Published in final edited form as:
J Speech Lang Hear Res. 2009 April ; 52(2): 359–372. doi:10.1044/1092-4388(2009/07-0012).

Inferencing Processes After Right Hemisphere Brain Damage: Maintenance of Inferences

Margaret Lehman Blake
University of Houston, TX

Abstract

Purpose—This study was designed to replicate and extend a previous study of inferencing in which some adults with right hemisphere damage (RHD) generated but did not maintain predictive inferences over time (M. Lehman-Blake & C. Tompkins, 2001). Two hypotheses were tested: (a) inferences were deactivated, and (b) selection of previously generated inferences was slowed and not measurable with the original stimuli. Existing literature did not support one hypothesis over the other.

Method—Fourteen adults with RHD and 14 with no brain damage (NBD) participated in this mixed-design study. Participants read short narratives that suggested a predictive inference. Reading times were obtained to assess inference generation, maintenance, and integration.

Results—The majority of participants evidenced generation and maintenance of inferences. For the few who did not maintain inferences, participants with NBD always deactivated the inferences, whereas those with RHD demonstrated either deactivation or slowed selection. Adults with RHD were more likely to exhibit slowing in inference generation and integration.

Conclusions—The results for inference maintenance differ from the original study in that most participants with RHD maintained inferences. Deactivation appeared in both groups, whereas slowed selection appeared to be an aberrant process related to RHD. Future work is needed to tease out the relationships between comprehension, working memory, and inferencing processes.

Keywords

language comprehension; cognitive-communication disorders; stroke

Impairments in inferencing processes have been linked with right hemisphere damage (RHD) in the brain for many years (Brownell, Potter, Bihrle, & Gardner, 1986; Moya, Benowitz, Levine, & Finklestein, 1986; P. S. Myers, 1991; Wapner, Hamby, & Gardner, 1981). Early work suggested that adults with RHD were unable to generate inferences and comprehended only explicitly stated information (e.g., Moya et al., 1986). Further research has provided evidence that these individuals can generate inferences under some conditions. For example, inferences needed to link new information to a previous context (i.e., bridging or local coherence inferences) typically are generated by adults with RHD (Brownell et al., 1986; Tompkins, Bloise, Timko, & Baumgaertner, 1994; Tompkins, Fassbinder, Blake, Baumgaertner, & Jayaram, 2004; Tompkins, Lehman-Blake, Baumgaertner, & Fassbinder, 2001; but see Beeman, 1993, for conflicting results). In normal comprehension processes, generation of bridging inferences is considered to be automatic, in that they are generated quickly with little demand on cognitive resources (e.g., McKoon & Ratcliff, 1992).

Contact author: Margaret Lehman Blake, University of Houston, Department of Communication Sciences and Disorders, 100 Clinical Research Center, Houston, TX 77204-6018. E-mail: mtblake@uh.edu.

Adults with RHD seem to have more difficulty with what McKoon and Ratcliff (1992) termed *elaborative inferences.* These inferences embellish information within a text. They are not considered automatic, as they are time consuming and require cognitive resources to be generated. Although they are not required for basic comprehension, generation of contextually relevant elaborative inferences can facilitate speed of comprehension and resolution of ambiguous interpretations (Garrod, O'Brien, Morris, & Rayner, 1990; O'Brien, Shank, Myers, & Rayner, 1988). For example, if the sentence “Ruth went to the closet and took out a broom” is immediately followed by “She swept the kitchen floor,” the second sentence is read more quickly when the inference “sweep” is generated than when it is not. One type of elaborative inference that has been examined extensively is predictive inferences, in which a comprehender guesses or predicts what will happen next. The prevailing view in the cognitive psychology literature is that predictive inferences can be reliably generated by young (Allbritton, 2004; Campion, 2004; Linderholm, 2002) and older (Valencia-Laver & Light, 2000; Zipin, Tompkins, & Kasper, 2000) adults. Generation of predictive inferences is most reliable when they provide a causal consequence. In the example above, the prediction that Ruth is going to sweep is both a prediction of what she will do next and an explanation for why she took the broom out of the closet.

Factors Influencing Inference Processes

Lehman and Tompkins (2000) reviewed the literature on inferencing as it pertained to adults with RHD. They concluded that, in addition to the type of inferences tested, characteristics of the task may account for the conflicting results. Another factor that must be considered is the component of the inference process that is being assessed.

Task Characteristics

In their discussion of task characteristics, Lehman and Tompkins (2000) suggested that online tasks, such as reading time or lexical decision, allow a more accurate measure of inferencing than offline tasks because the former eliminate confounds of memory, metalinguistic judgments, or other cognitive processes (see also Tompkins & Baumgaertner, 1998). One online method that has been used in several studies of elaborative inferencing is the elicitation of a contradiction effect (Albrecht & O'Brien, 1993; Fincher-Kiefer & D'Agostino, 2004; Klin, 1995; Klin, Murray, Levine, & Guzman, 1999). In this method, a specific inference is suggested within a story context, and reading time is assessed on a sentence that *disconfirms* the inference. Slowed reading times on disconfirming sentences are an indication that readers generated the inference and subsequently had difficulty integrating the contradictory information into their mental representation. Using the previous example of Ruth cleaning house, the sentence “She dusted her bookshelves and then sat down to rest” disconfirms the “sweep” inference (see Table 1). If readers generated the predictive inference that Ruth was going to sweep, then the sentence about dusting would contradict that inference, and reading time for the disconfirming sentence would be slowed as readers attempted to integrate the contradictory new information (dusting) into their mental model.

Inference Processes

Another factor that may influence results of inferencing studies is the specific inferencing process that is being assessed. Probing for an inference soon after it is suggested is a measure of inference generation. Probing for an inference some time or distance from the original suggestion may not be a measure of inference generation but rather maintenance or reactivation of the inference (J. L. Myers & O'Brien, 1998).[1] In the RHD literature, inferencing is often implicitly considered to be a single process, with no differentiation made between potential components, such as generation, integration, maintenance, or reactivation of inferences. Consideration of separate processes may help to reconcile conflicting results. For example, studies that use posttest comprehension questions as a measure of inferencing often report that adults with RHD do not make inferences (Beeman, 1993; Benowitz, Moya, & Levine, 1990; Mackenzie, Begg, Brady, & Lees, 1997; Moya et al., 1986; Purdy, Belanger, & Liles, 1992; Wapner et al., 1981). However, it is possible that individuals with RHD do generate inferences, but they do not integrate them into a mental model or cannot maintain them in working memory. In these cases, evidence of inferencing would not be apparent at a delayed point of testing.

Theories of Inferencing

Several models of memory-based text processing provide explanations of inferencing processes (Kintsch, 1988; J. L. Myers & O'Brien, 1998). These models purport that comprehension proceeds with an initial automatic activation (or resonance) process followed by a slower, controlled, integration process. According to J. L. Myers and O'Brien's (1998) resonance model, generation of inferences begins with automatic activation of elements in long-term memory that are similar to information being comprehended. If there is a sufficient match, the controlled phase is initiated, and items in long-term memory are pulled into working memory where they are integrated into a mental representation.

Several things can happen during generation of an elaborative inference (J. L. Myers & O'Brien, 1998). First, an inference may be integrated into a reader's mental representation of the story. The pattern match between getting a broom and sweeping may be strong enough that the concept "sweep" is brought into working memory and integrated into the story (see also McKoon & Ratcliff, 1989). Second, an inference may remain activated in long-term memory until it is necessary or until further information from the story strengthens the resonance enough for it to be selected and pulled into working memory. In this case, the reader maintains some activation of "sweeping" but does not integrate it into the story without additional support from the text. If new information appears later, then the activation of the concept "sweep" can be increased enough for it to be selected and integrated in working memory. This selection process may take some time to be accomplished (Albrecht & O'Brien, 1993; Huitema, Dopkins, Klin, & Myers, 1993; Klin et al., 1999). Third, an inference that is active in long-term memory may be deactivated if it does not sufficiently match the information in working memory (J. L. Myers & O'Brien, 1998). In this case, the inference can be considered lost. The sentence "Ruth took out her broom" may initially activate the concept "sweep," but if the story continued with general information about housecleaning, the inference may be deactivated if it is no longer strongly related to the concepts in working memory.

