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Focus Facilitation and Non-Associative Sets

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Abstract

Because it has a tremendous effect on the interpretation of a variety of phenomena, an understanding of the meaning of focus is crucial to a thorough theory of dialogue. Major theories of focus predict that speakers need to have in mind a set of alternatives when evaluating an utterance with a focused constituent. We report an experiment that provides additional experimental evidence that this set of alternatives is being used by speakers. In addition, by using only written stimuli, we show that the set of alternatives is evoked by the semantic notion of contrastiveness, even without explicit prosodic cues. Furthermore, in contrast to prior experiments which used alternative sets that could be derived from previously-learned semantic associations, we show that speakers use prior discourse context in a dynamic fashion to build the set of alternatives, even in the absence of pre-existing semantic associations. Our findings highlight the importance of incorporating rapid contextual sensitivity into models and theories of dialogue.

1 Introduction

The semantic notion of 'focus' influences a vast number of linguistic phenomena. For instance, focused constituents have been shown to be favored as antecedents when resolving anaphors (e.g., Cowles and Garnham 2005, but see Kaiser In Press). Frazier and Clifton (1998) showed that focus is used when resolving ambiguity in sluicing constructions. Carlson et al. (2005) took this one step further showing that the role of focus is so strong that just the expectation of focus is enough to guide ambiguity resolution. For these reasons and many others, a better understanding of how speakers are interpreting focus is necessary for a complete theory of spoken dialogue.

Current theories on the meaning of focus suggest that a speaker, upon encountering a focused constituent, creates in his/her mind a list of alternatives to the focused constituent. The experiment presented in this paper is a lexical decision study that provides evidence that this set of alternatives is cognitively real. In this respect, it agrees with similar experiments; although it accomplishes the result with written materials (which may trigger 'internal prosody') instead of having the participants listen to spoken stimuli with explicit prosodic cues. Furthermore, we show that speakers include in the alternative set not only (i) items that are semantically associated with the focused constituent (e.g. *nurse* if *doctor* is focused), but also (ii) items associated with the focused constituent only for the purposes of the conversation at hand (e.g. *investment banker* if *doctor* is focused in a conversation about high paying jobs).

The paper is organized as follows. Section 2 reviews the most popular theories of focus, showing that they all require a set of alternatives to the focused constituent. Section 3 summarizes existing experimental evidence for the set of alternatives. Section 4 presents the design and results of our experiment. A general discussion of the results is provided in Section 5. Section 6 is the conclusion.

2 Theories of the Meaning of Focus Predict a Set of Alternatives

While theories on the meaning of focus differ widely, the major theories all end up requiring at some point that (i) the speaker make use of a set of alternatives for the focused constituent and that (ii) the context of an utterance be used to compose this set. In this section, we review the main theories to show their shared dependence on the existence of a context-based set of alternatives.

Rooth's *Alternative Semantics* makes this the most explicit (Rooth 1985, 1992; also Beaver and Clark 2008 with some modifications). Rooth proposes that any sentence with a focused constituent has two meanings: (a) the ordinary semantic meaning and (b) the focus meaning which is derived by replacing all focused constituents in the ordinary semantic meaning with variables.

1) Mary loves $[\text{John}]_F$.
   a) Ordinary meaning: $[\![\text{Mary loves John}]\!]^0$

b) Focus meaning: $[\![\text{Mary loves x}]\!]^f$

The meaning of focus is a quantification over propositions so that the meaning of a sentence like (1) would be: "For any proposition in which Mary loves x is true, Mary loves John." Rooth proposes that an operator '~' combines with a covert semantic variable 'C' and a sentence that contains a focused constituent. So ex.(1) would appear as in (2).

2) [Mary loves $[\text{John}]_F$] ~C

'~C' introduced the presupposition that C is a subset of the focus meaning of a sentence containing the ordinary meaning of the sentence and at least one other element (Rooth 1992: 20). For a sentence like ex.(1, 2), '~C' would introduce the presupposition that C was a subset of [Mary loves x] containing "Mary loves John" and possibly "Mary loves Greg" and "Mary loves Michael" as well. Determining which specific items compose C, the set of alternatives, is left unspecified in the theory. It is only noted that pragmatics should determine this. The experiment in Section 4 aims to give support for the cognitive reality of the alternative set and to investigate how the set of alternatives is composed.

