

Conceptual Pacts, Syntactic Priming, and Referential Form

Kathleen Carbary (kcarbary@bcs.rochester.edu) & Michael Tanenhaus (mtan@bcs.rochester.edu)

Department of Brain & Cognitive Sciences, Meliora Hall 358, University of Rochester, Rochester, NY 14627

Abstract

Interlocutors repeat each other's referential forms, but theories of coordination in dialogue explain this repetition differently. One influential theory is Clark's (1996) collaborative joint activity framework, which implicates negotiated conceptual pacts; another is Pickering & Garrod's (2004) Interactive Alignment Model, which implicates automatic syntactic priming. This experiment examines the relative contributions of conceptual pacts and syntactic priming to repetition in an unscripted referential dialogue between naïve participants. The results show that syntactic priming is only strong when the referent is a consistent part of the situation model throughout the dialogue. In addition, syntactic repetition due to a conceptual pact was stronger than local syntactic priming, even when an explanation based on lexical repetition was ruled out. Finally, there was an association between communicative success and local syntactic priming. We conclude that syntactic priming has a small but significant effect on successful communication in dialogue, while conceptual pacts have a much larger impact on referential form.

Keywords: referential form; syntactic priming; conceptual pacts; communicative success; coordination; dialogue

Background

In dialogue, interlocutors repeat words, phrases, and syntactic structures (e.g. Branigan, Pickering, & Cleland, 2000). Brennan & Clark (1996) proposed that instances of referential repetition represent *conceptual pacts* – agreements between interlocutors about how to conceptualize a referent. More recently, Pickering & Garrod (2004; 2006) proposed that *syntactic priming* – the repetition of a syntactic structure from one utterance to the next – automatically aligns interlocutors' mental states, resulting in successful communication. Both theories seek to explain why repetition of referring expressions occurs in dialogue, and both address the relationship between repetition and successful communication. However, each makes different predictions about when and how such repetition occurs. Clark's (1992) collaborative joint activity view of language use predicts that repetition should be strongest when a referent is likely to be referred to many times, i.e., when it is part of a conceptual pact and important to the interlocutors' communicative goals. On this view, referential forms that are governed by conceptual pacts should be minimally sensitive to local syntactic priming. In contrast, the Interactive Alignment Model implicates local syntactic priming effects as the primary mechanism for successful communication. Partner-specific conceptual pacts contribute when automatic alignment through priming fails, leaving the possibility of "alignment via explicit 'other

modeling' which is used only as a last resort" (Garrod & Pickering, 2007, p. 1).

Despite the dramatically different predictions made by these two popular views, the repetition of referring expressions due to conceptual pacts has not been carefully dissociated from repetition due to syntactic priming. Therefore, most evidence for conceptual pacts in language production can also be taken as evidence for priming and alignment. The experiment presented here examines the repetition of referring expressions in an unscripted cooperative dialogue task, as a step toward assessing the role that both local syntactic priming and conceptual pacts play in determining referential form choice in dialogue. The specific goals of this experiment were: (1) to examine how syntactic repetition might be impacted by the structure of a goal-based task, (2) to compare the local repetition of syntactic structures with the repetition of structures due to conceptual pacts, and (3) to more carefully examine the relationship between syntactic repetition and communicative success. The remainder of this section briefly summarizes the questions and theoretical predictions for each goal.

Prediction 1

Syntactic repetition has been found to be stronger in structured referential dialogue than in unstructured dialogue (Reitter, Moore & Keller, 2006). Part of the reason for this difference may be that goal structure and situation model representations play a role in determining when and how structures are repeated. In referential dialogue in particular, we propose that when referents are highly relevant to the task goals, they are typically a consistent part of the interlocutors' situation model representations. Referents that are consistently represented in the situation model should be more susceptible to form-based repetition, due to either conceptual pacts or syntactic priming. On the other hand, when a referent is less relevant to the communicative goals of the task, or is not represented as a consistent part of the situation model, the syntactic structure used to refer to that item should be repeated less often. This is because participants should be more likely to converge on general referential strategies when a referent is likely to be referred to again, as is the case with referents that are part of the situation model, which participants must represent in order to complete the task. If the increased syntactic priming found in structured referential dialogue is dependent on goal structure and situation model representations, as we propose, then syntactic repetition should be higher for referents that are a consistent part of the situation model than for those that are not.

