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Generating references in naturalistic face-to-face and phone-mediated dialogue settings

Dominique KNUTSEN

Department of Psychology, University of Essex

Christine ROS & Ludovic LE BIGOT

Université de Poitiers, France ; CNRS (CeRCA, UMR 7295), France

Corresponding author

Dominique KNUTSEN

University of Essex

Wivenhoe Park

Colchester CO4 3SQ

United Kingdom

Email address: dknutsen@essex.ac.uk

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Abstract

During dialogue, references are presented, accepted and potentially reused (depending on their accessibility in memory). Two experiments were conducted to examine reuse in a naturalistic setting (a walk in a familiar environment). In Experiment 1, where the participants interacted face-to-face, self-presented references and references accepted through verbatim repetition were reused more. Such biases persisted after the end of the interaction. In Experiment 2, where the participants interacted over the phone, reference reuse mainly depended on whether the participant could see the landmarks being referred to, although this bias seemed to be only transient. In line with the memory-based approach to dialogue, these results shed light on how differences in accessibility in memory (due to how these references were initially added to the common ground or the media used) affect the unfolding of the interaction.

Generating references in naturalistic face-to-face and phone-mediated dialogue settings

1. Introduction

During dialogue, speakers interact in order to reach a common goal such as discussing a route, for instance. According to the collaborative approach to dialogue, speakers make individual efforts during the interaction to ensure mutual comprehension (e.g., Clark, 1996). One way of doing so consists in tailoring the content of one's utterances to the current addressee, for instance by favoring the production of references which are easily understandable to him or her (Isaacs & Clark, 1987). Partner-adapted reference production requires speakers to estimate their partner's level of knowledge. Such estimations are based on the partners' *common ground*, which includes the knowledge that two speakers are aware of sharing (Clark & Marshall, 1981).

In particular, the common ground includes the references produced by the speakers during past interactions. References are added to the common ground through a joint contribution process (Clark & Schaefer, 1989; Clark & Wilkes-Gibbs, 1986) consisting in a *presentation* phase, during which one of the speakers produces a reference, followed by an *acceptance* phase, during which the other speaker manifests his or her understanding of the reference presented. Acceptance is either explicit (e.g., verbatim repetition of the reference) or implicit (e.g., initiation of the next relevant speech turn) (Clark & Brennan, 1991). References are also accepted through non-linguistic cues (e.g., head nods; Clark & Krych, 2004).

Presented and accepted references are then potentially *reused* during the remainder of the interaction. Reuse depends on reference accessibility in memory from each speaker's point of view, with readily accessible references being more likely to be reused (Knutsen & Le Bigot, 2012). In particular, reference accessibility depends on reference production at the

time of presentation and/or acceptance. Self-presented references are more likely to be reused than partner-presented ones, and references accepted through verbatim repetition are more likely to be reused than references accepted implicitly (Knutsen & Le Bigot, 2014). However, the influence of presentation on reference accessibility seems to be only transient, as reference accessibility after the end of an interaction is no longer significantly affected by initial presentation. Rather, it depends on acceptance, but also on how many times a given reference was reused during the interaction, suggesting that the level of accessibility of the references which belong to the common ground changes during the interaction (Knutsen & Le Bigot, 2015). This pattern of results has been attributed to a production effect in memory whereby words produced aloud are remembered better than words read silently (MacLeod, Gopie, Hourihan, Neary, & Ozubko, 2010). This effect is reinforced when these words are self-produced rather than partner-produced (MacLeod, 2011). Hence, studies on dialogic reuse illustrate the idea that "ordinary" memory mechanisms (i.e., mechanisms which are not specific to dialogue) play a central role in dialogue; in this sense, these studies are in line with the *memory-based* approach to dialogue developed by Horton and colleagues (Horton, 2007; Horton & Gerrig, 2002, 2005a, 2005b).

Of central interest for the current study, there has recently been an effort to take dialogue studies outside the laboratory. For instance, Brennan, Schuhmann, and Batres (2013) have made available the Walking Around Corpus, which consists in the transcription of spontaneous dialogues produced by dyads of participants interacting over the phone. One of the participants (the Giver) gave instructions to the other participant (the Follower) to enable the latter to find various locations on a University campus. Analyzing this corpus revealed – among other results – that the time taken to complete the task was related to the Giver's mental rotation ability. Another example is offered by Bangerter and Mayor (2013), who reported an experiment during which a Narrator told a story to another participant. The

partners performed the task either without moving or walking along a more or less complex route. The results illustrate how dialogue partners jointly manage the constraints associated with two concurrent activities (i.e., interacting and navigating a spatial environment). Such studies have important theoretical implications. They illustrate how the constraints inherent to real-life interactions, which are not always represented in laboratory settings, interact with the psychological processes involved in dialogue.

The current study is part of this ongoing effort to take dialogue studies outside the laboratory. It seeks to examine reference reuse in a more naturalistic dialogue situation in order to determine how the features of this situation affect dialogue management. In particular, in naturalistic settings, the participants must decide how to refer to the referents deemed relevant to the task; in other words, they must *generate* these references. This is not necessarily the case in laboratory settings, where the references which should be used by the participants are usually predefined in advance by the experimenters. Therefore, in naturalistic dialogue settings, self-presented words benefit both from a production effect and a *generation* effect (Slamecka & Graf, 1978), which might cause the self-presentation benefit to decay slower than in laboratory settings.

Moreover, so far reference reuse has exclusively been investigated in face-to-face dialogue, raising the question of the generalizability of the findings to mediated dialogue. Media constrain dialogue in several different ways. For instance, dialogue partners gesture differently depending on whether they are interacting face-to-face or over the phone (Bavelas, Gerwing, Sutton, & Prevost, 2008). Access to visual copresence (e.g., through videoconferencing) also affects the partners' ability to jointly perform a complex task such as repairing a bike (Kraut, Fussell, & Siegel, 2003). Finally, media constrain the way in which speakers add information to their common ground, as all of the strategies used by the speakers in face-to-face dialogue are not necessarily available in mediated dialogue (Clark & Brennan,

1991). For instance, when speakers interact over the phone, they cannot manifest their understanding by using head nods, which makes them more likely to use linguistic acceptance. Media might also affect reference reuse. For instance, when A and B interact over the phone, they might refer to referents which are only visible to A. Because reuse also depends on referent visibility (Knutsen & Le Bigot, 2012), this would make A more likely to reuse the corresponding references than B. The second purpose of this study is to address this possibility.