Inferencing and RHD

Research has only just begun to examine conditions that may influence inferencing by adults with RHD and potential mechanisms that may explain the variability across conditions, tasks, and individuals. Lehman-Blake and Tompkins (2001) provided the first test of generation versus maintenance of inferences (i.e., recency effects) in adults with RHD. Details about the participants and methods are discussed here to provide a basis for the current study, which was designed as a replication and extension of the original study.

The participants in Lehman-Blake and Tompkins's (2001) study were 13 individuals with RHD and 11 adults with no brain damage (NBD). Individuals in the RHD group were between 21–139 months postonset of stroke (*M* = 41.3 months), and they were selected on the basis of a lesion in the right hemisphere and not the presence of cognitive-communication deficits.

---

[1] The phenomenon of "losing" inferences often is referred to as a *recency of mention* effect in literature, in which individuals exhibit evidence of inferencing when testing occurs close in time to the suggested inference but not when testing is distanced from the point at which the inference is thought to be generated (e.g., Glenberg, Meyer, & Lindem, 1987; Lehman-Blake & Tompkins, 2001; J. L. Myers & O'Brien, 1998; O'Brien, Plewes, & Albrecht, 1990; Walker & Meyer, 1980).

Individuals with visuospatial neglect (measured by the Behavioural Inattention Test; Wilson, Cockburn, & Halligan, 1987) were excluded from the study because of the visual nature of the stimuli. The groups did not differ in terms of age (NBD, *M* = 59.9; RHD, *M* = 65.7), education (NBD, *M* = 13.5; RHD, *M* = 13.9), or number of errors on a discourse comprehension measure (NBD, *M* = 3.7; RHD, *M* = 3.5; Discourse Comprehension Test [DCT]; Brookshire & Nicholas, 1993). The NBD group did make significantly fewer recall errors (*M* = 2.7) than the RHD group (*M* = 8.3) on an auditory working memory measure (Lehman & Tompkins, 1998; Tompkins et al., 1994).

The experimental stimuli (see Table 1) were seven base texts, each five sentences long. A single predictive sentence strongly suggested a specific outcome. The target outcome was not suggested or explicitly stated at any other point in the story. Four sentences described a common scene (e.g., cleaning house, getting ready for vacation) and included the predictive sentence. A fifth sentence was the target sentence that *disconfirmed* the predicted outcome. Three versions of each story were constructed to create Recent, Distant, and Control versions.

In the Recent version, the predictive sentence was the fourth sentence of the story and thus appeared immediately prior to the target disconfirming sentence. The Distant version was created by placing the predictive sentence as the second sentence of the story, allowing two intervening sentences between when the outcome was suggested in the predictive sentence and the point at which it was measured in the target sentence. Control versions were created by deleting the predictive sentence. In Control stories, the target (disconfirming) sentence was not contradictory because no specific outcome previously had been suggested. The Control stories were one sentence shorter than the Recent and Distant stories. Using shorter stories as controls was determined to be better than replacing the predictive sentence with another that could add new information to bias readers' interpretation of the stories. There was no reason to believe that shorter stories might impact comprehension or inference processes.

Results indicated that all of the participants with NBD and 83% of individuals in the RHD group generated the intended predictive inferences, as indicated by slower reading time on target sentences for Recent compared with Control stories. Maintenance of intended inferences, indicated by slower reading time for Distant than Control story target sentences, was detected for 83% of the NBD group but for only 58% of the RHD group. Two potential explanations for why some adults with RHD failed to exhibit maintenance of inferences were suggested. First, predictive inferences not immediately confirmed by a text could have been deactivated in long-term memory and essentially lost. Second, the slowed selection hypothesis suggests that the predictive inferences, although initially generated, were not integrated into a mental representation of the text. The inferences may have remained somewhat activated in long-term memory, available for later selection. If the selection of these previously generated inferences required some time to be completed, inferencing may not have been detected at the point at which measurement occurred. The stimuli used in Lehman-Blake and Tompkins's (2001) study did not allow for differentiation of these explanations.

Aims of the Current Study

The purposes of the current study were to replicate and extend the original study (Lehman-Blake & Tompkins, 2001) to test the two explanations of maintenance of inferences over time. The two competing hypotheses were (a) deactivation—predictive inferences not immediately confirmed by a text are deactivated in long-term memory— and (b) slowed selection—the selection of previously generated inferences requires some time to be completed, and thus inferencing may not be detected with some methods that test only one point in time.

There was little evidence to support one hypothesis over the other, and no theories directly related to the current question. Beeman (1993, 1998; Jung-Beeman, 2005) has suggested that RHD causes difficulty in generating and maintaining activation necessary for inferencing. Although generation of inferences has been demonstrated (Brownell et al., 1986; Lehman-Blake & Tompkins, 2001; Tompkins et al., 1994, 2001, 2004), perhaps these individuals are unable to maintain activation of inferences. In this case, deactivation may be seen. Alternatively, slowed selection may be related to an inefficient suppression mechanism. The suppression deficit hypothesis (Tompkins, Baumgaertner, Lehman, & Fassbinder, 2000; Tompkins et al., 2001, 2004) purports that adults with RHD are slow to suppress or inhibit unwanted meanings. Although the suppression deficit has been investigated primarily in relation to ambiguous meanings, it is possible that adults with RHD could retain some residual activation of predictive inferences in long-term memory. These inferences could be available for increased activation and selection, thus supporting the slowed selection hypothesis.

Method

Participants

All procedures for recruiting and testing participants were approved by the University of Houston Committee for the Protection of Human Subjects. Participants were recruited through newspaper advertisements, stroke support groups, and senior centers. Inclusion criteria were the same as for the original study (Lehman-Blake & Tompkins, 2001), such that participants had to (a) be right-handed (Annet, 1970), (b) be between 50 and 85 years of age, (c) be native speakers of American English with no other language learned prior to school age, (d) have a negative history of drug or alcohol abuse, and (e) have a negative history of neurological conditions besides stroke. The last two criteria were determined by self-report for individuals with NBD and by medical records review for individuals with RHD. In addition, individuals in the NBD group had to meet age- and education-based criteria on the Mini Mental State Exam (Crum, Anthony, Bassett, & Folstein, 1993; Folstein, Folstein, & McHugh, 1975). For the participants with NBD included in the study, the average Mini Mental State Exam score was 29.6 (*SD* = 0.51), with a range of 29–30. Twenty-two individuals with NBD and 23 with RHD met all inclusion criteria.

All participants met criteria for hearing and visual acuity. Hearing thresholds (unaided) had to be at least 35 dB at 500 and 1000 Hz and 40 dB at 2000 Hz (American National Standards Institute, 1996) in the better ear, as tested with a portable audiometer (Maico MA 27, Maico Diagnostics, Eden Prairie, MN). The vision screening was a sentence reading task (Lehman-Blake & Tompkins, 2001) presented via computer in the same format as the experimental task. The reading task consisted of 10 sentences printed in black ink on a white background in the same size (18-point) and font (Times New Roman) as the experimental stories. Potential participants read each sentence out loud. Anyone who made more than one uncorrected reading error was excluded from the study. The sentences were designed to screen for left visuospatial neglect as well as visual acuity. To this end, sentences began with a word or phrase that could be omitted and still leave a syntactically and semantically intact sentence (e.g., “Early one morning Bob went for a run in his neighborhood”).

