth, 1985, 1992)

[1] There is a debate on how the two accents H* and L+H* differ from one another. Studies on reference resolution have shown that whereas L+H*-accents clearly bias towards contrastive referents in an utterance (e.g., Pierrehumbert & Hirschberg, 1990; Ito & Speer, 2008; Watson et al., 2008), H*-accents can signal both new information and contrastive information (see e.g., Watson et al., 2008 for a detailed discussion).

Thus, focus introduces a variable that refers to an antecedent provided by the discourse context (Rooth, 1992; Wagner, 2020). For a correct focus interpretation, an anaphoric relation to that antecedent is needed (Wagner, 2020). Wagner further points out that the context does not have to provide an explicit antecedent to the focused expression, i.e., the antecedent can be implicitly or explicitly given within the communicative situation of the focused utterance. Nevertheless, context information is crucial for the composition of the focus alternatives set (cf. Section 3).

Recent experimental research on focus comprehension gives us an idea of how focus evokes alternatives in the listener's mind. However, very little is known about what happens in the speaker's mind during focus *production*. Do speakers also activate alternatives to a focused element? Does producing a contrastively marked utterance automatically lead to the activation of focus alternatives? In the current paper, we aim to investigate whether speakers make use of focus alternatives when producing an utterance containing a focused element and we show how context determines the activation of focus alternatives in three different experiments.

This paper begins with a short overview of relevant experiments in focus comprehension. After that, we will discuss the role of context in focus interpretation. We will see that context seems crucial, but also, that speakers do not always provide alternatives for the hearer explicitly. We want to investigate how this can influence the composition of the focus alternative set. We conducted a series of three explorative production experiments in which we used different context scenarios. Finally, we discuss our findings in the context of the current focus literature.

2 Empirical Background: Experimental Evidence on Focus Alternatives

Previous experimental research has shown that the focus alternative status shows a measurable behavioral reflex during cognitive processing. Evidence comes from behavioral tasks such as cued recall (e.g., Spalek et al., 2014), recognition memory (e.g., Fraundorf et al., 2010), probe recognition (e.g., Gotzner et al., 2013) and lexical decision (e.g., Braun & Tagliapietra, 2010; Husband & Ferreira, 2016) as well as visual world eye-tracking (e.g., Braun et al., 2019) and neurocognitive research (Spalek & Oganian, 2019). Priming experiments, for instance, have shown that prosodic focus evokes alternatives to the focused element. One main contribution comes from two cross-modal priming experiments by Braun & Tagliapietra (2010), in which they investigated the activation of contrastive associates and non-contrastive associates to a prime word in the listener's mind. Auditorily presented Dutch sentences like "*In Florida he photographed a FLAMINGO/ flamingo*."[2] [3] contained a semantically related prime word (e.g., flamingo) that was either realized with a contrastive (L+H*) or a non-contrastive intonation contour (H*). As control condition, a semantically unrelated prime word (e.g., CELEBRITY/ celebrity) was used instead. In a lexical decision task, participants were asked to decide as quickly as possible whether or not a letter string presented on the screen immediately after the prime sentence was an actual word of Dutch by pressing a button. Probe words were either contrastively related (= alternative, e.g., *pelican*) or non-contrastively related (= no alternative, e.g., *pink*) to the prime word. Only contrastively related probes, therefore, represented alternatives to that prime (e.g., *pelican* can replace *flamingo* in the original sentence, but *pink* cannot). Results revealed facilitation in the lexical decision task for contrastive associates when they were semantically related to the prime word, but only if the prime was presented with contrastive intonation contour compared to when it was presented with non-contrastive intonation contour or compared to the control condition. Performance for non-contrastively related probes (e.g., *pink*) was not affected by intonation contour differences; instead, there was a general priming effect that was of equal size in the two different intonation conditions. The authors

[2] Capital letters indicate prosodic focus marking in terms of contrastive intonation (L+H*).

[3] Note that the original sentences were in Dutch, with a double peak contour (on 'FLORIDA' and 'FLAMINGO') to clearly disambiguate the intended contrastive accent from other accent types (see Braun & Tagliapietra, 2010, for details; see also Braun, 2005, 2006).

argue that prosodic information serves as an important cue for the listener to interpret prosodic focus correctly by activating alternatives to the focused element.

Of equal importance is a study by Husband & Ferreira (2016) investigating the time course of focus comprehension. The authors argue for a selection process of focus alternatives during focus comprehension: Initially, comprehenders activate a large set of words related to the focused element that does not contain only focus alternatives, but also associatively related words. As focus comprehension continues, a selection process happens in which only relevant candidates remain activated in the listener's mind. In two cross-modal lexical decision tasks, participants were presented with spoken sentences with contrastively focused, or neutrally realized prime words (e.g., SCULPTOR/ *sculptor*). Written target words (probes) appeared on the screen that were either contrastive associates (e.g., *painter*), non-contrastive associates (e.g., *statue*) or unrelated to the prime (e.g., *register*). In the first experiment, the lexical decision task on the target word had to be performed at the offset of the prime word, i.e., with a stimulus offset asynchrony (SOA) of 0 ms; the second experiment tested at an SOA of 750 ms. Results showed that, at SOA 0, both contrastive and non-contrastive associates were facilitated when a prime word was presented with contrastive compared to the neutral condition. This is in contrast to Braun & Tagliapietra's (2010) findings where facilitation was revealed only for contrastive associates immediately after the prime word. However, the experiments differed in various ways which might explain differences in their findings. At SOA 750, contrastive associates were recognized faster than unrelated target words when the prime word was focused whereas non-contrastive associates showed no significant difference compared to unrelated targets. This can be interpreted as prosodic marking being a trigger for the selection process of focus alternatives. With a neutral prime, on the other hand, results showed activation for both types of associate. From the combined results of both experiments, the authors conclude that semantically related words are activated early during processing in terms of semantic priming. Given that neutral prosody does not provide any prosodic cue to trigger the selection mechanism, there is no restriction in the activation of semantic associates, whereas contrastive prosody initiates a selection mechanism which keeps only focus alternatives active.