Prediction 2

Clark's joint activity view and the Interactive Alignment Model make a number of assumptions about the role of each source of repetition in dialogue, although there has been no direct comparison of the two factors in the same experiment. We examine the extent to which conceptual pacts and local syntactic priming each contribute to the repetition of referential forms in dialogue. To examine this issue, we make use of Heller & Chambers (2011) recent extension of Brennan & Clark's (1996) conceptual pacts view to classes of items (as opposed to individual referents). Such cases are called *indirect conceptual pacts* because an agreement about how to refer to one contrast set member indirectly affects the referential expression used for other members of the contrast set.

Indirect conceptual pacts are ideal for an assessment of the relative contributions of conceptual pacts and local syntactic priming effects in the same study. This is because when a conceptual pact about how to refer to an individual item is formed, future references to that item are likely to be strongly governed by the negotiated referential term, making it difficult to observe how other factors affect subsequent references to that item. However, indirect conceptual pacts are presumably weaker than conceptual pacts involving a single referent, so even once a pact has been formed for the first-mentioned contrast set member, local syntactic priming effects might still influence referential form for subsequent references to subsequent contrast set members. This allows us to compare the effects of conceptual pacts with the effects of local syntactic priming in a situation where both might be expected to have an impact on referential form. Clark's view predicts that conceptual pacts will play a much larger role than local syntactic priming, while the Interactive Alignment model predicts that syntactic priming will play a larger role.

Prediction 3

The Interactive Alignment Model is partially based on the suggestion that syntactic priming is a mechanism for communicative success. If this is the case, then participants in a task-based dialogue should be more fluent, faster, and more accurate when they exhibit more syntactic priming. Surprisingly, this prediction has not been explored empirically. A relationship between syntactic priming and these measures of communicative success would support the view that low-level priming effects are involved in communication in dialogue. The alternative is that syntactic priming might decrease communicative success, especially if participants are influenced to use structures that they would not normally choose given the referent and the context, negatively affecting comprehension. This pattern, or a lack of any effect, would support the view that syntactic priming is only incidentally related to communication. Finally, we planned to test whether any relationship between syntactic repetition and success depended on situation model representations.

Methods

The experiment relied on a goal-directed picture-location-matching task, carefully structured to tease apart the effects of syntactic priming from the effects of repetition due to conceptual pacts. The main goal of the task was to collaboratively move pictures to their correct locations. This required that individual pictures be described uniquely, making picture description a subordinate goal.

Participants

Twenty-four pairs of self-identified friends were paid to participate. All were native English speakers who were naïve to the purposes of the experiment.

Experimental Design and Setup

Participants sat at two different computers, and took turns instructing each other about how to drag 18 objects around the computer screen on a grid with 35 possible locations, as shown in Figure 1. At the beginning of each trial, all the pictures in the display appeared in different locations on the two screens, and the participants collaborated to relocate them so that they were in the same positions on both screens. Initially, a colored square appeared around the first target picture on Participant 1's screen. This indicated to Participant 1 that it was her turn to tell Participant 2 where to move that picture. Participants alternated giving instructions and moving pictures until all 18 of the pictures had been referred to and moved.

Each instruction (for example, "move the pepperoni pizza to square 5B") included a *picture description phrase* ("the pepperoni pizza") and a *location phrase* ("to square 5B"). Location phrases involved reference to the locations on the grid where the pictures were displayed – these were referred to on every trial and were therefore a consistent part of participants' situation model representations. On the other hand, picture description phrases applied to individual pictures, which would only be described one time over the course of the dialogue. Thus, there was no need for participants to represent individual pictures as a consistent part of the situation model.

