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From Minor Mishap to Major Catastrophe: Lexical Choice in Miscommunication

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Abstract

Miscommunication is often regarded as noise or uninformative in psycholinguistic research. However, Coupland et al. (1991) suggest that miscommunication can provide rich information about how interlocutors come to communicate successfully. Successful communication necessarily needs the individuals involved to coordinate and update their mutual knowledge, experiences, beliefs, and assumptions. However, the process of updating this information may be ridden with unsuccessful attempts that eventually help interlocutors reach a common goal. This study evaluates the relative contribution of linguistic factors to communicative success, based on verbal grounding (e.g., mutual agreement on a referent) and visual congruency (e.g., interlocutor's visual environments match or mismatch) during a collaborative task. We show that varying levels of communicative success are laden with rich linguistic information that may uncover interesting aspects of successful and less successful communication.

Keywords: Joint action; grounding; successful communication; miscommunication; psycholinguistics.

Introduction

Interactive language, in particular face-to-face interactive conversation, is the most canonical form of language use (Clark, 1992; Goodwin & Duranti, 1992). In interactive conversation, interlocutors are typically both speakers and listeners (addressees) and they often are conversing to achieve joint goals. Nonetheless, most research on human language processing focuses on the speaker and the listener as individual cognitive agents in non-interactive tasks.

There are important exceptions. For example, a large body of work has used the Edinburgh Map Task (Brown et al., 1983) to address a range of psycholinguistic issues. In this task two interlocutors collaborate, with the director guiding the matcher to reproduce a route printed on the director's map. Aist and colleagues developed a "fruit cart" domain as a vehicle for eliciting human language production for (a) dialogue system research and development and (b) psycholinguistic research (Aist, Campana Allen, Swift & Tanenhaus, 2012). Senft (2002, 2007) developed a number of domains to evaluate lexical choice in spatial terms during a space game and tinker toy task for cross-cultural analysis. Brown-Schmidt, Tanenhaus and colleagues have adopted a complementary strategy, using targeted language games to produce trial-like structure in unrestricted interactive conversation to address specific psycholinguistic issues with real-time response measures, such as visual world eye-tracking (e.g., Brown-Schmidt, Gunlogson & Tanenhaus, 2008; Brown-Schmidt & Tanenhaus, 2008).

In this paper we provide a preliminary report on a project using a new domain intended to examine how referential domains are constructed, updated, accepted and rejected during a goal-driven task, with naïve participants and unrestricted speech. Here we examine how the language used in grounding might be diagnostic of, and contribute to, miscommunication.

The domain is similar to those discussed by Sentf (2002) and is designed to allow a face-to-face interaction through a barrier separating the two participants. This task involves a collaborative dyadic interaction that required participants to instruct each other in building a b•loc•o™ animal figure from abstract three-dimensional puzzle-like pieces (see Figure 1 for an image of the animals; Methods for full task description).

The b•loc•o™ paradigm was created to serve a number of purposes. First, we wanted a domain that would lend itself to investigating both generation and interpretation of referring expressions. Secondly, we wanted to observe how referring expressions change when the goals change. For example, during the build stage pieces that were initially referred to using conceptual pacts, such as "the Christmas tree" would eventually assume a different identity, "the body" (see the green item on the left of Figure 2). This domain offers a rich domain for investigating grounding.

The domain creates a corpus that contained frequent communication failures (e.g., confusions and misunderstandings) that had to be resolved. These failures in communication are often regarded as noise and therefore uninformative in psycholinguistic research (Coupland, Giles, & Weimann, 1991; Keysar, 2007). However, as

Coupland et al. (1991) argue, communication failure could provide valuable information about how interlocutors come to communicate successfully, much like speech errors can provide important insights into planning processes in language production.

Successful communication necessarily requires interlocutors to coordinate and regularly update their mutual knowledge, experiences, beliefs, and assumptions (e.g., Clark & Carlson, 1982; Clark & Marshal, 1981). However, the process of updating this information may be riddled with unsuccessful attempts that eventually help the interlocutors reach a common goal.