Braun et al. (2018) used a visual-word eye-tracking paradigm to test the online activation of focus alternatives during focus comprehension[4]. Sentences like "The SWIMMER wanted to put on flappers" were auditorily presented with either a contrastive accent or a non-contrastive accent (H+L*) on the sentence subject (here: *the swimmer*).[5] A broad focus realization of the sentence served as control condition. Participants saw four different words in the quadrants of the screen and they were asked to point and click as quickly as possible on the object noun (e.g., *flappers* in the example sentence). The four words were 1. a contrastive alternative to the subject (e.g., *diver*), 2. a non-contrastive associate (e.g., *sports*), 3. the object (= correct answer, e.g., *flappers*) and 4. an unrelated distractor as control word. During the task, eye-fixations were measured over time. Results revealed an effect in the time window of the subject phrase (*the swimmer*) with significantly more fixations on the contrastive alternative (e.g., *diver*) when the subject *the swimmer* was realized with contrastive pitch accent compared to when it was realized with non-contrastive accent (broad focus condition).

The results of the presented studies clearly show that prosodic information is important for correct focus interpretation. That is, contrastive intonation cues the activation (and selection) of contrastive focus alternatives. Nevertheless, the exact composition of the focus alternative set remains uncertain. In the next chapter, we discuss how context influences the composition of the focus alternative set from theoretical and empirical perspectives.

[4] Only the first experiment is of interest for the current paper.

[5] Note here, that both conditions are narrow focus realizations.

3 When Context Comes into Play: Context in Theoretical and Experimental Focus Research

3.1 Context in Theoretical Research on Focus

In the previous section, we have seen that prosodic focus evokes alternatives to the focused element, and that such alternatives are not simply based on semantic relationships between target and prime: First, not every semantically related word is a focus alternative; second, words need not necessarily be semantically related in order to be focus alternatives. Context also contributes to the composition of the focus alternatives set. Two important accounts are discussed with respect to this topic: the 'permissive' account by Rooth (1985, 1992) and the more 'restrictive' account by Wagner (2006, 2012).[6] [7] Following the 'permissive' view formulated within the theory of Alternative Semantics (Rooth, 1985), all elements of the same semantic type as the focused element would be considered as focus alternatives. Rooth (1985, 1992) introduces a variable C that restricts the elements of this rather large set to only contextually relevant alternatives determined by pragmatic processes such as context information or world knowledge. Hence, the question arises what role discourse context plays in the interpretation (and realization) of focus. Looking at a sentence like "Mia fed the MONKEYS in the zoo", in which the context of being photographed is replaced with the context of being fed, the set of possible alternatives to the focused element *monkeys* changes compared to (1). The focus alternative set could, again, include other zoo animals; however, trees, benches, zookeepers or visitors would not be considered as possible focus alternatives. What entities can and cannot be fed in a zoo is part of our world knowledge. This knowledge is used for the interpretation of focus and thus, the set of focus alternatives is restricted according to its relevance in the given context. Although the two sentences differ in only one word, the context situation and therefore the set of relevant focus alternatives is very different. This intuition is described in the literature such that the focus-semantic value is constrained by pragmatic processes. In other words, the meaning of possible alternatives to a focused element in a certain context restricts the focus-semantic value to relevant and plausible alternatives within that exact contextual environment of the focused expression. (see e.g., Rooth, 1992; Wagner, 2020)

According to Wagner (2006, 2012), the focus alternative set is even more restricted: only elements which are mutually exclusive to the focused element are included. The sentences in (3) based on Wagner (2006: 297) illustrate this view. With prosodic marking on *red* in (3a), only *blue* (3b) would represent a plausible alternative. On the contrary, *expensive* in (3c) would not be included in the focus alternative set as it is not mutually exclusive to the color adjective. A convertible can be both *red* and *expensive*, and therefore, (3c) does not fulfill the requirement of Wagner's 'restrictive' view on focus alternatives.

(3) a. Sue only likes [red]$_F$ convertibles.
b. Sue likes blue convertible.
c. Sue likes expensive convertibles.

As we will see in the next section, recent experimental studies show evidence in favor of a rather broad account as postulated by Rooth (1985, 1992).

3.2 Context in Experimental Research on Focus

In experimental research on focus, the important role of context has attracted attention only recently. When investigating focus alternative processing, often isolated sentences are presented. Possible focus alternatives are then tested as probe words immediately after a prime word in such an isolated focus utterance. By contrast, in experimental paradigms like visual

[6] For a detailed discussion on both accounts, see Katzir (2013). He also introduced the terms 'permissive' and 'restrictive' which we will adopt here.

[7] Note that Wagner proposed parts of his account first in his dissertation, see Wagner (2005).

world eye-tracking, recall or recognition tasks, possible alternatives or semantic categories are introduced as context information before or during focus processing: In a number of focus comprehension experiments, it has been demonstrated that context information serves as an important factor that determines the composition of the focus alternative set (e.g., Fraundorf et al., 2010; Byram Washburn, 2013; Kim et al., 2015; see also Kim, 2012). Kim et al. (2015), for instance, showed, using the visual world eye-tracking paradigm, that different types of context influence the performance of predicting an upcoming focused element in an utterance: with explicitly mentioned alternatives of the same semantic category (e.g., fruits) provided in the context, participants improved their predictions for an upcoming focused element of that category (e.g., *apple*) compared to when elements of a different semantic category have been mentioned. In another experiment, Kim et al. (2015) demonstrated that context determines the composition of the focus alternative set. Participants were presented with two different context settings: a specific and a more general setting (e.g., a baseball game vs. supermarket). Participants identified a contextually related target (e.g., *hot dogs*) faster when the introduced context setting was specific (and therefore more restrictive) compared to a more general setting such as the supermarket.