Each participant pair completed a practice display, followed by 14 experimental displays. Each display contained 2/3 contrast set members (e.g. a striped cat and a spotted cat) and 1/3 individual unrelated pictures. Each picture could be described with a number of syntactic structures, including prenominal constructions ("the striped cat"), postnominal constructions ("the cat with stripes") and unmodified nouns ("the cat"). Thus, the repetition of nouns and syntactic structures chosen for each of the contrast set members could be evaluated. References to contrast set members were always separated by at least one unrelated instruction in the dialogue – that is, the task never required that both contrast set members be referred to in a row. This dissociated repetition within a contrast set from local syntactic priming, allowing for a comparison of conceptual-pact based repetition with local syntactic priming effects.

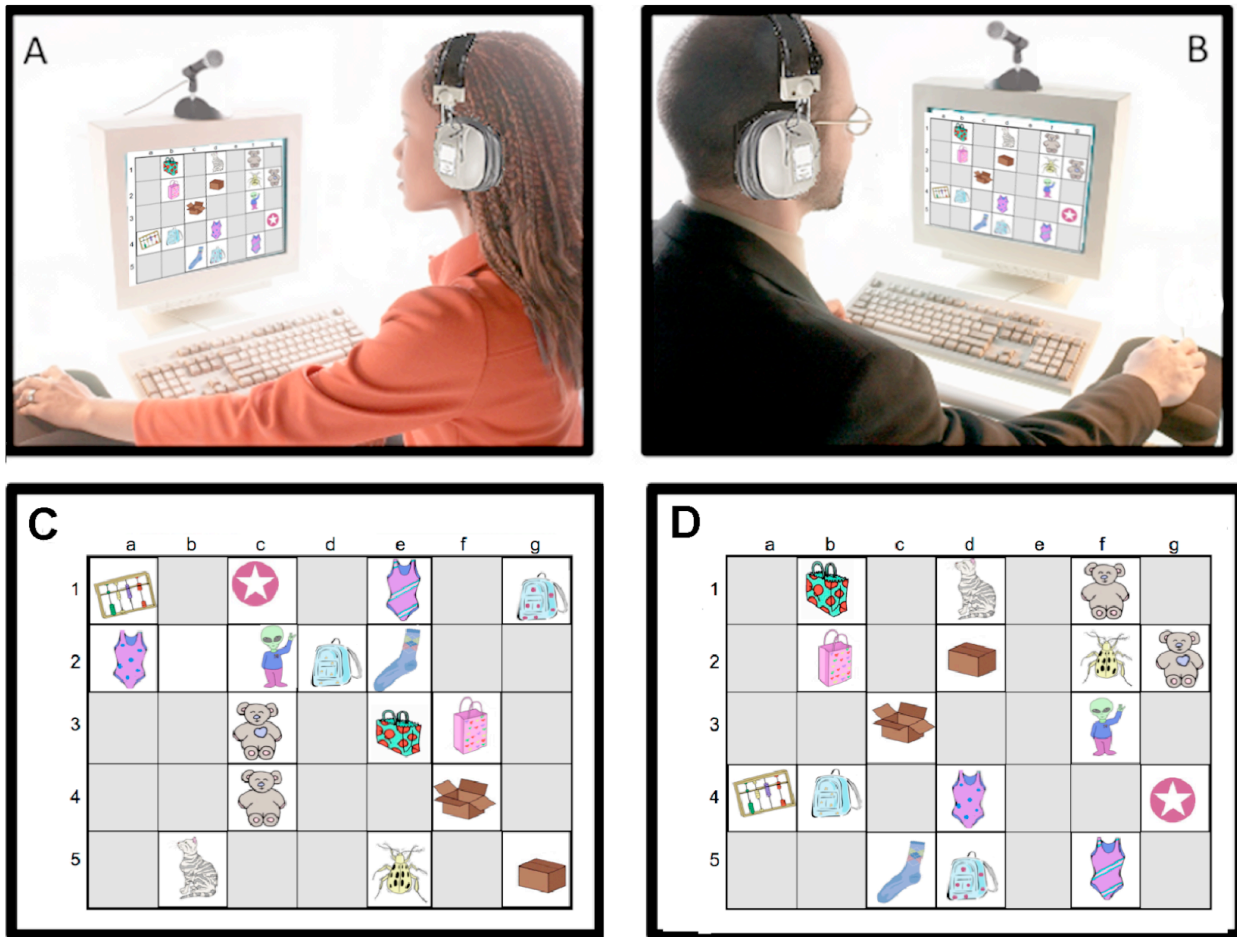


Figure 1: The experimental setup and an example display from the perspective of each participant.