Individuals with RHD were included on the basis of a lesion in the right hemisphere, not the presence of a cognitive-communication disorder. The average length of time postonset of stroke was 86.6 months, ranging from 14 to 162 months. Location of lesion was determined by medical records from the hospitalization for the stroke and/or magnetic resonance imaging (MRI) scan conducted at the time of the testing. Structural MRI scans were obtained for 18 participants. The remaining 5 participants did not consent to the MRI procedure. As with the original study (Lehman-Blake & Tompkins, 2001), potential participants with RHD had to score within the range of normal performance on the six conventional subtests of the

Behavioural Inattention Test (Wilson et al., 1987) to prevent confounds of neglect on comprehension of the visually presented experimental stimuli.

Testing was completed with 22 adults with NBD and 23 individuals with RHD. From the RHD group, 9 individuals were subsequently excluded on the basis of results from the structural MRI scans that indicated lesions in the left hemisphere that were not reported in the original medical records. This left 14 participants in the RHD group (see the Appendix for lesion data). It is possible that some or all of the 5 individuals who had not consented to the MRI scan had similar left hemisphere lesions that were not reported in the original medical records. Visual examination of the scores on the ancillary tests (e.g., discourse comprehension, working memory, receptive vocabulary, verbal and social inferencing) indicated that none of these 5 participants scored lower than the lowest score from the other 9 participants (who had undergone MRI to confirm site of lesion). Given that the ancillary tasks were highly language dependent, one could presume that participants with left hemisphere lesions causing aphasic deficits that could influence performance on the experimental task would demonstrate more difficulties than those with lesions restricted to the right hemisphere. As ancillary task scores from these 5 individuals were not noticeably different from the remaining participants, these 5 individuals were included in the analyses.

To limit the effects of unequal sample sizes and heterogeneity of variance on the statistical analyses (Keppel, 1991), 14 participants from the NBD group were selected. These individuals were matched as closely as possible to the RHD group on years of age and education. Select demographic and clinical data for the 28 participants included are provided in Table 2.

Materials

Experimental tasks—The stimuli from Lehman-Blake and Tompkins's (2001) study were used, with one modification. For the current study, a sixth (posttarget) sentence was added (see Table 1). This sentence was neutral in regard to the intended inference, but it was consistent with the general theme of the story, and it allowed evaluation of the deactivation versus slowed selection explanations. The inclusion of the posttarget sentence also allowed for measurement of a *spill-over effect*, or slowing that occurs beyond the target sentence. The source of the spill-over effect has been attributed to slowed inference generation (Calvo & Castillo, 1996) or continued integration processes (Albrecht & O'Brien, 1993) and has been reported in several studies of predictive inferencing in young adults (Albrecht & O'Brien, 1993; Calvo & Castillo, 1996; Huitema et al., 1993; Klin et al., 1999).

Generation of inferences was measured using the Recent and Control condition stimuli. Slowing on the Recent versus Control condition target sentences was taken as evidence that the participants generated the target inference. Slowing only on the posttarget sentence was indicative of slowed generation of the inference, and slowing on both target and posttarget sentences indicated that the participant generated the inference and also required extra time to integrate the inferred with the actual outcome.

Maintenance of inferences was measured using the Distant and Control condition stimuli. Slowed reading times on the target sentence were considered evidence of maintained activation of the target inference. If individuals required some time to select previously activated inferences, then inferencing (i.e., slowed reading times) should be detected only on the posttarget sentence. In contrast, if readers deactivated and lost the intended inferences, then slowed reading would not be detected on either the target or the posttarget sentences.

Ancillary tasks—Ancillary tasks were used to characterize the groups and also to explore potential correlates of predictive inferencing processes. Working memory was assessed with an auditory sentence verification task (Lehman & Tompkins, 1998; Tompkins et al., 1994), with both comprehension and recall components. The stimuli were auditorily presented statements (e.g., “Snow is cold” and “You eat a mountain”). Participants had to judge whether each statement was true or false, and then they had remember the last word of each statement. Once a set was completed, participants had to recall the last word of each statement in the set (e.g., cold, mountain). Sets ranged from two to five statements.

Language abilities were measured in terms of receptive vocabulary (Peabody Picture Vocabulary Test–III; Dunn & Dunn, 2000) and general reading comprehension ability. The latter was assessed using the five written stories from the DCT (Brookshire & Nicholas, 1993). Participants read the stories and then answered yes/no questions that assessed details and main ideas that were either implied or directly stated in the stories.

General inferencing abilities were measured with two tasks. The first was the Inferences and Metaphorical Language subtests from the Burns Brief Inventory of Communication and Cognition–Right Hemisphere Inventory (Burns, 1997). The Inferences subtest consists of five two-sentence vignettes, followed by two questions that probe inferences suggested in the stories. The Metaphorical Language subtest consists of five sentences, each of which includes a metaphor. Participants are asked about the meaning of the nonliteral phrase (e.g., “If a man checks out of a hospital, does it mean he leaves the hospital?”).

The second inferencing measure was The Awareness of Social Inference Test (TASIT)–Enriched subtest (McDonald, Flanagan, & Rollins, 2002). The stimuli consist of 16 brief video vignettes. Each segment involves two or three characters interacting in everyday situations. In half of them, a character tells a lie and intentionally tries to hide his or her true feelings. In the remaining segments, a character produces a sarcastic response. Participants watched each video clip and then answered four questions. The questions probed what a character was (a) doing to another person, (b) trying to say, (c) thinking, and (d) feeling toward a person or situation. The test was normed on individuals with NBD between 14 and 60 years of age, and data from adults with traumatic brain injury are reported in the test manual.

The presence of cognitive-communication deficits was not a criterion for inclusion of adults with RHD in the current study. However, examination of performance on the ancillary tasks (see Table 2) indicates that the RHD group exhibited cognitive-communication deficits. These included deficits in auditory working memory, reading comprehension for inferred details (DCT; Brookshire & Nicholas, 1993), and comprehension of social inferences (TASIT; McDonald et al., 2002).[2]

Procedure

The procedures mirrored those for the original study, with upgrades to the computer hardware and software. Participants read experimental stimuli one line at a time from a laptop computer screen (Dell Insprion 8200, 15-in. [38.1-cm] super XGA screen). Presentation rate was controlled by the participant, who pressed a button on a response box (Psychology Software Tools, 2000) to replace each sentence with a successive sentence. Participants were instructed to rest their preferred finger on the line advance button while reading to minimize movement times. Sentence reading time was measured as the amount of time that elapsed between button presses. E-Prime software (Psychology Software Tools, 2000) was used to present the stimuli and to calculate and store timing data. Testing was conducted in Margaret Lehman Blake’s laboratory at the University of Houston, at participants’ homes, or at local senior centers.

---

[2] The TASIT was developed in Australia and thus has an inherent cultural bias. The lower scores by adults with RHD compared with the participants with NBD could be a reflection of the increased demands required to comprehend or process the speakers’ accents and/or some language patterns.

Testing was conducted over three sessions, with at least 4 but not more than 14 days between consecutive sessions.

The first session consisted of signing consent forms; screenings for vision, hearing, cognition, and visuospatial neglect; the measure of receptive vocabulary; and one block of the experimental task. During the second and third sessions, experimental tasks were interspersed with the remaining ancillary tasks.

Results

Data Analysis

Preliminary analyses involved examination of extraneous factors that could influence the results. These included outlying data points, comprehension accuracy, and potential effects of order and gender.

Outlying data points were defined as reading times greater than two standard deviations above the mean within any one condition (e.g., target sentence Recent condition, final sentence Distant condition). Outliers were deleted, resulting in a loss of 1.5% of the data, spread approximately evenly across groups. One participant was excluded from the RHD group because of extremely slow reading times (average sentence reading times greater than 60 s; RHD group $M = 1.5$ s). These reading times may reflect not only sentence reading but also re-readings and other comprehension processes.

