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The resolution of ambiguity during conversation: More than mere mimicry?

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Abstract

Interlocutors often omit important words during conversation, which can lead to miscommunication during ambiguous scenarios (Rayner, Carlson, & Frasier, 1983). Haywood, Pickering and Branigan (2004) show that under ambiguous situations, listeners are highly sensitive to syntactic primes. The studies reported here evaluated the effects of linguistic and nonlinguistic cues to ambiguity. Experiment 1 implemented a syntactic prime and a visual mistake from a pseudo-confederate to promote disambiguation. Participants were successfully primed to disambiguate their statements during the pseudo-conversation but the visual mistake had no effect. Experiment 2 evaluated the effect of the visual mistake in the absence of a prime during an ambiguous pseudo-conversation. There was a significant effect of visual mistake for participants who believed they were speaking with a real person. Overall, participants did not merely mimic their pseudo-conversation partner's syntactic prime, but perceived other cues to the breakdown in communication to better clarify their own statements.

Keywords: Priming; conversation; language; linguistics; nonverbal communication

Introduction

Verbal and nonverbal communication requires individuals to correctly decode meaning behind an intended message. However, there is a great deal of ambiguity that naturally occurs during conversation. This may occur because individuals are presented with a multitude of information during communication scenarios (i.e., foreground and background information, with an influence from visual, auditory, and motor events). Yet interlocutors have the ability to interpret the intended message with relatively little difficulty (Garrod & Pickering, 2004; Pickering & Garrod, 2004). In fact, miscommunication often occurs (e.g., leaving out a seemingly useless bit of information because its utility is not recognized; Guhe & Bard, 2008). Individuals often leave out a single word that could help clarify the intended meaning behind a statement (e.g., "that" to group two objects as one, Haywood, Pickering, & Branigan, 2004). Some researchers have suggested that choices in the use of syntax are influenced by ease of production (Bock, 1986; Branigan, Pickering & Cleland, 2000).

This ease in production may help explain why interlocutors often omit information during conversations. Individuals may leave out words because it is initially easier to exclude information when s/he is unsure of what his/her communicative partner already knows (Lee, 2001; Levelt, 1989; Horton & Keysar, 1996). This strategy may save the speaker time in the beginning, but it will be costly in the

end. Recent research suggests that this strategy of responding is relatively egocentric. This often occurs because cognitive load is initially reduced at the onset of the conversation, especially when common knowledge has not been fully established (Bard, Anderson, Chen, Nicholson, Harvard, & Dazel-Job, 2007; Rayner, Carlson, & Frasier, 1983; Schober, 1993). Taking an egocentric perspective may eventually become quite cumbersome if the speaker must continually adjust his/her own previous statements when the message is unclear (Levelt, 1989; Miller & Johnson-Laird, 1976). In order to resolve the confusion, interlocutors must perceive the existing ambiguity early on in the conversation. If the existing ambiguity is realized, then there will be no need to restate the message because it will not be misunderstood. Therefore, it is important to investigate how individuals recover during these instances of miscommunication.

Haywood, Pickering and Branigan (2004) have demonstrated an effective method in which conversation partners may resolve instances of ambiguity. These authors suggest that syntactic priming is an effective and automatic strategy interlocutors use to communicate effectively with each other (Garrod & Pickering, 2004). They maintain that under certain situations (e.g., giving instructions) conversation partners will initially respond ambiguously unless they are primed to disambiguate. This type of syntactic strategy shows the listener how to correctly clarify his/her statements. Haywood, Pickering, and Branigan have also shown that syntactic priming has a quite substantial effect on future utterances. This is beneficial to the speakers, because s/he realizes how to disambiguate his/her own statements without explicitly being instructed to do so.

Priming clearly has a dominant influence in dialogue, but interlocutors rarely implement this strategy on their own (Haywood, Pickering, & Branigan, 2004). It should be considered that the effect of the prime might merely represent the automaticity of aligning at the syntactic level (Garrod & Pickering, 2004; Pickering & Garrod, 2004). This level of alignment could represent conversational mimicry, rather than the understanding of why the speaker is required to disambiguate. Other strategies are possible and it is imperative to evaluate other cues speakers may retroactively use to elucidate confusing situations (Horton & Keysar, 1996). The studies reported here will evaluate the contribution of linguistic and/or non-linguistic behavioral cues to the breakdown in communication. If priming truly represents the mechanism behind disambiguation, then there

should be no differences between the use of a prime and the inclusion of a non-linguistic cue.

