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The influence of partner-specific memory associations on language production:

Evidence from picture naming

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Abstract

In typical interactions, speakers frequently produce utterances that appear to reflect beliefs about the common ground shared with particular addressees. Horton and Gerrig (2005a) proposed that one important basis for audience design is the manner in which conversational partners serve as cues for the automatic retrieval of associated information from memory. This paper reports the results of two experiments demonstrating the influence of partner-specific memory associations on language production. Following an initial task designed to establish associations between specific words (Experiment 1) or object categories (Experiment 2) and each of two partners, participants named a series of pictures in the context of the same two individuals. Naming latencies were shortest for responses associated with the current partner, and were not significantly correlated with explicit recall of partner-item associations. Such partner-driven memory retrieval may constrain the information accessible to speakers as they produce utterances for particular addressees.

During conversational interactions, the form and content of speakers' utterances are potentially shaped in a variety of ways by the intended audience. Speakers not only adjust global characteristics of their speech, such as overall complexity, in response to the perceived needs of particular types of addressees (e.g., non-native speakers; Bortfeld & Brennan, 1997), but can also make relatively fine-grained adjustments to referential (e.g., Fussell & Krauss, 1989), syntactic (e.g., Haywood, Pickering, & Branigan, 2005) and even gestural (e.g., Özyürek, 2002) aspects of their behaviors based on interactions with specific individuals. Taken together, these partner-related adjustments are known as *audience design* (Clark & Murphy, 1982) and appear to be a ubiquitous feature of conversational speech.

Although utterances routinely show evidence of having been tailored for certain addressees, the cognitive mechanisms that underlie audience design are not well understood. A primary issue concerns the extent to which instances of audience design necessarily emerge on the basis of considerations of the knowledge taken as shared between interlocutors—their *common ground*. Although individuals are presumed to coordinate interactions on the basis of beliefs about common ground (Clark, 1996), evidence is mixed regarding when and how this actually occurs (for a discussion, see Schober & Brennan, 2003). For example, speakers sometimes fail to consider addressees as much as they “should,” producing utterances that are ambiguous (Keysar & Henly, 2002) or that show little evidence of addressee-specific adjustments (Ferreira & Dell, 2000; Kraljic & Brennan, 2005). Conversely, some aspects of utterances that could be potentially helpful for addressees—e.g., articulatory reduction (Bard et al., 2000; Fowler, Levy & Brown, 1997) or heavy NP shift (Arnold, Wasow, Losongco, & Ginstrom, 2000; Wasow, 1997)—may emerge instead on the basis of speaker-internal constraints.

To account for these disparate findings, cognitive models of language use should explain not only when and how partner-relevant information can influence different aspects of language production, but also how speakers have access to information about common ground in the first place. One recent attempt to address these issues was proposed by Horton and Gerrig (2005a), which described speakers' beliefs about common ground as emerging in part from how people automatically encode and retrieve information about other individuals from memory. The experiments presented in this paper are intended to provide preliminary evidence in support of this memory-based perspective.

Memory-based processes and audience design

The standard conceptualization of how speakers manage conversational common ground assumes that they explicitly consider the current knowledge states and perspectives of their addressees, either during initial utterance planning (Clark & Marshall, 1981) or through secondary monitoring processes (Horton & Keysar, 1996). Although strategic considerations of common ground can occur in particular circumstances, Horton and Gerrig (2005a) suggested that many instances of language use depend instead on relatively automatic "assessments" of common ground, mediated via low-level memory mechanisms. On this account, during routine interactions other individuals can become linked, or associated in memory, to a wide range of related information, simply due to the manner in which episodic traces of life experiences are encoded (Tulving, 1993; 2002). Once these traces have been established, these same individuals, when encountered subsequently, serve as memory cues for the retrieval of entire patterns of associated information. Similar to processes described by global-matching models of recognition memory (e.g., Gillund & Schiffrin, 1984; Hintzman, 1986; Ratcliff, 1978), these partner-based cues are assumed to resonate in parallel with the entire contents of long term memory, resulting

in the increased accessibility of memory traces associated with particular individuals. Thus, a conversational partner and a referential domain can act as a type of compound cue to guide memory retrieval (McKoon & Ratcliff, 1992). Such “resonance” models have been used in the text processing literature to describe how cues provided by texts can increase the accessibility of particular information, even in the absence of top-down processing goals (Albrecht & Myers, 1998; Gerrig & McKoon, 1998; Lea, Mason, Albrecht, Birch, & Meyers, 1998). As a consequence of this partner-driven memory retrieval, information that is strongly associated with the current conversational partner is especially likely to become accessible within the time course necessary to have an impact upon concurrent language processes (Metzing & Brennan, 2003). Crucially, it is this enhanced accessibility that contributes to implicit assessments of commonality, allowing speakers to produce utterances that appear on the surface to be formulated with respect to more explicit considerations of common ground.

Several recent studies have demonstrated the relevance of basic memory encoding and retrieval processes for audience design (Horton & Gerrig, 2002, 2005b; Horton & Spieler, in press). For example, Horton and Gerrig (2005b) reported the results of a task in which speakers, serving as the “Director,” helped each of two “Matchers” arrange sets of picture cards. Directors in an “orthogonal” card condition described completely different categories of cards with each Matcher (e.g., birds and dogs with Matcher A and fish and frogs with Matcher B), while Directors in an “overlapping” card condition described cards from all card categories with both Matchers. In the latter condition, this overlap across Matchers and categories was intended to make it relatively difficult to for Directors to encode associations in memory between each Matcher and specific cards. Although potential associations between any single card and a

specific Matcher were the same in both conditions, we expected the orthogonal condition to aid memory encoding by providing consistent category-level associations as well.