First systematic experimental reports that the focus alternative set is not restricted to the same semantic category as the focused element or to mutually exclusive elements to the focused constituent are presented in Gotzner (2015), Ndao & Spalek (2019) and Jördens et al. (2020). Here, we will focus only on the most recent study by Jördens et al. who presented participants with auditory prime sentences that introduced a specific context setting (e.g., *The farmer brought straw into the barn.*). Focus accent was either on the object (object focus condition, e.g., *straw*) or on the subject (subject focus condition, e.g., *the farmer*). Probe words (e.g., *cows*), tested in a recognition task, were related to the context of the sentence (e.g., farm setting), but could only replace the focused element in the object focus condition, i.e., they were only contrastive associates in the object focus condition, but not in the subject focus condition. An unrelated probe (e.g., *lifts*) served as control. Importantly, the critical probe word (e.g., *cows*) belonged to a different taxonomic category than the focused element in both conditions (e.g., *the farmer* for subject focus, *straw* for object focus). Participants were asked whether or not the probe word had appeared in the sentence. Results showed that participants rejected unrelated probes the fastest, but were slower when probes were contextually related (i.e., expected in the context setting such as the farm setting). Interestingly, in the related conditions (e.g., both focus conditions tested with the probe word *cows*), rejections were faster in the object focus condition than in the subject focus condition. Thus, when the probe represented a possible replacement for the focused element in the object focus condition, it became activated in the listener's mind, and could, therefore, be rejected faster compared to when it did not represent a focus alternative (and had not been activated to the same level).

To sum up, the focus alternative set can also comprise elements that are non-taxonomically related to the focused element, but are relevant in a certain context situation. Thus, an interaction of contextual relatedness and the focus alternative status is apparently required. This could explain the difference in reaction times of the two focus conditions in Jördens et al. (2020). If context alone would be triggering focus alternative activation, related probes (e.g., *cows*) should have shown no difference between the subject and object focus conditions. However, it is the case that the probe additionally had to be a meaningful replacement to the focused element. Both requirements need to be fulfilled.

One question that has never been addressed before in experimental focus research is whether speakers also activate a set of focus alternatives when producing an utterance containing focus. According to Calhoun (2009), the speaker aims to make focus alternatives salient for the hearer. Following Calhoun, and with the knowledge from focus comprehension research that the activation of focus alternatives is crucial for focus interpretation, we might expect speakers, too, to activate focus alternatives when planning the focus utterance. The research questions of the current paper are as follows: First, do speakers make use of focus alternatives

during speech planning? Second, what role does context play in the determination of the focus alternative se? We conducted three experiments and prior to each experiment, we introduced different context information to participants. In Experiment 1, context is created by means of taxonomic categories (e.g., fruits, tools, animals) similar to previous focus comprehension research. In Experiment 2, we tested isolated sentences with the same type of categories, but did not provide additional context information. In Experiment 3, non-taxonomic relations between elements based on natural color-similarities are created and served as context information for participants.

3.3 Context in Experimental Research on Speech Production

In speech production theories, different models try to capture the complexity of speech planning and production. According to Levelt (1989) and Levelt et al. (1999), word production is based on the following fundamental processes: based on the utterance to be expressed (the 'message'), a lexical concept is activated in the mind of the speaker. The concept representation spreads activation to the lemma, a representation of a word's lexical-grammatical properties that are needed for its production in a sentence context. Finally, the corresponding word form can be selected and produced. By virtue of spreading activation within the conceptual layer, a cohort of related concepts /lemmas is co-activated. While early studies on language production provided evidence for the co-activation of co-hyponyms, that is, concepts from the same taxonomic category, Abdel Rahman & Melinger (2009) showed that non-taxonomically related items can also be co-activated if they are supported by the experimental context like a common theme or a title making the connections between concepts explicit.

Levelt (1989) assumes that the assignment of focus occurs before lexical access. That is, before lexical concepts are activated and selected, the focus structure of the to-be-produced utterance is already determined. Thus, we expect that the lexical concept representing the focused element will co-activate related concepts/ lemmas, possibly even more strongly than non-focused elements do. A selection process then indicates which word form is finally produced. With respect to the current experiments, we expect that if a lemma is considered a focus alternative, its concept should be activated due to co-activation and competition of connected concepts (see Levelt et al., 1999). Hence, reaction times to that word should be different from reaction times to not activated words (and their concepts), i.e., non-alternatives.

4 Experiment 1: Focus Alternatives from Taxonomic Categories

4.1 Aims and Hypotheses

To investigate focus from the speaker's perspective, we decided to use a dual-task paradigm introduced by Levelt et al. (1991): The principal task was picture naming. In our study, unlike previous studies, pictures had to be named using simple sentences. The sequence of pictures was meant to introduce contrastive focus naturally (see Methods for details). While participants were preparing their spoken response for the naming task, a letter string was presented for lexical decision, probing whether possible alternatives connected to the to-be-produced focused element were active in the speaker's mind (see below for details). The lexical decision had to be made before speech onset, i.e., during the speech planning phase. In Experiment 1, focus alternatives tested in the lexical decision task came from the same taxonomic category as the focused element because there is reliable evidence from focus comprehension experiments that prosodic focus triggers the activation of focus alternatives within the same taxonomic category (e.g., Kim et al., 2015; Gotzner, 2017; Spalek & Oganian, 2019). We predict that if speakers make use of focus alternatives, then not only the focused element should be activated during speech planning, but also its (connected) possible alternatives. Thus, we would expect different patterns in reaction times for the LDT-task for possible focus alternatives compared to non-alternatives.

4.2 Method

4.2.1 Participants

48 native German students (36 female, mean age = 24.27 years) were recruited from the Berlin School of Mind and Brain's participant pool (Greiner, 2015). Students received monetary compensation for their participation. All participants had normal or corrected-to-normal vision, normal hearing as well as normal color vision. Written informed consent was obtained.

4.2.2 Materials and Design

Pictures: 100 line drawings of single-colored objects or animals were used, 50 pictures to create the experimental stimuli and context filler items and 50 further pictures for additional filler items. Originals were black and white line drawings chosen from a database based on Alario & Ferrand (1999). The lines were then colored in white, black, yellow, blue, red, green, turquoise, and purple. Pictures were presented on a grey background.

For experimental items, the pictures came from ten taxonomic categories (*wild animals*, *clothes*, *fruits*, *containers*, *furniture*, *body parts*, *vegetables*, *kitchen accessories*, *vehicles* and *farm animals*), with five different pictures per category. Numbers of syllables and normalized lemma frequencies were extracted from the DLEX database (Heister et al., 2011) for each word. Care was taken to ensure that picture names belonging to a given taxonomic category were as similar as possible in length and frequency. In addition, there was no phonological overlap between the picture names within a category. Each line drawing was then randomly assigned to one of the eight different colors. We aimed to evenly distribute all colors among the pictures while avoiding phonological overlap between color and object/ animal names. 50 filler pictures were taken from the set of critical pictures, displayed in different colors to serve as context pictures for the critical trials (see Section 4.2.3 for the structure of a single trial). 50 further filler pictures from ten new taxonomic categories were also presented in two different colors and were used as filler items to avoid strategy building and response bias.