Accuracy of comprehension was computed for the 52 comprehension questions. An a priori criterion of 80% accuracy was set, such that any participant who failed to meet the criterion would be eliminated from reading time analyses. No individual from either group was excluded on the basis of this criterion (average comprehension score: NBD, $M = 96.2\%$; RHD, $M = 92.9\%$).

The potential effect of order of presentation of stimuli was evaluated using a Kruskal–Wallis test. Results indicated that order was not related to inference generation, $\chi^2(5, N = 27) = 2.7$, $p = .75$, or maintenance, $\chi^2(5, N = 27) = 9.0$, $p = .11$, and thus was not considered further. Gender also was not related to generation, $t(25) = 1.57$, $p = .13$, $d = 0.62$, or maintenance of inferences, $t(25) = 0.47$, $p = .64$, $d = 0.19$.

Dependent variables for the main analyses were reading times for target (disconfirming) and posttarget sentences. Reading time ratios [(experimental – control)/control reading time] were computed to reduce the effect of general reading speed, which was slower for the RHD group. Inference generation was measured by comparing reading times for Recent versus Control conditions. Maintenance of inferences was based on reading times for Distant versus Control conditions. For both Recent/Control and Distant/Control ratios, higher values indicated more slowing. Average reading times and ratios for each group are provided in Table 3.

In addition to the main analyses to examine generation and maintenance of inferences, individual analyses were completed to evaluate whether individual participants followed the group patterns. Subsequently, analyses were conducted to examine correlates of inferencing and exploration of spill-over effects.

Between- and Within-Groups Comparisons

A repeated measures analysis of variance with one between-subjects factor (group) and two within-subjects factors was then conducted. The within-subjects factors each had two levels: condition (Recent/Control ratio; Distant/Control ratio) and sentence type (target; post-target). Levene’s test of equality of error variances indicated that the homogeneity of variance assumption was violated for the Recent/Control target sentence variable, $F(1, 25) = 4.7$, $p = .039$. Given that nonparametric tests also may be affected by substantial group differences in variance (Zimmerman, 1996), one option to mitigate the effects of heterogeneous variances is to use a more conservative significance level (Keppel, 1991). Thus, the alpha level for determining significance of results from the analysis of variance was set to $p < .01$.

Significant main effects were obtained for condition, $F(1, 25) = 15.27$, $p = .001$, $\eta^2 = .38$, and sentence, $F(1, 25) = 11.97$, $p = .002$, $\eta^2 = .32$, with higher ratios (greater slowing) for Recent (M =0.149) than Distant (M = 0.062) conditions, and higher ratios for target (M = 0.174) than posttarget (M = 0.037) sentences. The main effect of group was not significant, $F(1, 25) = 0.05$, $p = .82$, $\eta^2 = .002$.

The Condition × Sentence interaction was significant, $F(1, 25) = 8.25$, $p = .008$, $\eta^2 = .25$, with a larger difference in target versus posttarget sentences for Recent/Control than Distant/Control conditions. There was no significant two-way Group × Condition interaction, $F(1, 25) = 0.37$, $p = .55$, $\eta^2 = .01$, or Group × Sentence interaction, $F(1, 25) = 0.93$, $p = .35$, $\eta^2 = .04$. The three-way Group × Condition × Sentence interaction also did not reach significance, $F(1, 25) = 3.73$, $p = .07$, $\eta^2 = .13$.

To examine inference generation and maintenance within groups, four contrasts of interest were examined for each group using one-sample t tests. To control the Type I error, the alpha level for each group was divided by four. Significant results were thus based on significance levels of $p < .0125$. Within the NBD group, participants generated the target inferences on target, $t(13) = 3.39$, $p = .005$, $d = 1.88$, but not posttarget sentences, $t(13) = 0.46$, $p = .65$, $d = 0.26$. Maintenance of inferences was not significant for either target sentences, $t(13) = 2.05$, $p = .061$, $d = 1.14$, or posttarget sentences, $t(13) = 0.80$, $p = .46$ $d = 0.43$.

For the RHD group, activation of inferences (Recent/Control) was observed on target sentences, $t(12) = 3.92$, $p = .002$, $d = 2.26$, and posttarget sentences, $t(12) = 3.04$, $p = .010$, $d = 1.75$. Maintenance of inferences (Distant/Control) was not apparent on either target sentences, $t(12) = 2.75$, $p = .018$, $d = 1.59$, or posttarget sentences, $t(12) = 1.26$, $p = .23$, $d = 0.73$, although the large effect size suggested a potential effect for the target sentences.

Individual Differences

Following the group analyses, inferencing was examined for each participant individually. Activation of a target inference was defined as experimental reading times that were at least 5% longer than control condition reading times (see Figures 1 and 2).

For the NBD group, 12 of the 14 participants exhibited generation of intended predictive inferences in the Recent condition. For 10 of those, slowing was observed on the target sentence. The remaining 2 demonstrated slowing only on the posttarget sentence, suggesting slowed inference generation.

For the RHD group, 11 of the 13 participants exhibited generation of the intended predictive inferences in the Recent condition. For 10 of those, the slowing was observed on the target sentence, whereas 2 individuals demonstrated slowing only on the posttarget sentence.

Maintenance of inferences was examined only for those individuals who demonstrated generation of the inferences; in this way, absence of evidence for maintenance could not be attributed to the lack of initial inference generation. This left 12 adults with NBD and 11 with RHD. Eight individuals with NBD maintained the inferences, with slower reading times for Distant versus Control condition target sentences. The remaining 4 did not maintain the inferences. No participant in the NBD group demonstrated slowed reactivation. These individual analyses indicated that despite the nonsignificant result on the *t* tests, the majority of participants in the NBD group did maintain the predictive inferences, which was consistent with the large effect size ($d = 1.14$).

In the RHD group, 8 of the 11 individuals exhibited maintenance of inferences over time, with slowing on Distant versus Control target sentences. Again, despite the nonsignificant effect obtained using the adjusted *p* value, the majority of participants with RHD maintained the inference, consistent with the large effect size ($d = 1.59$). Two individuals exhibited slowed reactivation, with slowed reading time evident only on the Distant condition posttarget sentence. The remaining participant deactivated the inference.

Inferencing Correlates

To examine possible correlations between inferencing and working memory and discourse comprehension, Pearson correlation coefficients were computed. Dependent variables were reading time ratios, the total error score for the DCT, and the recall error score for the working memory task. Because of the absence of group effects, the groups were combined to increase the power. None of the correlations were meaningfully large or significant (all $rs < .36$, all $ps > .07$). The only correlation that approached significance was Recent/Control ratio with the DCT score ($r = −.36$, $p = .069$), suggesting a possible relationship between generation of predictive inferences and general comprehension.

Results from the neuroimaging reports were examined to determine whether there were any apparent relationships between site of lesion and performance on the inferencing task. Because of the relatively small number of participants and the heterogeneity in size and location of lesion, statistical analyses were not performed. No obvious relationships were observed upon visual inspection.

Spill-Over Effects

Of the 10 individuals in the NBD group who generated the inference as measured on the Recent condition target sentence, 4 of them demonstrated a spill-over effect (i.e., continued slowing that extended to the posttarget sentence). Of the 10 participants in the RHD group, 7 demonstrated this effect. For maintenance of inferences, the spill-over effect was observed for 5 of the 8 individuals with NBD and 4 of the 8 individuals in the RHD group.

Continued activation of inferences was further analyzed to explore potential relationships with certain demographic and clinical variables (age, education, months postonset [for RHD only], comprehension, working memory). Independent *t* tests were conducted to explore whether there were meaningful differences between individuals who did and did not demonstrate continued activation of inferences on the posttarget sentence. The only significant result was for continued activation for the Recent condition and age, $t(22) = −2.84$, $p = .01$, $d = 1.14$. Individuals who did exhibit a spill-over effect were older than those who did not.