Data Coding

An audio track of the entire interaction was digitally recorded and participants' descriptions of the pictures were transcribed word-by-word. Each instruction was coded according to the structure used for the picture description phrase, and the structure used for the location phrase. Task-irrelevant utterances (e.g. *what time is it?*) were not included in the analysis.

Results and Discussion

The data were analyzed in order to test the three predictions of the study; each prediction is addressed below.

Result 1:

The susceptibility of a referring expression to syntactic priming depended on whether the referent was consistently represented in the situation model.

We looked at local syntactic priming within picture descriptions and location phrases. Picture descriptions, which involved references to items that were not a consistent part of the situation model throughout the dialogue, were not affected by syntactic priming: participants repeated the syntactic structure of the previous

picture description an average of 33% of the time, and chose an alternative structure 67% of the time. As shown in Table 1, even when the analysis was restricted to only cases where participants used a prenominal or postnominal adjective in the current and the preceding picture description, repetition of a syntactic structure was not different from chance.

Table 1: Local syntactic repetition for picture description phrases (limited situation model representation) and location phrases (long-term situation model representation).

Phrase Type	Same Structure % (SE)
Picture Description Phrases: All Descriptions Included	Mean = 33% (1.0%)
Picture Description Phrases: Only Adjective-Containing Descriptions Included	Mean = 51% (1.8%)
Picture Location Phrases: Both Lexical and Syntactic Differences Counted*	Mean = 88% (3.9%) (Median = 97%)

*Any change from one location phrase to the next was counted as a difference, whether it was due to structure or word choice (e.g. "onto [location]" was treated as a different structure than "in [location]"). This was done because repetition of same structure reached ceiling (at virtually 100%) when only *syntactic* differences were counted as "different."

This pattern held for both prenominal and postnominal adjective use.

One possible concern was that the picture descriptions generated by these particular items were not conducive to syntactic priming. However, this is an unlikely explanation for the pattern observed here, since syntactic priming has previously been shown with similar noun phrase structures (Branigan, McLean, & Jones, 2005). In addition, a set of pictures that were highly similar to those used here were subject to syntactic priming in simpler versions of this task (Carbary, Frohning, & Tanenhaus, 2010). Thus, the low rate of local syntactic priming for picture descriptions suggests that when referents in a complex, goal directed task are not a consistent part of the situation model, syntactic priming has little or no effect on referential form.

Were syntactic priming effects very weak across the board in this task? The answer is no. Local syntactic priming effects were strong in the case of location phrases, which referred to locations that were consistently present throughout the dialogue. Participants repeated the structure that had been used for the previous location phrase almost all of the time. Even when variations in word choice (e.g. “put ___ in B4” vs. “drag ___ to B4”) were counted as a difference in location phrase structure, repetition was still 88% – significantly higher than the repetition rate for picture description structures ($t(23)=17.6, p<0.0001$). This occurred despite the fact that participant pairs could, and occasionally did, use many different structures for the locations phrases (e.g. “on B4 there’s a log,” “move the log to B4,” “B4 has the log on it” etc.). One interpretation of this result is that the strong effects of syntactic priming found in other studies of goal-based dialogues (Garrod & Anderson, 1987; Reitter, Moore, & Keller, 2006) might be related to the relevance of the referents to the goals of the task, and the representation of those referents in the situation model.

Result 2:

Syntactic repetition as part of a conceptual pact is stronger than local syntactic priming, even in the absence of lexical repetition.

