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Hippocampal amnesia disrupts verbal play and the creative use of language in social interaction

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Abstract

Background—While the neural substrates and cognitive components of creativity have received considerable attention in cognitive neuroscience, the creative use of language in social interaction has been less well studied. As part of a broader program of research on language-and-memory-in-use in individuals with hippocampal amnesia, we analyzed *verbal play*, a creative use of language that is pervasive in everyday communicative interaction.

Aims—To identify instances of creative uses of language in the protocols of social and collaborative interactions, to characterize the qualitative nature, and to determine the frequency of these interactions initiated by participants with hippocampal amnesia vs. comparison participants in order to ascertain whether amnesia impairs this aspect of social communication.

Methods and Procedures—This study uses quantitative group comparisons and detailed discourse analysis to analyze verbal play in the interactional discourse sessions of 4 participants with hippocampal amnesia and 4 healthy (demographically matched) comparison participants, each interacting with a familiar partner while completing a collaborative referencing task and with a researcher between task trials.

Results—All participants used verbal play. However, significantly fewer episodes were initiated in sessions with amnesia participants (312) and by participants with amnesia themselves (187) than in sessions with comparison participants (572) and by comparison participants (395). No significant group differences were observed for interactional forms, resources, or functions. Qualitative differences were also observed in amnesia sessions (e.g., more rotely produced episodes, lack of thematically linked episodes).

Conclusions—These findings suggest that hippocampal amnesia disrupts the creative use of language in social interaction and accord with our previous work pointing to impairments in language-and-memory-in-use more broadly. These findings highlight the interdependence of language and memory especially in the interactional aspects of communication.

The current study, examining creativity and verbal play, is part of a programmatic line of research examining the contribution of declarative memory to meeting the real-world demands that communication places on language-and-memory-in-use (Duff, Hengst, Tranel, & Cohen, 2006; Duff, Hengst, Tranel, & Cohen, 2007; Duff, Hengst, Tengshe, Krema, Tranel, & Cohen, 2008a; Duff, Hengst, Tranel, & Cohen, 2008b). Patients with hippocampal amnesia, who have

profound impairments in acquiring new declarative memory (i.e., memory for facts, vocabulary, autobiographical events), but who have preserved intellectual, and other cognitive abilities (i.e., language, attention, reasoning) and procedural memory (e.g., Cohen, 1984), provide a unique opportunity to study the interdependent relationship between language and memory.

In previous work, we examined the ability of individuals with hippocampal amnesia and their partners to acquire and use referential labels for novel and abstract stimuli (Chinese tangrams) across repeated trials (Duff et al., 2006). We found that despite profound declarative memory impairments, amnesia participants displayed collaborative learning across trials, resulting in increasingly rapid and efficient communication, or “common ground,” at a rate *equal* to that of healthy comparison participants. The observed learning of referential labels expands the domain of preserved learning abilities in amnesia, and stands in contrast to the modest and slow semantic learning seen in amnesia when tested formally. Further, it suggests that these interactive communication sessions are potent learning environments.

It is important to note, however, that participants with amnesia were not required to learn arbitrarily related, experimenter-generated labels, but rather drew on preexisting mental representations, or semantic knowledge, to self-generate appropriate and meaningful card labels, such as “siesta man” for a figure that could be seen as a man resting or reclining. Yet, despite their impressive learning, the collaborative task itself appeared more challenging for participants managing profound memory impairments than for comparison participants—i.e., pairs with an amnesia participant consistently displayed more communicative effort (e.g., words) and time to complete trials.

In a follow-up analysis (Duff et al., 2008b), we documented consistent differences across groups in the patterns of interactional discourse during these collaborative sessions (e.g., pairs with an amnesia participant produced more turns dedicated to task management and fewer turns to non-task talk, or small talk, than pairs with a comparison participant). Of critical interest to the current analysis was that despite their obvious success and reports of enjoyment, we observed very little playful behavior across pairs with an amnesia participant. This observation was striking in contrast to comparison participants who engaged in a great deal of playful behavior and to the marked use of verbal play by individuals with aphasia and their partners completing a similar task (Hengst, 2006). Taken together, these findings suggest that while individuals with hippocampal amnesia can develop and use shared referential labels in this task, the extent of their declarative memory impairments may interfere with the flexible and creative deployment of communicative resources typical of interactional discourse.