In two experiments, dyads of participants interacted to establish a route for foreign students visiting their University campus. In Experiment 1, the participants followed the route as they discussed it, referring to the landmarks they encountered. The purpose of this experiment was to determine whether reference reuse also depends on presentation and acceptance in naturalistic face-to-face dialogue. The first hypothesis was that self-presented references are more likely to be reused than partner-presented ones. The second hypothesis was that references accepted through verbatim repetition are more likely to be reused than references accepted implicitly. The reuse of references accepted anaphorically was also examined to determine whether the acceptance effect is due to verbatim repetition in particular or to repetition in general.

In Experiment 2, only one of the participants (the on-campus participant) followed the route during the interaction; the other participant (the remote participant) stayed at the laboratory. Thus, the landmarks mentioned were only visible to the former. The participants interacted over the phone. The purpose of this experiment was to determine whether reference reuse depends on the communication medium used. The first two hypotheses were the same as in Experiment 1. The third hypothesis was that on-campus participants are more likely to reuse references than remote participants.

In both experiments, the participants' memory for the route discussed was then assessed in an individual recall test to determine whether these differences in accessibility persist after the end of the interaction.

2. Experiment 1

2.1. Participants

Twenty-six participants (8 male; mean age 21.73, *SD* = 4.75) divided into dyads volunteered to take part in the experiment. They had been living in the University town the experiment took place in for 2.38 years (*SD* = 1.58) on average prior to the experiment. They all signed an informed consent form before the beginning of the experiment and were fully debriefed about the purpose of the study after the end of the experiment.

2.2. Apparatus

A microphone connected to a digital recorder was used to record the participants.

2.3. Task and procedure

The participants' task was to organize a visit of their University campus for foreign students who had never visited it before. The visit ran from an amphitheater to a dining hall, with an intermediate stop in front of the library. The participants were free to choose whichever itinerary they liked between these points. They were told that they should discuss the route as they followed it to make sure that they agreed on it.

The experiment was divided in two phases. During the first phase (dialogue phase), the participants were accompanied by the experimenter to the starting point of the visit. There, they were informed that they had as much time as necessary to set up a route as they followed it themselves. The experimenter stayed with the participants during the entire dialogue phase. The participants then walked back to the laboratory. During the second phase (recall phase), each participant had a maximum of 10 minutes to individually write the route out. No communication was allowed during this phase.

2.4. Experimental design

There were three independent variables (IVs): Presentation (a reference had either been self- or partner-presented), Acceptance (a reference had either been accepted through verbatim repetition, anaphorically or implicitly) and the Number of Reuses in the Dyad (which was a centered continuous IV).

2.5. Data coding

The landmarks mentioned by at least one of the dyads during the experiment (79 in total; some were mentioned by all dyads, some were mentioned by some of the dyads only and others were only mentioned by one of the dyads) were listed and coded for Presentation, Acceptance, Reuse and Recall (Tables 1 & 2). Only buildings and streets were counted as landmarks. References to other locations (e.g., "Room 4") were not counted as landmarks. Participants tended to use these references several times to refer to different locations (e.g., the reference "Room 4" was used to refer to Room 4 in the psychology building and Room 4 in the literature building) and it was not always possible to determine from the context which

location was referred to. Thus, discarding these references from the analysis allowed minimizing the number of potential coding mistakes.

----------Insert Table 1 about here----------

----------Insert Table 2 about here----------

2.5.1. Presentation, acceptance and reuse during the dialogue phase

When a reference was produced for the first time, its initiator was identified to determine whether it was self-presented or partner-presented from each participant's point of view. For instance, in Table 1, the reference "the psychology building" is coded as self-presented from B's point of view and as partner-presented from A's point of view.

After its presentation by one of the participants, each reference was then accepted by the other participant. The evidence produced by the latter between the moment when the reference was presented and the moment when its initiator produced another reference was examined to determine whether it was accepted through verbatim repetition (in which case it was repeated verbatim, as for "the psychology building") or anaphorically (in which case the referent was re-referred to by using a pronoun or a zero anaphor, as for "the student house"). All other presented references were coded as accepted implicitly (as for "the literature building"). Note that contrary to Presentation, Acceptance was coded at the dyadic level. For instance, the reference "the literature building" is coded as accepted implicitly from *both* participants' point of view.

All other occurrences of reference production were coded as reuses. In line with Knutsen and Le Bigot (2012, 2014, 2015), the only criterion was that reuse had to occur in a

speech turn preceded by two speech turns in which the reference had not been produced. Reuse was coded at two different levels. It was first coded as a binary variable from each participant's point of view (the participant either reused the reference or not, regardless of how many times he or she reused it). For instance, the reference "the psychology building" is coded as non-reused from A's point of view and as reused from B's point of view. This coding served as the binary dependent variable in the Reuse analysis. Reuse was then coded as a continuous variable at the dyadic level. This coding reflected how many times each reference was reused by the dyad. For instance, the reference "the psychology building" is only reused once: it is thus coded as having been reused once by the dyad from both participants' point of view. This coding served as a continuous IV in the Recall analysis.

2.5.2. Recall during the recall phase

The routes written out during the drafting phase were coded for recall. This was a binary variable: from each participant's point of view, a reference was either recalled or non-recalled. For instance, the reference "the student house" is coded as recalled from A's point of view and as non-recalled from B's point of view.