Our memory-based perspective predicted that the ease with which speakers could access partner-specific associations would greatly influence the extent to which evidence for audience design would emerge in their utterances. To test this claim, we asked Directors to carry out a final round with each Matcher in which they described the full set of cards. In these critical rounds, half of the cards were “old” for each Matcher, while half were “new.” Of interest was the extent to which the Directors’ descriptions would reflect which cards were old or new for each Matcher. In line with the memory-based account, descriptions given by Directors who had experienced the orthogonal card distribution exhibited more sensitivity to the distinction between old and new cards compared to the descriptions provided by Directors who had experienced the overlapping distribution. These results demonstrate how memory accessibility can play an important role in routine language use. An open question, though, is the extent to which this accessibility can emerge through relatively strategic or automatic processes.

Demonstrating the automatic nature of partner-driven memory accessibility

Understandably, most experimental investigations into the processes underlying conversational common ground have done so in the context of overtly communicative tasks. According to the account proposed in Horton and Gerrig (2005a), however, effects attributable to common ground can emerge via domain-general encoding and retrieval mechanisms that apply quite broadly, beyond conversational contexts. Resonance, in particular, is a cue-driven memory process that is, by definition, not intrinsically goal-directed (Gerrig & O’Brien, 2005). If this view is correct, then partner-related memory associations should exert an influence on language production even in the absence of an explicit intent to communicate—as long as the presence of

another individual is sufficient to increase the accessibility of associated memory traces. The two experiments reported here test this prediction by investigating whether the presence of specific individuals as memory cues can facilitate language production in a non-communicative context.

Both experiments begin with an initial phase designed to foster the creation of partner-specific memory associations. Specifically, participants attempted to generate category exemplars based on category cues provided by two different experimental partners, each of whom were present during separate blocks of trials. The correct answer on each trial was constrained by visually presented word fragments. For example, upon receiving the category cue “*a musical instrument*” from one partner, the participant might see “B__J O” on the computer screen and would be expected to produce the response *banjo*. Because participants responded to different items with each partner, they were expected to encode separate associations in memory with respect to each individual. Experiment 1 examined the possible influence of associations between each partner and specific lexical items (e.g., *banjo* vs. *harp*), while Experiment 2 examined associations between each partner and more general object categories (e.g., “musical instruments” vs. “birds”).

In both experiments, a second task phase served as the crucial test of whether these partner-specific memory associations would exert an influence upon language production. Specifically, participants named a series of pictures in the context of each of the same two partners, who once again were present for separate blocks of trials. In Experiment 1, the critical stimuli had labels that were the same as target responses from the previous exemplar generation task (e.g., a picture of a banjo). In Experiment 2, these stimuli were from critical object categories. If the presence of each partner facilitates the retrieval of relevant memory

associations, then participants should show evidence for partner-specific priming. That is, they should be faster to name pictures with labels associated with their current partner than pictures with labels associated with the other partner.

According to the memory-based account, such partner-specific priming should be mediated via relatively implicit memory mechanisms. It is possible, however, that these effects will occur at least partially on the basis of relatively explicit uses of memory, suggesting that participants who most successfully encode items with respect to specific partners will also show the strongest evidence for partner-specific priming. To assess the possible influence of explicit memory for partner-item encodings, a final phase asked participants to carry out a standard source memory task in which they identified the specific partner associated with each item they recognized as having been presented originally. This permitted an examination of the extent to which accurate partner identification would correlate with partner-specific facilitation on picture naming. If there is little or no evidence of a relationship between the degree of partner-specific priming and levels of successful partner identification, this would suggest that any differences in priming across partners are relatively independent of participants' capacity to explicitly recall the original partner contexts. This type of dissociation between implicit and explicit measures of memory for related material has been called *stochastic independence* (Perruchet & Baveux, 1989), and would lend support to the claim that partner-relevant information can become accessible on the basis of implicit memory processes.

Experiment 1

Method

Participants. Sixteen undergraduates from Georgia Tech served as participants. All were native speakers of English and received partial course credit for their participation.

Materials. Critical items for the initial exemplar generation task consisted of two exemplars from each of 16 object categories (e.g., HARP and BANJO for the category “*a musical instrument*,” see Appendix A for the complete list), chosen on the basis of constraints determined by the picture naming task, described below. Two exemplars from each of another 20 object categories were selected to serve as filler items. All object exemplars and categories were taken from recent category exemplar generation norms (Van Overschelde, Rawson, & Dunlosky, 2004). Eight counterbalanced lists of items were created in complementary pairs, one for each partner, with the two exemplars in each category assigned to different lists. Thus, although both partners provided the same category cues, each participant saw 36 object exemplars with one partner and the complementary set of 36 exemplars with the other partner. To help illustrate the logic behind the design of Experiment 1, Table 1 provides a schematic example of how items were assigned to partner contexts across task phases. For the exemplar generation task, word fragments were created by removing several letters from each exemplar name.

 Insert Table 1 about here

Stimuli for the picture naming task consisted of full-color object photographs obtained from a commercially-available collection of digital images (*Photo-Objects 50,000 Volumes I and II* distributed by Hemera Technologies Inc.). These pictures had served as stimuli for an unrelated picture naming study (LaGrone & Spieler, 2006), and the data from that study helped identify items with relatively high levels of name agreement—that is, cases in which the majority of respondents produced the same name for a given picture. These names became the target

label for each picture, resulting in a mean name agreement of 88% ($SD = 13.4$) for the experimental items. To control for frequency effects upon naming latencies (e.g., Huttenlocher & Kubicek, 1983; Jescheniak & Levelt, 1994), object category pairs (e.g., HARP-BANJO) were matched on name frequency using the English word form frequencies per million from the CELEX database (Baayen, Piepenbrock, & van Rijn, 1993). One picture from each of the 16 experimental pairs was then assigned to one of two item lists, arbitrarily called Set A and Set B, as shown in Appendix A. The items in Set A had a mean name frequency of 6.25 occurrences per million ($SD = 6.02$), while the items in Set B had a mean name frequency of 6.31 occurrences per million ($SD = 5.63$).