VERBAL PLAY, CREATIVITY, AND DECLARATIVE MEMORY

From a sociolinguistic perspective, *verbal play*, or playing with the sounds and meanings of words through the use of puns, voices and sound effects, teasing, and telling funny stories or jokes, is ubiquitous in everyday interaction and serves important interpersonal functions (Crystal, 1998; Sherzer, 2002). Indeed, according to Crystal, “Ludic linguistic behavior is a sign that all is well with human relationships. And conversely, when a couple or a family begin to be irritated by each other’s language play, or to stop using it, it is a sure sign that the relationship is breaking down” (1998, p. 53). We find the clinical implications compelling. That is, if our impression holds, and hippocampal amnesia does disrupt the use of verbal play in everyday interaction, it could shed light on reports of impoverished social networks and interpersonal relationships (e.g., Tate, 2002) and further characterize the social-emotional ramifications of living with amnesia.

The neural underpinnings of creativity and the cognitive components (e.g., memory) for its successful deployment are of considerable interest in cognitive neuroscience. Neuroscientists

have argued that creativity requires the rapid combination and recombination of existing mental representations to create novel ideas and ways of thinking (Bristol & Viskontas, 2006; Damasio, 2001). Further, the hippocampal system, through its interaction with neocortical storage sites, provides the relational database necessary for the creation, updating, and juxtaposition of mental representations and for their flexible and novel use (Cohen & Eichenbaum, 1993; Eichenbaum & Cohen, 2001). Accordingly, we predict that verbal play, as a form of creativity, might be disrupted in the discourse of patients with hippocampal amnesia.

From an interactional sociolinguistic perspective, all language use in communicative interactions involves, to a greater or lesser degree, some level of creativity, as individuals rhetorically or poetically select particular sounds, meanings, and patterns of language in crafting their utterances. Verbal play offers us highly marked instances of such creativity. Of particular interest to us here is the way that linguists (e.g., Crystal, 1998; Sherzer, 2002) describe verbal play and humor as involving the slippage of categories or the juxtaposition of multiple frames—the playing of one frame against another. The notion of *frames* should be understood broadly as a means of contextualizing talk and action (see Bateson, 1972; Goffman, 1974; Hanks, 1990), such as, marking particular utterances as playful or serious, teasing or angry, honest or deceitful, and so on. Specific instances of verbal play may be as focal as making a pun by playing with sounds and meanings of a single word, or as expansive as acting out conversations of imaginary characters, and may be deployed within fleeting moments, linked across sustained stretches of interaction, and may be returned to in later interactions. Verbal play and humor are deployed wittingly, as participants draw on diverse resources to craft play (e.g., a parody of a politician through gestures, word use, prosody) or call attention after the fact to unexpected occurrences (e.g., *you sounded just like ...*). Although not all instances of verbal play and humor may be deemed skillful, they are recognized as playful attempts by partners who routinely respond in kind—e.g., groaning at the pun, laughing at the joke, or carrying on the sarcastic tone or playful enactment. Although people often describe verbal play as enjoyable, appreciated and savored for its own sake, it is not without social risk—e.g., jokes may fall flat or be misinterpreted as threatening rather than playful, and cast the teller as an outsider. Research points to the importance of trust in successful teasing, arguing that verbal banter and teasing may not only reflect, but also facilitate the building of trusting social relationships (e.g., Strahle, 1993).

Although verbal play has not been studied in patients with profound declarative memory impairments, recent research links hippocampal damage to impairments in imagining events (Hassabis, Kumaran, Vann, & Maguire, 2007) and to disruptions in other aspects of the creative and flexible use of other interactional discourse resources (e.g., reported speech, procedural discourse) (Duff et al., 2007; Duff, 2008a). These findings support growing perspectives that declarative memory and the hippocampus play a critical role in creative and flexible cognition. The current study extends the neuroscientific examination of creativity to include verbal play in everyday communicative interaction.

THE CURRENT STUDY

The collaborative and interactive paradigms (Duff et al., 2006; also see Hengst & Duff, 2007) used in our previous work are well suited for examining the declarative memory requirements and the role of the hippocampus in interactional discourse and more generally, in language-and-memory-in-use. Here we extend this line of work to examine verbal play as a form of linguistic creativity. The goal of the current study is to systematically document and characterize the extent and types of verbal play in the communicative interactions of individuals with hippocampal amnesia and their familiar partners. It is, to our knowledge, the first study of verbal play, and creativity more broadly, in individuals with isolated declarative memory

impairments from hippocampal amnesia, and certainly the first to explore it within a rich interactional, collaborative communication paradigm.