Experiment 1

The original Haywood, Branigan and Pickering (2004) study used a live confederate to prime participants to disambiguate during a two-referent instructional task. They found that participants were more likely to disambiguate on future trials if they were exposed to a syntactic prime (e.g., the complementizer “that”) that resolved existing ambiguity. This study was successfully replicated using a pseudo-confederate (pre-recorded confederate statements; Roche, Caucci, Dale, & Kreuz, 2009; Roche, Dale, & Caucci, 2009). The next logical step to understanding how interlocutors resolve ambiguity during conversation was to evaluate other possible strategies they might use to disambiguate. The current study evaluated the contribution of a prime (“that”) and a non-linguistic behavior cue (a visual mistake) to disambiguating ambiguous scenarios. If participants recognize the non-linguistic cue as a salient indication of their own ambiguity, they should then increase the number of times they disambiguate during the entirety of the conversation.

Method

Participants. Participants included 23 University of Memphis undergraduate students (mean age = 19.84 years years; 13 females). All participants were native speakers of American English with normal to corrected vision and no reports of hearing/speech impairments.

Materials. The experiment took place in a private laboratory room. Participants were seated at a comfortable distance from a 20-inch iMac computer screen. A headset with microphone was used to present and record acoustic data. MATLAB PsychToolbox-3 programs (Brainard, 1997) controlled stimulus presentation and recorded participant responses for the conversation.

Stimuli. There were 3 conditions (ambiguous, unambiguous, and incorrect), 12 rounds and 8 instructions per round (4 participant and 4 pseudo-confederate instructions per round). Experimental object stimuli included twenty-five images placed in a 5x5 grid. These grids contained four types of images (13 containers and/or objects, 4 containers + objects and 8 geometric shapes; see Figure 1a for an example of object placement; with 8 empty cells by the end of the round). Auditory stimuli included 48 pre-recorded pseudo-confederate statements (44.1kHz, 16 bit sampling rate, with equated RMS amplitude to adjust for comfortable listening level and to prevent unwanted acoustic cuing) that described 4 types of instruction statements about the object to be moved [e.g., container, object, “that” prime (container + object), no prime (container + object), see Table 1 for example statements]. It should be noted that there was only one prime from the pseudo-confederate per round (12 primes total). However,

there were two instances in which the participant could disambiguate his/her instructions. Finally, visual stimuli included 48 pre-recorded pseudo-confederate video responses to the participant statements. Each condition contained a total of 48 videos, which differed by the type of pseudo-confederate video response the participant received (mistake or correct).

The *unambiguous* condition included 7 videos that contained a mistake in which the pseudo-confederate moved the wrong container or object. The *ambiguous* condition included 7 pseudo-confederate videos comprised of a container and object that was initially moved, but then the correct container + object was moved. Finally, the *incorrect* conditions included 7 pseudo-confederate videos comprised of cases in which the corresponding separate container and object were moved, but the correct grouped (C+O) object was never moved (see Figure 1b, for an example of video presentation). It should be noted that the video files that contained mistakes all occurred in the beginning (first 24 trials) of the experiment and were pseudo-randomly assigned to each condition.

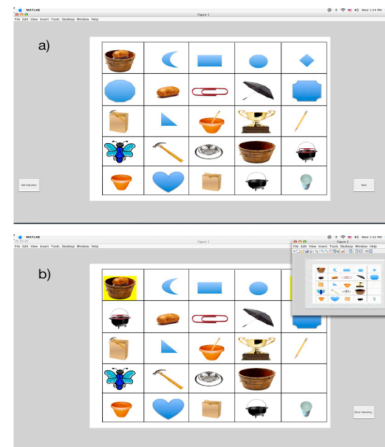


Figure 1. a) The 5x5 grid of objects to be moved by the participant; b) Represents the screen participants see after they have finished giving their instruction to the pseudo-confederate (the small box in the right corner was the video presented to the participant).