Some researchers have provided insights into how interlocutors might resolve communication problems (e.g., through ambiguity resolution or asking clarification questions; see Clark & Brennan, 1991; Haywood, Pickering & Branigan, 2004; Levelt, 1983; Pickering & Garrod, 2004; Roche, Dale, Jaeger, & Kreuz, under revision). However, the literature has minimally, at best, explored the rich information these failures could provide. For example, interlocutors' language is often ambiguous because ambiguity minimizes effort in production and because a speaker can usually assume that her addressee can rapidly use context to infer her intended meaning, perhaps because it is easier on the production system (e.g., Bard et al., 2007; Bock, 1986). This can result in utterances that initially appear to be egocentric. However, once an interlocutor realizes that her ambiguity might reduce the success of the interaction, she almost immediately adapts her utterances to eliminate the type of ambiguity that was confusing for her listener (Roche, Dale, Jaeger & Kreuz, under revision).

Despite these efforts, the focus of the existing literature has been primarily on the successful exchange of information and largely ignores what happens when interlocutors' shared knowledge becomes de-coupled. Yet, miscommunication occurs regularly and can directly impact the quality and effectiveness of an interaction (McTear, 2008). Therefore, the current study provides a preliminary analysis of how language reflects and perhaps influences communicative successes and failures.

Methods

Participants

Participants were 20 dyads of paid undergraduate students (N = 40; females = 26; mean age = 19 years) from the University of Rochester. Participants were native speakers of American English. All reported normal to corrected vision and no speech or hearing impairments.

Stimuli

The experiment included two types of b•loc•o™ animal figures (see Figure 1).

Figure 1: Images of the grasshopper (left) and lizard (right) animal figures used in the task.

The grasshopper figure consisted of 25 pieces, and the lizard figure consisted of 28 pieces. Each animal piece was abstract and did not have a proscribed name (see Figure 2 for example pieces).

Figure 2: Sample of items from the animal figures.

Instruction Cards Each animal figure had a set of instruction cards, each corresponding to one step of the building process. The grasshopper and lizard figures consisted of 13 and 15 instructions cards each, respectively (see Figure 3 for sample instruction cards).

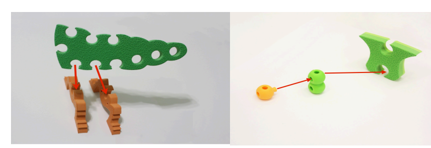

Figure 3: Sample of the animal figure instruction cards (right: grasshopper; left: lizard).

Conditions We had a between-subjects condition, in which dyads instructed each other in collaboratively building an animal (lizard or grasshopper), but were separated by a partition[1].

Data Recording Three digital cameras recorded the participant interaction from different angles (left, center-wide, right). All video files were time-aligned and compressed into a single .mov file using Final Cut Pro.

Procedures

Participants were seated across from each other, separated by a partition. The participants were given identical sets of b•loc•o™ pieces on identical workspaces. Workspaces featured a flat, white surface with a black box outline drawn in each corner. Participants were told that they would be working together to build identical objects. They were not, however, told what the resulting object would become. The

[1] The design of the experiment was more complex, including a non-hidden phase that was not analyzed here. In the full design, the animals were counterbalanced across the possible conditions. For the purpose of the present analyses, only a subset of the data is included here.

experiment was divided into two phases: an Item Phase and a Building Phase.

During the Item Phase, the participants moved the individual b•loc•o™ pieces into the four boxes on their workspace. They were told that their workspaces had to match before they could proceed to the next phase. They were further instructed to take turns and decide together how to separate their items.

Once the workspaces matched, they were allowed to continue to the Build Phase. During the Build Phase, each participant was given half of the instruction cards in a predefined order. Participants alternated giving instructions. They were told that they could ask each other questions and, more generally, talk freely with one another. The majority of pairs successfully built matching objects. The unsuccessful pairs made only minor errors (e.g., wrong orientation of the animal's legs).

Measures

Transcription and coding of various behaviors were annotated from a single workable file that contained a compressed version of the video files from the three different angles (left, center-wide, right) to aid in coding.

Coded Measures

The video files of each dyad's interactions were transcribed. After transcription, additional measures were coded and included the following categories: confirmed and negated utterances, visual congruency, and several standard LIWC categories (Linguistic Inquiry and Word Count; Pennebaker, Booth, & Francis, 2001).

Confirmed and Negated Utterances: We divided utterances that presented new information into two categories according to whether they were *confirmed* (e.g., *yes*, *uh huh*) or *negated* by the addressee. An utterance was coded as *Confirmed* if the partner indicated acceptance of the new information with an explicit confirmation (e.g., with a variant of yes) similar to the Common Ground Units described by Nakatani and Traum (1999). At each turn, T_1 presented a new piece of information. Once T_2 accepted this information it was coded as a *Confirmed* utterance. For example:

T_1: Uh, that piece, uh it's in the, the center of box three, it looks like a bell.
T_2: ***Mhm.***

An utterance was coded as *Negated* if presentation of new information by T_1 was negated or rejected by the T_2. For example:

T_1: Ok, so what was the? Put it three rows down.
T_2: ***No***, ***no***, ***no***, ***no***, ***no***, three squares to the right.