Given what we believe are the obvious demands verbal play places on declarative memory and given that declarative memory is the hallmark deficit in amnesia, we predict that hippocampal amnesia will broadly disrupt the creative and flexible use of interactional discourse, including verbal play. Specifically, we predict that participants with amnesia will produce fewer verbal play episodes than comparison participants and that there will be fewer extended and thematically linked episodes across trials, sessions and days. To examine this prediction about the contribution of declarative memory to verbal play, and the impairments likely to result from amnesia, analyses of participants' verbal play will be conducted with regard to: 1) the total number of playful episodes in amnesia and comparison sessions; 2) comparisons of the total number of verbal play episodes initiated by amnesia and comparison participants; 3) the qualitative nature and interactional forms, resources, and functions of playful episodes in amnesia and comparison sessions.

METHODS

Participants and Data Set

Analysis was performed on interactional data obtained as four amnesia pairs (individuals with amnesia and their partners) and four comparison pairs (healthy participants and their partners) ⁱ completed a collaborative referencing task (Duff et al., 2006). The task was completed on a total of 24 trials, with 6 trials conducted in each of 4 sessions, 2 sessions per day. Participant pairs sat facing each other with a low barrier between them and each member of the pair had a board with 12 numbered spaces and a set of 12 Chinese tangram playing cards. The director (individual with amnesia) began with his/her cards on the board and communicated to the matcher (familiar partner) how to fill the numbered spaces so that at the end of the trial the boards were identical. Pairs were instructed to treat the task as a game and to have fun, but there was no explicit attempt to elicit verbal play. The researcher (Duff) left the room between trials but interacted freely with pairs during task instructions and between trials while giving feedback on accuracy and setting up the next trial. All sessions were videotaped and transcribed in their entirety and data analysis was completed across the entire session including when the researcher was in the room between trials. The full set of sessions, varying in length from 11 to 62 minutes, involved more than 14 hours of videotaped data. Consistent with our previous reports that amnesia pairs were slower overall and produced more words during the collaborative referencing trials than comparison pairs (Duff et al., 2006; Duff et al., 2008b), there were more videotaped data from amnesia than comparison pairs, 9 and 5 hours, respectively.

Etiologies of amnesia included anoxia/hypoxia, resulting in bilateral hippocampal damage, and closed head injury (CHI), resulting in shearing lesions in the white matter tracts surrounding the hippocampus. At the time of data collection, participants were in the chronic epoch, with time-post-onset ranging 3 to 18 years and age ranging 47 to 54 years. Neuropsychological testing confirmed a selective and severe memory impairment disproportionate to any deficits in general cognitive or intellectual functioning. Performance on the Wechsler Memory Scale-III (Wechsler, 1997a) (General Memory Index) was at least 25 points lower than performance on the Wechsler Adult Intelligence Scale-III (Wechsler, 1997b) (Full Scale IQ) (mean FSIQ-GMI difference = 41.3), with an average delay score on the memory scale (62.7) that was more than 2 SDs below population means. Speech and language abilities were within normal limits

ⁱParticipants were recruited from the Amnesia Research Laboratory at the Beckman Institute at the University of Illinois and the Patient Registry of the Division of Behavioral Neurology and Cognitive Neuroscience at the University of Iowa. All participants gave informed consent.

on standardized measures from the Multilingual Aphasia Examination (Benton, Hamsher, Rey, & Sivan, 1994) and Boston Diagnostic Aphasia Examination (Goodglass & Kaplan, 1983). Table 1 presents the amnesia participants' demographic and neuropsychological information. Comparison participants were matched pair wise to amnesia participants on age, sex, education, and handedness.

Each amnesia and comparison participant selected a familiar partner with whom they completed all task trials. Familiar partners had at least 5 years of frequent (monthly) communication with participants although this history was much longer for many pairs (e.g., siblings, spouses). The familiar partners of the amnesia and comparison participants were similar in age (49.7 vs. 45.3) and education (14.0 vs. 14.5) and had no history of neurological disease.

Data Analysis

Through repeated viewings of the videotapes supported by use of transcripts, we analyzed verbal play throughout the 32 sessions (four sessions for each of eight pairs), which included playful episodes produced by both members of the pair (amnesia participants and their partners) during the 24 collaborative referencing trials as well as the researcher during the interactions between trials. Two research assistants and M. Duff completed the analysis using a three-phase consensus coding procedure. In the first phase, descriptions of verbal play from the literature (e.g., Crystal, 1998; Sherzer, 2002) and a broad definition of verbal play from Hengst (2006) were used to capture instances of telling funny stories or jokes, playing with sounds or making puns, overt teasing of other or self-deprecating humor, use of marked or playful voices or registers, singing or song-like intonations, and use of sound effects and gestures. A primary coder identified all such instances, marking in the transcripts where each episode began and ended, and began preliminary characterizations of each episode by resources used and communicative function (see below). In the second phase, a secondary coder reviewed the videos and the marked transcripts from the first coding pass and looked specifically for any episodes not identified by the primary coder, and marked the transcripts for all agreements and disagreements.