Discussion

The purposes of the current study were to replicate and extend a previous study of predictive inferencing (Lehman-Blake & Tompkins, 2001) to examine factors contributing to the failure to maintain inferences by some individuals with RHD. The replication was partially successful: Although inference generation results were replicated, patterns of results for maintenance of inferences differed.

In the previous study, both healthy older adults and those with RHD (with mild communication deficits) generated strongly suggested predictive inferences (Recent/Control comparisons).

That finding was replicated here, with all but 2 individuals in each group generating the inferences.

The results for maintenance of inferences (Distant/Control comparisons) differed from those reported by Lehman-Blake and Tompkins (2001). In the original study, group differences were apparent: The NBD group maintained inferences over time, whereas only about half of the RHD group did. This led to the conclusion that RHD may affect maintenance of inferences, and it spurred the search for an explanation for poor maintenance. In the current study, group differences were not apparent. Although the analyses indicated nonsignificant results for the Distant condition, the effect sizes were large ($d > 1.0$), and examination of individual data indicated that a majority of participants in each group (85% RHD; 86% NBD) evidenced maintenance of inferences over time. These results cause problems for the hypothesis drawn from the previous study that RHD may result in poor inference maintenance.

There is no obvious explanation for differences in the inference maintenance findings across studies. Minimal methodological differences occurred. The procedures were essentially the same in both studies, and the stimuli differed only in the addition of one sentence that appeared after the target disconfirming sentence. The minor changes would be expected to affect both generation and maintenance components equally. Given that the results for generation of inferences did replicate the original study, methodological changes are not likely the cause of differences in results for inference maintenance.

One possible but uninteresting explanation of the differences is sampling error. Both studies included only small groups of participants with RHD. In the first study, 8 of 12 (58%) participants demonstrated maintenance of inferencing, whereas 12 of 14 (85%) participants did so in the current study. Larger samples would provide a better estimate of the true incidence of inference maintenance after RHD, which was apparent in the majority of participants in both studies.

Another explanation could be differences in the participant groups. Visual examination of data across studies suggests that overall, participants in the current study (both RHD and NBD) scored lower than their respective groups in the original study on tests of discourse comprehension and working memory. One-tailed, independent *t* tests were conducted to explore these differences. The current groups made more errors on the discourse comprehension task, although the results were nonsignificant: NBD, $t(23) = 0.34$, $p = .37$; RHD, $t(25) = 1.7$, $p = .06$. The current groups also made significantly more errors on the working memory task: NBD, $t(21) = 1.9$, $p = .03$; RHD, $t(24) = 2.8$, $p = .005$. The pattern of working memory error scores across studies is particularly interesting. The average error score on the working memory test for the original NBD group was 2.7, whereas the average score for the current NBD group ($M = 8.1$) was nearly equivalent to that of the original RHD group ($M = 8.3$). The potential effect of these cross-study group differences is difficult to determine. One would suspect that poor working memory should be related to poor maintenance of inferences (as suggested by Lehman-Blake & Tompkins, 2001). However, the current RHD group had much lower working memory scores but better maintenance. In addition, there was no significant relationship between working memory and reading times. Further work is needed to explore potential relationships between working memory and inferencing.

Evaluating Hypotheses: Failure to Maintain and Continued Activation

Evaluation of the explanations for maintenance of inferences must proceed with caution, given that only a small number of participants in the current study did not maintain inferences. Individuals with NBD either integrated predictive inferences into their mental representation or deactivated them. None of the participants in the NBD group demonstrated slowed selection. Thus, if the inference was not deemed important (and integrated into a mental model), it was cleared from memory. For the RHD group, of the 3 individuals who did not maintain inferences, 2 exhibited slowed selection, and the third deactivated the inferences. Given that the slowed selection occurred only for adults with RHD, one could tentatively conclude that this is an aberrant process. As suggested earlier, the suppression deficit hypothesis is one explanation for the slowed selection. This is only speculation, as the suppression deficit traditionally has been tested in relation to ambiguities and multiple meanings and thus may not be valid in this situation (Tompkins, Scharp, Meigh, & Fassbinder, 2008).

The inclusion of the posttarget sentences in this study provided additional information about inferencing beyond just the slowed selection/deactivation hypotheses. The individual data indicated that within the RHD group, more participants showed continued activation on Recent than Distant condition posttarget sentences, whereas the numbers were approximately equal across conditions for the NBD group.

Continued activation of inferences into the posttarget sentence is referred to as a spill-over effect. There are several explanations of the source of this effect. First, elaborative inferences (including predictive inferences) may take some time to be fully generated or instantiated. Thus, slowed reading time on both target and posttarget sentences could be seen as the comprehender activates and fully instantiates the target inference (Calvo & Castillo, 1996). A second explanation for the spill-over effect is slowed selection or reactivation. The target inference is generated and instantiated earlier in the story but then backgrounded by other information in the text. When the reader encounters the contradiction in the target sentence, some time is needed to reactivate or select the previously generated inference. In this case, slowed reading may be detected only on the posttarget sentence, after the actual outcome is encountered in the target sentence. A third explanation is that readers who have generated the target inference may require additional time to integrate the conflicting information into their mental model of the story (Albrecht & O’Brien, 1993; Huitema et al., 1993). In this case, slowing would initially be seen on the target sentence, when the contradiction appears, and would continue on to the posttarget sentence as the comprehender attempts to reconcile the contradiction between the predicted and actual outcomes.

The first explanation, slowed inference generation, is consistent with the literature on comprehension in older adults, which suggests that these individuals have more difficulty using context to predict information, and that facilitatory effects of contextual bias are slowed in older as compared with younger adults (Federmeier & Kutas, 2005; Federmeier, Van Petten, Schwartz, & Kutas, 2003). The finding that participants who exhibited continued slowing were older than those who did not also is consistent with this explanation.

The stronger spill-over effect in Recent compared with Distant conditions for adults with RHD also is consistent with slowed inference generation. In the Recent condition, slowing could have been caused by both the slowed inference generation and the processing of the contradiction in the target sentence. These two processes together could have spanned the time needed to read both the target and posttarget sentences. In contrast, in the Distant condition, the inference would be generated before the target sentence appeared, leaving only the contradiction effect to create slowing on the target sentence. The slowed generation account, although consistent with the data obtained for the current study, was not observed in a study of inferencing with varying contextual bias (see companion article in this issue [Blake, 2009]).

Slowed selection, as described earlier, was observed for only 2 participants with RHD. Inefficient selection or reactivation of previously generated inferences may occur in contexts that do not strongly support a target inference (see Blake, 2009). Given that the predictive inferences in the present study were all strongly suggested by the context, slowed selection is less likely to be a relevant factor.

The slowed integration explanation for spill-over effects (Albrecht & O'Brien, 1993; Huitema et al., 1993) could account for the results in Recent versus Distant conditions. Slowed integration may be related to strength of activation of inferences (see Blake, 2009). For adults with RHD, inferences generated in the Recent condition could have been strongly activated when the disconfirming sentence was read. The strong contradiction between the inferred and actual event may have required extra time to be processed. In contrast, the strength of activation of the predictive inference in the Distant condition may have waned; thus, the contradiction was not as strong, which allowed the readers to more quickly accept the alternative outcome. Participants in the NBD group, who had better comprehension and working memory abilities, could have been able to quickly integrate the information regardless of strength of inference activation. These interpretations are speculative, especially given the absence of meaningful relationships specifically between inference maintenance, comprehension, and working memory.

Caveats

Several caveats should be considered in the interpretation of the results. First, although elicitation of a contradiction effect is a fairly standard procedure for measuring inferences in the cognitive psychology literature, it is an implicit measure of inferencing. One could argue that slowed reading time does not necessarily reflect generation or maintenance of a specific target inference, but it could be a related inference or any other interpretation that conflicted with the content of the target sentence. This argument could be applied to most all implicit measures of inferencing, and balances between metacognitive demands of explicit measures and uncertainties of the implicit measures must be considered in task selection.