Because the exemplar generation task exposed participants to the labels for the experimental stimuli, this could be expected to facilitate their naming responses for these items regardless of the partner context. To distinguish such general repetition priming from more specific partner-dependent facilitation, the picture naming task also included a control condition in which participants named 32 additional pictures depicting completely novel objects, selected from the same LaGrone and Spieler (2006) norms as the experimental stimuli. These “novel” pictures were divided into two lists, one for each partner, and the 16 items on each list (shown in Appendix B) were matched to the experimental items based on mean name frequency per million (List 1: $M = 6.25$, $SD = 5.21$; List 2: $M = 6.31$, $SD = 5.63$) and name agreement (List 1: $M = 91\%$, $SD = 7.1$; List 2: $M = 89\%$, $SD = 7.1$). Finally, 120 additional unrelated pictures served as filler items. Four complementary pairs of stimuli lists were created that counterbalanced sets of experimental, novel, and filler pictures across participants. Each participant named 92 pictures in the context of each partner: 16 experimental items, 16 novel items, and 60 fillers.

Each picture measured approximately 200 X 200 pixels in size and was centered against a gray background on the computer screen. Because picture naming is a well-learned and rapid behavior, the picture stimuli were partially degraded in order to impede naming performance (e.g., Meyer, Schvaneveldt, & Ruddy, 1975), allowing differences between partner conditions to emerge. A crosshatch of lines 10 pixels wide was superimposed over each picture, partially obscuring the images.¹

For the partner identification test, booklets were prepared that asked participants to make old/new recognition judgments and Partner A/Partner B source judgments for 144 words: 32 experimental item labels, 40 target responses from the filler items in the exemplar generation task, 32 names for the novel items from the naming task, and 40 completely new words taken from the same object categories as the exemplar generation task items. These words were completely randomized before being assigned to booklet pages.

Procedure. To begin, the experimenter explained that the purpose of this study was to assess how people performed on verbal and visual recognition tasks in conjunction with different individuals. The experimenter then introduced the two undergraduate research assistants who would be serving as partners. It was explained that the partners would be switching in and out during the different tasks and that we were interested whether performance on the various tasks would change across partners. One assistant was introduced as Partner A, while the other assistant was introduced as Partner B. In Experiment 1, one partner was male and one partner was female.

For the first task phase, the participant sat in a small testing room before a desktop computer. The partner sat at the participant's side, facing in the same direction. A vertical barrier on the table surface obscured the participant's view of the partner's answer sheet, but did

not obscure their view of each other. The participant initiated each trial with a keypress, causing an item number to appear on the computer screen. The participant read this number for the partner, who consulted an answer sheet and read back out loud the corresponding category cue. The participant then pressed a key to display a word fragment and had five seconds to respond out loud with the correct solution. The partner always gave verbal feedback about the accuracy of the participant's responses. The computer beeped to signal the end of the response period, and the full, correct word then appeared on the computer screen for an additional five seconds. This ensured that participants received exposure to all of the target words, regardless of their success at identifying the correct category exemplar. On each trial, the partner recorded on the answer sheet whether the participant produced the correct solution. Having the partner give the category cues and verbal feedback about the participant's answers was intended to make the presence of the partner highly salient. Participants always completed the first block of trials with Partner A, who then exchanged places with Partner B for the second block of trials. Both partners provided the same set of category cues, although the particular target responses for each category were different across partners (see Table 1). Each block of trials began with a set of five practice items.

After completing the category exemplar generation task, participants immediately moved to another testing room for the picture naming task, where again they sat adjacent to the partner in front of a computer monitor and microphone. The experimenter informed participants that their task was to quickly name each picture with its most commonly-used label, and that although the pictures would be partially degraded, they would all correspond to familiar, recognizable objects. The partner's presence was motivated by having them initiate each trial with a keypress that caused a fixation cross to appear on the screen for 500 ms, followed

immediately by the picture to be named. The computer automatically recorded participants' responses at a sampling rate of 22,050 Hz. On each trial, the partner consulted a sheet that listed the expected picture names and silently used the "Y" or "N" keys on the computer keyboard to record whether or not the response was correct; otherwise, the partners did not interact directly with the participants. Partner order was counterbalanced such that, for half of the participants, Partner A served as the partner for the first block of naming trials followed by Partner B. For the remaining participants, Partner B was the first partner. As in the first task, the research assistant not currently serving as the partner remained outside the testing room.

Immediately following the naming task, participants received the booklet for the partner identification test. For each word in the test booklet, they first indicated whether that word was one they recognized as having appeared during the initial exemplar generation task. The instructions explained that some of the words also might have appeared during the picture naming task, but that their only concern should be whether they had seen each word during the first task phase. Then, for each word they recognized, they were to indicate whether they had seen that word with Partner A or with Partner B. The instructions reminded participants about the specific identities of both partners, who were absent from the testing room for the memory task.

Design. During the picture naming task, each participant named 16 experimental pictures in the context of each partner. Item pairs from eight of the 16 object categories were named in the context of the same partner as the individual who had been present when those object names had appeared during the first task phase, while item pairs from the other eight categories were named in the context of the different partner. Additionally, each participant named 16 frequency-matched novel pictures with each partner. Thus, picture name novelty (repeated from

the first task vs. novel) was manipulated within-participants and between lists of experimental vs. novel items. For the experimental items, partner context (same vs. different) was manipulated within-participants and within-items. Initial analyses of variance found no effects arising from counterbalancing partner order across tasks (all $F_s < 1$), so this factor will not be considered further.

Results

The results from each task phase will be considered separately. All statistical analyses were conducted with both participants (t_1, F_1) and items (t_2, F_2) as random variables, and estimates of effect size are reported using partial eta squared (η_p^2). Unless otherwise stated, reported effects are significant at $p < .05$.

Phase 1: Exemplar generation. Collapsing across partners, participants' mean accuracy at generating the correct category exemplars was 71% for the experimental items and 75% for the filler items. Although accuracy was not at ceiling, participants always saw the complete word on each trial. Thus, regardless of their success at solving the fragments, participants always had the opportunity to associate critical words with each of the experimental partners.