Table 1. Examples of pseudo-confederate instructions (C: Container, O: Object, C+O: Container + Object).

Object	Prime	Statement
C	No	“Put the bucket on the circle.”
O	No	“Put the paperclip on the stop sign.”
C + O	No	“Put the pencil in the flowerpot on the rectangle.”
	Yes	“Put the potato <i>that’s</i> in the bucket on the diamond.”

Procedure. To begin, the participant was seated next to a Caucasian female confederate while completing the informed consent, but separated during the experimental sessions. This is an important to control, because much of

perceived talker variability is related to race and gender (Ryalls, Zipprer, & Bauldauff, 1997; Walton & Orlikoff, 1994). Therefore, it was important to match the confederate to the pseudo-confederate's race and gender, to conceal the deception of the task. Participants were then told that their conversation partner (the confederate) would receive instructions first, in a separate room. Once the participant and confederate were separated, the participant was told that they were separated from his/her conversation partner in order to obtain uncontaminated auditory recordings, because individuals often speak over each other during conversations.

Participants were assigned to 1 of 3 conditions that differed based on the pseudo-confederate's video responses (*i.e.*, ambiguous, unambiguous or incorrect). The participant and pseudo-confederate took turns giving instructions about moving objects around the screen (8 instructions per round: 4 participant and 4 pseudo-confederate). It should be noted that each pseudo-confederate statement and video file had a 2s delay before its presentation to imply she was thinking about giving and receiving the instruction.

Participants were informed that the pseudo-confederate would initiate the conversation because she had been viewing the first screen longer. After each pseudo-confederate response, the participant was asked to follow the instructions provided by his/her conversation partner. Once the participant finished moving his/her object, s/he would click a button to transition to another screen to provide instruction to his/her partner (e.g., the object to be moved had a yellow background, and its location had a yellow highlight around it). Once the participant finished giving his/her partner instructions, a smaller window would pop-up on the screen showing the participant if his/her partner made a correct or an incorrect response.

To ensure participants understood the task, they were presented with a brief video prior to the experimental session. This video included 3 mock trials, with 2 male talkers providing each other with instructions and moving the objects around the screen. Once the video was finished, the researcher then asked the participants to rephrase the instructions for the task in their own words. When the researcher felt the participant understood the task, the participant was then asked to make a mental note of how many mistakes were made by his/her conversation partner during the experiment (this helped the researchers determine if they were paying attention to the mistakes). All participants recognized the existence of the mistakes, but on average reported viewing 3-5 out of 12 mistakes (this was not surprising, since the experiment lasted about an hour). Upon completion of the experimental session, the confederate returned and participants were asked, "Would you be surprised if I told you that you were not actually speaking with the person sitting next to you?" The resulting percentage of deceived participants was 92.3%.

Results

A 3 (Condition: ambiguous, unambiguous, & incorrect) x 3 (Block: rounds 1-4, 5-8, & 9-12) mixed fixed effects, repeated measures model with a compound symmetry variance-covariance structure was used to assess the proportion of disambiguated responses from participants during the pseudo-conversation. This model provided non-significant results between the three conditions (see Table 2 for means and standard errors). However, it should be noted that the results from the current experiment did in fact replicate Haywood, Pickering and Branigan's (2004) study, suggesting that participants were significantly affected by the prime (no prime: 25% said "that", 15% disambiguated; prime: 53% said "that", 60% disambiguated).

Table 2. Means and standard errors for the proportion of disambiguation for each condition.

Condition	Mean	SE
ambiguous	0.55	0.15
unambiguous	0.63	0.09
incorrect	0.49	0.14

Discussion. The results from Experiment 1 replicated Haywood, Pickering and Branigan's (2004) study suggesting that participants used the syntactic prime "that" reliably to disambiguate their statements. This suggests that the use of a syntactic prime is effective for disambiguation. Unfortunately, including a visual mistake with a syntactic prime did not seem to significantly influence interlocutors. The interpretation of this non-significant effect may be that the results are an indication of the strength of the prime "that". The prime may have been a highly effective cue participants used to disambiguate. However, the prime alone may have created a ceiling effect in which participants were unable to find a more creative strategy of responding, thus leaving the effect of the behavioral cue hidden. An egocentric perspective may prevent participants from using a syntactic prime, such as "that". Under more natural situations, interlocutors must find other methods to help them disambiguate confusing scenarios.