Trial structure: Each picture had to be named with an utterance of the form "The [object] is [color]", for example: "The elephant is red.". The two focus conditions were created by means of the context pictures preceding the critical picture. For object focus, a preceding context picture introduced an object in the same color as the upcoming prime picture. Thus, the minimal contrast between the context item and the prime item appears on the object name, which should elicit a contrastive accent on the object in the naming task. For color focus, the preceding context picture showed the same object as the prime picture, but in a different color. Here, the minimal contrast on the color should elicit a contrastive accent on the color in the naming task. In addition to the picture naming task, a lexical decision task had to be performed in all critical trials and several filler trials. Each critical prime picture was therefore presented with a letter string (probe word) and participants were asked to decide whether or not this letter string is a German word by pressing a yes-no button before naming the picture.

Words: All probe words were names of the objects included in the taxonomic categories and thus, were of the same semantic category as the prime object. However, in the object focus condition, the probe word represented a focus alternative to the prime object (4 B/C), whereas in the color focus condition, it did not represent an alternative to the contrastively marked color name (4 B'/C). Out of all 300 items, 185 were combined with a lexical decision: 100 critical items were presented with a probe word resulting in a yes-answer (critical target words, both focus conditions), 85 filler items were presented with nonwords, resulting in a no-answer in the LDT. The remaining 115 filler items were presented without lexical decision task to keep participants' attention on naming. This was important for the main aim of the experiment, namely to test the potential activation of focus alternatives during the speech preparation phase of a focused utterance.

(4) Example of an item set for each condition:

A. Context sentence	Der Apfel ist blau.	(‘The apple is blue.’)	**Object focus**
B. Prime sentence	Das [Zebra]$_F$ ist blau.	(‘The [zebra]$_F$ is blue.’)	
A’. Context sentence	Der Tiger ist rot.	(‘The tiger is red.’)	**Color focus**
B’. Prime sentence	Der Tiger ist [blau]$_F$.	(‘The tiger is [blue]$_F$.’)	
C. Target (probe)	Elefant	(‘Elephant‘)	

Category: wild animals; introduced alternative set: Zebra (‘zebra’), Giraffe (‘giraffe’), Tiger (‘tiger’), Affe (‘monkey’)

4.3 Procedure

Participants were tested in a laboratory room and seated in front of a 17-inch Belinea LCP-screen. They were provided with a PC131 Sennheiser headset including a microphone, and a button box placed on the desk in front of them. Participants were informed that the complete experiment comprises three parts: first, a familiarization phase to familiarize them with all experimental pictures and their respective names, a training phase and, finally, the main experiment. During familiarization, participants received a printed handout that displayed all experimental pictures in black and white with object names below each picture. Pictures were ordered by semantic categories (e.g., first all pictures of ‘fruit’, then ‘musical instruments’), however, category names were not provided and no attention was drawn to the fact that groups of items belonged together. The training phase started with written instructions on the computer screen. Instructions informed participants that the line drawings would now be presented on the screen in one of eight colors. The task was to name the line drawings (e.g., of a red tiger) as in “The tiger is red.”. The time window for naming was limited and participants could initiate the next trial by pressing a button on the button box when they had given the answer. We aimed to achieve a certain naming routine, and we wanted to ensure that participants were familiar with all pictures and their names as well as all color names.

Each trial started with a fixation cross displayed for 500 ms followed by a picture that was to be named. In the training phase, the picture was presented for 3000 ms. During the first 1200 ms, the target sentence (e.g., *The tiger is red*.) was written underneath the picture and then disappeared leaving only the picture on the screen. After picture presentation, a blank screen was shown until participants initiated the next trial by pressing a button. After the training phase, the main experiment started with written instructions on the screen. Subsequently, a short video was presented to illustrate the order of naming and lexical decision, i.e., first, perform the LDT by pressing a button on the button box and then, name the picture out loud. Participants were never instructed to use a particular accent structure. However, the speaker in the video used the intended accents. We hoped that this would be a subtle cue for participants to use accentuation in their own speech. The instructions were followed by 20 practice trials. Each trial in the main experiment began with a fixation cross displayed for 500 ms after which a picture appeared on the screen and participants were asked to name the picture (see Figure 1). The picture was displayed for 1000 ms and then disappeared leaving a blank screen. In LDT-trials (critical prime trials), a written letter string (probe word) appeared with the prime picture on the screen at a stimulus onset asynchrony (SOA) of 200 ms. Probe words were located in the center of the picture. Participants indicated by button press whether or not the presented letter string was a German word. The screen went blank 1000 ms after picture onset or after a button press (in case of LDT-trials). Picture naming responses were recorded in the main experiment.

The main experiment contained five blocks with 60 experimental items each. Prime pictures were always presented in combination with a context picture. Experimental items were pseudo-randomized. We created four lists with balanced prime-probe pairs for each category. A total number of 300 stimuli were presented in each list. Participants were randomly assigned to one of the lists. The experiment lasted about 70 minutes.