Phase 2: Picture naming. For this phase, the question was whether naming latencies for items associated with the same partner across tasks would be faster than latencies for items associated with the other partner. To measure naming latencies, a trained research assistant used sound analysis software to transcribe the responses for in the experimental and novel control conditions and to identify the exact time from picture onset when participants' spoken responses began. Eliminating disfluent responses (e.g., "uhh ostrich") removed 2.3% of the data. Eliminating responses that did not match the expected object label for each picture (e.g., calling the picture of a grasshopper a "cricket") removed 10% of the data for the experimental stimuli

and 27% of the data for the novel controls, a significant difference ($t_1(15) = 5.08$; $t_2(62) = 3.52$). Prior exposure to the experimental object labels during the category exemplar generation task presumably increased the likelihood that participants would identify these items using the correct labels. This possibility is reinforced by evidence of repetition priming in the analysis of naming latencies between item types. One-way ANOVAs with picture name novelty as the independent variable revealed that speakers were significantly faster to name the experimental pictures ($M = 906$ ms, $SD = 440$) compared to the novel picture condition ($M = 1088$ ms, $SD = 377$), $F_1(1,15) = 36.26$, $MSE = .007$, $\eta_p^2 = .71$; $F_2(1,62) = 10.90$, $MSE = .063$, $\eta_p^2 = .15$.

To examine whether there was an additional influence of partner-specific memory associations, naming latencies for the experimental items were compared across partner contexts. As shown in Table 2, participants were 86 ms faster to name pictures with labels associated with the current partner than they were to name stimuli with labels associated with the other partner. One-way ANOVAs carried out on mean naming latencies for the experimental items revealed a significant effect of partner context, $F_1(1,15) = 7.48$, $MSE = .007$, $\eta_p^2 = .33$; $F_2(1,31) = 4.05$, $MSE = .045$, $p < .06$, $\eta_p^2 = .12$. This partner-specific priming suggests that the presence of individuals as experimental partners facilitated the production of object names associated with those same individuals. Naming accuracy was not different across partner contexts: 89% correct for the same-partner condition and 91% for the different-partner condition (both $F_s < 1$).

Insert Table 2 about here

Phase 3: Partner identification. For this phase, the primary question of interest was whether each participant's successful recall of specific partner-word associations would correlate

with the extent to which he or she showed evidence of partner-specific priming during the picture naming task. In this task, participants identified the partner associated with each of the 32 experimental object names seen during the exemplar generation task (e.g., HARP and BANJO) and each of the 40 filler words from the same task (e.g., NURSE and DENTIST, exemplars from the filler category “*an occupation*”)—plus words that served as labels for filler pictures from the picture naming task, along with a set of completely new words. Because pictures corresponding to the experimental items also appeared during the subsequent naming task, a concern was that this intervening presentation would potentially bias recollection of the original partner contexts for these items, half of which appeared with the same partner across tasks while the other half appeared with different partners. Thus, each participant’s explicit memory for the original partner-word associations was assessed based on his or her judgments for the 40 filler items from the first task (e.g., NURSE, DENTIST). Partner identification scores were calculated by counting the total number of words for which the original partner was correctly identified, dividing by the number of words correctly recognized as having appeared in the first task phase.

Using this measure, the average level of partner identification across participants was 85% (significantly better than chance, $p < .001$), and ranged from 69% to 97% ($SD = 9.0$). This suggests that participants were generally able to identify the partner who originally had been present for specific items, even though there was no particular emphasis on the need to remember this information. These scores were then correlated with each participant’s level of partner-specific priming in the picture naming task, computed by subtracting the mean naming latency for pictures in the same-partner condition from the mean latency for items from the different-partner condition. A positive correlation would indicate that higher levels of explicit

recall for specific partner-word associations were related to stronger evidence for partner-specific priming. This correlation, however, failed to reach significance ($r = .23, p = .38$), suggesting that partner-specific priming was not driven primarily by explicit recall of partner-specific associations. Note that if the partner identification scores for the experimental items are used to compute this correlation instead (rather than the filler items from the initial task phase), there is still no evidence of a relationship between explicit recall of partner-item associations and partner-specific priming ($r = -.03$).

Discussion

In this study, participants were given the opportunity to establish associations between particular object exemplar names and each of two experimental partners. Subsequently, participants named pictures of these objects in the context of each of the same two partners. In general, speakers were faster to name pictures of objects with labels associated with their current partner compared to pictures with labels associated with the other partner. Such partner-specific priming suggests that the partners were serving as contextual cues to facilitate the retrieval of associated information—in this case, the names of particular objects.

Importantly, the degree of partner-specific priming exhibited by individual participants was not significantly correlated with their levels of explicit recall for specific partner-word associations. The memory task tested each participant's ability to recollect the particular partner associated with words from the initial exemplar generation task, and the lack of a significant correlation suggests that explicit memory retrieval was not primarily responsible for the observed partner-specific facilitation on picture naming. This is consistent with the general claim that other individuals can function as cues for the to enhance the accessibility of associated

information in memory, allowing that information to be more readily available as input for concurrent language production processes.

During debriefing, participants were asked whether they had noticed the repetition of object labels across the first two phases of the experiment. All of the participants (16 out of 16) said that they had noticed this, but only one participant correctly guessed that the purpose was to associate specific items with each partner. The remaining participants simply thought that the repetition made those items easier to identify during the picture naming task and easier to remember during the final memory task. The design of Experiment 2 eliminated the repetition of specific object labels across tasks.

Experiment 2

In Experiment 1, critical associations were created between each partner and specific words, and these same lexical items then served as target responses during the picture naming task. In many contexts, however, individuals may be associated with relatively broad classes of information as well. That is, people may be the focus of general semantic or episodic associations such as “job-related information” or “Beth’s party.” Presumably, connections within domains can enable a wide range of conceptual information to become associated with other individuals. For example, if you frequently discuss favorite movies with David, then other kinds of movie-related knowledge may become more accessible every time you encounter David.