Experiment 2

Experiment 1 replicated Haywood, Pickering, and Branigan's (2004) study, but failed to show an effect of the visual mistake. Regardless of the null effect, it is still important to evaluate the influence of non-linguistic behavioral cues to communication breakdown. Haywood, Pickering and Branigan suggest that interlocutors often do not automatically use complementizers on their own to disambiguate. They suggest that a listener should be primed to do so, but this is not to say syntactic priming of this nature never occurs naturally. Interlocutors must find other methods to demonstrate the ambiguity perceived, if the syntactic strategy is not naturally elicited. This is especially

important when it is too costly to explicitly describe the ambiguity (e.g., under time constraint).

Therefore, evaluating the use of other strategies interlocutors may enlist during perceived ambiguity is crucial. Again, a syntactic prime is an extremely effective and powerful strategy interlocutors may use to disambiguate ambiguous scenarios. The prevailing nature of the syntactic priming effect might have dampened the effects of the non-linguistic behavioral cue to communication breakdown in Experiment 1. The purpose of Experiment 2 was to evaluate the effects of non-linguistic behavioral cues to miscommunication in the absence of a syntactic prime. If this is an effective cue to disambiguation, then priming that may never occur naturally may be unnecessary under certain communicative scenarios.

Method

Participants. Participants included 16 University of Memphis undergraduate students (mean age = 19.64 years; 12 females). All participants were native speakers of American English with normal to corrected vision and no reports of hearing/speech impairments.

Materials. All the materials were identical to those in Experiment 1.

Stimuli. There were 2 conditions (correct or mistake), 12 rounds with 8 instructions per round (4 participant and 4 pseudo-confederate instructions per round). The object stimuli for this experiment were identical to Experiment 1. The auditory stimuli were identical to Experiment 1, except the prime “that” was removed. The vocally produced word “that” was clipped at the zero crossing at the onset and offset of the production from the original sound files using Audacity. The video stimuli consisted of either a correct response or a mistake provided by the pseudo-confederate. There were a total of 12 mistakes pseudo-randomly assigned throughout the mistake condition. The construction of the mistake was identical to the mistakes created for the “incorrect” condition in Experiment 1 (the incorrect objects were moved).

Procedure. The setup and instructions to the participants were identical to Experiment 1. It should be noted that the pseudo-confederate video presented to participants was moved to the middle of the computer screen to increase the likelihood that the participants would see the mistake. All participants noticed the mistakes and were able to reliably describe the mistakes when asked, but reported seeing on average 2-3 mistakes out of 12. This is not surprising since the experiment lasted about an hour.

Results

Upon the completion of the experimental session, participants were asked, “Would you be surprised if I told you that you were not actually speaking with the person sitting next to you?” The resulting percentage of deceived

participants was 67%. Since some participants were not deceived by the experimental design, the statistical analysis for this experiment will include Deception as a factor.

A 2 (Condition: correct & mistakes) x 2 (Deception: deceived & not deceived) x 3 (Block: rounds 1-4, 5-8, & 9-12) mixed repeated fixed effects model with a first-order auto-regressive (AR1) variance-covariance structure, was used to evaluate the probability that individuals disambiguate their statements during an ambiguous instruction task. Upon initial analysis of the variance-covariance structure, the AR1 variance-covariance structure was used because it seemed to have the best fit for the data. The results from this model suggests there was a significant main effect of deception [$F(1, 14.139) = 10.593, p < .01$]; see Figure 2] and block [$F(2, 24.933) = 5.087, p < .05$] see Figure 3]. The model also revealed a significant Condition x Deception interaction [$F(1, 14.139) = 12.682, p < .005$]; see Figure 4].

