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The Independence between the History of Usage of an Expression and Common Ground: A processing account for pragmatic effects on comprehension

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Abstract

It has been thought that during conversation, the effect of the history of usage of an expression on comprehension depends on common ground. We tracked listeners' eye movements during a referential communication task in which they received instructions from two different speakers who described a referent either consistently or inconsistently with a previous description. We also manipulated cognitive load. Results showed that the effect of common ground and history of usage on comprehension are independent. A processing account for pragmatic effects on language comprehension is suggested.

Introduction

In conversation, when people refer multiple times to the same objects, they tend to stabilize their descriptions (Krauss & Weinheimer, 1966). This phenomenon has been referred to variously as *lexical entrainment* (Garrod & Anderson, 1987), or as the establishment of *conceptual pacts* (Brennan & Clark, 1996) or *linguistic precedents* (Barr & Keysar, 2002).

The fact that speakers use the same expressions consistently across a conversation and listeners expect such consistent use, has important implications for theories of spoken language comprehension and referential communication. One of those consequences is that not only the features of the objects are relevant for the description to be successful, but also the history of usage of the expression. For example, Brennan and Clark (1996) showed that people would violate the Gricean Maxim of Quantity (Grice, 1975), over-specifying a referent using a subordinate level term where the basic level term would have been enough to differentiate the object from among the other objects with which it was presented. Thus, if in a previous mention the (subordinate level) expression *loafer* was used to refer to a shoe in the context of other shoes, then in a subsequent mention, the speaker would re-use the description *loafer*, even when there was no other shoe in the array of context objects, making the basic level term *shoe* appropriate. Barr and Keysar (2002) showed in a series of eye-tracking experiments that listeners, indeed, are sensitive to the history of usage of an expression, expecting the use of precedents by the speaker.

Because the history of a conversation is something that we share with the people present in the conversation, and not with people outside of it, it has been assumed that the use of linguistic precedents and their benefit to comprehension depend on common ground: knowledge that is shared and known to be shared by the participants in a conversation (Clark and Marshall, 1981; Clark and Carlson, 1981). For example, imagine that you and I are zoologists classifying new specimens of flies we recently collected in South America. We are working in the lab and we have all our flies on the classification table. One of the specimens on the table is really small, but not as small as another specimen that got lost in our trip back. Nevertheless, we keep calling that small fly *the big fly*, even thought in the new context of flies it is the smallest one. Thus, we are being consistent with the name we gave to that fly to differentiate it from the other, smaller fly, that is no longer present. At a certain moment I leave the lab. During my absence a student stops by and, looking at the classification table, he says to you: *the big fly is still alive!* If the historical effect depends on common ground, then the precedent we have established to refer to the smallest fly (*the big fly*) should not be used in interpreting the expression *the big fly* uttered by the student, who wasn't present during the trip when we established the precedent; instead, you should interpret that expression against the context of all the flies that you and the student mutually know about. In this example, that context is all the flies on the table, where the fly we called *the big fly*, is actually the smallest one.

Empirical evidence, however, has shown that people use precedents even when they are not in common ground. Barr and Keysar (2002) and Metzing and Brennan (2003) found that the latency to launch a first fixation to a target object upon hearing a description previously used to refer to that object—a precedent—was the same independently of whether the speaker who uttered the description was the same or different from the speaker who established the precedent. Importantly, this was the case even when the listeners knew the speakers did not share any information about how to refer to the object. In our example, you would consider the smallest fly as the referent for the expression *the big fly* uttered by the student—even if you knew the student couldn't know about the other even smaller fly that got lost in the trip back—just because you had that precedent available in memory and not because it was mutually known with the student. Listeners, then, do not appear to rely on common ground when they interpret expressions that are consistent with an established precedent.

However, Metzing and Brennan (2003) showed that listeners delayed their fixations to a target object more when a speaker used a new expression to refer to an object

previously named by him with a different name, than when a different speaker referred for the first time to an object previously named by another speaker using a different name. In other words, if an old speaker breaks a precedent there is a delay in recognizing the target object compared when a new speaker breaks somebody else's precedent. In our example, if I suddenly stop referring to the smaller fly as *the big fly* and start using the expression *the short fly*, then you should experience more interference than if the student uses the expression *the short fly*. This finding could suggest that information about what a specific speaker knows is considered early in comprehension, producing a sort of interference. This interference could be taken as evidence that the history of referring and common ground might not be independent, at least, in the cases where a speaker breaks a precedent.