Visual Congruence. We coded the participants' workspaces as either matching or mismatching (*congruent*) or mismatching (*incongruent*) throughout the task (e.g., the orientation of the object being described). Here we focus on within-trial instances of *congruent* and *incongruent* targets. Congruency and *Confirmed*/*Negated* utterances were used to create a 2 x 2 contingency table of the different types of communicative success (see next section).

Communicative Success was measured relative to the *congruent* and *incongruent* physical environments in conjunction with the verbal acknowledgement of the information presented. Often, interlocutors believed their objects were *congruent* when in fact they mismatched in ways that interfered with the goal in that trial. A contingency table illustrates the four types of outcomes created by crossing confirmed and negated utterances with object congruency: *Confirmed Congruent* (CC), *Confirmed Incongruent* (CI), *Negated Congruent* (NC), and *Negated Incongruent* (NI; see Table 1 for the outcome labels).

A CC outcome is an instance of *Successful Communication.* The new information is confirmed (and acted upon) and the objects are indeed visually *congruent*. For example, one member of the pair says, "Yes, I got it," when in fact she did "get" it. A CI (*Unrecognized Miscommunication*) outcome occurs when one of the participants accepts the information presented, but the objects in her visual workspace do not match those of her partner (e.g., saying, "Yes, I got it," when she did not actually "get" it). The pair believes they have successfully communicated, but in fact they have not. A NC outcome (*Unrecognized Success*) occurs when a participant negates her partner's statement, but her visual workspace objects matches her partner's (e.g., saying, "No, I didn't get it," when she actually did "get" it). The pair has actually succeeded but believe they have not. Finally, in an NI outcome, the pair has recognized the miscommunication. *Recognized Miscommunication* occurs when at least one of the participants fails to ground, and their visual workspace objects do not match (e.g., saying, "No, I didn't get it," when in fact she did not "get" it).

Table 1: Communicative Success Outcome Variables.

Acceptance Type		*Visual Environment*
	Congruent	**Incongruent**
Confirmation	*Successful Communication*	*Unrecognized Miscommunication*
Negated	*Unrecognized Success*	*Recognized Miscommunication*

LIWC Categories were selected to determine the types of linguistic categories that contribute to the varying outcomes. Given the nature of the predetermined LIWC categories, we do not venture to argue that this provides a thorough linguistic analysis of miscommunication. The main objective was to use these general categories as a first-pass attempt to see what linguistic patterns emerge as miscommunication unfolds. These included the words per statement, assent, negation (i.e., different than "Negated" described above), cognitive mechanisms, personal pronouns, spatial, and perceptual linguistic forms. The LIWC categories are structured to distinguish at most general predicate classes (e.g., cognitive mechanisms) as well as linguistic particles whose function conveys degrees of interlocutor agreement (e.g., assent, negation).

Within the predetermined LIWC categories, we also created novel subcategories for assent and negation that included specific words (see Table 2 for the categories evaluated and examples within a category). Assent and negation were subdivided because it seemed at the time of transcription that varying forms of these categories could interact in interesting ways depending on the type of success.

Table 2: LIWC and linguistic category examples.

Category	Subcategories	Example
Negation	Strong Negation	*No*, *nope*
	Weak Negation	*Don't, didn't*
Personal Pronoun	First Person	*I, We*
	Second Person	*You*
Cognitive Mechanism	Insight	*Think*, *know*
	Certainty	*Always*, *never*
Physical	Perceptual	*See*, *hear*, *feel*
	Spatial	*Top*, *bottom*
Assent	Strong Yes	*Yes*, *okay*
	Weak Yes	*Mhm*, *uh huh*

Results

We first established that, as expected, assenting and negating words were associated with visual congruency. We used a mixed logit model (Jaeger, 2008) to evaluate the proportion of visual incongruency, as predicted by assenting and negating words (LIWC categories), with trial set as a covariate and dyad as a random effect. The results from this analysis revealed that there were significantly fewer assenting words (b = -.177, z = -4.973, p < .001), but more negating words (b = .392, z = 5. 210, p < .001) when visual incongruence occurred (see Figure 4 for means and standard errors for assent and negation for the visual congruency categories). Nonetheless, it is striking how often assenting words are used when the objects are incongruent.