In terms of the participants, inclusion of individuals in the RHD group was based on the hemisphere of lesion and not the presence of cognitive-communication disorders, resulting in a heterogeneous group. Because of this, the group results should be interpreted cautiously. Examination of individual data provides better information about inferencing after RHD and allows one to explore factors that potentially influence inferencing performance. Examination of subgroups of individuals with RHD could be one approach to future studies. Unfortunately, there currently is no obvious method of creating subgroups a priori: Neither this study nor previous studies that have reported differential performance across participants with RHD (e.g., Lehman-Blake & Tompkins, 2001; Tompkins et al., 2001, 2004) have identified specific demographic or clinical variables that distinguish subgroups. Further analysis of potential correlates, with more sensitive and/or modality-specific measures of comprehension and inferencing, may help tease out factors that may contribute to inferencing abilities. Second, the large variability across participants likely contributed to some of the nonsignificant findings. Third, the participants in the RHD group had chronic lesions and relatively mild cognitive-communication deficits. Future studies should examine a broader range of individuals. Finally, the participant groups were relatively small, which could have contributed to the different results across studies and precludes the generalization of conclusions to larger populations.

Conclusions

Results from the current study provide further evidence that adults with RHD can generate inferences, even those that are not essential for comprehension. Generalizing this to clinical practice, treatment for inferencing deficits should not focus on the generation of inferences but on other inferencing processes. Treatment might be more effective if it focused on evaluating which inferences or interpretations could be more important or appropriate for a given context (see Blake, 2007, for further treatment suggestions). This may facilitate maintenance of appropriate inferences and suppression of less appropriate interpretations.

Although the process of inference generation by adults with RHD is becoming clearer, other inference processes—such as maintenance, reactivation, and integration—need further exploration. Careful research is needed to explore potential relationships between inferencing and suppression processes, and the potential sources of the spill-over effect. Additional work is needed to tease out the relationships between comprehension, working memory, and various inferencing processes to more clearly understand how inferencing processes and deficits may impact (and be impacted by) functional communication processes.

Acknowledgments

This project was supported by National Institute on Deafness and Other Communication Disorders Grant R03-DC00563-01A1. Kimberly Lesniewicz provided invaluable assistance in collection of the data. Jeffrey Williams assisted with the statistical analyses in earlier stages of the project.

References

Albrecht JE, O’Brien EJ. Updating a mental model: Maintaining both local and global coherence. Journal of Experimental Psychology: Learning, Memory, and Cognition 1993;19:1061–1070.

Allbritton D. Strategic production of predictive inferences during comprehension. Discourse Processes 2004;38:309–322.

American National Standards Institute. ANSI S3.6-2004. New York: Author; 1996. Specification for audiometers.

Annet M. A classification of hand preference by association analysis. British Journal of Psychology 1970;61:303–321. [PubMed: 5457503]

Beeman M. Semantic processing in the right hemisphere may contribute to drawing inferences from discourse. Brain and Language 1993;44:80–120. [PubMed: 8467379]

Beeman, M. Coarse semantic coding and discourse comprehension. In: Beeman, M.; Chiarello, C., editors. Right hemisphere language comprehension: Perspectives from cognitive neuroscience. Mahwah, NJ: Erlbaum; 1998. p. 255-284.

Benowitz LI, Moya KL, Levine DN. Impaired verbal reasoning and constructional apraxia in subjects with right hemisphere damage. Neuropsychologia 1990;28:231–241. [PubMed: 2325836]

Blake ML. Inferencing processes after right hemisphere brain damage: Effects of contextual bias. Journal of Speech, Language, and Hearing Research 2009;52:373–384.

Blake ML. Perspectives on treatment for communication deficits associated with right hemisphere brain damage. American Journal of Speech-Language Pathology 2007;16:331–342. [PubMed: 17971493]

Brookshire, RH.; Nicholas, LE. Discourse Comprehension Test. Tucson, AZ: Communication Skill Builders; 1993.

Brownell HH, Potter HH, Bihrle AM, Gardner H. Inference deficits in right brain-damaged patients. Brain and Language 1986;27:310–321. [PubMed: 3955344]

Burns, MS. Burns Brief Inventory of Communication and Cognition. San Antonio, TX: The Psychological Corporation; 1997.

Calvo MG, Castillo MD. Predictive inferences occur on-line, but with delay: Convergence of naming and reading times. Discourse Processes 1996;22:57–78.

Campion N. Predictive inferences are represented as hypothetical facts. Journal of Memory and Language 2004;50:149–164.

Crum RM, Anthony JC, Bassett SS, Folstein MF. Population-based norms for the Mini-Mental State Examination by age and education level. Journal of the American Medical Association 1993;269:2386–2392. [PubMed: 8479064]

Dunn, LM.; Dunn, LM. Peabody Picture Vocabulary Test–III. Circle Pines, MN: AGS; 2000.

Federmeier KD, Kutas M. Aging in context: Age-related changes in context use during language comprehension. Psychophysiology 2005;42:133–141. [PubMed: 15787850]

Federmeier KD, Van Petten C, Schwartz TJ, Kutas M. Sounds, words, sentences: Age-related changes across levels of language processing. Psychology and Aging 2003;18:858–872. [PubMed: 14692871]

Fincher-Kiefer R, D'Agostino PR. The role of visuospatial resources in generating predictive and bridging inferences. Discourse Processes 2004;37:205–224.

Folstein MF, Folstein SE, McHugh PR. Mini Mental State: A practical method for grading the cognitive state of patients for the clinician. Journal of Psychiatric Research 1975;12:189–198. [PubMed: 1202204]

Garrod SC, O'Brien EJ, Morris RK, Rayner K. Elaborative inferencing as an active or passive process. Journal of Experimental Psychology: Learning, memory, and Cognition 1990;16:250–257.

Glenberg AM, Meyer M, Lindem K. Mental models contribute to foregrounding during text comprehension. Journal of Memory and Language 1987;26:69–83.

Huitema JS, Dopkins S, Klin CM, Myers JL. Connecting goals and actions during reading. Journal of Experimental Psychology: Learning, Memory, and Cognition 1993;19:1053–1060.

Jung-Beeman M. Bilateral brain processes for comprehending natural language. Trends in Cognitive Sciences 2005;9:512–518. [PubMed: 16214387]

Keppel, G. Design and analysis: A researcher's handbook. Vol. 3. Englewood Cliffs, NJ: Prentice Hall; 1991.

Kintsch W. The role of knowledge in discourse comprehension: A construction integration model. Psychological Review 1988;95:163–182. [PubMed: 3375398]

Klin CM. Causal inferences in reading: From immediate activation to long-term memory. Journal of Experimental Psychology: Learning, Memory, and Cognition 1995;21:1483–1494.

Klin CM, Murray JD, Levine WH, Guzman A. Forward inferences: From activation to long-term memory. Discourse Processes 1999;27:241–260.

Lehman MT, Tompkins CA. Reliability and validity of an auditory working memory measure: Data from elderly and right-hemisphere damaged adults. Aphasiology 1998;12:771–784.

Lehman MT, Tompkins CA. Inferencing in adults with right hemisphere brain damage: An analysis of conflicting results. Aphasiology 2000;14:485–499.

Lehman-Blake MT, Tompkins CA. Predictive inferencing in adults with right hemisphere brain damage. Journal of Speech, Language, and Hearing Research 2001;44:639–654.

Linderholm T. Predictive inference generation as a function of working memory capacity and causal text constraints. Discourse Processes 2002;34:259–280.

Mackenzie C, Begg T, Brady M, Lees KR. The effects on verbal communication skills of right hemisphere stroke in middle age. Aphasiology 1997;11:929–946.