2.6. Results

The average number of words produced per dyad during the dialogue phase was 1858.08 (*SD* = 861.66), and the average number of references presented per dyad was 22.77 (*SD* = 6.56). A total of 296 references were presented. Among these, 87 (29.39%) were accepted through verbatim repetition, 98 (33.11%) were accepted anaphorically and 111 (37.50%) were accepted implicitly. The average number of words produced per participant during the recall

phase was 203.73 (*SD* = 50.88), and the average number of references recalled per participant was 10.69 (*SD* = 2.84).

The data were analyzed using logistic mixed models to account for the nesting of participants in dyads (McMahon, Pouget, & Tortu, 2006). The procedure followed to specify the random effects structures in these analyses is presented in Appendix A. For each dyad, only the data corresponding to the references which had been presented during the dialogue phase were analyzed, implying that the number of observations varied across dyads. This was accounted for in the analyses by applying the Satterthwaite correction (Keselman, Algina, Kowalchuk, & Wolfinger, 1999). The same analyses were conducted using the Kenward-Roger correction: because the pattern of results obtained was identical to that obtained by applying the Satterthwaite correction, only the latter is reported. Main effects were systematically included in the models; interactions were only included when they reached significance.

2.6.1. Reference reuse (dialogue phase)

A total of 183 references were reused (i.e., the total number of "reused" in the Reuse column was 183) (Table 3). We first examined the odd ratios (*OR*) associated with the differences between the modalities of each independent variable to determine the direction of these differences. Self-presented references were more likely to be reused than partner-presented ones, *OR* = 1.78, $CI_{.95}$ = 1.11, 2.86. References accepted through verbatim repetition or anaphorically were more likely to be reused than those accepted implicitly, respectively *OR* = 2.02, $CI_{.95}$ = 1.27, 3.20 and *OR* = 1.84, $CI_{.95}$ = 1.17, 2.89.

----------Insert Table 3 about here----------

A model was implemented including Presentation and Acceptance as fixed effects and Reuse as the binary outcome variable. The random structure included by-participant random slopes corresponding to Presentation. As expected, Presentation predicted Reuse, $F(1, 49) = 6.06$, $p = .017$. Acceptance also predicted Reuse, $F(2, 588) = 5.29$, $p = .005$. References accepted through verbatim repetition or anaphorically were more likely to be reused than references accepted implicitly. An additional pairwise comparison revealed no significant difference between references accepted through verbatim repetition and anaphorically, $p > .05$ (Sequential Bonferroni). The model parameters are reported in Appendix B (Table B1).

2.6.2. Reference recall (recall phase)

A total of 278 references were recalled (Table 4). Self-presented references were more likely to be recalled than partner-presented ones, $OR = 1.49$, $CI_{.95} = 1.02, 2.18$. References accepted through verbatim repetition or anaphorically were more likely to be recalled than references accepted implicitly, respectively $OR = 2.89$, $CI_{.95} = 1.80, 4.64$ and $OR = 1.22$, $CI_{.95} = 0.77, 1.94$. Finally, the odds of recalling a reference increased with the number of reuses, $OR = 4.00$, $CI_{.95} = 2.65, 6.02$.

----------Insert Table 4 about here----------

A model was implemented including Presentation, Acceptance and the Number of Reuses in the Dyad as fixed effects and Recall as the outcome variable. The random structure included by-dyad random intercepts and slopes corresponding to the Number of Reuses in the Dyad. Presentation predicted Recall, $F(1, 587) = 4.37$, $p = .037$. Acceptance also predicted Recall, $F(2, 587) = 10.56$, $p < .001$. References accepted through verbatim repetition were more likely to be recalled than references accepted implicitly. An additional pairwise

comparison revealed that references accepted through verbatim repetition were recalled more often than references accepted anaphorically, $p = .002$ (Sequential Bonferroni). Finally, the Number of Reuses in the Dyad predicted Recall, $F(1, 12) = 54.63$, $p < .001$. The model parameters are reported in Appendix B (Table B2).

2.7. Discussion

Experiment 1 sought to examine reference reuse outside the laboratory. As expected, self-presented references were reused more often than partner-presented ones, and references accepted through verbatim repetition were reused more often than references accepted implicitly. These results replicate and extend those initially obtained by Knutsen and Le Bigot (2014) in a laboratory setting by showing how production and/or generation at the time of presentation and acceptance affect subsequent reuse.

Furthermore, reference accessibility at the end of the interaction depended on presentation, acceptance and reuse. The significant difference between self- and partner-presented references confirmed that the presentation effect is increased in naturalistic settings, possibly due to generation. As for acceptance and reuse, the results follow the same pattern as in Knutsen and Le Bigot (2014). First, the differences in accessibility due to acceptance are observed after the end of the interaction. Second, the results confirm that reference accessibility in the common ground depends on reference production during the interaction, as recall also depended on how many times a reference was reused.

The reuse and recall of references accepted anaphorically were analyzed to determine whether the greater accessibility in memory of references accepted through repetition is due to repetition in general or to verbatim repetition in particular. The recall data suggest that this effect is due to verbatim repetition in particular, as references accepted through verbatim

repetition were recalled better than references accepted anaphorically. However, the difference between these two kinds of references was not significant in the reuse analysis, which revealed that both references accepted through verbatim repetition and anaphorically were more likely to be reused than those accepted implicitly. This is a priori incompatible with the suggestion that references accepted through verbatim repetition are more readily accessible than references accepted anaphorically, as reference accessibility in memory guides reference reuse (Knutsen & Le Bigot, 2012). One possible explanation is that the effect of acceptance on reuse reflects not only greater accessibility in memory of references accepted through verbatim repetition, but also strategic reasoning as to which references one's partner is capable of understanding. Indeed, references accepted through verbatim repetition or anaphorically might be perceived by speakers as more easy to understand than references accepted implicitly, as the former are explicitly marked as mutually known. If this assumption is correct, during the interaction, references accepted anaphorically are reused because the speakers assume that their partner is capable of understanding them. References accepted through verbatim repetition are reused for the same reason, and also because they are more readily accessible due to a production effect. During the recall test, the participants' performance is essentially driven by reference accessibility in memory, thus causing references accepted through verbatim repetition to be recalled better than any other kind of reference, including references accepted anaphorically. In sum, then, the effect of acceptance on reuse seems to be guided by accessibility in memory and strategic reasoning, and concerns all references accepted through repetition; by contrast, the effect of acceptance on recall seems to be guided mainly by accessibility in memory, and mainly concerns references accepted through verbatim repetition.