The focus of Experiment 2, then, involved demonstrating how resonance processes could enable other individuals to cue information beyond specific partner-item associations. Table 3 illustrates the logic behind the assignment of items to partner contexts across the task phases in this experiment. The same three-phase procedure as Experiment 1 was used, except that instead

of creating associations between specific partners and the exact labels for critical items presented during the naming task, the initial exemplar generation task established associations between partners and more general object categories. Specifically, each partner provided completely different sets of category cues during this task. Furthermore, to increase the likelihood that a given category would become associated with that partner, each cue was provided four times. For example, Partner A might give the cue “a musical instrument” for four different word fragments representing different instances of instruments, thus becoming generally associated with musical instruments, while Partner B might repeatedly give the category cue “a bird” for four different birds, becoming associated with birds. Importantly, Partner A would never mention anything about birds and Partner B would never mention instruments. The critical question was whether speakers would subsequently be faster to name pictures from categories associated with their current partner. That is, in the scenario just described, would a speaker be faster to name a picture of a harp in the context of Partner A and a picture of a penguin in the context of Partner B, even if she had received no specific exposure to either HARP or PENGUIN during the first task?

Insert Table 3 about here

Beyond testing for the influence of these more general associations between partners and object categories, this procedure also eliminated the repetition of specific object labels across the first two tasks. To test for possible category-level priming, though, Experiment 2 retained the novel picture control condition in the picture naming task. As before, a final partner

identification task measured the potential correlation between implicit partner priming and explicit memory for partner-specific associations.

Method

Participants. Twenty-four undergraduates from Georgia Tech served as participants. All were native speakers of English and none had participated previously in Experiment 1. They received partial course credit for their participation.

Materials. For the initial category exemplar generation task, four different exemplar labels from each of the same 16 object categories used in Experiment 1 served as target responses (e.g., TRUMPET, VIOLIN, ORGAN, and TUBA for the category “*musical instrument*”). None of these exemplars corresponded to the critical objects shown during the picture naming task. Four complementary pairs of item lists were created that contained all exemplars from eight of the 16 critical object categories on one list and the exemplars from the other eight categories on the other list, and list pairs were counterbalanced across participants and partners. The design of Experiment 2 did not require filler items during the exemplar generation task. The picture naming task used the same stimuli as Experiment 1, including the novel controls and filler items (see Table 3). Booklets for the partner identification task contained 140 words: 32 experimental item names, 64 target responses from the exemplar generation task, 32 names for the novel pictures from the naming task, and 12 completely new words. The booklet format was identical to that used in Experiment 1.

Procedure and Design. The experimental procedures for all three phases were the same as Experiment 1, except that during the initial category exemplar generation task each partner gave different sets of category cues a total of four times each. The two research assistants serving as partners for Experiment 2 were both female undergraduates. During the picture

naming task, participants again named equal numbers of items in the same-partner, different-partner and novel picture control conditions. Picture category novelty (repeated from the first task vs. novel) was manipulated within-participants and between lists of experimental vs. novel items. For the experimental object categories, partner context (same vs. different) was manipulated within-participants and within-items. As in Experiment 1, partner order was counterbalanced across the first two task phases, but initial analyses of variance revealed no reliable effects due to partner order (all F s < 1), so this will not be considered further.

Results

Phase 1: Exemplar generation. Mean accuracy at generating the correct category exemplars based on the word fragments was 74%. Recall, however, that the exemplars presented in this task did not directly correspond to any items presented during the subsequent picture naming task. Instead, the critical manipulation involved associating each partner with completely different object categories.

Phase 2: Picture naming. In this phase, the question was whether participants would be faster to name pictures of objects from categories associated with the current partner compared to pictures from categories associated with the other partner. As in Experiment 1, a research assistant transcribed the naming responses for items in the experimental and novel control conditions and used sound analysis software to measure naming latencies. Eliminating disfluent responses removed 3.4% of the data, and eliminating responses that did not match the expected object label for each picture removed 19% of the data for the experimental items and 24% for the novel controls, a significant difference in the analysis by participants only, $t_1(23) = 3.04$, $p < .01$; $t_2(62) = 1.06$, *n.s.* Recall that, unlike Experiment 1, participants did not have any prior exposure to the critical object labels, which may account for the relatively high levels of misidentification

for both stimuli types. In the first task phase, however, participants were exposed to the critical object categories, which did appear to facilitate naming responses for the experimental items. One-way ANOVAs with picture name novelty as the independent variable revealed that speakers were faster to name the experimental stimuli ($M = 977$ ms, $SD = 510$) compared to items in the novel control condition ($M = 1133$ ms, $SD = 580$), $F_1(1,23) = 15.88$, $MSE = .018$, $\eta_p^2 = .41$; $F_2(1,62) = 5.18$, $MSE = .106$, $\eta_p^2 = .08$. The recent experience of identifying category exemplars on the basis of specific cues may have served to speed identification of other items from those same categories (Lupker, 1988).

Focusing on just the trials involving experimental stimuli, however, reveals evidence consistent with partner-specific priming. As shown in Table 2, participants were 67 ms faster to name critical pictures that belonged to object categories associated with their current partner than pictures belonging to categories associated with the other partner. One-way ANOVAs carried out on the experimental items, treating partner context as the independent variable, confirmed that this difference was significant, $F_1(1,23) = 4.39$, $MSE = .016$, $\eta_p^2 = .16$; $F_2(1,31) = 6.33$, $MSE = .018$, $\eta_p^2 = .17$. This suggests that the partner present during each block of naming trials specifically facilitated identification of objects from categories associated with that same individual. Naming accuracy was not different across partner contexts: 84% for the same-partner condition and 83% for the different-partner condition (both $F_s < 1$).