In addition to Rooth's Alternative Semantics, approach, other theories of focus, such as *Structured Meanings* (von Stechow 1981, 1982; Cresswell and von Stechow 1982; Krifka 1991, 2001; Reich 2003) and *focus with events* (Bonomi and Casalegno 1993; Herburger 2000), also make explicit reference to a set of alternatives. The major innovation of *focus with events* is treating verbs as event descriptions. The way it deals with focus, though, is very similar to Rooth. Focus with events makes use of an ordinary meaning of a sentence that is the same (sans the use of verbs as event descriptions) as Rooth's ordinary meaning. Focus with event's background material also requires that the focused constituent be replaced by a variable, and it is proposed that focus sensitive particles like 'only' make use of a set composed of variants of the main meaning that contain only the background information. This results in a set of alternatives identical to that in Alternative Semantics.

In the *Structured Meanings* approach, a sentence such as (1) is divided into two parts based on what is background and what is foreground. The background material would be "the property of Mary loving someone" and the foreground would be "John." "John" would be taken to have "the property of Mary loving someone." Structured meanings proposes a function $\lambda x.\, \text{alt}_c(x)$ that creates, using context, a set of alternatives to the foreground material. So we see again that a set of alternatives is derived by replacing a focused constituent with contextually-appropriate variants.

Even theories that derive the meaning of focus outside of the semantics, such as *Roberts' integrated theory of pragmatics* (1996, building on work by Stalnaker 1978) still eventually require the existence of a set of alternatives determined by the context of the utterance. Roberts views dialogues as being structured by the need to answer an ultimate question: "What is the way things are?" The participants in a conversation take turns posing subquestions to this ultimate question, both explicitly and implicitly, and then answering them. Constituents are focused as a matter of question-answer congruence. A focused constituent is the new part, the answer to the current question. While this view of focus does not make explicit reference to a set of alternatives, it must be noted that it still does rely on such a set, as long as we then ask what the meaning of these questions is. The meaning of a question is held to be the set of possible answers (Hamblin 1973; Karttunen 1977 [1]; Groenendijk and Stokhof 1985). This set of propositions would be arrived at by substituting variables for all question words in a sentence and filling in these variables with contextually appropriate options. In the case of a sentence with a focused constituent, the focused constituent would have to correspond to one of these variables, and so this theory too arrives at a set of alternatives to the uttered sentence that is determined by context.

Finally, even *Schwarzschild's (1999) theory of focus*, in which givenness vs. newness (instead of contrastiveness) is appealed to, eventually arrives at the need for a set of alternatives. Under Schwarzschild's givenness theory, prosodically unmarked constituents are necessarily given, but prosodically marked constituents, though they may be new, are not required to be new. A speaker's primary goal is to avoid putting stress on given things. In order to determine if an utterance is giv-

[1] Karttunen took the meaning of a question to be the set of all true answers. This would make a meaningful difference in what composes the set of alternatives, but not in the existence of a set of alternatives.

en or not, a speaker must determine if the utterance has an antecedent earlier in the conversation. Schwarzschild proposes that a speaker does this by first existentially closing the utterance at hand. A sentence like (1) above would become like (3):

3) ∃y [Mary loves y]

Everything entailed by the existential closure of the utterance would then be relevant for determining if the utterance has an antecedent. The speaker, though, while searching for an antecedent, would have to keep in mind all of the things entailed by the existential closure of the utterance. This set of entailed propositions that the speaker has composed is, again, the set of alternatives.

In sum, we see that *all major theories of focus arrive at the necessity of a set of alternatives determined somehow by the context*. The question remains though whether this is actually occurring in the mind of a listener upon hearing a focused constituent. Three notable studies have sought to answer that question; they are reviewed in the next section. The experiment in Section 4 also sought to show that the set of alternatives is cognitively real, and, crucially, extends the results of these previous studies by using written stimuli to eliminate explicit cues to focus from prosody and testing whether newly-learned, contextual relations between items help to compose the set of alternatives.