In the final coding pass the primary and secondary coders along with the consensus coder (M. Duff) reviewed all episodes and finalized the resource and function coding. During this final stage, episode boundaries were clarified to differentiate playful episodes that consisted of single or multiple (contiguous or simultaneous) utterances that shared a common playful theme, and thus were counted as one episode, from playful exchanges that were a series of unrelated episodes or playful exchanges on the same theme but that were temporally disconnected (across trials, sessions, or days), and were thus counted as separate episodes.

Coding Resources, Functions, and Interactional Form

Coding procedures for resources, functions, and interactional forms were adapted from Hengst (2006). For the analysis of resources we coded three types: verbal, prosodic, and gestural. *Verbal resources* included playing with sounds and meanings of words (e.g., *bucking bronco*; *the horsie of course*) as well as playful names and nicknames (e.g., *the biscuit* for the racehorse Seabiscuit), and expressions (e.g., *play it again, Sam*). *Prosodic resources* included sound effects (e.g., *tick, tock, tick, tock*) and singing (e.g., *Movin' on up, to the east side*) as well as marked shifts in voicing and exaggerated prosody (e.g., *I'm never gonna get to be the boss* [sad voice]). *Gestural resources* included gestures that contributed significant meaning to episodes (e.g., *dropped jaw* in disbelief, skeptical *raised eyebrows*). Episodes could have multiple resources.

To identify the communicative functions of playful episodes, we categorized each as having one of four functions: narrative, teasing, referencing, and other. *Narrative functions* captured jokes and funny stories of everyday events (e.g., The first time my husband ever met Angie we were at a wedding...we just danced right over to Kevin and Angie and Glen pinched her butt [whispered] [laughing]). *Teasing functions* included competitive teasing, scolding, bragging, and self-deprecating comments (e.g., We rule!; This is no time to slip up). Referencing functions included playing with the sounds, words, and meanings of labels (e.g., *Dragon Doggie*). The *other functions* documented playful episodes not captured by the above categories.

To examine the interactional form of playful episodes, two production forms were coded: *simple* and *extended*. *Simple episodes* were short, spanning just 1 to 3 contiguous turns in the form of either single-utterance episodes, or episodes consisting of a playful utterance and a response by one or more interlocutors. *Extended episodes* consisted of multiple, more than 3, thematically related and contiguous utterances. Extended episodes included participants telling funny stories about everyday events and extended playful conversational exchanges and banter.

Reliability of Coding—The two initial coding passes resulted in 88% agreement between the two coders. Coding differences were attributable to the number of new episodes coded in the second pass (86) and disagreements about episode boundaries (e.g., single vs. multiple episodes). Disagreements on the final coding pass were resolved through discussion and consensus. Point-by-point inter-rater and intra-rater reliability were obtained on the final coding pass for approximately 12% of the data (3 trials and the following between-trial talk, randomly selected per pair) for the three verbal play resources and the four verbal play functions. Intra-rater and inter-rater reliability was high with 92.4% and 93.7% for resource and 86.1% and 86.8% for function coding, respectively.

RESULTS

Frequency of verbal play

Across the entire data set, 884 verbal play episodes were coded, with each of the eight participant pairs contributing 36-203 episodes. As predicted, considerably fewer verbal play episodes were produced in the amnesia sessions ($M = 78.0$; $SD = 34.7$) than in comparison sessions ($M = 143.0$; $SD = 43.9$) ($t(6) = 2.322, p = .059$). In fact, comparison sessions contained nearly twice as many episodes, on average, than amnesia sessions. Focusing on just those episodes initiated by either participants with amnesia or comparison participants, fewer than half as many play episodes were produced by amnesia participants than comparison participants (187 vs. 395, respectively; ($t(6) = 2.920, p = .027$)). These differences cannot to be attributed to differences in the amount of talk: amnesia pairs produced more words across trials than comparison pairs. Interestingly, it was not just the amnesia participants who produced fewer playful episodes in amnesia sessions. All participants in the amnesia sessions produced fewer verbal play episodes. The partners and the researcher in the amnesia sessions produced only 97 (31.1%) and 28 (9.0%) verbal play episodes, respectively, compared to 148 (25.9%) by partners and 29 (5.1%) by the researcher in comparison sessions.