Phase 3: Partner identification. To investigate whether partner-specific priming would correlate with participants' recall of particular partner-item associations, partner identification scores were calculated for the 64 target words from the initial category exemplar generation task (e.g., CANARY, VIOLIN). Recall that participants were not asked to name pictures of these objects during the second task phase, so intervening exposure to these items was not a concern.

Calculated in the same manner as in Experiment 1, successful partner identification averaged 81% (significantly better than chance, $p < .001$), and ranged from 59% to 98% across participants ($SD = 10.0$). The correlation between each participant's level of partner recall and his or her degree of partner-specific priming did not reach significance ($r = .25, p = .23$). Again, this suggests that that explicit memory retrieval was not a primary mediator of the observed partner-specific priming.

Discussion

Experiment 2 examined the influence of category-level memory associations upon picture naming. During the initial exemplar generation task, participants were able to associate each partner with different object categories. Subsequently, they were faster to name pictures of objects from categories associated with their current partner than they were to name pictures from categories associated with the other partner, as would be expected if each partner served as a memory cue for the retrieval of associated concepts. Again, the results from the source memory task suggest that participants' explicit recall for partner-item associations did not significantly mediate the observed partner-specific priming. During debriefing, ten of 24 (42%) participants said they noticed that many of the pictures from the picture naming task were from object categories presented during the first task, which is markedly less than the 100% awareness shown by participants in Experiment 1. Only two participants, though, gave any indication of being aware of the specific role of the two partners in facilitating memory retrieval.

In general, then, Experiment 2 provides additional evidence for how partner-specific memory associations can influence basic processes in language production. In particular, partner-specific facilitation emerged on the basis of associations between other individuals and general object categories. Recall that Horton and Gerrig (2005a) found that Directors in a

referential communication task showed more evidence for audience design when each of two Matchers was associated with different card categories. The present data demonstrate how resonance from category-based partner associations could function to constrain message planning in similar circumstances.

General Discussion

In two experiments, participants were given the opportunity to establish partner-specific associations in memory with respect to each of two experimental partners. In Experiment 1, each partner was associated with specific object names, while in Experiment 2 each partner was associated with separate object categories. When asked subsequently to name pictures of objects in the context of each of the same two partners, speakers were faster to name pictures associated with their current partner than they were to name pictures associated with the other partner. Simply by being present for the naming task, each partner appears to have acted as a cue to facilitate retrieval of associated object names or categories. Moreover, participants' levels of explicit identification of the partner associated with specific items failed to show a significant relationship to their degree of partner-specific priming. Although one should be cautious in interpreting this null result, the lack of a strong relationship between explicit and implicit memory performance lends support to the claim that the observed priming effects were mediated primarily via implicit memory mechanisms (Perruchet & Baveux, 1989). Taken together, these findings show how ordinary memory mechanisms can influence the accessibility of information associated with particular interpersonal contexts.

Importantly, these results were obtained in a task context that was not overtly communicative—participants were simply naming pictures, not trying to convey particular meanings to their partners. The fact that the mere presence of each partner had an influence

upon naming latencies, though, provides a demonstration of how partner-driven memory accessibility may function in service of audience design. Analogous to similar effects of conceptual or lexical accessibility upon language production (e.g., Bock, 1987; Bock & Warren, 1985; Ferreira & Dell, 2000; Slevc & Ferreira, 2004), information that is highly accessible at the time of speaking may be more readily incorporated into utterance planning. Moreover, the impact of partner-specific memory associations was observed for two decidedly different aspects of language production. Experiment 1 demonstrated how specific conversational partners might influence the particular words a speaker might select, while Experiment 2 demonstrated how particular partners could shape the conceptual information available to speakers during message planning. Both of these effects are consistent with related constraint-based approaches that view language processing as involving the simultaneous integration of multiple types of information, both linguistic and non-linguistic (e.g., MacDonald, Pearlmutter, & Seidenberg, 1994; McRae, Spivey-Knowlton, & Tanenhaus, 1998). Such models have considered, for example, how factors like lexical frequency and contextual plausibility can serve to constrain the likelihood of particular sentence parses. Implicit in many of these accounts is the assumption that such factors will have an impact upon processing that is dependent upon the strength of their availability as cues in memory. In a similar fashion, information associated with one's conversational partner, accessible on the basis of low-level memory processes like resonance, may serve as another potential constraint on message planning and formulation (Horton and Gerrig, 2005a).

Partner-specific memory associations and common ground

The present findings are also relevant to recent debates concerning the role of partner-specificity in language comprehension (Barr & Keysar, 2002; Kronmüller & Barr, 2007; Metzling & Brennan, 2003). Metzling and Brennan (2003) found that addressees took longer to identify

referents when a familiar speaker used a novel expression to refer to a familiar object, but not when a new speaker used the same expression to refer to the same object. Metzger and Brennan suggested the delay in the former case arose in part due to the need for addressees to ignore the existing strong episodic associations between the familiar speaker and previously established referring expressions. Presumably, the familiar partner served as a strong cue for these expressions in a way that the new partner could not.

More recently, however, Kronmüller and Barr (2007) have argued that the influence of a prior expression upon reference resolution is not specific to any particular speaker. They suggest instead that the simple availability of previous referring expressions will “preempt” addressees from being able to easily interpret new descriptions intended to refer to familiar referents, and that slower and more effortful recovery processes are required when this occurs in the context of a familiar speaker. Kronmüller and Barr support this claim with eye-tracking data showing that the impact of the availability of previous referring expressions upon referent identification is quite rapid compared to the impact of specific speakers. Whereas this is taken to suggest two qualitatively different processes—rapid use of available linguistic precedents followed by slower recovery processes as needed—this account cannot be distinguished from a more general memory-based account without knowing more about the strength and availability of the cues present in the communicative context. If associations between referents and referring expressions are suitably strong and/or available at the time of processing, it should be possible to observe strong and immediate effects of linguistic precedents, as demonstrated by Kronmüller and Barr. However, this does not preclude the possibility that equally strong, if not stronger, associations with respect to specific partners might be available in many situations. On this

view, predictions about the likelihood of observing partner-specific effects would be contingent upon understanding the memory availability of partner-specific cues (Horton & Gerrig, 2005a).