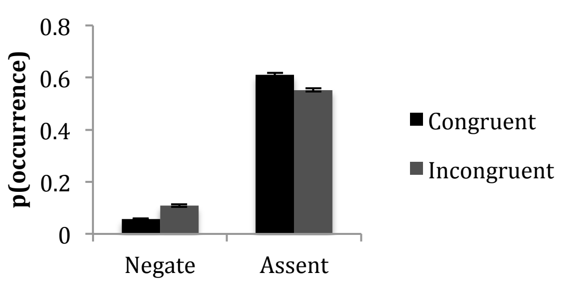

Figure 4. Mean and standard errors for negation and assent categories for the visual congruency measure.

In order to further explore the relationship between language and outcome, we examined the four different outcomes [*Successful Communication* (SC), *Unrecognized Miscommunication* (UM), *Unrecognized Success* (US) and *Recognized Miscommunication* (RM)] as predicted by words per statement, assent (strong yes and weak yes), negation (strong and weak negation), and LIWC category measures (personal pronouns, cognitive mechanisms, perceptual, and spatial categories; Croissant, 2012). The results from this model suggest that the measures successfully predict the different outcomes (x^2 = 1105.9, p < .001; see Figure 5 for the proportion of occurrence within each category). Additionally, the evaluation of the significant odds ratios below represent the comparison of each linguistic category relative to the SC trials and are provided with regards to each of the types of communicative success (see Table 3 for results).

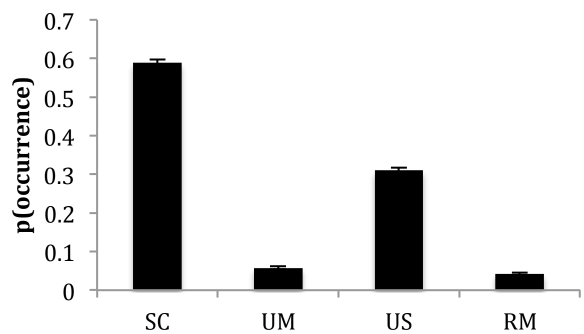

Figure 5. Mean and standard errors of the proportion of occurrence within each of the types of communicative outcomes.

Table 3: Significant predictors for the four outcomes, with SC as the reference category: $^*p < .05$; $^{**}p < .01$, $^{***}p < .001$.

	Linguistic Category	Odds Ratio	t-value
US	WPS	1.053	4.083***
	Weak Yes	1.589	2.528*
	Strong Negation	129.907	13.621***
	Weak Negation	17.439	10.9857***
	We	1.474	2.361*
	Insight	4.468	7.059***
	Perceptual	1.229	3.268**
UR	WPS	0.983	-1.982*
	Strong Yes	0.727	-3.452***
	Strong Negation	6.463	5.159***
	I	1.767	5.943***
	You	1.207	2.681**
	Spatial	1.071	2.708**
RM	WPS	1.051	3.441***
	Strong Negation	207.009	14.655***
	Weak Negation	21.919	11.279***
	You	1.333	2.317*
	Insight	3.699	5.447***
	Certainty	1.931	2.077*

Conclusions

Overall, our results suggest that interlocutors use language in interesting ways when they are having problems with communication. The results for words per statement suggest that using more words can be both helpful and harmful. For example, during US (*Unrecognized Success*) and RM (*Recognized Miscommunication*), interlocutors use more words. This might suggest that explaining things too extensively may prevent the listener from encoding all of the information presented due to the limits of processing load. This overload may then result in loss of essential information leading to a communication breakdown. However, fewer words per statement were also associated with UM (*Unrecognized Miscommunication*) relative to SC (*Successful Communication*). This might suggest that not providing enough detailed information may furnish the listener with insufficient information to reject the speaker's statement when necessary.