Importantly, examining reference recall is informative not only regarding the persistence of the accessibility differences observed during the interaction, but also regarding

the content of the trace left by the interaction in each speaker's memory. This point is important, as such traces are resorted to by the speakers in subsequent interactions to determine which references belong to their common ground (Brennan & Clark, 1996; Clark & Marshall, 1981). The results suggest that the content of such traces depends on how a reference was grounded and on whether it was reused, implying that some references should be easier to subsequently access than others (Knutsen & Le Bigot, 2015). Furthermore, A's self-presented references correspond to B's partner-presented references (and vice-versa), suggesting that the representations that A and B hold of their common ground are not necessarily identical.

To recap, naturalistic reference reuse depends on generation and/or production at the time of presentation and acceptance; the corresponding accessibility differences persist until after the end of the interaction. The purpose of Experiment 2 is to extend these findings by examining reference reuse in phone-mediated dialogue, as using a non-face-to-face medium might constrain reference reuse through referent visibility. In Experiment 2, the landmarks referred to during the dialogue phase were visible to one of the participants only. This should cause this participant to reuse more references than his or her partner (Knutsen & Le Bigot, 2012).

3. Experiment 2

3.1. Participants

Twenty-eight participants (6 male, mean age 21.86, *SD* = 2.95) who had been living in the University town the experiment took place in for 3.09 years (*SD* = 2.19) on average prior to the experiment were recruited under the same conditions as in Experiment 1.

3.2. Apparatus

A mobile phone and a land phone were used by the participants to communicate during the experiment. The dialogues were recorded using a digital recorder connected to the land phone.

3.3. Task and procedure

The task was similar to Experiment 1, except that the route was discussed over the phone. At the beginning of the experiment, each participant was assigned a role at random. The on-campus participant was informed that he or she would follow the route while interacting over the phone with the remote participant, who would stay at the laboratory. An experimenter then accompanied the on-campus participant to the starting point of the visit while the remote participant stayed at the laboratory with another experimenter. At the end of the dialogue phase, the on-campus participant walked back to the laboratory, where both participants individually wrote the route out.

3.4. Experimental design and data coding

The experimental design was similar to that of Experiment 1, except that it included an additional IV, Partner Role (on-campus participant vs. remote participant). The data were coded in the same way as in Experiment 1.

3.5. Results

The average number of words produced per dyad during the dialogue phase was 1767.86 (*SD* = 789.54), and the average number of references presented per dyad was 18.57 (*SD* = 3.34). A total of 260 references were presented. Among these, 47 (18.08%) were accepted through verbatim repetition, 158 (60.77%) were accepted anaphorically and 55 (21.15%) were accepted implicitly. The average number of words produced per participant during the recall phase was 192.32 (*SD* = 40.63), and the average number of references recalled per participant was 11.11 (*SD* = 2.56). The data were analyzed in the same way as in Experiment 1.

3.5.1. Reference reuse (dialogue phase)

A total of 230 references were reused (Table 5). On-campus participants were more likely to reuse references than remote participants, *OR* = 2.43, $CI_{.95}$ = 1.11, 5.31. Self-presented references were slightly more likely to be reused than partner-presented ones, *OR* = 1.07, $CI_{.95}$ = 0.63, 1.82. Finally, references accepted through verbatim repetition or anaphorically were more likely to be reused than references accepted implicitly, respectively *OR* = 2.47, $CI_{.95}$ = 1.31, 4.67 and *OR* = 1.74, $CI_{.95}$ = 1.03, 2.93.

----------Insert Table 5 about here----------

A model was implemented including Presentation, Acceptance and Partner Role as fixed effects and Reuse as the outcome variable. The random structure included by-dyad random intercepts and slopes corresponding to Partner Role and by-participant random intercepts and slopes corresponding to Partner Role and Presentation. Acceptance predicted Reuse, $F(2, 515) = 4.04$, $p = .018$. References accepted through verbatim repetition or anaphorically were more likely to be reused than references accepted implicitly. An additional pairwise comparison revealed no significant difference between references accepted through

verbatim repetition and references accepted anaphorically, $p > .05$ (Sequential Bonferroni). Partner Role also predicted reuse, $F(1, 15) = 5.85$, $p = .029$. In contrast, the effect of Presentation failed to reach statistical significance, $F(1, 25) = 0.07$, $p = .790$. The model parameters are reported in Appendix B (Table B3).

3.5.2. Reference recall (recall phase)

A total of 311 references were recalled (Table 6). Contrary to what was found previously, on-campus participants were *less* likely to recall references than remote participants, $OR = 0.69$, $CI_{.95} = 0.42, 1.15$. Self-presented references were more likely to be recalled than partner-presented ones, $OR = 1.28$, $CI_{.95} = 0.78, 2.10$. Once again contrary to what was found previously, references accepted through verbatim repetition or anaphorically were *less* likely to be recalled than references accepted implicitly, respectively $OR = 0.90$, $CI_{.95} = 0.27, 3.02$ and $OR = 0.61$, $CI_{.95} = 0.20, 1.90$. Finally, the odds of recalling a reference increased with the number of reuses, $OR = 20.29$.