Note that this claim can be contrasted with Clark and Marshall's (1978; 1981) concept of *reference diaries*, which was described as a set of special-purpose memory representations that encode information with respect to particular interlocutors. Language users are assumed to make use of the information from reference diaries to make inferences about common ground. Similar to the present view, the notion of reference diaries emphasizes the importance of memory and memory retrieval for language use. However, reference diaries were seen as specifically encoding information about "triple co-presence"—that is, the simultaneous presence of speakers, addressees, and referents within particular discourse contexts. The representations assumed by the memory-based account, however, are much more general, typically falling short of the standard of triple co-presence (Horton & Gerrig, 2005b). Instead, ordinary mechanisms of episodic memory simply establish links in memory between stimuli experienced at the same time. As described nicely by Baddeley (1994), once links of this kind have been established, "one such experience [can] evoke another. Hence, if I met Charlie and Gladys together at the Green Dragon Pub, then meeting Charlie is likely to remind me of both Gladys and the pub" (p. 353). It is the strength of this "reminding" evoked by others that constrains the likelihood of observing partner-specific effects.

To understand the relevance of this claim for language use more generally, consider a circumstance in which one has extensive experience of talking with a colleague about a particular topic. During subsequent encounters with that person, cues would resonate in memory in ways that would modify the accessibility of information associated with this topic. As a result, one's "readiness" (Gerrig & McKoon, 1998) to interact with this individual would be

increased without the need to explicitly consult any kind of reference diary or other representation of this person's knowledge. By establishing an effect of partner-specific associations upon picture naming, the current studies show how the salience of other individuals as memory cues can influence the accessibility of associated information, both lexical and conceptual, even in the absence of an explicit intent to communicate with that particular individual. In this manner, some aspects of utterances that appear to presuppose commonality may be generated instead on the basis of relatively automatic memory mechanisms working off of domain-general memory associations.

This is not intended to suggest, however, that interlocutors never choose to assess common ground strategically. Indeed, there are likely many instances in which particular conversational goals (such as keeping a secret) or certain communicative situations (such as those in which feedback is limited) may prompt more explicit considerations of the information likely to be in common ground (Horton & Gerrig, 2005a). However, the memory-based view presented here is intended to account instead for those aspects of audience design mediated through relatively automatic processes. In this respect it is similar to aspects of the recent interactive alignment model of dialogue proposed by Pickering and Garrod (2004), in which language processing is seen as benefiting from basic mechanisms of "alignment" that enable interlocutors to converge on similar linguistic representations. Alignment is thought to occur through activation of similar representations across interlocutors. An important consequence of interactive alignment is that, like the current memory-based account, it obviates the general need for more complicated partner-modeling in a variety of circumstances. Although Pickering and Garrod do not commit themselves to specific mechanisms, it seems plausible to suggest that

resonance, as an automatic, cue-based retrieval of information from memory, may be a likely process through which interactive alignment can occur.

Connections to domain-general memory processes

A distinct advantage of this memory-based account is that the processes involved in language use and common ground can be explicitly linked to other cognitive psychological work in memory encoding and retrieval. Specifically, global-matching models of recognition memory (e.g., Gillund & Schiffrin, 1984; Hintzman, 1986; Ratcliff, 1978) provide a possible description of the essential processes by which information associated with particular individuals may become accessible in memory. For example, SAM (Search of Associative Memory; Gillund & Schiffrin, 1984) and its more recent incarnation REM (Schiffrin & Steyvers, 1997) conceptualize memory retrieval as a cue-dependent global search of long-term memory. According to REM, contextual information present at the time of encoding will likely become part of relevant memory traces. If this context information matches the cues present at the time of search, then the likelihood of successful retrieval will increase. In this model, then, priming may occur as the result of simple overlap between contextual associations during encoding and retrieval (Pecher & Raaijmakers, 2004).

Previous demonstrations of the implicit influence of contextual information on memory retrieval can be found, for instance, in episodic priming paradigms in which participants are faster to name a target word when it is repeatedly preceded by the same prime than when it is preceded by a different prime upon each presentation (e.g., McKoon & Ratcliff, 1979; Spieler & Balota, 1996). This repetition of prime-target pairings is thought to establish implicit contextual encodings that facilitate word recognition, even at short SOAs. Also relevant is the work on context-dependent memory, which has shown that material learned under particular conditions is

recalled better if those same conditions are reinstated at test (Smith, 1988; 1994). Although context-dependent memory has been observed most frequently in tasks that measure explicit recall, reinstatement of the same context at test has been shown to facilitate conceptual implicit memory as well (Parker, Gellatly, & Waterman, 1999). On the current view, then, conversational partners act as contextual cues for the automatic retrieval of associated information just as different rooms or different physical contexts can facilitate memory depending on the type of overlap with the context of encoding. Automatic commonality assessment, then, can be thought of as a type of context-dependent memory process in which other individuals serve as the relevant contexts.

Because memory cues have different strengths, and because the threshold at which information will become accessible from memory can vary, the current approach also provides one explanation for why people in conversation sometimes make the kinds of errors they do about the knowledge taken as shared (Horton & Gerrig, 2005a; Horton & Spieler, in press). Other individuals are potentially the focus of a wide range of associations, only some of which are going to be strong enough to have an immediate impact upon fluent production. Associations that are too weak may fail to reach some threshold for the purposes of utterance planning, in which case the resulting utterance may simply look like “bad” audience design. Similarly, speakers may find themselves assuming, incorrectly, that particular information is already shared in situations where different interlocutors share high amounts of contextual overlap (such as groups of colleagues who all interact regularly about similar topics). In general, the cues made available by the conversational partner and by the situation will converge to constrain the accessibility of information in memory. As an implicit process of commonality assessment,

information that is most highly accessible within a given time course will be taken as being in common ground.