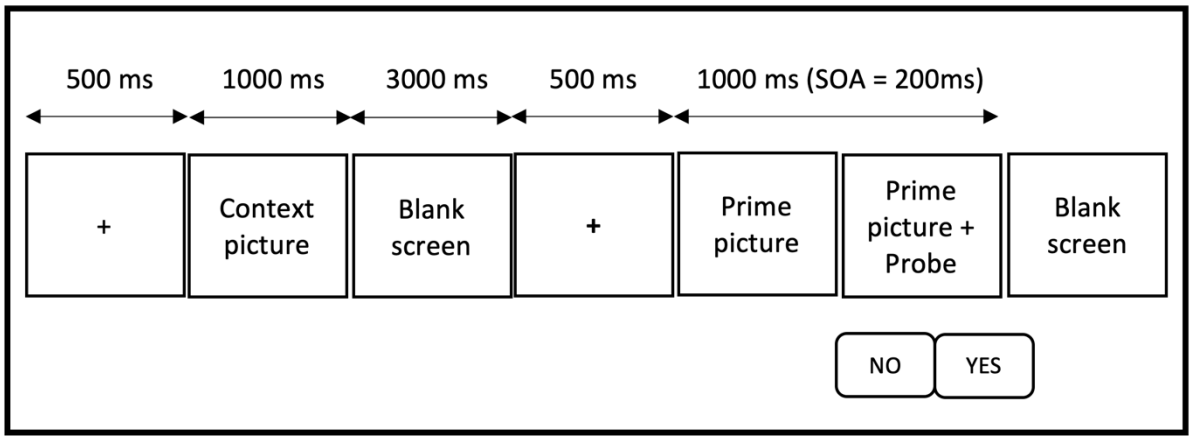

Figure 1. Basic structure of a critical trial pair (context and prime picture) and the probe word presented with the prime item in a LDT-trial

4.4 Results

Recorded answers to the naming task were transcribed and annotated. One participant was excluded from further analysis because their number of errors (n = 22) deviated more than three standard deviations from the mean number of errors. We statistically analyzed those remaining data points with correct answers in the LDT (1.49 % loss of the original data) and correctly named pictures (5.9 % loss of the original data) to ensure that we actually compare a possible alternative. We did not include answers in which the button press for the LDT occurred after speech onset (7.4 % loss of the original data) because we were interested in the speech preparation phase. We analyzed logarithmically transformed reaction times (RTs) within two standard deviations of the by-participant mean using the R-package lme4 (Bates et al., 2015). The model included focus condition and trial (centered) as fixed effects. The random effect structure included random intercepts for participant and item. Results revealed longer reaction times in the object focus condition compared to the color focus condition (t = 3.11, p < .01). That is, when the target represented a semantically related alternative to the focused-marked prime, participants took significantly longer to react in the LDT than when it was no alternative. The mean reaction times for the two conditions are displayed in Figure 2.[8]

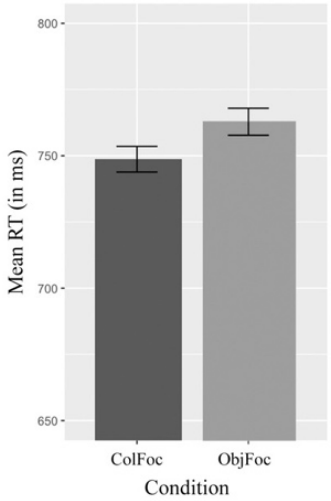

Figure 2. Mean reaction times (in ms) on probe words for both conditions (color-focus and object-focus). Error bars represent standard errors

[8] The data was also annotated with respect to the prosodic marking in the responses. Two trained linguists coded responses as either 1 (marked) or 0 (unmarked/not clear). An analysis of the marked subset did not indicate a change in significance.

4.5 Discussion

In the first experiment, we tested whether possible semantically related alternatives to a focused element are activated in the speaker's mind. Results revealed a significant difference between the two focus conditions such that reaction times on a probe word were longer in the object focus condition, in which the probe represented a possible focus alternative, compared to the color focus condition (control), in which the probe was no possible alternative. This indicates that participants take longer to decide that a probe word is an actual German word when it is a focus alternative compared to when it is no alternative. One way to interpret the results is that during the speech preparation phase of the focused element (or focused utterance), not only the focused element is activated in the speaker's mind, but also its possible alternatives. Following Levelt et al. (1999), an activated lexical concept spreads activation to connected concepts, leading to co-activation. Co-activation of categorically related elements results in competition between elements in the mental lexicon as assumed in speech production models (see Abdel Rahman & Melinger, 2009, 2019). Production experiments have shown that competition between activated elements results in longer reaction times (see e.g., Schriefers et al., 1990; Belke et al., 2005), just as in the previously described experiment. This would suggest that the focus alternative status introduces competition over and above the usual competition between semantically related words during speech production. However, one concern about this finding was that in the focus condition, the context and prime picture showed objects from two different semantic categories. In contrast, in the color focus condition (control), the context and prime pictures showed the same object. This repetition in one condition but not the other probably highly influenced speech planning. Thus, the data pattern could also be interpreted as a result from identity priming. We tested this in an additional control experiment (n = 19) with the same material and design as Experiment 1, where participants named the pictures with a single noun (that is, no focus was included in the response). We replicated the results of Experiment 1. In fact, the difference between the color and object focus condition was even stronger, suggesting that it can indeed be traced back to facilitation in the color focus condition, due to the repeated object in context and prime picture. This is a clear limitation in interpreting the results because we do not know to what extent the priming effect might have masked a potential focus effect. In the next two experiments, we adjusted the paradigm in two different ways to avoid semantic priming. This is important to correctly interpret the results.

5 Experiment 2: Focus Alternatives in the Absence of Context

In this experiment, we presented critical items without any context (i.e., without a preceding picture to induce minimal contrast on either the object or the color name as we did in Experiment 1). In several studies on focus comprehension (e.g., Braun & Tagliapietra, 2010; Husband & Ferreira, 2016; Braun et al., 2018; Braun & Biezma, 2019), critical items have been presented in isolated sentences without any supporting context. This was sufficient to trigger the activation of focus alternatives. If this is applicable to focus production, we expect speakers to activate alternatives to the focused element. Therefore, we presented prime pictures in isolation and instructed participants explicitly to use prosodic marking on the object or on the color name.

5.1 Method

5.1.1 Participants

44 German native speakers (37 female, mean age = 22.73 years) from the same population as in Experiment 1 participated for monetary compensation. None of them reported any visual or hearing impairments. Written informed consent was obtained. None of the participants took part in the first experiment.

5.1.2 Materials and Design

The material used in Experiment 2 was a subset of the material in Experiment 1: We excluded all context pictures (e.g., blue drill) from the experiment such that the naming task only included all prime pictures of the first experiment (e.g., blue monkey). Prosodic focus was induced by minimal explicit instructions to either prosodically mark the object name or the color name while naming the picture (e.g., as in "The MONKEY is blue." or "The monkey is BLUE."). Probe words were a subset of those in the first experiment. The complete experiment comprised 80 critical items and 160 filler items. Filler items were included to keep the word/ non-word ratio in the LDT balanced (80 yes-answers in the critical trials, 70 no-answers in the filler trials), and for trials without lexical decision to keep the participant's focus on the naming (90 trials).