Turning to the issue of conceptual pacts and local syntactic priming effects in dialogue, we compared syntactic priming effects for picture descriptions with repetition of syntactic structures due to conceptual pacts. This comparison revealed that participants were much more likely to repeat syntactic structures due to a conceptual pact than to repeat the most recently used structure ($t(23)=15.3, p<0.0001$). Overall, the syntactic structure used to describe a first-mentioned contrast set member was repeated when referring to a second contrast set member more than 70% of the time. This occurred even though references to contrast set members were always separated by at least one, and as many as eight, unrelated instructions.

This pattern suggests that conceptual pacts – even indirect conceptual pacts – affected picture description phrases more

strongly than local syntactic priming did. However, there is an alternative possibility: lexical overlap, which is known to enhance syntactic priming effects, may have played a role in the high rate of syntactic repetition within a contrast set. This “lexical boost” effect is typically limited to structures that are produced adjacent to one another (Hartsuiker, Bernolet, Schoonbaert, Speybroeck, & Vanderelst, 2008). However, since lexical overlap is known to strongly impact priming in dialogue (e.g. Branigan et al., 2000), it may have partly explained the high repetition rate within contrast sets.

To rule out a lexical boost explanation, three types of syntactic repetition were compared: repetition within contrast sets where nouns were repeated, repetition within contrast sets when nouns were not repeated, and repetition from the previous description. As Table 2 shows, syntactic repetition within a contrast set was more likely when the head noun was repeated than when it was not, suggesting that a lexical boost effect did partially explain the increased syntactic repetition. A one-way ANOVA revealed an overall effect of repetition type on the rate of syntactic repetition observed ($F(2,69)=37.2, p<0.0001$). Post-hoc Bonferroni corrected t-tests showed that all the paired comparisons were significant (all corrected p 's<0.05).

Table 2: Repetition the structure used to describe a previous contrast set member (conceptual pact use) vs. repetition of the immediately preceding syntactic structure (local syntactic priming).

Syntactic Repetition Type	Same Structure % (SE)
Within Contrast Set: With Lexical Repetition	Mean = 75% (1.9%)
Within Contrast Set: Without Lexical Repetition	Mean = 47% (5.6%)
Local Syntactic Repetition	Mean = 33% (0.07%)

For picture description phrases, syntactic repetition was highest for second contrast set members when lexical content was also repeated, intermediate for second contrast set members when lexical content was not repeated, and lowest for local syntactic priming. This pattern shows that both lexical overlap *and* conceptual similarity played a role in the repetition of syntactic structures within contrast sets. Importantly, the rate of syntactic repetition within contrast sets in the absence of lexical repetition was still significantly higher than the rate of local priming for picture descriptions. This supports the view that conceptual similarity within a contrast set played a role in the selection of referential form.

Another potential concern was that the strong effect of repetition due to conceptual similarity within the contrast sets might have masked a local syntactic priming effect. To rule this out, we looked at local syntactic priming for the cases where a conceptual pact did not exist: the first-mentioned contrast set members, and the pictures that were not contrast set members. When only the pictures that were not subject to conceptual pacts were considered, local syntactic repetition for the picture descriptions still occurred

only 33% of the time. This shows that syntactic priming for picture descriptions was not masked by the stronger influence of conceptual pact based repetition.

These results also support the hypothesis that in dialogue, syntactic repetition occurs more often when a referent is a consistent part of the situation model. Both members of a contrast set must be considered in order to describe each member uniquely. Therefore, referring to the first contrast set member requires consideration of the second contrast set member, implicitly introducing the second contrast set member into the discourse. (For evidence supporting this view, see Sedivy, 2002; Sedivy, 2003; and Wolter, Gorman, & Tanenhaus, in press). Thus, the contrast set members in this study can be seen as intermediate case, in which the referent is part of the situation model representation for more than a single utterance, but is not represented in the situation model consistently throughout the entire dialogue. This predicts that syntactic repetition will be higher for contrast set members than for local repetition of picture descriptions (which do not involve long term situation model representations). Conversely, syntactic repetition should be lower for contrast set members (which must be represented only during a single display) than for picture locations (which are consistently represented in the situation model throughout the entire dialogue). As predicted, the degree of representation in the situation model was related to the degree of syntactic repetition in this experiment.