3 Previous Studies Support the Existence of a Set of Alternatives

There still exists rather minimal experimental evidence that listeners do in fact use a set of alternatives when evaluating the meaning of a focused constituent, but there are three studies that should be mentioned: Kim et al 2010, Braun and Tagliapietra 2009, and Norris et al 2006.

Kim et al 2010 conducted a series of eye tracking studies. Participants heard a set of sentences such as ex.(4a,b), where sentence (a) contained a set of items and sentence (b) contained either the focus particle 'only' or 'also.'

4) a) Mark has candy and apples.
   b) Jane (only/also) has some apples.

The relationship between the items that Mark has and the items that Jane has was altered in the different experiments to investigate how the set of alternatives is composed. In the first experiment, Jane always has an item that is identical to one of the items that Mark has, as in ex.(4). This was to investigate whether previously mentioned items were considered for the set of alternatives. In the second experiment, Jane has an item that is semantically related to an item that Mark has. For instance, if sentence (a) was kept the same, "Mark has candy and apples," then Jane might have oranges: "Jane (only/also) has some *oranges*." This was to investigate whether semantic kinds were considered for the set of alternatives. The third experiment (not crucial for our purposes) investigated the effect of plausibility on the development of the set of alternatives.

In all three experiments, participants saw a display with four regions (e.g. Fig.1) and were asked to click on the item that Jane has.

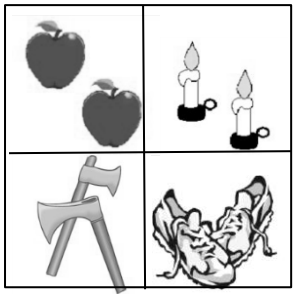

Fig. 1 Display for Kim et al (2010)

The display would include (i) the actual item that Jane has (target item: *apples*), (ii) a cohort competitor for the target item (i.e., an item starting with the same sound as the target item, e.g. *axes*), (iii) a cohort competitor for the second item that Mark had (e.g. *candles*), and (iv) an unrelated distractor item (e.g. *shoes*). The logic was that when participants heard the word 'only' or 'also,' they would build a set of alternatives to choose the next word from. If they are using sentence (a) to build the set of alternatives, then they will want to include the items that Mark had (experiment 1) or items related to the ones Mark had (experiment 2) in their set of alternatives. This should lead participants to look at "apples" faster when hearing a sentence with the focus particles 'only' or 'also' than when hearing a sentence without a focus particle. However, if participants are not using sentence (a) to build a set of alternatives or are not building a set of alternatives at all, participants will only be

guided by the sounds that they hear. For sentences with 'only' or 'also' as well as for sentences without a focus-sensitive word, participants should be equally likely to look at any of the items until the beginning of the word "apples," at which point, participants should be as likely to look at "axes" as "apples" (as the initial vowel is the same). In other words, if participants are building a set of alternatives when they hear 'only' or 'also,' they should be faster to look at the target item after hearing 'only' or 'also' than they would be with no focus-sensitive words in the sentence.

Kim et al found that this effect did indeed exist; participants were faster to disambiguate the target word when it was preceded by a focus sensitive word than when it was not. This is evidence that the set of alternatives is cognitively real. This can also be taken as evidence that speakers use previous context to build the set of alternatives. However, it should be noted that this study only made use of commonly associated words that would have been associated prior to this study and so didn't require any context (e.g. *oranges* and *apples* are known to be semantically associated). Because of this, it still remains uncertain whether the set of alternatives was being built based on context or prior knowledge about word associations.

Braun and Tagliapietra (2009) took steps to ensure that their result was due to a set of alternatives and not a priming phenomenon. Priming occurs when a word (known as the prime or cue, e.g. *doctor*) commonly causes another word to come to mind (known as the target, e.g. *nurse*). Priming happens automatically when a word is presented in isolation or when a word is presented as part of an utterance or dialogue. In the Kim et al study, words in the first sentence of things Mark has (e.g. *oranges*) are already known to prime words in the second sentence of things Jane has (e.g. *apples*). In that study, it is possible that focusing – instead of creating a set of alternatives – was strengthening the priming between the items in the first and second sentence, perhaps by increasing the saliency of the primed word.