In the following experiment, we present fine grain time-course eyetracking data from a comprehension task, and the results of a cognitive load manipulation, that suggest that the history of usage (henceforth precedents) and common ground are independent effects. Specifically, we show that they have a different temporal profile, and that they are affected in different degrees by cognitive load.

We tracked participants' eye movements as they performed a referential communication task with two speakers. During the task, speakers produced certain 'test instructions' in which they referred to an old referent for which a precedent had been established. The experiment involved three independent variables: (1) the variable of *speaker*, corresponding to whether the speaker producing the test instruction was the same as (Old), or different from (New), the speaker who originally established the precedent; (2) *precedent*, which was whether the precedent that was established was consistent with (Maintain) or inconsistent with (Break) the test instruction; and (3) *cognitive load* (No Load versus Load).

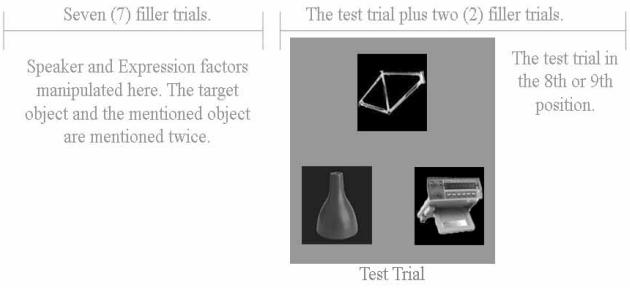
Method

Participants

Fifty-six (56) undergraduate students from the University of California, Riverside participated in the study in exchange for course credit. All were native English speakers.

Procedure and design

We tracked participants' eye movements while they listened to pre-recorded instructions from two different speakers asking them to click on one of three pictures of objects in the screen. The objects lacked conventional names, making the success of the task strongly rely on the use of precedents. Each test trial was embedded in a 10 trial block. The speakers referred to the target object twice before the test trial, which was either the trial 8th or 9th of the block. In the test trial, along with the target object there appeared another object that had been mentioned twice before the test trial, and an 'unmentioned' object that had never been referred to before the test trial (see figure 1). The speaker manipulation was implemented by either having the same speaker giving the instruction across the whole block, or changing the speaker in trial 8, right before the test trial. We motivated these changes of speaker by telling the participants that the goal of the experiment was to investigate the comprehension of instructions from different speakers. We made sure the participants knew the speakers had no communication between them during the recording of the instructions. To this end, we told them that the instructions were recorded in two different sessions (see below). The precedent manipulation was implemented by keeping the test trial instruction constant and varying the previous mentions of the objects (see figure 1). Finally, the load manipulation was instantiated by introducing a secondary task, in which listeners had to keep in memory a string of numbers presented right before the test trial started, for a test that would take place after the test trial ended. For the trials in the no load condition, no additional task was performed by the listeners. All three factors were combined factorially and administered within subject (2 x 2 x 2 within factor design).



Condition	First Mention	Second Mention	Test Mention
Old/Maintain	...black vase	...black vase	...the black vase
Old/Break	...upsidedown funnel	...upsidedown funnel	...the black vase
New/Maintain	*...black vase*	*...black vase*	...the black vase
New/Break	*...upsidedown funnel*	*...upsidedown funnel*	...the black vase

Figure 1: Example of an experimental item: The target object is in the lower-left part of the display, the Unmentioned object on the top, and the Mentioned object in the lower-right part of the display. The italiced text represents speech by the male speaker and the normal text represents speech by a female speaker. Applicable for both load conditions.

Materials

There were 32 items consisting of five pictures presented three at a time in a set of ten displays. The instructions were recorded by two naïve participants in a production version of the experiment. In order to produce the stimuli for all the conditions, we asked the participants, after the production sessions, to imitate the other speaker's instructions. We instructed them to use the same words used by the other speaker and convey the same level of certainty, but with their own style. Half of the test expressions were the original ones and the other half were imitations. For the secondary task we used 256 random strings of 6 digits from

0-9. 64 of these were strings to be remembered, 32 for the test trials and the other 32 for trials in the block other than the test trial. The other 192 were used as distractors presented three at the time for each memory test.