----------Insert Table 6 about here----------

A model was implemented including Partner Role, Presentation, Acceptance, the Number of Reuses in the Dyad and the interaction between the Number of Reuses in the Dyad and Acceptance as fixed effects and Recall as the outcome variable. The random structure included by-dyad intercepts and slopes corresponding to Acceptance and the Number of Reuses and by-participant slopes corresponding to the Number of Reuses. The Number of Reuses in the Dyad predicted Recall, $F(1, 32) = 30.08$, $p < .001$. This main effect was modulated by a significant interaction with Acceptance, $F(2, 367) = 4.76$, $p = .009$. This interaction revealed that the odds of recalling a reference tended to increase with the number

of reuses in the dyad but that this tendency was weaker when this reference had been accepted through verbatim repetition than when it had been accepted implicitly. The effects of Presentation, Acceptance and Partner Role failed to reach statistical significance, respectively $F(1, 512) = 0.93$, $p = .335$, $F(2, 32) = 0.68$, $p = .516$ and $F(1, 269) = 2.01$, $p = .157$. The model parameters are reported in Appendix B (Table B4).

3.6. Discussion

Experiment 2 sought to replicate Experiment 1 in a phone-mediated dialogue setting. Consistent with the finding that referent visibility guides reuse (Knutsen & Le Bigot, 2012), on-campus participants reused more references than remote participants. Thus, communication media affect not only the way in which speakers add information to their common ground (Clark & Brennan, 1991), but also the use that the speakers make of this common ground in the remainder of the interaction, for instance because the absence of visual copresence causes references to landmarks to be more readily accessible to one of the partners than to the other. Furthermore, contrary to Experiment 1, the effect of presentation on reuse failed to reach statistical significance in Experiment 2, suggesting that the speakers' tendency to reuse self-presented references more often is attenuated when two speakers interact over the phone. One possible explanation is that the visibility effect is much stronger than the presentation effect, thus causing the latter to become non-significant statistically.

As in Experiment 1, reuse also depended on acceptance: references accepted through verbatim repetition were reused more often than references accepted implicitly. The effect of acceptance on reuse remained significant even when Partner Role was included in the model, suggesting that this effect was stronger than the presentation effect. This is consistent with the idea (developed above) that this effect is due to both greater accessibly in memory of

references accepted through verbatim repetition and strategic reasoning as to which references one's partner is capable of understanding, whereas the effect of presentation is mainly due to greater accessibility in memory of self-presented references.

In Experiment 2, reference recall mainly depended on how many times the references had been reused during the interaction. A significant interaction with acceptance suggested that in phone-mediated settings, the references which do not benefit from an accessibility increase due to verbatim repetition at the time of acceptance are all the more likely to benefit from an accessibility increase due to reference reuse during the interaction. A plausible explanation is that in such settings, the accessibility increase due to acceptance through verbatim repetition causes a ceiling effect which limits the extent of which reference accessibility can subsequently be increased through reuse. Besides, the influence of Partner Role on reference recall failed to reach statistical significance, suggesting that the influence of landmark visibility was fairly low at the end of the interaction. Reference reuse during the interaction might have contributed to increase reference accessibility in memory from the remote participant's point of view, thus making the references mentioned during the interaction similarly accessible from this participant's and the on-campus participant's point of view.

4. General discussion

The current study falls in a theoretical framework whose purpose is to account for the interaction between ordinary memory processes and common ground use in dialogue (e.g., Horton & Gerrig, 2005a). The aim of this study was to offer a better understanding of how differences in accessibility between the references which belong to the speakers' common ground influence their reuse in a non-laboratory setting.

The results obtained confirm that in naturalistic dialogue settings, the differences in accessibility due to the joint nature of grounding (i.e., presentation and acceptance) affect reuse in the remainder of the interaction. Reuse is also guided by referent visibility, which has important implications for mediated communication. Part of these memory biases persist after the end of the interaction. In line with the memory-based approach to dialogue (e.g., Horton & Gerrig, 2005a), these findings illustrate how ordinary memory mechanisms such as the production effect and/or the generation effect affect dialogue.

These experiments also shed light on the benefits associated with taking dialogue studies outside the laboratory in at least two different ways. First, the fact that the presentation effect persisted after the end of the interaction in Experiment 1, whereas this was not the case in a laboratory setting (Knutsen & Le Bigot, 2014), suggests that more naturalistic experimental settings allow detecting effects which cannot necessarily be detected in the laboratory. Second, the fact that this study involved both face-to-face and mediated communication contributes to generalizing the results obtained to various kinds of naturalistic situations. It is important to point out here that mediated dialogue settings different from the one used in this experiment might give rise to different reuse patterns. For instance, part of the referents mentioned during an interaction between A and B might be visible only to A while others might be visible only to B, thus causing speakers to preferentially reuse different subsets of the references presented.

The current study was introduced within the framework of the memory-based approach to dialogue (e.g., Horton & Gerrig, 2005a), as its initial goal was to show how ordinary memory mechanisms might influence dialogue management. However, the results obtained are also compatible with other theoretical frameworks. Among these, the interactive alignment model (Pickering & Garrod, 2004, 2006; see also Garrod & Pickering, 2004, 2009) suggests that dialogue partners come to share the same representations (i.e., linguistic [lexical,

syntactic, etc.] representations) as they interact. Such *local* alignment eventually leads to global alignment, that is, speakers come to share similar mental models of the situation under discussion. Local alignment relies on an automatic priming process which causes active linguistic representations to temporarily remain readily accessible in memory. Importantly, priming concerns both production and comprehension (Branigan, Pickering, & Cleland, 2000). It may occur because a speaker produces an utterance based on one or several given representation(s), but also because he or she hears his or her partner producing an utterance based on the same representation(s). In the current study, producing a reference (i.e., presenting a reference, accepting a reference through verbatim repetition or reusing a reference) and/or understanding a reference (i.e., hearing one's partner presenting a reference, hearing one's partner accepting a reference through verbatim repetition or hearing one's partner reusing a reference) made the participants more likely to subsequently reuse and/or to recall this reference. Therefore, the results reported here might also reflect between- and within-partner priming in dialogue. The fact that such priming was observed in both experiments would suggest that lexical alignment occurs both in face-to-face and mediated dialogue. What's more, as highlighted above, one of the functions of local alignment (e.g., lexical alignment) is to contribute to global alignment (Pickering & Garrod, 2004). Such function might be all the more important in mediated dialogue settings where the partners do not have access to visual copresence, as it is presumably more difficult for the partners to build similar representations of the situation under discussion in such settings. In particular, the fact that there was not significant effect of Partner Role on recall in Experiment 2 would imply that at the end of the experiment, both participants held a similar representation of the route discussed, thus suggesting that the strength of the priming mechanisms at play during the interaction was sufficient to increase mental model similarity regardless of the role initially played during the interaction.