Priming alone cannot explain Braun and Tagliapietra's results because they used two different types of targets: a contrastive associate and a non-contrastive associate. If the target word was 'flamingo,' then the contrastive associate would be 'pelican' because 'pelican' could be grammatically substituted for 'flamingo.' 'Pink' would be the non-contrastive associate because even though 'flamingo' primes 'pink,' 'pink' could not be grammatically substituted for 'flamingo.' An unrelated, non-associated word was also used. For this example, a word such as 'celebrity' could be used.

Braun and Tagliapietra were building on an earlier study by *Norris et al (2006).* Norris et al conducted a cross-modal priming study, which showed that priming was stronger when the prime word was preceded by a focus-sensitive word (e.g., 'only') and/or contrastively accented. Braun and Tagliapietra were concerned that in the Norris et al study, it was difficult to tell what was causing the contrastive focus effect since the results treated contrastive accenting and focus sensitive words the same, so in the Braun and Tagliapietra experiment, focus was only marked by a contrastive accent.

Braun and Tagliapietra used a *lexical decision task* where the participant first saw a prime word, and then had to decide if the next word that appeared was a real word of Dutch or a non-word. Only real words were used in experimental conditions. The logic of a lexical decision task is that participants must access a word's lexical representation in order to decide that it is real and not a non-word. The faster a participant is able to affirm that a word is real, then the more salient/activated that word had to be in their mind already. In other words, if a participant is already thinking about a word (it is already activated), then they will be faster to affirm that that word is real when it is presented to them.

In the Braun and Tagliapietra study, the participants first heard the prime word (e.g. *flamingo*) with either a neutral or a contrastive accent. They were then shown (in writing) (i) a word that contrasts with the prime word and is semantically related to it (i.e., is an alternative to the prime word, e.g. *pelican*), (ii) a related, non-contrastive word (e.g. *pink*), or (iii) an unrelated, unassociated word (e.g. *celebrity*).

The more that the prime word made the participant think about the target word before it appeared, the faster the participant should respond to the target word. The related words (e.g. *pelican*, *pink*) should be recognized faster than the unrelated word (e.g. *celebrit*y), in light of the well-known phenomenon of semantic priming. However, if an alternative set really does exist for focused constituents, then only the related contrastive word (e.g. *pelican*), but not the others, should be included in

this set. Consequently, when the prime is heard with a contrastive accent, the related contrastive word should be more on the participant's mind. Thus, *pelican* should be recognized faster than either *pink* or *celebrity*.

Braun and Tagliapietra's results support this prediction. When the prime word (e.g. *flamingo*) was *heard with a neutral intonation*, both of the related words (e.g. *pelican, pink*) were responded to faster than the unrelated word (e.g. *celebrity*), but there was no significant difference in the response times of the two related words. However, when the *prime word was contrastively focused*, participants still responded to the related non-contrastive word (e.g. *pink*) faster than the unrelated word (*e.g. celebrity*), but they responded even faster to the related contrastive word (e.g. *pelican*). This cannot be attributed to semantic priming being strengthened by the saliency of the word in focus because participants only responded faster to the related contrastive word, not the equally related, equally primed non-contrastive word. This is additional evidence for the existence of a set of alternatives when a word is focused. However, it should again be noted that this study, as well as Norris et al (2006), only used previously associated target-prime pairs (e.g. *pelican* is a semantic associate of *flamingo*), so it remains unclear whether the set of alternatives can be built from context.

4 The Experiment

Our experiment has two main goals: (1) to replicate the results of previous studies and provide additional evidence that the set of alternatives for a focused constituent exists as predicted, and (2) to test whether the set of alternatives can be built dynamically from the context of the utterance, instead of relying on previously learned semantic associations.

Participants: Data from forty-two native speakers of English was included in the final analysis. They were naïve to the purpose of the study.

Materials and Design: Thirty sets of four sentences and a target word were composed as the experimental materials. All stimuli were written, not spoken. Together, the four sentences told a short narrative, as illustrated in ex. (5).