The main effect of deception revealed that deceived individuals disambiguated their statements 36.9% more than participants who were not deceived (see Figure 2).

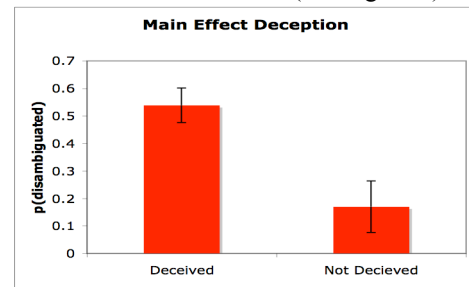


Figure 2. Means and standard errors for the proportion of disambiguated statements for deceived and not deceived participants.

Post-hoc adjusted Bonferroni pair-wise comparisons for the main effect of block revealed that there were significantly fewer instances of disambiguation in block 1, relative to block 2 (19.7%, $p < .05$) and marginally different than block 3 (18.5%, $p = .08$; see Figure 3 for means and standard errors).

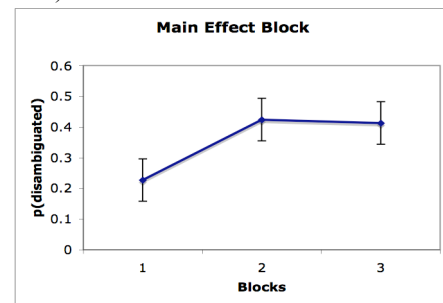


Figure 3. Means and standard errors for the probability of disambiguating during the 1st four rounds, 2nd four rounds and last four rounds.

Post-hoc adjusted Bonferroni pair-wise comparisons for the Condition x Deception interaction revealed that deceived participants who viewed the pseudo-confederate mistakes

disambiguated 52.2% more than participants who did not view mistakes ($p < .001$). However, there were no significant differences between the participants who were not deceived and the condition they were in ($p = .206$).

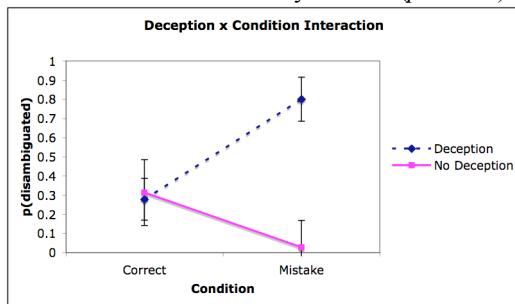


Figure 4. Means and standard errors for the probability of disambiguating when a behavioral cue was provided (a mistake) or not provided (correct).

Discussion

Upon initial evaluation, only 67% of the participants were deceived. However, when participants were asked why they felt the deception failed, many of the participants said that they were aware of the deception that usually occurs during psychological experiments. Many of these participants who were not deceived reported being upper division psychology students or had experience participating in other psychology experiments. This resulted in differential responding between deceived and not deceived participants in Experiment 2. This may have been due to the fact that some participants were more invested (deceived participants) in helping their conversation partner because they may have felt they were truly influencing another person's behavior. The individuals who were not deceived may have felt it was unnecessary to disambiguate, because there was nothing to lose or gain by instructing ambiguously.

Overall, all of the participants disambiguated their statements more as their interaction progressed. This suggests that participants may begin instructing their partners in an egocentric manner because they are initially unsure about the task at hand, but as time progressed they were able to take the other person's perspective into account. Also, the Deception x Condition interaction suggests that when the conversation scenario seemed relatively natural, providing a nonverbal behavioral cue to miscommunication was highly effective. The non-linguistic behavioral cue may have been successful above and beyond the use of a prime to communicate during ambiguous situations [Experiment 1 incorrect condition = 49% disambiguation; Experiment 2 mistake condition = 80% disambiguation; $F(2,18.386) = 50.928, p < .001$].

This suggests that a nonverbal cue to miscommunication may be a more effective cue to use during conversations that are ambiguous. Therefore, addressing such a concern will allow for the evaluation of a non-linguistic behavioral cue such as this under conditions that require interlocutors to quickly and accurately provide information to their conversation partner.