Results and Discussion

If speaker (common ground) and precedent (history of usage) effects are independent, then they should be distinguishable in the time-course of processing. They also might be affected in a different manner by cognitive load. We tested these predictions by examine the proportion of looks to the Unmentioned object in the displays, across seven different time windows starting from the onset of the referring expression plus 180ms (time necessary to program an eye movement, Matin, Shao & Boff, 1993). The idea that broken precedents depend on common ground predicts that a new expression inconsistent with an established precedent should be mapped onto the unmentioned object differently when the speaker is old than when the speaker is new. Specifically, if precedent and speaker effects are dependent, listeners should look to the unmentioned object more in the case where an old speaker breaks a precedent than when a new speaker, with whom there is no precedent established, uses a new expression to refer to the already-mentioned target.

As Figure 2 top panel shows for the case of No Load, this speaker effect in the Break condition appears in the fourth time window (900-1200 ms), well after the effect of precedent, which starts in the second window and is carried over the next five windows. This shows that the effect of precedent (whether or not the expression has been used before or not) is prior to the effect of speaker: they have different onsets. Interestingly, this effect of speaker is not present in the same fourth window in the Load condition (bottom panel), in which appears only an effect of precedent. A three-way within-factor Anova by subjects (F1) and items (F2) shows a reliable three-way interaction for that window: $F1(1, 55) = 5.611$, $MSe = .021$, $p < .05$; $F2(1, 31) = 7.44$, $MSe = .009$, $p = .01$. Further analysis shows that this three-way interaction is mainly driven by the presence of a two-way speaker by precedent interaction in the No Load condition ($F1(1, 55) = 9.743$, $MSe = .016$, $p < .01$, $F2(1, 31) = 8.15$, $MSe = .011$, $p < .01$), and the absence of that same interaction in the Load condition ($F1(1, 55) = .403$, $MSe = .021$, $p = .53$, $F2(1, 31) = .463$, $MSe = .011$, $p = .50$). Cell means comparisons show that the old and new speaker break conditions differ in the No Load condition ($t1(55) = 2.56$, $Se = .032$, $p < .05$, $t2(31) = 2.24$, $Se = .036$, $p < .05$) but not in the Load condition ($t1(55) = .375$, $Se = .033$, $p = .71$, $t2(31) = .386$, $Se = .032$, $p < .7$).

The effect of speaker in the break conditions seems that it might appear later in the Load conditions (bottom panel); namely, in the sixth and seventh time windows (bottom panel). However, there is no reliable three-way interaction in window seven, and a two-way within factor Anova for the Load conditions in the seventh window shows a marginal speaker by precedent interaction by both subjects and items: $F1(1, 55) = 2.98$, $MSe = .011$, $p = .09$ and $F2(1, 31) = 3.09$, $MSe = .006$, $p = .09$.

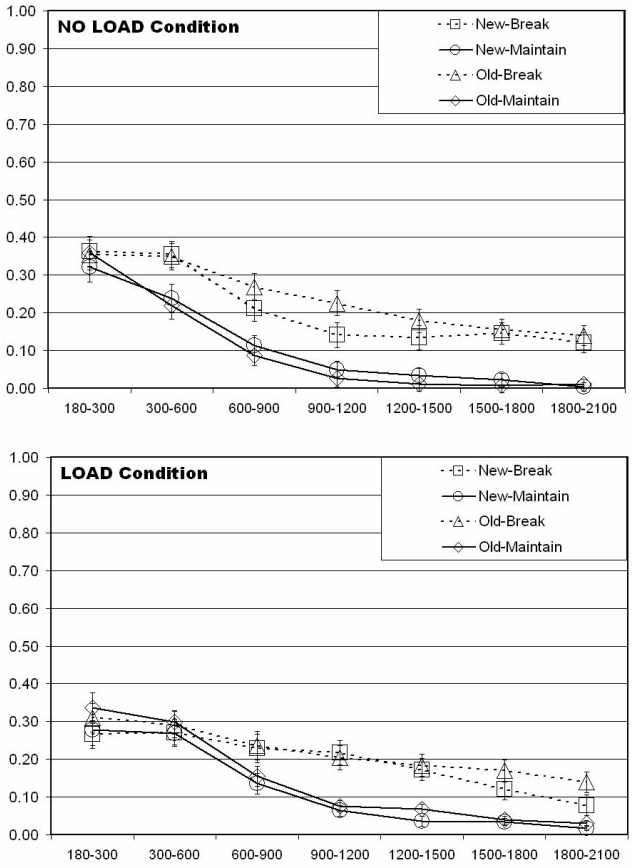


Figure 2: Proportion of fixations to the unmentioned objects across experimental conditions in the No Load condition (top panel) and the Load condition (bottom panel). The error bars represent the standard error of the difference between new and old speaker for each level of Precedent.