McDonald, S.; Flanagan, S.; Rollins, J. The Awareness of Social Inference Test. Edmonds, Bury St, editor. Suffolk, England: Thames Valley Test Company; 2002.

McKoon G, Ratcliff R. Assessing the occurrence of elaborative inference with recognition: Compatibility checking vs. compound cue theory. Journal of Memory and Language 1989;28:547–563.

McKoon G, Ratcliff R. Inference during reading. Psychological Review 1992;99:440–466. [PubMed: 1502273]

Moya KL, Benowitz LI, Levine DN, Finklestein S. Covariant defects in visuospatial abilities and recall of verbal narrative after right hemisphere stroke. Cortex 1986;22:381–397. [PubMed: 3769493]

Myers JL, O'Brien EJ. Accessing the discourse representation during reading. Discourse Processes 1998;26:131–157.

Myers PS. Inference failure: The underlying impairment in right-hemisphere communication disorders. Clinical Aphasiology 1991;20:167–180.

O'Brien EJ, Plewes PS, Albrecht JE. Antecedent retrieval processes. Journal of Experimental Psychology: Learning, Memory, and Cognition 1990;16:241–249.

O'Brien EJ, Shank DM, Myers JL, Rayner K. Elaborative inferences during reading: Do they occur on-line? Journal of Experimental Psychology: Learning, Memory, and Cognition 1988;14:410–420.

Psychology Software Tools. E-Prime. Pittsburgh, PA: Author; 2000.

Purdy MH, Belanger S, Liles BZ. Right-hemisphere-damaged subjects' ability to use context in inferencing. Clinical Aphasiology 1992;21:135–143.

Tompkins CA, Baumgaertner A. Clinical value of online measures for adults with right hemisphere brain damage. American Journal of Speech-Language Pathology 1998;7:68–74.

Tompkins CA, Baumgaertner A, Lehman MT, Fassbinder W. Mechanisms of discourse comprehension impairment after right hemisphere brain damage: Suppression and enhancement in lexical ambiguity resolution. Journal of Speech, Language, and Hearing Research 2000;43:62–78.

Tompkins CA, Bloise CGR, Timko ML, Baumgaertner A. Working memory and inference revision in brain-damaged and normally aging adults. Journal of Speech and Hearing Research 1994;37:896–912. [PubMed: 7967574]

Tompkins CA, Fassbinder W, Blake ML, Baumgaertner A, Jayaram N. Inference generation during text comprehension by adults with right hemisphere brain damage: Activation failure versus multiple activation. Journal of Speech, Language, and Hearing Research 2004;47:1380–1395.

Tompkins CA, Lehman-Blake MT, Baumgaertner A, Fassbinder W. Mechanisms of discourse comprehension impairment after right hemisphere brain damage: Suppression in inferential ambiguity resolution. Journal of Speech, Language, and Hearing Research 2001;44:400–415.

Tompkins CA, Scharp VL, Meigh KM, Fassbinder W. Coarse coding and discourse comprehension in adults with right hemisphere brain damage. Aphasiology 2008;22:204–223.

Valencia-Laver DL, Light LL. The occurrence of causal bridging and predictive inferences in young and older adults. Discourse Processes 2000;30:27–56.

Walker CH, Meyer BJF. Integrating different types of information in text. Journal of Verbal Learning and Verbal Behavior 1980;19:263–275.

Wapner W, Hamby S, Gardner H. The role of the right hemisphere in the apprehension of complex linguistic materials. Brain and Language 1981;14:15–33. [PubMed: 7272721]

Wilson, B.; Cockburn, J.; Halligan, P. Behavioural Inattention Test. Edmonds, Bury St, editor. Suffolk, England: Thames Valley Test Company; 1987.

Zimmerman DW. A note on homogeneity of variance of scores and ranks. Journal of Experimental Education 1996;64:351–362.

Zipin LM, Tompkins CA, Kasper SC. Effects of foregrounding on predictive inference generation by normally ageing adults. Aphasiology 2000;14:115–131.

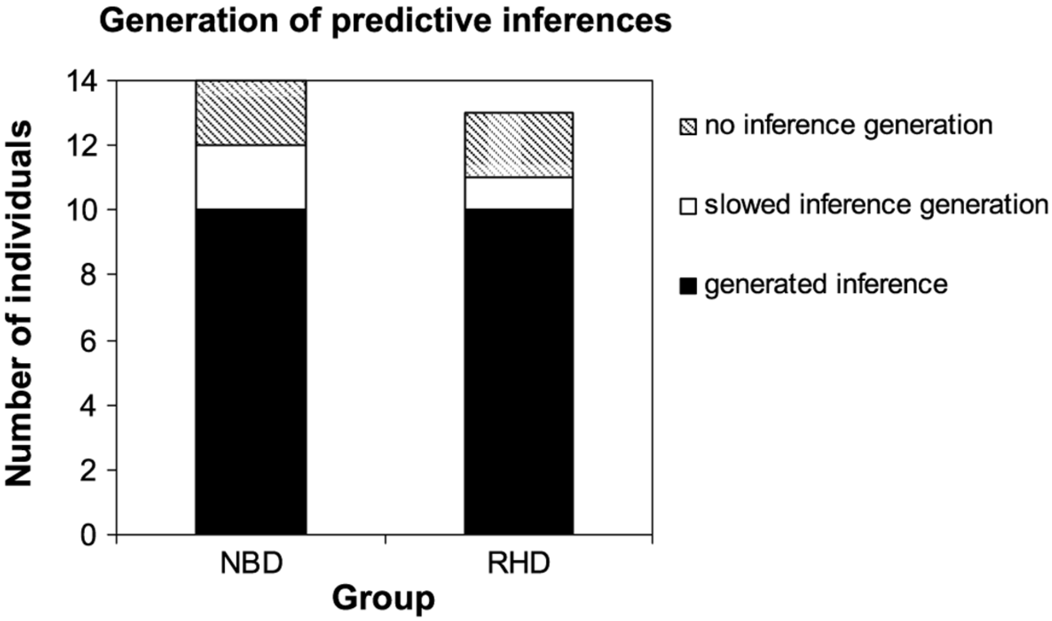

Figure 1.
Individual data indicating generation of predictive inferences by participants in two groups. NBD = no brain damage; RHD = right hemisphere damage.

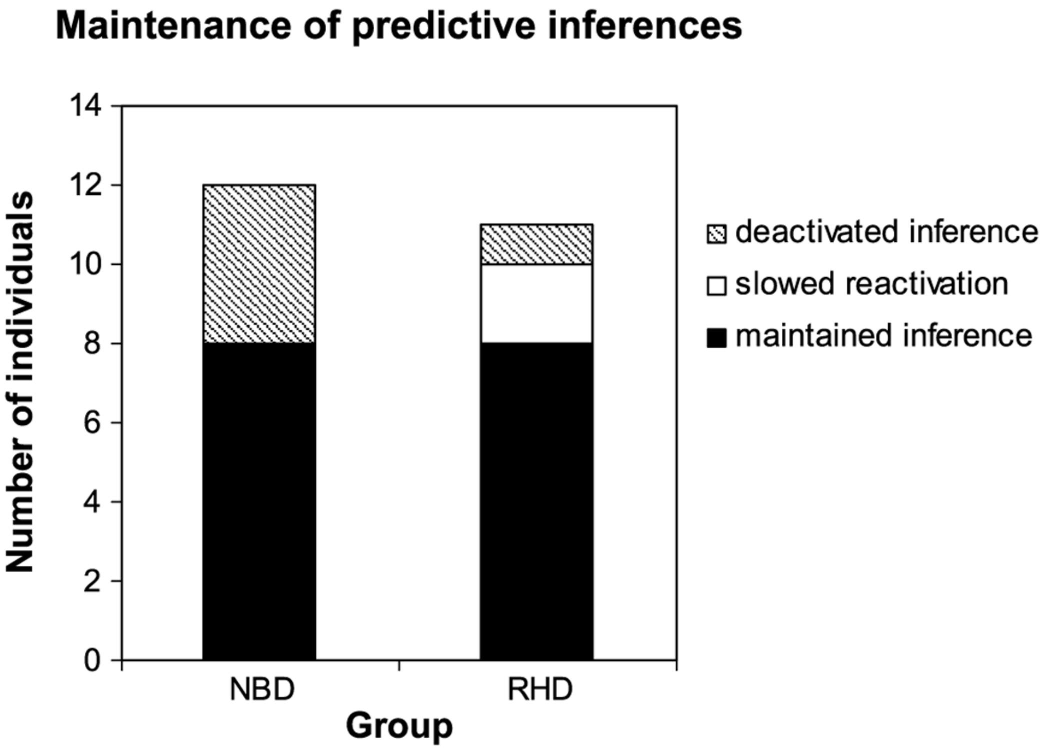

Figure 2.
Individual data depicting maintenance of predictive inferences by participants in two groups.