5) (a) Christina wants to buy a lock, nails, and a bolt.
(b) She needs these to fix her front entrance.
(c) Two days ago, she went to a store that didn't have a wide selection.
(d) At the store, she was able to buy <**Prime Word here**>.

Target Word: **lock**

Sentence (a) introduced a set of three common household items. The first item was the target word (e.g. *lock*), the second item (e.g. *nails*) was not associated with the target, and the third item was commonly associated with the target (e.g. *bolt*). Association was defined using the South Florida Free Association Norms (Nelson, McEvoy & Schreiber 1998). *Associated* words had a forward cue-to-target strength of .08-.25. Cue-to-target strength is a ratio derived by dividing the number of people who responded with a particular word when given a cue word by the total number of people. For example, *bolt-lock* has a forward cue-to-target strength of .16, meaning that when given the word 'bolt,' 16% of the people in a group responded 'lock.' The words that we used in the *unassociated* condition were words that never cued the target – i.e., when given the unassociated word, no one responded with the target word.

Sentence (b) assigned a common property to the set introduced in the first sentence, to reinforce their relationship to one another. Sentence (c) moved the narrative along, Sentence (d) contained the *prime word* as the last word of the sentence. The prime word was bare or focused with 'only'. We also manipulated the association between the prime word and the target word: (i) **Associated**: The prime was an associate of the target word (e.g. *bolt* if the target is *lock*). (ii) **Unassociated**: The prime was not associated with the target word but included in the set from the first sentence (e.g. *nails*). (iii) **Unrelated**: The prime is not associated with the target word and not in the set from the first sentence (e.g. *lamp*). Thus, by manipulating **Focus** (presence vs. absence of 'only') and **Relatedness** (associated, unassociated, unrelated), we created six conditions, shown below:

6) At the store, she was able to buy…
   (i) Focused, associated: *only a bolt*
   (ii) Unfocused, associated: *a bolt*
   (iii) Focused, unassociated: *only nails*
   (iv) Unfocused, associated: *nails*
   (v) Focused, unrelated: *only a lamp*
   (vi) Unfocused unrelated: *a lamp*

All three primes for an item (the associated, the unassociated, and the unrelated) were matched for frequency to be within 10 words/million of each other. All target words were between 10 and 29 words/million. The target word was constant within an item so that differences such as cohort size, orthographic shallowness, etc would not affect reaction times unevenly across conditions.

In addition to the 30 targets, the study also included 48 fillers. Fillers used real words and non-words. The full experiment had a 1:1.5 real words to non-words ratio.

Procedure: We used a lexical decision task. All stimuli were presented in writing on a computer screen. The first three sentences of an item (Sentences (a,b,c)) were presented one at a time. Participants hit the space bar to move to the next sentence. The fourth sentence (Sentence (d)) was presented in one or two words at a time (small function words were grouped together to make it easier to read), and participants used the space bar to move through the sentence. This word-by-word presentation was done to control the timing between when the participant saw the prime word and the target word. The primes were presented with the article and sometimes 'only' all at once (e.g. *only a bolt*).

The participant pressed the spacebar when he/she finished reading the prime, and the target word appeared in the center of the screen after a 250ms delay. As the target word appeared, the background color of the screen also changed. Participants were trained that the color change meant they should decide if the string of letters was a word or not. They pressed the 'f' key if the string of letters was a real word of English and the 'j' key if it was not. Participants were instructed to take their time reading the sentences, but to carry out the lexical decision task as quickly as possible. Reaction time was measured from the onset of the target word to when the participant pressed 'f.'

There were also four comprehension questions evenly spaced throughout the experiment. All participants included in the final analysis answered at least three of the four questions correctly.