The effect of precedent in the Load conditions also appears delayed compared to the No Load conditions. It starts in the third window and, as in the No Load condition, is carried over the subsequent windows. A Three-way Anova on window two shows the delayed effect of precedent in the Load conditions compared to the No Load conditions in a Load by Precedent interaction: $F1(1, 55) = 10.79$, $MSe = .040$, $p < .01$; $F2(1, 31) = 8.53$, $MSe = .029$, $p < .01$. Collapsing over Speaker, the effect of precedent is significant in the No Load condition ($t1(55) = 5.45$, $Se = .023$, $p < .001$, $t2(31) = 3.96$, $Se = .031$, $p < .001$), and not significant in the Load condition ($\underline{t1}(55) = .087$, $Se = .028$, $p = .93$, $t2(31) = .099$, $Se = .025$, $p = .92$).

The results presented above show that the effect of precedents and speaker are different in at least two ways. First, they have a different time course: The onset of the

effect of precedent precedes the onset of the effect of speaker. Second, cognitive load more drastically delays the onset of the speaker effect than the precedent effect. There are, then, reasons to believe that these two pragmatic effects are independent.

General Discussion

How can, then, these two pragmatic effects be characterized in terms of processing?

The history of usage, manipulated in our experiments as whether or not the expression was used before or not (independently of the speaker), can be thought of as produced by the difference between the processes involved in finding a referent when there is a previous expression-object relation already established (i.e., when a precedent is maintained), and the processes involved in find a referent when that expression-object relation does not exist (i.e., when a new expression is interpreted). When speech following a precedent is heard, the task is to retrieve from memory a expression-object relation: It is a memory search process using no more information than the certainty that that expression being used is familiar. Once retrieved, the task is solved, and no further processing and information is necessary. This would explain why the unmentioned object is rapidly discarded as a potential referent when a precedent is maintained. One important prediction derived from this view of the use of precedents is that the time needed to identify a referent when a precedent is used is a power function of the number of times that identification as taken place before, i.e., precedent use should display the properties of automatization (Logan, 1988).

In contrast, when a new expression is heard and a precedent is broken, there is no memory instance relating that expression to a specific referent; therefore, it is necessary to match the features of the potential referents with the description given. This task should demand more time, as predicted by the power law relation assumed before. Because it demands more time, it gives the chance for other, slower pragmatic effects to appear; in this case, the effect of common ground. We believe that the processing of common ground requires more steps than the processing of a precedent explained above, because it requires more complex inferences that take more time. For example, consider the case of a new speaker using a new expression. When the object that best matches a new expression is one that was previously referred to using a different expression, by using common ground the listener can reach the conclusion that that object is the target because the previous name given to the object is not known by the current speaker, and it makes perfect sense for a new speaker to use a different expression than a previous speaker in referring to the same object. In the case of an old speaker using a new expression, in contrast, there would be no straightforward inference that could explain why she is using a new expression, making listeners consider the new object as a potential referent for longer time. Now, the fact that the common ground effect is delayed more drastically by the cognitive load manipulation than the precedent effect, may suggest that not only one effect is fast because it requires less steps and information than the other, but that they are different types of processing. One, the faster one, could be characterized as an associative process; the slower one, in contrast, could be characterized as inferential rule base processing. This distinction between different types of processing can be found throughout the literature on reasoning (for a review see Sloman, 1996).

There are many ways in which these two hypothesize processes could interact; they might start sequentially, in parallel, or in cascade (McClelland, 1987). These and other issues regarding the specifics of the processes are interesting questions for future research.

We have provided empirical support for the claim that pragmatic information can be integrated at different moments in comprehension. More importantly, our processing account provides an explanation for why different pragmatic information might impact comprehension at different moments. By doing this, we are shifting attention from the time-course of the effects to the characteristics of the processes involved. Time-course data by itself may be insufficient to identify different kinds of processing mechanisms. Despite much attention to time-course data, the controversy of how common ground is used in comprehension remains unresolved (Keysar, Barr, Balin and Paek, 1998; Keysar, Barr, Balin and Brauner, 2000; Hanna, Tanenhaus and Trueswell, 2003; Hanna and Tanenhaus, 2004; Barr and Keysar, 2002). We believe that an experimental approach focused on differentiating the different cognitive processes involved in integrating pragmatic and linguistic information might help in understanding language comprehension in its natural environment.

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