Resources, and functions, and interactional forms of verbal play

All participants used the full range of verbal, prosodic, and gestural resources in the production of verbal play. Although the majority of verbal play episodes produced across both groups were verbal only (67.1%, 594/884), there was evidence that the participants in amnesia sessions relied more on single resource episodes (e.g., verbal or prosodic only) (75.3%) than participants in comparison sessions (65.7%), although this difference was not statistically significant ($t(6) = 1.787, p = .124$). In the comparison sessions 65 (11.4%) verbal play episodes were produced

with all three resources (e.g., verbal + prosodic + gestural), providing evidence of greater complexity in their verbal play episodes. Of these 65 episodes, comparison participants produced 30 and each comparison participant produced at least one. For example, one comparison participant, who after arguing with her partner about whether or not a specific card looked like a *bunny*, struck a Dean Martin stance and sang, *Every bunny needs some bunny sometimes*. In contrast, only 14 (4.5%) playful episodes in amnesia sessions were produced with all three resources and an amnesia participant produced only 3 of the 14. The same amnesia participant, 0002, produced all 3 episodes. No other amnesia participant ever produced a playful episode using all three resources.

All functions of verbal play were coded in both groups and all participant pairs used all functions, except one amnesia pair who did not produce any playful episodes coded as narrative. Across all 32 sessions, 51.2% (453/884) of the playful episodes were coded as referencing, 34.5% (305/884) as teasing, 9.8% (87/884) as other, and 4.4% (39/884) as narrative. Although comparison sessions contained more episodes overall than amnesia sessions, the distribution of playful episodes for each of the functions was remarkably similar: referencing 48.1% and 53.0%; teasing 37.5% and 32.9%; other 10.6% and 9.4%; and narrative 3.8% and 4.7%, for amnesia and comparison sessions, respectively. Examination of the proportion of episodes produced by the amnesia and comparison participants coded as each of the four functions revealed no significant group differences (two-tailed Wilcoxon matched pairs signed rank and a Bonferroni correction for multiple comparisons (alpha of .0125)): referencing ($Z = -.289$, $p = .773$); teasing $Z = -.289$, $p = .773$); other ($Z = -.877$, $p = .381$); and narrative ($Z = -2.352$, $p = .019$). The stringency of the Bonferroni correction increases the risk of Type 2 errors. It is worth noting that statistically significant group differences would have been observed for the narrative function without the correction, suggesting that there may be group differences for this function.

The majority of all verbal play episodes were coded as simple, or extending just 1 to 3 contiguous turns (809/884 = 91.5%). In contrast to our prediction, there was no difference in the number of verbal play episodes coded as simple or extended in amnesia (291/312 = 93.2% simple) vs. comparison (518/572 = 90.5% simple) sessions, ($t(6) = 2.057$, $p = .085$).

Thematically linked episodes

More striking than the group differences observed in the *quantity* of verbal play produced was the way comparison pairs, but not amnesia pairs, flexibly sustained, built on, and returned to previous playful episodes across the space of multiple turns, trials, and even sessions, and days. These thematically linked episodes included playing with labels for specific cards, as when a comparison pair sustained a line of play around the initial labeling of one card as *Kramer*, by then putting Kramer in a variety of his outlandish predicaments. Three of these included Kramer dancing, Kramer with a box of Seinfeld cereal, and *Kramer in a kilt*. It is precisely this weaving of their shared history of the TV show into the task of developing shared labels for the set of abstract figures that displays their marked use of creativity. References such as *man dancing* or *man holding a box* (labels used by other pairs) do not require the juxtaposition or shift in frames and were thus not produced as or taken up as playful. Comparison pairs also produced thematically linked episodes related to playing with the task itself by making the game faster and teasing their partners. One comparison pair played with the task by pretending to communicate telepathically, with the partner stating, *I'm psychic, call me Dionne* [Warwick]. By the second session, the comparison participant was rubbing his head stating, *I'm going to send you my thoughts*. Across the four sessions, 11 episodes were identified related to this theme.

Although we predicted fewer sustained and thematically linked episodes, we were surprised at just how few there were in the amnesia sessions. Of those playful episodes that were returned

to, when initiated by amnesia participants, they were often rote produced and highly repetitive, (e.g., as when an amnesia participant reproduced the same joke, nearly verbatim, multiple times), and over time fell flat. The partners' response to these rote and repetitive episodes ranged from evidence of visual frustration and irritation to no response at all. When initiated by partners, over time amnesia participants failed to recognize the playful frame, unable to hold on to or reconstruct the playful context or history, as evidenced by a blank or confused look. In these cases, the partner often abandoned the play. For example, a partner teased an amnesia participant on day one about having difficulty labeling a particular card across several trials. The amnesia participant responded in kind by laughing and making self-deprecating comments (e.g., *I don't know what the heck it is*), but on the following day when the partner returned to this line of play, the amnesia participant appeared confused and the partner had to explain the history of the playful banter to him, marking the end of this sustained playful theme.