General Discussion

Under conditions in which an interlocutor aligns with a pseudo-conversation partner, priming has been shown to be highly effective (Haywood, Pickering & Branigan, 2004). When ambiguity exists and no prime is naturally produced, participants must find another method to help them disambiguate. The results from these studies do in fact support the notion that priming interlocutors is highly effective under ambiguous scenarios. This finding is supported by Garrod and Pickering's (2004) theory of interactive alignment, which suggests interlocutors automatically align at many levels (syntactic being one of them; Pickering & Garrod, 2004). The use of a syntactic prime may be a successful conversation strategy if at least one of the interlocutors is aware of the ambiguity in the beginning of the conversation. However, if neither participant realizes the magnitude of the ambiguity that exists, both partners might be less likely to adopt a syntactic strategy.

The efficiency of a syntactic prime is apparent, but the nature of participant responses may represent mere mimicry. The possibility that participants are mimicking the syntactic prime may lead to disambiguation. Within this artificial, confederate/pseudo-confederate design, it is quite possible that participants may never become aware of the ambiguity. This disregard of ambiguity may create a situation in which s/he may never realize why s/he needed to disambiguate his/her own statements. This strategy may never be elicited, if conversation partners do not naturally prime each other syntactically, because the ambiguity of the situation is not apparent. This seems to be evident in Experiment 2, when deceived participants in the correct condition disambiguate significantly less than participants who received the non-linguistic behavioral cue. The problem of ambiguity still exists, in which interlocutors never use disambiguating strategies if they do not realize there was a failure in comprehension.

Thus, providing a visual mistake or some other type of behavioral cue should be an alternative and effective strategy interlocutors have available for use during natural conversation scenarios. This notion was supported by Experiment 2, in which the non-linguistic disambiguating cue did in fact help the participants recognize the ambiguity. Recognizing the vagueness in their productions was retroactively beneficial, which allowed them revise their statements to accommodate their listener (Horton & Keysar, 1996). This type of cue to communication breakdown allowed participants to respond effectively and creatively when resolving the confusion.

Unfortunately, the pseudo-confederate paradigm was less effective because some of the participants recognized the artificial nature of the conversation in Experiment 2. This created a situation in which participants may have felt that it was unnecessary to disambiguate their own statements because there was no cost/benefit in doing so. This supports the concept that there may have been a perceived social exchange or *reciprocal altruism* necessary for the

conversation to work properly (Cosmides & Tooby, 1992). When the participants perceived no benefit in disambiguating, they expended less effort and disregarded the constraints of the conversation.

Another assumption in previous literatures has suggested that humans are generally egocentric in regards to their conversation strategies. This suggests that interlocutors rarely take the other person's perspective into account. However, when participants were deceived by the paradigm, they were highly affected by the mistake. This suggests that when interlocutors interact with each other, if there is something to gain or lose during a conversational situation, they are more likely to take the other person's perspective into account. Therefore, the presentation of a behavioral cue may help interlocutors assess the degree to which they invest their energies into the conversation.

It should also be noted, that upon evaluation of the types of syntactic structures the deceived participants chose, they not only used the word "that", when not primed to do so; they also used other syntactic strategies to group the "container+object" images. This supports the view that once speakers become aware of the ambiguity, they are better able to implement a syntactic strategy in the future and a prime may be unnecessary. A non-linguistic mistake has a dominant influence on the strategies interlocutors use to disambiguate scenarios. Therefore, if participants understand that they are communicating ambiguously and there are direct perceived consequences, then they will more quickly try to recover from their mistakes by any means available to them.

Though the pseudo-confederate paradigm was not as effective during the implementation of the nonverbal cue, it was still relatively successful. Future studies should evaluate other scenarios in which the use of a nonverbal behavioral cue to the breakdown of communication might be useful. For example, future studies should evaluate nonverbal behavioral cues under time-constrained tasks. These non-linguistic behavioral cues should also be assessed in more natural conversation scenarios. Future evaluation of such issues will help clarify whether or not a non-linguistic behavioral cue to miscommunication helps interlocutors resolve ambiguity within their own statements quickly and naturally. Understanding the role of such behavioral cues should provide valuable insight into how individuals are able to communicate within their own environment.

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