In conclusion, these two experiments shed light on the interconnections between ordinary memory processes and common ground use in dialogue. Indeed, the results are in line with the idea that accounting for speaker behavior during dialogue requires to study dialogue as a collaborative activity during which speakers jointly gather common ground (Clark, 1996). However, the fact that individual speakers are sensitive to ordinary processes which might affect dialogue management must also be taken into account (e.g., Horton & Gerrig, 2005a; Pickering & Garrod, 2004), if only to explain how reference production at the time of presentation and acceptance affects subsequent reference accessibility in memory. Experimenting outside of the laboratory contributes to enhancing the validity of the findings obtained within this framework.

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Table 1

Annotated Dialogue and Route Samples

Part.	Utterance content (English translation)	Comments	Coding
B	towards the end of *the literature building* to arrive in front of *the psychology building*	The references "the literature building" and "the psychology building" are produced for the first time in the dyad.	The references "the literature building" and "the psychology building" are coded as self-presented from B's point of view and as partner-presented from A's point of view.
A	*the psychology building*	The reference "the psychology building" is repeated verbatim by the other participant (A) before its initiator (B) produces another reference.	The reference "the psychology building" is coded as accepted through verbatim repetition.
B	Yeah		
A	Well		
B	so here *the student house* is in front of us to the left	The reference "the student house" is produced for the first time in the dyad. B, who presented the reference "the literature building", produces another reference before A has the opportunity to accept this reference through verbatim repetition or anaphorically.	The reference "the student house" is coded as self-presented from B's point of view and as partner-presented from A's point of view. The reference "the literature building" is coded as accepted implicitly.
A	in front of us yes	A zero anaphor ("yes" in fact meaning "yes [the student house is in front of us]") is used by the other participant (A) to re-refer to the student house before its initiator (B) produces another reference.	The reference "the student house" is coded as accepted anaphorically.
B	yes in front of us *the student house* and to the left *the psychology building*	The reference to the student house is not coded as reused, as this speech turn is not	The reference "the psychology building" is coded by reused by B and as non-reused by

		preceded by two speech turns in which this reference was not produced, contrary to the reference to the psychology building.	A. It is also coded as reused once by the dyad.

Part.	Route content	Coding
A	[…] After that you should cross the street and to the left you will see the *psychology building*. Continue straight on, just in front of you you will find the *student house*. […]	The references "the psychology building" and "the student house" are coded as recalled by Speaker A.
B	[…] We cross the street and we continue straight on. We walk past of the *psychology building* and the laboratory. […]	The reference "the psychology building" is coded as recalled by Speaker B.

Table 2

Coding Example

Reference	Participant	Presentation (IV#1)	Acceptance (IV#2)	Reuse (DV#1)	Reuses in Dyad (IV#3)	Recall (DV#2)
Psychology building	A	Partner-presented	Verbatim	Non-reused	1	Recalled
Psychology building	B	Self-presented	Verbatim	Reused	1	Recalled
Student house	A	Partner-presented	Anaphoric	Non-reused	0	Recalled
Student house	B	Self-presented	Anaphoric	Non-reused	0	Non-recalled
Literature building	A	Partner-presented	Implicit	Non-reused	0	Non-recalled
Literature building	B	Self-presented	Implicit	Non-reused	0	Non-recalled
Pyramid-shaped building	A	Non-presented	/	/	/	/
Pyramid-shaped building	B	Non-presented	/	/	/	/

Table 3

Experiment 1 – Number (and Proportions) of References Reused and Non-Reused by the Participants as a Function of Presentation and of Acceptance

	Self-presented	Partner-presented
Accepted through verbatim repetition		
Reused	33 (.38)	31 (.36)
Non-reused	54 (.62)	56 (.64)
Total	87	87
Accepted anaphorically		
Reused	42 (.43)	26 (.27)
Non-reused	56 (.57)	72 (.73)
Total	98	98
Accepted implicitly		
Reused	36 (.32)	15 (.14)
Non-reused	75 (.68)	96 (.86)
Total	111	111

Note. The total number of presented references being 296, the maximum number of reuses was 592 (296*2), as any presented reference could be reused by up to two participants. The proportions reported in parentheses were calculated by dividing the number of reused references (or the number of non-reused references) by the total number of references presented in each cell of the experimental design.

Table 4

Experiment 1 – Number (and Proportions) of References Recalled and Non-Recalled by the Participants as a Function of Presentation and of Acceptance

	Self-presented	Partner-presented
Accepted through verbatim repetition		
Recalled	59 (.68)	53 (.61)
Non-recalled	28 (.32)	34 (.39)
Total	87	87
Accepted anaphorically		
Recalled	43 (.44)	41 (.42)
Non-recalled	55 (.56)	57 (.58)
Total	98	98
Accepted implicitly		
Recalled	48 (.43)	34 (.31)
Non-recalled	63 (.57)	77 (.69)
Total	111	111

Note. The corresponding proportions are reported in parentheses.