For both groups, across multiple trials and multiple repetitions of the labels, particularly as pairs got faster at the game, more efficient in their interactions, and as the labels became more streamlined, the highly emotive and marked use of resources and framing (e.g., prosody, laughter, partner responses) faded as references were produced without these marked features. Comparison pairs, however, worked to maintain the traces of these playful trajectories (e.g., a slight smile, a wink) and even created opportunities to launch whole new episodes. For example, during the last session, one comparison participant created new episodes by giving clues or synonyms for labels (e.g., *the person starting to stand up* became *Help I can't get up*) and created narratives from the labels (e.g., piranha fish, sliding down the messed up mountain, that runs into the person kneeling, that messes up the Christmas tree, and the dog with a fin runs away, to the barn with the arrow). Another comparison pair, added prosody to labels (e.g., *the mess* [breathy voice]) and played with words from previously established labels (e.g., the tree recliner, not to be confused with a tree hugger). For the amnesia participants, their memory impairment isolates them from earlier episodes along this playful trajectory.

Consistent with research arguing that verbal play serves important interpersonal functions (Crystal, 1998) and facilitates the building of trusting social relationships (Straehle, 1993), comparison pairs worked to build a relationship with the researcher. One partner in a comparison pair discovered she and the researcher were from the same town and told the researcher stories about her home town (e.g., *For genealogy research...[it's] the worst... They'll say, no we don't have it and I'll go down there in person and find it*) and teased her about her accent (e.g., *She's got a little drawl to her*). Another comparison participant solicited the researcher's help in teasing his partner, who objected to the card description of *a woman in a kimono* in favor of *a man in a suit*. The comparison director told the partner the difference in perspectives was, *Cause you're gay. Actually this test is trying to find out if you're gay and the researcher added, And we'll give you the verdict at the end of the test. This same pair teased the researcher in the first session that she looked and sounded like a flight attendant when giving the instructions as she pointed to the barrier and the cards. In the second session, they again teased her about giving the same instructions, sarcastically asking, Can we look over the barrier* and the research responded, *No, but you can you use your seats as a flotation device in the event of a water landing. These last two examples point to the social risk of teasing using controversial categories and stereotypes (i.e., gay, flight attendant) that could easily have been taken up as a challenge instead of playful.*

In the amnesia sessions, we did not observe any thematically linked episodes initiated by amnesia participants directed towards the researcher. There were a few initiated by amnesia partners (e.g., teasing the researcher, *You didn't tell us to have fun*) but these lacked the same depth across trials and in terms of the nature of the interaction. Again, the amnesia participants

did not seem to recognize the playful nature of their partner's interactions with the researcher or the context for how these episodes originated and did not contribute to these playful episodes.

DISCUSSION

Consistent with perspectives of verbal play as a pervasive discourse form in everyday communicative interactions, all participants, including those diagnosed with hippocampal amnesia, initiated and contributed to verbal play episodes. However, fewer verbal play episodes occurred in the sessions of amnesia participants than those of the comparison participants, and the amnesia participants themselves initiated significantly fewer episodes than their partners or than comparison participants. The quality of verbal play episodes also differed. In contrast to comparison participants, verbal play episodes produced by individuals with amnesia were more rote produced and less richly or skillfully deployed (i.e., few multi-resource productions), and playful themes were not sustained across stretches of interaction or returned to in later episodes. These findings suggest that hippocampal amnesia disrupts the creative use of language in social interaction, seen here as a reduction in the use and complexity of verbal play. These findings are consistent with our previous work pointing to the role of declarative memory in meeting the real-world demands of everyday communication (Duff et al., 2007; 2008a). Yet, despite these quantitative and qualitative disruptions in verbal play, the amnesia participants clearly enjoyed the task based both on their self-reports (e.g., *This is fun, I like this game*) and demonstrated by the positive and playful demeanor (e.g., laughter, smiles) they displayed during game play, especially on later trials. Thus, hippocampal amnesia does not prevent these individuals from experiencing basic emotion or enjoying social interaction. Rather, profound declarative memory deficits impair the ability to creatively and flexibly deploy the communicative and cognitive resources necessary to meet the moment-to-moment demands of interactional discourse resources such as verbal play.