5.2 Procedure

The apparatus was the same as in Experiment 1. Before the main experiment, participants familiarized themselves with the object names by virtue of a printed handout showing all line drawings of objects and animals in black and white. The following training phase was similar to the one in Experiment 1. Participants saw all experimental pictures in their colored versions on the screen, and were asked to name the pictures (e.g., *monkey*) to ensure their familiarization with the object and color names. The main experiment started with written instructions on the screen. Instructions said that colored line drawings were presented on the screen and had to be named in the following way: "The monkey is blue". To elicit prosodic focus marking on either the object name (object focus) or the color name (color focus), participants were explicitly instructed to prosodically mark either the object or the color for a block of upcoming pictures. Instructions concerning naming and lexical decision were the same as in Experiment 1. Different from the previous experiment, the main experiment started with two practice blocks including ten trials each, one with prosodic marking on the object and one with prosodic marking on the subject. The practice was meant to familiarize the participants with the complexity of the procedure. Each trial started with a fixation cross displayed for 500 ms. Then the to-be-named (prime) picture appeared on the screen. In LDT-trials, additional probe words were presented with an SOA of 200 ms. The picture and probe word disappeared 1000 ms after picture onset or after the button press for the LDT, leaving a blank screen. Each instruction period lasted for 12 trials. The main experiment included four blocks with four changes of instructions each. All spoken responses in the main experiment were recorded. The complete experiment lasted about 45 minutes.

5.3 Results

Recordings were treated in the same way as in Experiment 1. We analyzed reaction times on the probe words in the LDT. Exclusion criteria were the same as in Experiment 1, resulting in a data loss of 9.1 %. Logarithmically transformed reaction times (RTs) were analyzed with linear mixed effects models with the R-package lme4 (Bates et al., 2015). The model included condition and centered trial as fixed effects, and random effects for participant and item. Mean RTs are illustrated in Figure 3. Surprisingly, results did not reveal any significant differences between the two focus conditions (t = -0.09). Using prosodic focus in response to an explicit instruction apparently did not affect focus production processes in the speaker's mind.

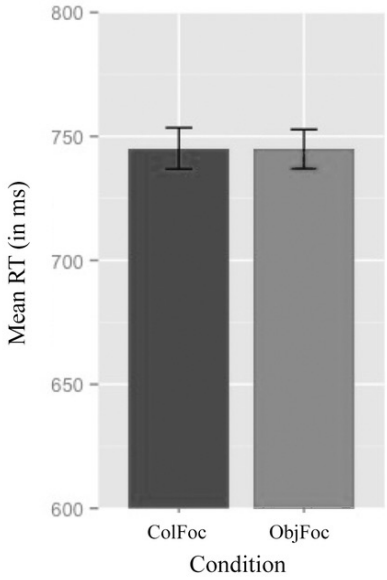

Figure 3. Mean reaction times (in ms) on probe words for color- and object focus condition respectively. Error bars represent standard errors

5.4 Discussion

In the second experiment, participants were explicitly instructed to prosodically emphasize either the object or the color name in the picture naming task. While they were preparing their spoken response, they performed a LDT on a probe word semantically related to the prime's object, which was either emphasized or deaccentuated in the prime sentence. Probe words only represented a possible focus alternative to the prime's object when it was emphasized. We did not replicate the findings of the first experiment in which we had elicited minimal contrast by means of preceding context sentences. It seems that prosodic marking induced by explicit instructions is not enough to trigger the activation of focus alternatives in the speaker's mind. This is in contrast to findings in focus comprehension research, in which isolated prime sentences with bare prosodic focus marking do show focus effects on related probe words (e.g., Braun & Tagliapietra, 2010; Husband & Ferreira, 2016; Braun et al., 2018). However, the prime sentences in the current experiment did not introduce a specific semantic setting or scene in the same way prime sentences in focus comprehension experiments often do. In the current experiments, the sentences describe a specific object and one of its features, namely, its color. In focus comprehension experiments, prime sentences are often more complex, and, for instance, describe an event (e.g., "The tourist photographed a dolphin on the boat trip."). At this stage of understanding, we believe that prosodic marking alone is not sufficient to trigger the activation of focus alternatives in the speaker's mind.

6 Experiment 3: Focus Alternatives from Non-Taxonomic Categories

In the previous two experiments, we saw that in focus production, context information lead to a confound between focus placement and priming. Without context information, however, we did not find reaction time differences between possible alternatives and non-alternatives. Apparently, explicit prosodic marking alone does not trigger the activation of focus alternatives in the speaker's mind. At this juncture, other psycholinguistic research on speech production is of interest for two reasons: first, experiments with e.g., the semantic blocking paradigm show that elements belonging to the same semantic category are co-activated in speech production processes (e.g., Belke et al., 2005). Second, non-taxonomically connected elements can be co-activated during picture naming if a meaningful context is provided that gives reason to relate otherwise unrelated elements. In semantic blocking experiments, for instance, Abdel Rahman

& Melinger (2011) showed that the same interference effect that is well-established for elements of the same semantic/ taxonomic category can be induced in thematic blocking. Usually, naming latencies are slower in semantically related blocks of pictures compared to semantically unrelated blocks. Such interference effects are based on the co-activation of connected elements resulting in competition. Interestingly, when unrelated objects are meaningfully related by context information (e.g., a concrete theme or title such as 'fishing trip'), similar interference effects occur in naming driven by context information (see Abdel Rahman & Melinger, 2011). In terms of focus, Ndao & Spalek (2019) as well as Jördens et al. (2020) recently revealed that, in comprehension, focus effects also occur for non-taxonomically connected elements. That's why, in the third experiment of the current paper, we introduced sets of elements that were based on non-taxonomic relations: pictures of objects and animals sharing a well-known prototypical feature, namely, their natural color. Thus, we could create connections between elements within a categorical set while avoiding semantic priming.