Analysis: Any trial where the participant answered incorrectly that the target was not a word was excluded from analysis. This resulted in 1.3% of the data being excluded. No participant responded incorrectly to more than 3 trials (90% accuracy). Reaction times (RTs) were adjusted so that any RT that was more than three standard deviations from a participant's mean in that condition was adjusted to the participant's mean for that condition. This affected .2% of the data (3 trials)

The RTs for all six conditions are shown in Figure 2. To analyze the data statistically, we used ANOVA with two factors (focus and relatedness). There was a significant **main effect of focus** ($F_1(1, 41)= 6.62$, $p < .05$; $F_2(1, 29)= 4.26$, $p < .05$). *Participants responded faster to the target word when the prime was focused by 'only' than when the prime was unfocused*, as can be seen in Figure 3. This corroborates prior work which found that focus increases the priming effect. This is additional evidence that speakers are in fact using a set of

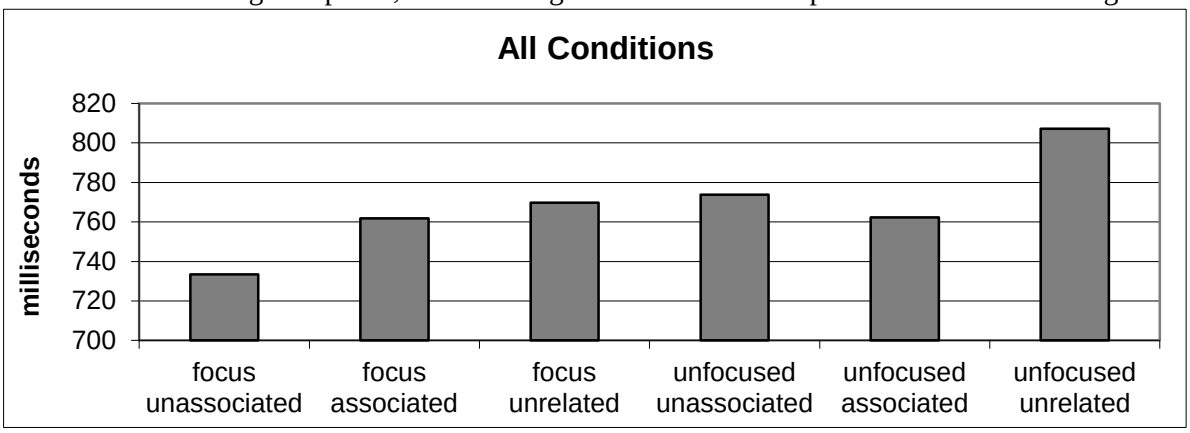

Fig. 2 Reaction time for all experimental conditions.

alternatives when evaluating a focused constituent.

We also found a marginal **main effect of relatedness** ($F_1(2, 40)= 2.55$, $p_1= .091$, $F_2(2, 28)= 3.06$, $p_2= .063$). Thus, participants' RTs were influenced by the nature of the relation between the prime and the target.

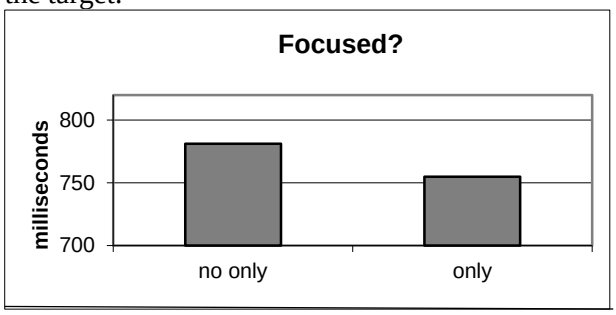

Fig. 3 Reaction times on trials with and without the focus-marker 'only'

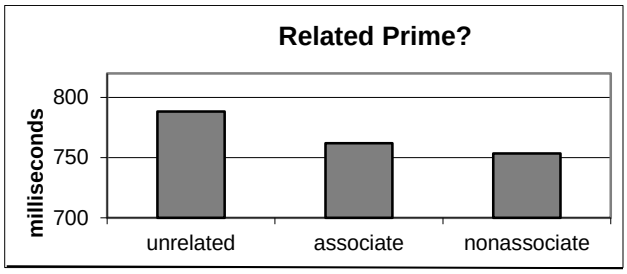

Fig. 4 Reaction times as a function of how the prime was related to the target

To investigate which differences in the relatedness factor were driving the main effect, t-tests were run comparing the associated and the unassociated condition to the unrelated condition, both when focused and when not focused (e.g. *a bolt* vs. *a lamp*; *only a bolt* vs. *only a lamp*, see Figure 1). T-tests comparing the focused version of each prime to its unfocused version were also run (e.g. *a bolt* to *only a bolt*). The overall RTs, collapsing the focused and unfocused conditions, are shown in Figure 4. Three significant or marginal effects were found:

The focused, unassociated condition (e.g. *only nails*) was significantly faster than the focused, unrelated condition (*only a lamp*) ($t_1(41)= -3.2$, $t_2(29)= -2.2$, $p<.05$). This indicates *a priming effect for items associated to the target only by the context* (nails had been mentioned in the context set). This is evidence that context, not just previously learned semantic associations, is used when building the set of alternatives for a focused constituent.