The collaborative referencing paradigm offers a rich environment for observing memory-and-language-in-use across extended and repeated collaborative interactions. The analysis of verbal play by individuals with amnesia while in the midst of demonstrating robust collaborative learning by these pairs provides a unique window into the interaction of language and memory. This approach allows us to reveal more complex patterns of spared (acquisition and use shared referential labels, or common ground) and impaired (reduced use of verbal play) performance than is typical of formal laboratory tasks. Verbal play was not critical to showing intact learning, and hence amnesia participants were not disadvantaged on our original measures of learning (e.g., changes in time, words) (Duff et al., 2006). If anything, given the reduced use of verbal play by amnesia pairs, compared to comparison pairs, their normal rate of learning is all that more impressive. We have commented previously (Duff et al., 2006; 2008b), however, that common ground likely has multiple forms and determinants, dependent upon the contributions of different memory systems in the brain with more procedural forms of memory supporting the gradual acquisition of linguistic, conceptual, and perceptual information necessary to arrive at concise referential labels in this task (intact in amnesia) and declarative memory supporting the use of high-level discourse practices, like verbal play, (impaired in amnesia).

Although the goal of the current study was to examine the contribution of declarative memory to verbal creativity, these data also contribute to our understanding of the role of memory in building and sustaining relationships and the social-emotional consequences of living with amnesia. The declarative memory system supports the creation of representations for successive events including information about the co-occurrences of people, places, and things, along with the spatial, temporal and interactional relations among them as well as the larger record of one's experience over time (Cohen & Banich, 2003). In the current study, we observe healthy comparison participants drawing on declarative memory to explicitly link and build on thematically related playful episodes across the space of turns, trials, and even sessions and

days. Creation of an explicit record of what was said, by whom, and when to (re)construct or recognize the playful episode is well beyond the memory abilities of the amnesia participants and consequentially, isolates them from the evolving playful trajectories. Ogden (1996) characterizes this inability to create rich and detailed records of the conversations, experiences and events of one's day in the amnesic patient H.M. as being "Marooned in the Moment." Communicatively, given that we routinely return to and elaborate on conversations across long stretches of interaction (days, weeks, and longer), participants with amnesia are *interactionally marooned*; cut off from opportunities to (re)engage in the themes and with the people of their everyday lives. Our examination of verbal play in social interaction begins to reveal the consequences of declarative memory impairments on social-emotional communication and the ongoing development and maintenance of social relationships (e.g., Crystal, 1998).

Cognitive deficits that disrupt long-standing patterns of interaction and communication are common following brain injury and constitute significant challenges to the psychosocial adjustments of these patients and their families. Such disruptions are often profound and contribute to a loss of communicative involvement among previously routine partners. In our experience with this population, the individuals with amnesia sense this loss but can only point to potential causes of their partners' frustration (e.g., I cover the same topic over and over and over and over). For the partners, this loss is articulated in terms of the communicative intimacy that is now missing from their interactions (e.g., I really miss our conversations about world events, our banter, and how we used to play with words). The case of the CHI participant is an interesting exception. She is noteworthy in terms of her remarkable functional outcome, her success in establishing and maintaining interpersonal relationships since the onset of her amnesia, and the real-world abilities she maintains despite the severity of memory impairment (see Duff, Wszalek, Tranel, & Cohen, 2008). While she and her partner did not have the most verbal play episodes of the amnesia pairs, their episodes were more similar to comparison pairs (e.g., partner sustained a line of thematically related episodes, only amnesia participant to produce episodes with all three resources). Interestingly, of all the amnesia pairs, this was the only pair who did not know each other prior to the onset of amnesia. This is not to say, however, that this partner does not have to make accommodations to facilitate successful communication with her memory impaired partner but rather highlights the fact that these patterns of interaction were newly developed after the onset of amnesia, and that the amnesia did not mark a disruption in, or require a renegotiation of, previously established practices and social identities. While the extent to which their exclusively post amnesia communicative history contributed to their pattern of verbal play use awaits further investigation, we believe it may have direct implications for intervention and counseling.

More broadly, we have advocated for the development of rich learning and communicative environments that support new learning and permit the examination and *co-construction* of socially complex, goal-directed communication (see Duff et al., 2008b; Hengst & Duff, 2007). The successful deployment of interactional discourse resources, like verbal play, requires the dynamic coordination and collaboration of *both* communication partners, whether that partner is the patient's spouse or clinician. Thus, for clients with profound and chronic declarative memory impairments, where it is unlikely for memory function to be sufficiently restored to support fully intact verbal play use, intervention targeted at the communicative practices of *both* partners (e.g., understanding the nature of the impairment, reducing frustration and irritation, structuring and creating supportive opportunities for verbal play) is warranted.