6.1 Method

6.1.1 Participants

Thirty-two participants took part in this experiment (26 female, mean age = 22.94 years) from the same population as in the previous experiments for monetary compensation. All participants had normal or corrected-to-normal vision capacity, normal color vision, and normal hearing capacity. Written informed consent was obtained. Additional participants were tested in a preliminary object-color norming study (n = 120, mean age = 27.66). Participants for the norming study were recruited from several online platforms as well as from the Humboldt University of Berlin. All participants of the third experiment and the norming study did not participate in the first two experiments.

6.1.2 Materials and Design

Materials and design were based on the first experiment. In the current experiment, however, we introduced a different type of alternative set, namely ten categories of items sharing a prototypical natural color (red, yellow, blue, green, orange, black, white, gold, grey and brown). Line drawings were chosen from the same database as in the first two experiments, but colored in their most prototypical natural color (e.g., the line drawing of a 'tomato' was colored red). In a previously conducted norming study, we had asked participants to estimate on a Likert scale how prototypical natural a specific color is for a certain object or animal. Participants could choose from 1 "no prototypical natural color for the object or animal" up to 5 "very prototypical natural color". We then classified the objects according to their most prototypical colors into sets for the main experiment (see Figure 4 for the category of white-colored objects). We tried to use objects from different taxonomic categories within the same color category, which was not always possible. Each critical item (prime picture) was combined with a preceding context item that either introduced an object of the same color category as the prime (contrastive condition, see 5A) or an object of a different color category than the prime (neutral condition, see 5A') to induce minimal contrast and therefore, license prosodic focus marking only in the contrastive condition (5B). This follows the notion expressed by Rooth (2016; see also Repp, 2016) that list-structured phrases evoke alternatives. In the neutral condition, a new object of a different color category was introduced instead such that there would be no minimal contrast in the item pair. The probe word in the LDT shared the prime's prototypical color in both conditions. However, only in the contrastive condition, with contrastive marking on the prime's object, it would represent a contextually relevant alternative. In contrast, the probe word in the neutral condition represented no alternative to the prime's object.[9] Altogether, the

[9] In a pilot study (n = 31), we omitted the color-information of the items and asked participants to name the pictures only with their object names (e.g., *tiger*). Again, pictures were presented in pairs, and a LDT was required before naming the second picture of a pair. One condition showed two subsequent objects from the same color category

experiment comprised 60 critical items, 60 context filler items and additional 120 filler pairs. Filler items were of the same structure as the critical items. 80 filler items were presented with non-words in the LDT, resulting in a no-answer, to balance the word/non-word ratio. The remaining filler trials were presented without additional LDT to keep the participant's focus on the naming or to serve as context information for upcoming lexical decision trials (200 trials).

(5) Example of an item set for each condition:

A. Context sentence	Das Iglu ist weiß.	('The igloo is white.')	**Contrastive focus**
B. Prime sentence	Das [Schaf]$_F$ ist weiß.	('The [sheep]$_F$ is white.')	
A'. Context sentence	Die Hose ist blau.	('The trousers are blue.')	**Neutral**
B'. Prime sentence	Das Schaf ist weiß.	('The sheep is white.')	
C. Target (probe)	Zahn	('tooth')	

Category: prototypical *white*-colored objects/animals; introduced alternative set: Teller ('plate'), Spargel ('asparagus'), Schaf ('sheep'), Kissen ('pillow'), Iglu ('igloo'), Zahn ('tooth')

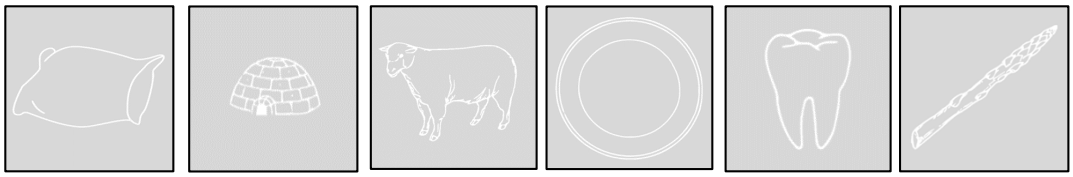

Figure 4. Critical items belonging to the category of naturally white things: pillow, igloo, sheep, plate, tooth, asparagus

6.2 Procedure

The procedure of the current experiment was identical to the one in Experiment 1.

6.3 Results

Two participants had to be excluded due to technical problems. For the remaining participants, we recorded all naming responses and measured reaction times for the LDTs. All recordings were annotated by two trained linguists. Trials with incorrect responses in the LDT (3.9 % of the original data) or naming (6.7 % of the original data) were discarded. We investigated all data points for non-taxonomically related item triples (context – prime – target) and discarded those for which the button presses for the LDT occurred after speech onset in the recording (6.1 % loss of the original data). Further, all trials with reaction times deviating more than two standard deviations from a participant's mean RT were discarded (4 %). Logarithmically transformed RTs were analyzed with linear mixed effects models using the R-package lme4 (Bates et al., 2015). The model included condition and centered trial as fixed effects, and participant and item as random effects, and random slopes for centered trial on the participant intercept. The difference between the two conditions was significant, with longer reaction times in the contrastive condition ($t = 2.19$, $p < .05$). Thus, participants took longer to decide whether a probe word was a German word when the probe word represented an alternative to the contrastively-marked prime word than when the probe word was no possible alternative because the prime was unmarked. Mean reaction times are displayed in Figure 5.

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of the main experiment, the other condition showed two objects of different color categories of the main experiment. Reaction times in the LDT did not differ significantly between conditions ($t = 1.17$). We thus ensured that no additional priming effect would influence the results of the main experiment.