Table 5

Experiment 2 – Number (and Proportions) of References Reused and Non-Reused by the Participants as a Function of Presentation, Acceptance and Partner Role

	Self-presented	Partner-presented
On-campus participant		
Accepted through verbatim repetition		
Reused	21 (.68)	9 (.56)
Non-reused	10 (.32)	7 (.44)
Total	31	16
Accepted anaphorically		
Reused	66 (.55)	22 (.56)
Non-reused	53 (.45)	17 (.44)
Total	119	39
Accepted implicitly		
Reused	19 (.40)	5 (.71)
Non-reused	29 (.60)	2 (.29)
Total	48	7
Remote participant		
Accepted through verbatim repetition		
Reused	9 (.56)	15 (.48)
Non-reused	7 (.44)	16 (.52)
Total	16	31
Accepted anaphorically		
Reused	16 (.41)	37 (.31)
Non-reused	23 (.59)	82 (.68)
Total	39	119
Accepted implicitly		
Reused	3 (.43)	8 (.17)
Non-reused	4 (.57)	40 (.83)
Total	7	48

Note. The total number of presented references being 260, the maximum number of reuses was 520. The corresponding proportions are reported in parentheses.

Table 6

Experiment 2 – Number (and Proportions) of References Recalled and Non-Recalled by the Participants as a Function of Presentation, Acceptance and Partner Role

	Self-presented	Partner-presented
On-campus participant		
Accepted through verbatim repetition		
Recalled	21 (.68)	11 (.69)
Non-recalled	10 (.32)	5 (.31)
Total	31	16
Accepted anaphorically		
Recalled	69 (.58)	20 (.51)
Non-recalled	50 (.42)	19 (.49)
Total	119	39
Accepted implicitly		
Recalled	25 (.52)	4 (.57)
Non-recalled	23 (.48)	3 (.43)
Total	48	7
Remote participant		
Accepted through verbatim repetition		
Recalled	12 (.75)	20 (.65)
Non-recalled	4 (.25)	11 (.35)
Total	16	31
Accepted anaphorically		
Recalled	25 (.64)	74 (.62)
Non-recalled	14 (.36)	45 (.38)
Total	39	119
Accepted implicitly		
Recalled	5 (.71)	25 (.52)
Non-recalled	2 (.29)	23 (.48)
Total	7	48

Note. The corresponding proportions are reported in parentheses.

Appendix A: Specifying the random structure of the models used to analyze the data

Logistic mixed models were used to analyze the data in the two experiments reported in this study. Logistic models are used in analyses where the outcome variable is binary (see Jaeger, 2008). As for mixed models, they include both fixed effects (i.e., the IVs) and random effects. Random effects have two main functions in such models. First, there is potentially a strong dependency between the behaviors of two participants belonging to the same dyad (see McMahon et al., 2006). For instance, A's tendency to reuse references more or less often might influence B's tendency to reuse references more or less often, and vice-versa. In this context, mixed models are used to model the multilevel structure of the data (e.g., the fact that participants were nested within dyads in this study). Second, mixed models are used to account for potential variability between analysis units. Precisely, random intercepts allow accounting for variability across analysis units (in this case, dyads and participants) and random slopes allow accounting for analysis units differing in their sensitivity to the within-unit fixed effects. For instance, in this study, some dyads might have tended to reuse more references than others, which was accounted for by including by-dyad random intercepts in the models; in a similar way, some dyads might have been more sensitive to the acceptance effect than others, which was accounted for by including by-dyad random slopes corresponding to the Acceptance IV in the models. Note that the same rationale can be applied at the participant level; when the study includes items (which was not the case here), the rationale can also be applied at the item level.

Barr, Levy, Scheepers, and Tily (2013) have suggested that mixed models should initially include the maximal random effects structure justified by the experimental design. In other words, they should include all random intercepts and all random slopes corresponding to within-unit IVs. However, doing so might cause the models to fail to converge (i.e., to find an

appropriate way of modelling the data within the specified number of iterations). There are different kinds of convergence problems, one of which can easily be solved using the GLIMMIX procedure in SAS (Kiernan, Tao, & Gibbs, 2012). This problem concerns the variance-covariance matrix for the random effects, or G matrix. G matrix convergence issues occur when the variance of at least one of the random effects included in the model is equal to zero, controlling for everything else in the model. For instance, in the current study, dyads might not have significantly differed in their sensitivity to Acceptance: in this case, the variance associated with by-dyad random slopes corresponding to Acceptance would be zero, and the model including this random effect would fail to converge. The random effects causing such convergence problems can be removed from the model without affecting the output of the analysis (slight variations in *F* values and model parameters might be observed); they can also be left in the model, because, as pointed out by Kiernan et al. (2012), "there is nothing inherently wrong with the results when this [convergence problem] occurs" (p. 10). SAS 9.4 allows directly identifying which random effects cause the G matrix convergence problem and removing these from the model without having to perform a step-by-step model comparison analysis. These random effects can then be removed from the model without affecting the output of the analysis.

In this study, each analysis was initially conducted using a model including by-dyad and by-participant random intercepts, as well as all by-dyad and by-participant random slopes corresponding to within-participant IVs (in other words, each analysis was initially conducted using the maximal random effect structure justified by the design; Barr et al., 2013). However, this structure systematically led to G matrix convergence problems, as at least one of the random effects was associated with a variance of zero. These effects were identified and removed from the model for the final analysis. Only the results from the final analyses are reported in Appendix B: indeed, reporting the results from the initial analysis would have

been redundant, for in each analysis, the model parameters corresponding to the initial model and final model were identical (Kiernan et al., 2012). For information purposes, the SAS syntax used to run both the initial and final analyses is provided in the online supplementary material.

Appendix B: Test of Fixed Effects, Model Parameters and Covariance Parameter Estimates Corresponding to the Final Analyses Conducted

Table B1

Experiment 1 – Reuse Analysis – Test of Fixed Effects, Model Parameters and Covariance Parameter Estimates Corresponding to the Final Model

Test of fixed effects				
Effect	Num DF	Den DF	*F* value	*p* value
Presentation	1	49	6.06	.017
Acceptance	2	588	5.29	.005

Model parameters					
Effect	Estimate	Standard Error	DF	*t* value	*p* value
Intercept	-1.57	0.22	146	-7.02	< .001
Presentation: Self	0.58	0.24	49	2.46	.017
Presentation: Partner	0				
Acceptance: Verbatim	0.70	0.24	588	2.98	.003
Acceptance: Anaphoric	0.61	0.23	588	2.66	.008
Acceptance: Implicit	0				

Note. Estimate values set to 0 correspond to the baselines used in the analysis.