Finally, while hippocampal amnesia does not cause the kind of devastating language impairments seen in aphasia, declarative memory impairments can interfere with high-level discourse practices that are typical of everyday communication. Thus, by creating rich learning and communicative environments that afford the opportunity to observe interactional aspects of communication, we are beginning to capture disruptions in social interaction that may be

common in individuals who have declarative memory impairments as part of a more complex pattern of neuropsychological impairment (e.g., TBI, AD).

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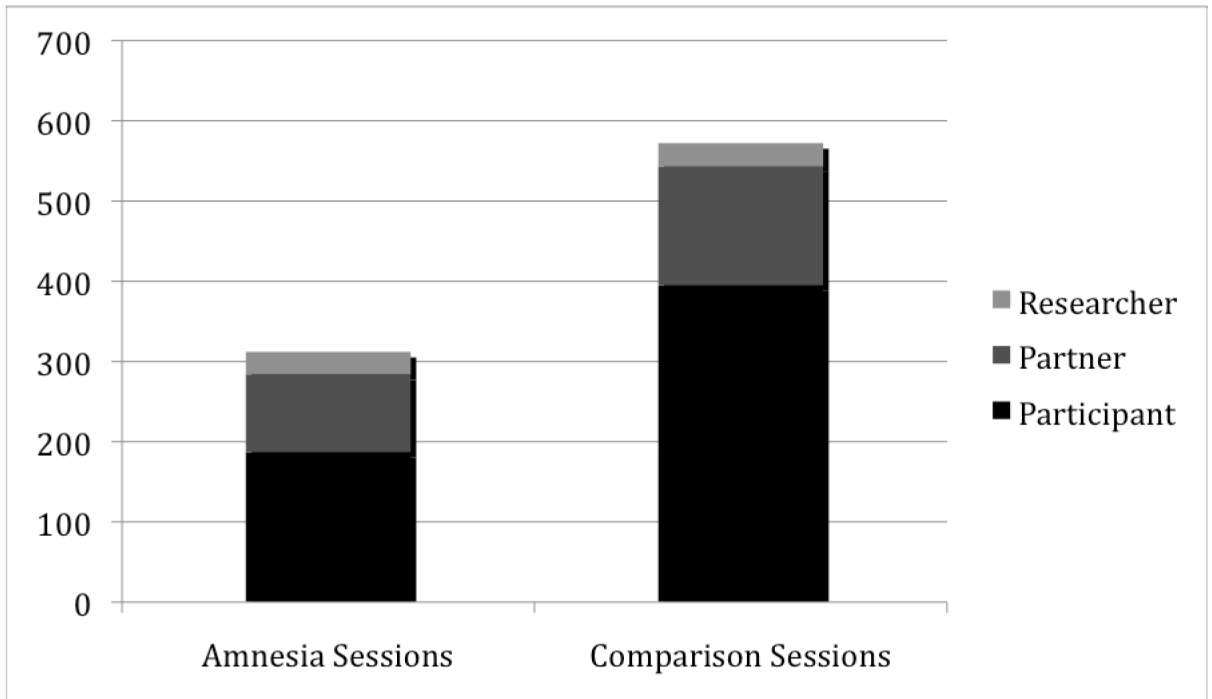


Figure 1. Total Number of Verbal Play Episodes by Group and Participant

Table 1

Demographic and Neuropsychological Data for Participants with Amnesia

	Participants with Amnesia			
	2563	2363	0001	0002
Demographic Data				
Year of Birth	1955	1956	1948	1955
Sex	M	M	F	F
Handedness	L	R	R	R
Etiology	Anoxic	Anoxic	Anoxic	CHI
Neuropsychological Data				
WAIS-III FSIQ	102	98	90	126
WMS-III GMI	75	73	54	49
Boston Naming Test ¹	52	58	56	59
Token Test ²	44	44	44	44

Note. M = male; F = female; L = left; R = right; CHI = Closed Head Injury; WAIS-III = Wechsler Adult Intelligence Scale-III; FSIQ = Full Scale Intelligence Quotient; WMS-III = Wechsler Memory Scale-III; GMI = General Memory Index

¹ = from the Boston Diagnostic Aphasia Examination, maximum score of 60

² = from the Multilingual Aphasia Examination, maximum score of 44