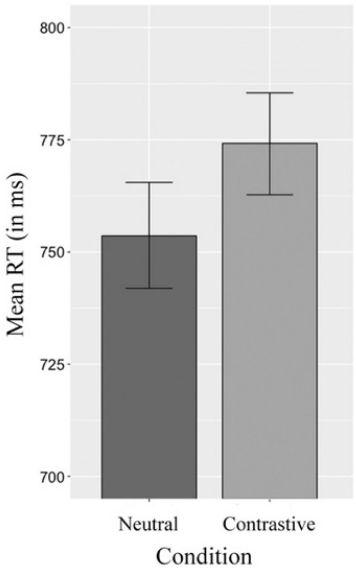

Figure 5. Mean reaction times (in ms) on probe words for both conditions (neutral and contrastive condition). Error bars represent standard errors

6.4 Discussion

In the third experiment, we tested whether speakers activate alternatives from a non-taxonomic set when they produce a focused element from this set. Sets were introduced prior to the main experiment and practiced in a training phase. Results of the main experiment revealed that participants were slower in reacting to a probe word when it represented a focus alternative, i.e., when the object name in the prime sentence was contrastively marked, compared to when it was unmarked. This indicates a co-activation of focus alternatives during the speech preparation phase causing longer reaction times due to competition between the activated elements. The observed data pattern suggests that speakers make use of contextually relevant alternatives during the speech preparation phase. The type of context information as well as the familiarization phase might be crucial here for creating a plausible connection between the color-related elements in the lexical network similar to connections based on thematic context information in speech production experiments (cf. Abdel Rahman & Melinger, 2011).

The results of the third experiment revealed longer reaction times for focus alternatives, just as in the first experiment. However, in the third experiment, any semantic priming was avoided. Another important finding is that the focus effect we found in the third experiment appeared for non-taxonomically related elements, which are connected through (familiarized) context information. This is in line with previous findings in focus comprehension research (e.g., Gotzner, 2015; Ndao & Spalek, 2019; Jördens et al., 2020).

7 General Discussion and Conclusions

In a series of three picture naming experiments combined with lexical decision on a written probe word, we investigated whether speakers make use of focus alternatives during the planning of an utterance with focus. Pictures were named with small sentences of the type "The [object] is [color]." in order to allow for variation in the placement of focus (on the color or on the object, respectively). We varied the nature of the alternative set (taxonomic categories in Experiments 1 and 2, sets based on their shared natural color, e.g., "yellow things" in Experiment 3) and the way in which focus was licensed. In Experiments 1 and 3, the sequence of to-be-named pictures introduced a contrast either in the objects or in the color (Exp. 1) or a contrast

in the object or no contrast (Exp. 3), making the use of focus natural. In Experiment 2, participants were explicitly instructed to use a particular focus structure for a block of trials. No licensing context was presented in Experiment 2.

In Experiments 1 and 3, that is, the experiments licensing the use of focus through context, we observed longer reaction times for the lexical decision task when the object was focused, making the probe word a potential focus alternative (i.e., belonging to the same taxonomic category as the focused object (Exp. 1) or coming from the same color set as the focused object (Exp. 3) compared to when the color was focused (Exp. 1) or to a control condition (Exp. 3)). Experiment 1 suffered from a confound such that the longer reaction times in the object focus condition could alternatively be explained as shorter reaction times in the color focus condition due to item repetition between context trial and prime trial. This confound had been taken care of in the design of Experiment 3.

The results demonstrate three things. First, speakers make use of alternatives to the prime's object when it was contrastively marked compared to when it was not marked. This result casts new light on the representation of focus and focus alternatives in the speaker's mind. We assume that the speaker considers the presence of focus alternatives which are contextually relevant and therefore makes the contrast more salient to ease comprehension. Second, the data strongly support the assumption of a semantically less restricted set of focus alternatives, as it is postulated in Rooth (1992). Participants considered also non-taxonomic – but contextually connected – elements as focus alternatives in the third experiment which would not have been the case according to Wagner's (2006, 2012) restrictive account. This is in line with previous findings of focus comprehension experiments (e.g., Ndao & Spalek, 2019; Jördens et al., 2020). Third, co-activation of focus alternatives in production is indexed by longer reaction times in the contrastive focus condition compared to the non-contrastive control condition, whereas comprehension studies have found facilitation. It is a well-known asymmetry that co-activation in comprehension mostly results in facilitation (see Neely, 1991, for a comprehensive review) whereas co-activation in production makes selection of the correct lemma more difficult, resulting in longer reaction times, similar to the pattern we observed in the third experiment (see the swinging lexical network account postulated in Abdel Rahman & Melinger, 2009; for an updated version of that account, see Abdel Rahman & Melinger, 2019). Still, even in comprehension there are indications that co-activated focus alternatives compete with one another if the task is not lexical decision but probe recognition (see, e.g., Gotzner et al., 2013; Gotzner & Spalek, 2016). Note for the current experiment, that the color categories are indeed natural but also established through the familiarization phase prior to the experiment. Clearly, further research will be needed to validate these explorative findings we presented.

In contrast to Experiments 1 and 3, no difference in the lexical decision times for the object focus condition and the color focus condition was observed in Experiment 2, where we had instructed participants to use a certain focus accent for all trials within a block. Thus, context information might be a crucial trigger that licenses the use of focus for the speaker. Interestingly, the results contradict previous findings in focus comprehension research (e.g., Braun & Tagliapietra, 2010; Braun et al., 2018). As outlined above, prosodic marking in focus comprehension seems to be a sufficient trigger for the activation of focus alternatives. This is not the case in focus production. This finding needs to be investigated further. Differences between production and comprehension have been described in other domains (see Meyer et al., 2016, and all contributions therein). Phonology (segmental and suprasegmental) is the entry point for spoken language comprehension and therefore it might be processed automatically. Assigning information structure to a planned utterance in speech production is also an early process: Levelt (1989) assigns it to the level of micro-planning which precedes lexical access. However, the pronunciation process itself happens late during speech production. Possibly, the very specific requirement of placing an accent on the object (or on the color) was fulfilled only at this very late processing stage, long after activation in the lexicon had ceased to spread. In this case, no effects of the different focus conditions on lexical decision times would be expected. Another

plausible explanation for the null effect in Experiment 2 – in contrast to findings from focus comprehension – might be the difference in semantic richness. Whereas sentences used in comprehension experiments (Braun & Tagliapietra, 2010; Husband & Ferreira, 2016; Jördens et al., 2020) often describe events and as such do provide an elaborate context, our target sentences were very simple assignments of a color to an object, lacking this semantic richness. In order to determine which of these two explanations is correct, further research is required.

Together the present results show that, first, speakers activate focus alternatives during their speech preparation, which goes beyond previous reports of focus alternative research, and second, a co-activation of focus alternatives in the speaker's mind strongly relies on the context provided.

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