Covariance parameter estimates			
Subject	Parameter	Estimate	Standard Error
Dyad	Intercept	/	/
Dyad	Presentation	/	/
Dyad	Acceptance	/	/
Participant	Intercept	/	/
Participant	Presentation	0.26	0.14
Participant	Acceptance	/	/

Note. Estimate values noted / correspond to the random effects which were associated with a variance equal to zero in the initial analysis and which were therefore removed in the final analysis.

Table B2

Experiment 1 – Recall Analysis – Test of Fixed Effects, Model Parameters and Covariance Parameter Estimates Corresponding to the Final Model

Test of fixed effects				
Effect	Num DF	Den DF	*F* value	*p* value

Presentation	1	587	4.37	.037
Acceptance	2	587	10.56	< .001
Number of Reuses	1	12	54.63	< .001

Model parameters

Effect	Estimate	Standard Error	DF	*t* value	*p* value
Intercept	-0.50	0.24	45	-2.10	.041
Presentation: Self	0.40	0.19	587	2.09	.037
Presentation: Partner	0				
Acceptance: Verbatim	1.06	0.24	587	4.39	< .001
Acceptance: Anaphoric	0.20	0.24	587	0.84	.400
Acceptance: Implicit	0				
Number of Reuses	1.39	0.19	12	7.39	< .001

Note. Estimate values set to 0 correspond to the baselines used in the analysis.

Covariance parameter estimates

Subject	Parameter	Estimate	Standard Error
Dyad	Intercept	0.25	0.15
Dyad	Presentation	/	/
Dyad	Acceptance	/	/
Dyad	Reuses	0.14	0.17
Participant	Intercept	/	/
Participant	Presentation	/	/
Participant	Acceptance	/	/
Participant	Reuses	/	/

Note. Estimate values noted / correspond to the random effects which were associated with a variance equal to zero in the initial analysis and which were therefore removed in the final analysis.

Table B3

Experiment 2 – Reuse Analysis – Test of Fixed Effects, Model Parameters and Covariance

Parameter Estimates Corresponding to the Final Model

Test of fixed effects

Effect	Num DF	Den DF	*F* value	*p* value
Partner Role	1	14.75	5.85	.029
Presentation	1	24.09	0.07	.790
Acceptance	2	11.60	3.99	.048

Model parameters

Effect	Estimate	Standard Error	DF	*t* value	*p* value
Intercept	-1.28	0.36	52	-3.58	< .001
Presentation: Self	0.07	0.26	24	0.27	.790
Presentation: Partner	0				

Acceptance: Verbatim	0.91	0.33	18	2.78	.012
Acceptance: Anaphoric	0.55	0.27	12	2.05	.063
Acceptance: Implicit	0				
Partner role: On-campus	0.89	0.37	15	2.42	.029
Partner role: Remote					

Note. Estimate values set to 0 correspond to the baselines used in the analysis.

Covariance parameter estimates			
Subject	Parameter	Estimate	Standard Error
Dyad	Intercept	0.18	0.34
Dyad	Presentation	/	/
Dyad	Acceptance	0.01	0.27
Dyad	Location	0.38	/
Participant	Intercept	0.08	/
Participant	Presentation	0.14	0.22
Participant	Acceptance	/	0.36
Participant	Location	0.02	0.41

Note. Estimate values noted / correspond to the random effects which were associated with a variance equal to zero in the initial analysis and which were therefore removed in the final analysis.

Table B4

Experiment 2 – Recall Analysis – Test of Fixed Effects, Model Parameters and Covariance Parameter Estimates Corresponding to the Final Model

Test of fixed effects				
Effect	Num DF	Den DF	*F* value	*p* value
Presentation	1	512	0.93	.335
Acceptance	2	32	0.68	.516
Location	1	269	2.01	.157
Number of Reuses	1	32	30.08	< .001
Number of Reuses * Acceptance	2	367	4.76	.009

Model parameters					
Effect	Estimate	Standard Error	DF	*t* value	*p* value
Intercept	1.29	0.60	86	2.14	.035
Presentation: Self	0.24	0.25	512	0.97	.335
Presentation: Partner	0				
Acceptance: Verbatim	-0.11	0.61	62	-0.18	.858
Acceptance: Anaphoric	-0.50	0.57	66	-0.87	.386
Acceptance: Implicit	0				
Number of reuses	3.01	0.83	412	3.64	< .001
Partner role: On-campus	-0.37	0.26	269	-1.42	.157
Partner role: Remote	0				
Number of reuses * Acceptance:	-2.20	0.89	505	-2.47	.014

Verbatim					
Number of reuses * Acceptance:	-1.11	0.85	440	-1.31	.191
Anaphoric					
Number of reuses * Acceptance:	0				
Implicit					

Note. Estimate values set to 0 correspond to the baselines used in the analysis.

Covariance parameter estimates

Subject	Parameter	Estimate	Standard Error
Dyad	Intercept	1.04	0.62
Dyad	Location	/	/
Dyad	Presentation	/	/
Dyad	Acceptance	0.37	0.28
Dyad	Number of Reuses	0.12	0.42
Dyad	Number of Reuses * Acceptance	/	/
Participant	Intercept	/	/
Participant	Location	/	/
Participant	Presentation	/	/
Participant	Acceptance	/	/
Participant	Number of Reuses	0.27	0.34
Participant	Number of Reuses * Acceptance	/	/

Note. Estimate values noted / correspond to the random effects which were associated with a variance equal to zero in the initial analysis and which were therefore removed in the final analysis.