Table 1

Example of stimuli used to assess generation and maintenance of the inference “sweep.”

Condition	**Sample story**
Recent[a]	Jane was cleaning house on Saturday. She had already worked most of the day. Now Jane had one more task to do. **She went to the closet and took out a broom.** She dusted her bookshelves and then sat down to rest.
	She was glad when everything was finally done.
Distant[a]	Ruth was cleaning house on Saturday. **She went to the closet and took out a broom.** She had already cleaned most of the house. Now Ruth had one more task to do. She dusted her bookshelves and then sat down to rest.
	She was glad when everything was finally done.
Control[b]	Beth was cleaning house on Thursday. She had already worked most of the day. Now Beth had one final task to do. She dusted her bookshelves and then sat down to rest.
	She was glad when everything was finally done.

Note. Predictive sentences are in bold; target sentences are underlined; posttarget sentences are in italics. Posttarget sentences were included only in the current study (and not in Lehman-Blake & Tompkins, 2001).

[a] Prediction disconfirmed.

[b] No inference.

Table 2

Select demographic and clinical data for two participant groups.

	NBD ($n = 14$)[a]			RHD (n=14)[b]					
Variable	***M***	***SD***	**Range**	***M***	***SD***	**Range**	***t***	***p***	***d***
Age (years)	65.2	7.2	53–79	67.6	98.8	54–81	−0.79	.43	0.30
Years of education	14.6	2.7	10–19	14.07	2.4	11–18	0.59	.56	0.20
Discourse Comprehension Test (DCT)[c]									
Total errors	4.1	2.3	0–7	5.2	2.9	2–12	−1.06	.30	0.42
Detail stated	1.6	1.1	0–3	1.6	1.3	0–4	0	1.0	0
Detail inferred	1.9	1.0	0–4	3.1	1.3	2–7	−2.6	.02	1.0
Main idea stated	0.36	0.63	0–2	0.21	0.43	0–1	0.70	.49	0.28
Main idea inferred	0.29	0.47	0–1	0.36	0.75	0–2	−0.30	.76	0.16
Receptive vocabulary[d] (standard score)	106.8	13.9	80–124	98.8	11.1	77–114	1.69	.10	0.64
Inferencing and nonliteral language[e] (20 possible)	19.0	1.9	14–20	18.4	1.6	16–20	0.87	.40	0.34
Working memory[f]	8.1	5.7	1–18	13.8	5.2	4–23	−2.73	.01	1.0
The Awareness of Social Inference Test (TASIT)[g]									
Total score (64 possible)	51.5	5.7	37–58	43.4	7.1	29–55	3.33	.003	1.3
Sarcasm (32 possible)	24.4	4.2	17–31	18.9	4.3	12–27	3.37	.002	1.3
Lies (32 possible)	27.1	3.6	17–31	24.5	4.9	13–32	1.63	.12	0.60

Note. Independent t test statistics (t value, p value, and effect size [d]) are provided. The d values represent the effect size for the between-groups comparisons. NBD = no brain damage; RHD = right hemisphere brain damage.

[a] Group = 9 women, 5 men.

[b] Group = 6 women, 8 men.

[c] Brookshire and Nicholas (1993).

[d] Peabody Picture Vocabulary Test–III (Dunn & Dunn, 2000).

[e] Inferencing and nonliteral language subtests of the Burns Brief Inventory of Communication and Cognition (Burns, 1997).

[f] Tompkins et al. (1994).

[g] Enriched subtest of the TASIT (McDonald et al., 2002).

Table 3

Mean reading times and standard deviations (in seconds) for two groups.

	NBD (n = 14)				RHD (n= 13)			
Condition and sentence	**Mean reading time**	***SD***	**Mean reading time ratio**[a]	***SD***	**Mean reading time**	***SD***	**Mean reading time ratio**[a]	***SD***
Recent target sentence	3.310	0.899			3.990	1.425		
Recent posttarget sentence	2.360	0.438			3.310	1.174		
Distant target sentence	2.783	0.412			3.744	1.418		
Distant posttarget sentence	2.363	0.382			3.212	1.330		
Control target sentence	2.597	0.442			3.433	1.507		
Control posttarget sentence	2.337	0.418			3.097	1.213		
Grand mean	2.625	0.389			3.464	1.314		
Recent/Control target sentence			0.288	0.318			0.205	0.188
Recent/Control posttarget sentence			0.013	0.015			0.088	0.104
Distant/Control target sentence			0.086	0.157			0.113	0.148
Distant/Control posttarget sentence			0.017	0.081			0.036	0.102
Grand mean			0.101	0.110			0.110	0.104

[a] Calculated individually as follows: (experimental – control)/control reading time.

Appendix

Select clinical variables for adults with right hemisphere brain damage.

Participant	Months postonset	Type of stroke	Left neglect diagnosed at onset	Location of lesion[a]
1	140	Unknown	No	Superior right basal ganglia, right cerebral white matter (associated with Wallerian degeneration); left cortical cerebellum
2	132	Ischemic	No	Right centrum semiovale; right subinsular cortex extending to corona radiata
3	58	Hemorrhagic	Yes	Subarachnoid hemorrhage affecting right parietal and temporal lobes
4	14	Ischemic	No	Right frontal periventricular white matter; right basal ganglia and centrum semiovale
5	48	Hemorrhagic	No	Right temporal lobe—inferior lateral cortex and white matter with some extension into occipital white matter; right thalamus
6	45	Ischemic	No	Right hemisphere (not otherwise specified)
7	244	Ischemic	No	Posterior right frontal lobe and adjacent anterior right parietal lobe with extension to posterior temporal insular cortex and posterior and lateral right basal ganglia
8	162	Ischemic	Yes	Extensive encephalomalacia replaces right frontal lobe and right parietal lobe with some sparing of cortex posteriorly and laterally; also involves medial, posterior, and superior right temporal lobe; extends to right basal ganglia
9	24	Ischemic	No	Right cortical because of right middle cerebral artery stroke (not otherwise specified)
10	38	Ischemic	Yes	Small superior–posterior right frontal and posterior medial right parietal cortical infarct; larger posterior lateral right temporal/occipital cortical infarct
11	119	Ischemic	No	Medial right occipital lobe extending posteriorly to the medial right occipital cortex
12	73	Ischemic	No	Mid- to posterior right temporal lobe involving the cortex of the right frontal and parietal lobe superiorly and laterally
13	108	Unknown	No	Right parietal cortex and white matter; posterior right frontal white matter and lateral right basal ganglia
14	24	Unknown	No	Cortex and white matter of posterior right frontal lobe and anterior right parietal lobe

[a] Location of lesion is based on structural magnetic resonance imaging scans performed at the time of participation in the current study for Participants 1,5, 7, 8, and 10–14; location of lesion is based on medical records for Participants 2–4, 6, and 9.