Result 3:

Local syntactic repetition was associated with communicative success as measured by fluency, speed and accuracy.

Pickering & Garrod (2004; 2006) suggest that local syntactic priming is instrumentally involved in successful communication. However, there is little direct evidence for this claim; only “long-term” syntactic adaptation, and not local syntactic priming, has been shown to predict communicative success (Reitter & Moore, 2007). Other recent work (Howes, Healy, & Purver, 2010; Reitter, Moore, & Keller, 2006), taken together with the results of this experiment, suggests that local syntactic priming might be extensive only in structured dialogue tasks. This calls into question the claim that local syntactic priming is instrumental to communicative success. We tested for a relationship between local syntactic priming¹ and three separate measures of successful communication: fluency (as measured by the number of disfluencies produced), speed (time taken to complete each display), and accuracy

¹ An analysis of syntactic repetition for picture description phrases most closely approximates the “primitive” priming mechanism that has been implicated in successful communication (Garrod & Pickering, 2007). Location phrase repetition was virtually at ceiling making it difficult to determine whether variations in priming predicted success. However, the high rate of location phrase repetition suggests that this repetition was important to successfully communicating in this task.

(number of mistakes made). Each was tested in a separate linear regression model predicting successful communication from the proportion of picture descriptions involving local syntactic repetition. Contrary to our predictions, local syntactic repetition, when it did occur, predicted successful communication. That is, local syntactic priming was negatively related to disfluencies, time to completion, and mistakes. Table 3 shows the model and statistics for each predictor tested.

Table 3: Results of three linear regressions predicting disfluencies, completion times, and mistakes from local syntactic priming in the picture descriptions. All models are simple linear regressions with negative slopes.

	Linear Model*	R^2	$p <$
1	Disfluencies ~Local Priming	0.019	0.05
2	Completion Time ~ Local Priming	0.040	0.001
3	Mistakes ~Local Priming	0.151	0.067

*Models 1 and 2 predict the by-display disfluency rates and completion times, respectively. Model 3 predicts the by-pair number of mistakes, because many displays involved no mistakes. This left one data point per pair for Model 3, which may have reduced the significance of that model.

The converging evidence from these three models points to a very small, but significant relationship between priming and successful communication. In this experiment, participants were not more likely to repeat the structure just used by their partner than to use an alternative when the referent was not a consistent part of the situation model. However, when the same picture description structure was repeated, participants were more successful at the task, and at communicating in general. These results can be interpreted as support for the hypothesis that local syntactic priming is mechanically involved in communication, as Pickering & Garrod (2004) proposed. However, such a conclusion would be premature, since the results are also compatible with a model in which another variable, such as attention to the task, increases both syntactic priming and communicative success.

A third explanation is that when speakers encounter processing difficulty in producing an utterance, they are more likely to re-use the previous syntactic structure as part of a cognitive heuristic for resolving this processing difficulty. For example, when difficulty is encountered in describing a picture, a speaker might fall back on the most recently activated syntactic form. This explanation is compatible with an account where syntactic priming is associated with resolving difficulties in communication, as opposed to facilitating communication to begin with – an interesting possibility. This alternative explanation gives automatic syntactic priming a small, secondary role in communicative success. In contrast to the prediction of the Interactive Alignment Model, this view predicts that syntactic priming would increase communicative success when other mechanisms for successful communication, such

as conceptual pact use or modeling a partner's perspective, have failed. If this were the case, then a very small effect of syntactic priming on communicative success would be expected, with other factors playing a stronger role – and that is exactly what was observed in this experiment.

Conclusions

This study allowed for a novel comparison of the different types of syntactic repetition that occur in unscripted referential dialogue. The results show, for the first time, that syntactic repetition is stronger when a referent is a consistent part of the situation model. This may partially explain why previous studies have only found strong priming effects in structured, task-based dialogues, where highly similar referents are likely to be mentioned again and again.