The unfocused, associated condition (*a bolt*) was significantly faster than the unfocused, unrelated condition (*a lamp*) by subject but not by item ($t_1(41)= -2.1$, $p_1<.05$; $t_2(29)= -1.35$, $p_2= .187$). This is the classic lexical-decision result showing that the target was indeed being primed by a related word. The lack of significance by item may be caused by variation across items, perhaps due to frequency.

Finally, the focused, unassociated condition (*only nails*) was significantly faster than the unfocused, unassociated condition (*nails*) by item ($t_2(29)= -2.29$, $p_2<.05$) and marginally faster by subject ($t_1(41)= -1.8$, $p_1=.076$). This finding is important because it further supports the idea that the unassociated items were included in the participants' set of focus alternatives, presumably due to their membership in the 'ad-hoc' set that was created in the narrative. The other result supporting this, that unassociated items were recognized faster than unrelated items in the focused condition of this study, is harder to interpret, because the unrelated prime words were also unmentioned, and therefore the only condition that wasn't given. Thus, the effect previously discussed could be attributed to givenness. However, this additional finding that unassociated words were recognized marginally faster in the focused condition than in the unfocused condition, shows that the unassociated words were sensitive to the focus manipulation. This argues strongly that the unassociated words were part of the focus alternative set, and therefore primed. This is consistent with other work on priming newly learned associations (c.f. McKoon & Ratcliff 1979).

5 General Discussion

Our lexical decision experiment confirmed prior findings that the presence of focus speeds up word recognition (Kim et al (2010), Braun and Tagliapietra (2009), Norris et al (2006)). Importantly, we also found that unassociated primes (e.g. *only nails*) primed the target better than unrelated primes (e.g. *only a lamp*) in the focused condition. In other words, focused primes related to the targets only by context (rather than long-term, learned semantic associations) also cause the target to be recognized faster than when an unrelated prime is used. This suggests that unassociated primes, relat-

ed to the target only by the context of the utterance, are used in the set of alternatives.

Thus, our study provides the evidence from an English lexical decision task for the cognitive reality of the set of alternatives being constructed dynamically from the context.

Finally, this study has methodological significance because the results were achieved with written materials. Prior work (Fodor 2002) has shown that readers often impose 'silent prosody' when they are reading. Thus, our materials may have received such silent prosody from the comprehenders, but no explicit prosodic cues were provided. Other results showing a set of alternatives for focused constituents (Braun and Tagliapietra 2009, Norris et al 2006) have been obtained with cross-modal studies where the participant *hears the focused constituent, usually spoken with a contrastive accent*. In contrast, our study relied on the word 'only' in written materials. This helps to show that the *focus effect, whereby related contrastive words are more activated/salient, is not just the result of a prominent accent, but of contrastiveness itself.*

6 Conclusion

All major theories of focus eventually require that speakers be making active use of a set of alternatives when evaluating an utterance with a focused constituent. Our experiment adds to the experimental evidence showing the cognitive reality of the set of alternatives by showing that target words are recognized faster when a prime word is focused than when it is not. Additionally, our study goes beyond prior work by (1) showing that this focus effect exists without explicit prosodic cues and (2) also showing that primes related to the target only by context are included in the set of alternatives.

Our findings regarding the dynamic consequences of context for the construction of the alternative set have implications for theories and models of dialogue. Our results highlight the importance of comprehenders being able to rapidly take context into account when processing information. Given that focus has wide-reaching effects on comprehension (see Section 1), our findings indicate that many aspects of comprehension are constrained by a finite set of alternatives, derived from the context of the utterance.

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