In sum, the model of common ground supported by the current results assumes that the partner-relevant representations that partially constrain language processing are domain-general episodic traces, and that the processes that act upon these representations work in the same manner as other sorts of memory-dependent processes—except that the information in question concerns the patterns of associations that exist with respect to other individuals. In this manner, our conceptual and perceptual experiences of other individuals can become accessible in ways that are directly relevant for language use. This perspective highlights how our understanding of higher-level aspects of language use can be informed by consideration of more fundamental cognitive psychological mechanisms. Although processes such as resonance may not be sufficient by themselves to provide a complete explanation for phenomena like audience design, the products of these basic processes are presumably an important means through which language users gain access to the information they need to manage complex aspects of message planning and production.

Footnote

¹ As the data will show, people were less accurate when naming these degraded stimuli compared to the LaGrone and Spieler (2006) data, which were based on intact images. Because accuracy never differed significantly across partner conditions, though, and because each experimental item served as its own control across participants, the fact that people were generally less able to identify these degraded images was not a concern.

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Table 1

Sample item organization for Experiment 1.

Task Phase	Partner Context	
	Partner A	Partner B
Phase 1: Exemplar Generation	Cue: “ <i>a musical instrument</i> ”	Cue: “ <i>a musical instrument</i> ”
	Fragment: B _ _ J O	Fragment: H _ R P
	Cue: “ <i>a bird</i> ”	Cue: “ <i>a bird</i> ”
	Fragment: O S _ _ I C _	Fragment: P _ N G _ I _
	Cue: “ <i>an occupation</i> ”	Cue: “ <i>an occupation</i> ”
	Fragment: D _ N T _ S _	Fragment: _ U R _ E
	<i>Etc.</i>	<i>Etc.</i>
Phase 2: Picture Naming ^a	<i>Ostrich</i> (Same partner)	<i>Penguin</i> (Same partner)
	<i>Harp</i> (Different partner)	<i>Banjo</i> (Different partner)
	<i>Cactus</i> (Novel control)	<i>Skis</i> (Novel control)
	<i>Etc.</i>	<i>Etc.</i>
Phase 3: Partner Identification ^b	DENTIST (“old” - Partner A)	
	EARRING (“new”)	
	HARP (“old” – Partner B)	
	<i>Etc.</i>	

^a Item names listed in Phase 2 represent pictorial stimuli.

^b Participants carried out Phase 3 in isolation, independent of either partner context.

Table 2

Mean naming latencies (in milliseconds) for the experimental stimuli by partner context, and for the novel picture control condition, in Experiments 1 and 2 (standard deviations in parentheses).

	Experimental stimuli		Novel controls
	Same partner	Different partner	
Experiment 1	863 (318)	949 (530)	1088 (377)
Experiment 2	943 (398)	1010 (600)	1133 (580)

Table 3

Sample item organization for Experiment 2.

Task Phase	Partner Context	
	Partner A	Partner B
Phase 1: Exemplar Generation	Cue: “ <i>a bird</i> ” (4 unique fragments)	Cue: “ <i>a musical instrument</i> ” (4 unique fragments)
	Cue: “ <i>an article of furniture</i> ” (4 unique fragments)	Cue: “ <i>an insect</i> ” (4 unique fragments)
	<i>Etc.</i>	<i>Etc.</i>
	<hr/>	
Phase 2: Picture Naming ^a	<i>Ostrich</i> (Same partner)	<i>Penguin</i> (Different partner)
	<i>Harp</i> (Different partner)	<i>Banjo</i> (Same partner)
	<i>Cactus</i> (Novel control)	<i>Skis</i> (Novel control)
	<i>Etc.</i>	<i>Etc.</i>
<hr/>		
Phase 3: Partner Identification ^b	CANARY (“old” - Partner A) EARRING (“new”) VIOLIN (“old” – Partner B) <i>Etc.</i>	

^a Item names listed in Phase 2 represent pictorial stimuli.

^b Participants carried out Phase 3 in isolation, independent of either partner context.

Appendix A

Object Categories and Exemplar Labels for the Experimental Stimuli in Experiments 1 and 2.

Object category	Set A	Set B
<i>a four-footed animal</i>	ZEBRA	GIRAFFE
<i>a gardener's tool</i>	PITCHFORK	WHEELBARROW
<i>a musical instrument</i>	HARP	BANJO
<i>a type of footwear</i>	SOCKS	SLIPPERS
<i>a type of ship or boat</i>	YACHT	CANOE
<i>a vehicle</i>	MOTORCYCLE	HELICOPTER
<i>a weapon</i>	ARROW	RIFLE
<i>an article of furniture</i>	LAMP	STOOL
<i>a bird</i>	OSTRICH	PENGUIN
<i>a carpenter's tool</i>	PLIERS	WRENCH
<i>a fruit</i>	CHERRY	LEMON
<i>a kitchen utensil</i>	LADLE	BLENDER
<i>a thing that women wear</i>	LIPSTICK	PERFUME
<i>a vegetable</i>	ONION	CELERY
<i>an article of clothing</i>	BELT	GLOVES
<i>an insect</i>	GRASSHOPPER	CATERPILLAR

Note. In Experiment 2, four different object exemplars (not shown) from each experimental category served as target responses during the category exemplar generation task. Both experiments used the same 32 pictures as experimental stimuli during the naming task.

Appendix B

Labels for the Novel Pictures Presented During the Picture Naming Task in Experiments 1 and 2.

List 1	List 2
BALLERINA	BRIEFCASE
BINOCULARS	CANE
BUDDHA	CLIPBOARD
CACTUS	DART
CANNON	DOUGHNUT
COOLER	FUNNEL
GLOBE	LIGHT BULB
PIE	PEANUT
PRETZEL	PILLOW
SAFE	PYRAMID
SEAHORSE	RIBBON
SUNDIAL	SKIS
TIRE	SPAGHETTI
TYPEWRITER	STOPWATCH
WAGON	STROLLER
WHISTLE	THERMOMETER