Interlocutors' use of personal pronouns (i.e., *I*, *you*, and *we*) may be indicative of a unique role of perspective taking in creating and repairing unsuccessful communication, as seen in US, UM, and RM. Specifically, there were more instances of saying *I* and *you*, during UM (and *you* for RM), suggesting that the talkers may be attempting to reconcile differing perspectives. Additionally, the increased occurrence of *we* during US suggests that interlocutors attempt to find a shared perspective when a "minor mishap" occurs. These findings are interesting given a common interpretation of speakers as primarily egocentric (e.g., Keysar, 2007). While there was no difference in the use of personal pronouns during *Successful Communication* (SC), it would seem as if dyads tended to respond somewhat egocentrically during instances of less-than-successful communication. However, miscommunicating may have allowed them to (1) remedy a communication breakdown by highlighting their individual and shared perspectives and (2) access more information. Thus, it appears that a dyad may reference their partner's point of view to help re-couple their perspectives.

Additionally, use of spatial terminology increased during *Unrecognized Miscommunication* (UM). Anecdotally, we noticed that participants' interpretation of each other's use of spatial orientation was often problematic. For example, one participant's use of the word "top" was often not the same as her partner's, especially when the animal pieces were not similarly oriented in space. This type of mistake was not quickly realized, and it was not until a "major catastrophe" happened (i.e., they could not continue with the build until the problem was resolved) that they were able to reconcile each other's meanings of spatial terms. Although intuitively simple, the uses of spatial terms appear to be highly perspective-dependent and can result in communication problems if interlocutors' perspectives are not aligned.

Participants appear to use assent and negation differently during various outcomes. The use of strong and weak confirmation words (such as *yes* and *mhm*) may carry different meaning depending on the context. One explanation of how interlocutors may use the varying forms of *confirming* and *negating* words may be that these words help the talker keep track of what they are doing and how they understand it while simultaneously communicating their state of mind to their partner (e.g., saying *yes* and *no* to themselves while trying to interpret an instruction). This may be especially important when the talker is confused about how to describe something. In these cases, *confirming* and *negating* words may cue the listener to help the talker find the best way to describe something. Therefore, an indirect expression of *confirmation* and *negation* may be a cue to the mental state of the speaker.

Alternatively, a *confirmation* may sometimes be a social nicety. Anecdotally, participants sometimes use a weak form of *yes* while clearly ignoring their partner (e.g., doing something completely different or unrelated to the current instruction). In these cases, the *confirmation* may be a socially acceptable filler word used to mask his or her inattention.

Finally, insight words (e.g., *think*, *know*) are more prevalent during both *Unrecognized Success* (US) and *Recognized Miscommunication* (RM). The prevalence of these words in the US outcomes is particularly interesting. This may indicate some degree of uncertainty. Additionally, interlocutors were more likely to use certainty words during *Recognized Miscommunication* (RM).

Some of our results are clearly expected given both common sense and previous observations (e.g. see Senft, 2002 for similar results for a tinker-toy task with Trobriand Islanders). For example, interlocutors confirm to ground and they negate to indicate confusion. Nonetheless, there are clearly subtle differences in the language used when participants are grounding successfully (SC) and incorrectly (UM). RM results in an increase in spatial language that reflects a negotiation about differences in perspective. This indicates that interlocutors recognize the importance of shared perspective to resolve confusion when communication is unsuccessful. Speakers may say less and appear to disregard listeners' perspective in an attempt to balance egocentrism and audience needs; providing less detail allows speakers to sample the space of the interaction cheaply and easily, while listeners' requests for additional information continually refine speakers' understanding of listeners' needs.

The main outcome of this preliminary analysis is that different communicative outcomes are associated with subtle differences in language use. This provides insight into how language reflects and influences how miscommunication is recognized and resolved. In order to establish this, however, we will need to investigate whether the language used in miscommunication predicts more global measures of success in the task. For example, RM might result in strategies that will improve performance because it forces interlocutors to negotiate about and resolve alignment of their perspectives. In contrast, failures to recognize the correct state (US) might result either in interlocutors discounting each other's confirmations or alternatively becoming more sensitive to subtle cues that their interlocutor is uncertain.

While this initial pass of the b•loc•o™ corpus (currently lacking measures of reliability for our coding procedure) should be interpreted mindfully, our findings do provide interesting preliminary insights into how lexical choice influences communicative success. Additionally, the categories investigated with LIWC may seem somewhat arbitrary, but the category labels selected were standard and validated LIWC labels (e.g., cognitive mechanisms). In the current form, these categories are not meant to map onto any specific linguistic forms or stages of language processing. Nevertheless, we view the patterns that emerged through these categories as a springboard for more thorough analyses. For example, within the categories of negation and assent, we can next look at specific forms of confirmation to study how they emerge as a function of certainty. Further analyses of the corpus should provide data that will help evaluate these hypotheses.

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