For items that were not a consistent part of the situation model, syntactic repetition was mostly due to the formation and use of conceptual pacts. Local syntactic priming effects played a small role, if any, when the referent was not consistently represented in the situation model. This suggests that automatic repetition of syntactic structures in dialogue is much weaker than has often been suggested, and provides further support for the hypothesis that when referents are represented in the situation model, they are more susceptible to syntactic repetition. For picture descriptions, conceptual pacts played a much larger role in determining referential form than local syntactic priming, even after lexical priming effects were ruled out.

However, when local syntactic repetition did occur, it was weakly but significantly associated with communicative success. That is, when local syntactic repetition was higher, interlocutors were more fluent, faster, and more accurate in completing the task. This converging evidence from three different measures of success supports the hypothesis that syntactic priming facilitates communicative success in dialogue. However, given the lack of syntactic priming in the absence of conceptual pacts or consistent situation model representations, additional work will be necessary before the relationship between syntactic repetition and communication can be fully understood.

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References

- Branigan, H., Pickering, M., & Cleland, A. (2000). Syntactic co-ordination in dialogue. *Cognition*, 75, B13-B25.
- Branigan, H., McLean, J., & Jones, M.W. (2005). A blue cat or a cat that is blue? Evidence for abstract syntax in young children's noun phrases. In *Proceedings of the 29th Annual Boston University Conference on Language Development*. Somerville, MA: Cascadilla Press.
- Brennan, S. E., & Clark, H. H. (1996). Conceptual pacts and lexical choice in conversation. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 22(6), 1482-1493.
- Carbary, K., Frohning, E., & Tanenhaus, M. (2010). Context, syntactic priming, and referential form in an interactive dialogue task: implications for models of alignment. In *Proceedings of the 32nd Annual Conference of the Cognitive Science Society*, Austin, TX: Cognitive Science Society.
- Clark, H. H. (1992). *Arenas of language use*. University of Chicago Press.
- Garrod, S. & Anderson, A. (1987). Saying what you mean in dialogue: a study in conceptual and semantic co-ordination. *Cognition*, 27, 181-218.
- Garrod, S., & Pickering, M. J. (2007). Automaticity of language production in monologue and dialogue. In Meyer, Wheeldon & Krott (Eds.), *Automaticity and Control in Language Processing*, New York: Psychology Press.
- Heller, D. & Chambers, C. (2011). Producing and comprehending contrastive reference: effects of prior discourse. Poster presented at the 24th Annual CUNY Conference on Human Sentence Processing, Stanford.
- Howes, C., Healey, P., & Purver, M. (2010). Tracking lexical and syntactic alignment in conversation. Poster presented at the 32nd Annual Conference of the Cognitive Science Society, Portland, OR.
- Pickering, M. & Garrod, S. (2006). Alignment as the basis for successful communication. *Research on Language and Computation*, 4, 203-228.
- Pickering, M. & Garrod, S. (2004). Toward a mechanistic psychology of dialogue. *Behavioral and Brain Sciences*, 27, 169-226.
- Reitter, D., & Moore, J. D. (2007). Predicting success in dialogue. In *Proceedings of the 45th Annual Meeting of the Association of Computational Linguistics*, 808-815.
- Reitter, D., Moore, J. D., & Keller, F. (2006). Priming of syntactic rules in task-oriented dialogue and spontaneous conversation. Paper presented at the 28th Annual Conference of the Cognitive Science Society, Vancouver.
- Sedivy, J. C. (2002). Invoking discourse-based contrast sets and resolving syntactic ambiguities. *Journal of Memory and Language*, 46(2), 341-370.
- Sedivy, J. C. (2003). Pragmatic versus form-based accounts of referential contrast: evidence for effects of informativity expectations. *Journal of Psycholinguistic Research*, 32(1), 3-23.
- Wolter, L., Gorman, K. S., Tanenhaus, M. K. (in press, 2011). Scalar reference, contrast and discourse: Separating effects of linguistic discourse from availability of the referent. *Journal of Memory and Language*.