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A study of humour and communicative intention following right hemisphere stroke

HENRY S. CHEANG & MARC D. PELL

School of Communication Sciences and Disorders, McGill University, Canada

Abstract

This research provides further data regarding non-literal language comprehension following right hemisphere damage (RHD). To assess the impact of RHD on the processing of non-literal language, ten participants presenting with RHD and ten matched healthy control participants were administered tasks tapping humour appreciation and pragmatic interpretation of non-literal language. Although the RHD participants exhibited a relatively intact ability to interpret humour from jokes, their use of pragmatic knowledge about interpersonal relationships in discourse was significantly reduced, leading to abnormalities in their understanding of communicative intentions (CI). Results imply that explicitly detailing CI in discourse facilitates RHD participants' comprehension of non-literal language.

Keywords: *Right hemisphere damage, stroke, communicative intention, pragmatic impairment, humour deficit*

Stroke victims with right hemisphere damage (RHD) typically do not present with aphasia or aphasic symptoms. Regardless, they are known to have communicative impairments that occur at the level of discourse. Two communication deficits (among many) that have been observed following RHD are difficulties in comprehending humour and problems in discerning the underlying messages in other people's speech (for a review see Sabbagh, 1999; Shammi & Stuss, 1999). Given that humour use is prevalent in communication and substantial amounts of communication employ implicit, i.e., non-literal, messages (Dews & Winner, 1999; Kreuz, Roberts, Johnson, & Bertus, 1996), such deficits may have significant implications on the communication abilities of persons with RHD. It has been argued that both humour appreciation and the ability to decipher underlying messages in discourse are skills that derive in part from understanding *communicative intention*. It follows that persons who present with RHD and have difficulties in appreciating humour and in discerning implied meaning may have difficulties with appreciating communicative intention (Sabbagh, 1999).

As characterized by Sabbagh (1999), communicative intention is the actual message a speaker hopes to express regardless of the literal semantics of the sentences he or she

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employs. Note that the concept of communicative intention as described here is a reformulation of Grice's Cooperative Principle and communicative maxims, (which state that participants mutually understand that their shared purpose in communication is to convey ideas and that their contributions to conversations, including what appear to be intended anomalies or deviations in language, are meant to convey a particular and intended meaning) (Grice, 1975). Another construct relevant to the present discussion is *pragmatics* (also referred to as *pragmatic information*, or *pragmatic knowledge*) which, in the present context, will be considered "the interaction between language behaviour and the specific contexts in which language occurs" (Hough & Pierce, 1994, p. 246)". An intact ability to use pragmatic knowledge is likely to have a significant impact on communicating adequately, as full communicative ability depends on both linguistic and pragmatic competence (Joanette & Ansaldo, 1999; Martin & McDonald, 2003; Paradis, 1998).

Consider the statement "I could care less". In recent popular usage, this statement is uttered at a noticeably higher volume relative to contiguous utterances by the same speaker and with particular emphasis on the word "less" to convey the message that the speaker has no interest in pursuing a given topic (i.e., "I could care less" is equivalent to "I don't care at all"). Note that the speaker meaning ("I don't care at all") is not the same as the literal meaning of "I could care less." Moreover, the statement "I couldn't care less" (also uttered at a higher volume but with emphasis on the word "couldn't") conveys the *same* speaker meaning (i.e., unconcern) despite the fact that the literal meanings of the former and latter statements are antonymous. With an intact ability to use pragmatic knowledge (e.g., awareness that vocal cues such as volume and stress are likely to convey information that may be different from the literal semantics of utterances), the literal distinction between the literally antonymous statements is moot, as competent English speakers will comprehend the intended, non-literal meaning of the statements (i.e., the communicative intention). However, if pragmatic knowledge were impaired, confusion as to the intended meaning of "I could care less" or similar non-literal constructions might be expected. The discussion now turns to empirical findings.

As stated earlier, persons with RHD tend to have difficulties appreciating humour (Bihrle, Brownell, Powelson, & Gardner, 1986; Brownell, Michel, Powelson, & Gardner, 1983; Dagge & Hartje, 1985; Shammi & Stuss, 1999). Studies of humour appreciation typically employ "joke completion" tasks, whereby participants are presented with the beginnings (or set-ups) of written jokes (or sometimes visual, cartoon stimuli) followed by a variety of possible interpretations or punch lines to choose from. Participants are then required to select the punch line from among a set of distractors that renders the joke humorous (Brownell et al., 1983). A control condition in which participants must recognize the coherent ending to non-humorous stories composed of the same set-ups to the jokes ("story completion" task) has also been administered in some of these studies (Bihrle et al., 1986; Brownell et al., 1983; Shammi & Stuss, 1999).

In joke completion studies of this nature that have compared age-matched adults with and without RHD, the RHD group consistently performed significantly less accurately than their controls (Bihrle et al., 1986; Brownell et al., 1983; Shammi & Stuss, 1999). Interestingly, upon examination of the pattern of errors, RHD participants were found to exhibit a significant bias towards choosing surprising but unrelated endings (i.e., slapstick endings) to complete the set-ups, contrary to the control participants. This finding suggests that RHD participants recognized the importance of the surprise element in comprehending humour, implying that the RHD participants had some recognition of the

communicative intention but were unable to accurately infer which surprising choice was coherent with the text of the joke (Brownell et al., 1983; Shammi & Stuss, 1999).

In addition to humour impairments, persons with RHD have a reduced sensitivity to pragmatic conventions or have a reduced ability to apply them properly (Brownell, Pincus, Blum, Rehak, & Winner, 1997; Rehak, Kaplan, & Gardner, 1992). More central to the present study is the finding that persons with RHD appear to have particular difficulties using pragmatic information to discern the intended meaning of various forms of ironic remarks (Giora, Zaidel, Soroker, Batori, and Kasher, 2000; Kaplan, Brownell, Jacobs, & Gardner, 1990; McDonald, 2000). The last line of inquiry will be detailed.

In one study, Kaplan et al. (1990) presented RHD participants and healthy controls with vignettes to listen to in which two characters interacted. In each vignette, the characters' relationship was explicitly detailed to the participants as being friendly or hostile. Each vignette ended with a conversational remark spoken in a neutral tone by the voice actor. This remark was a comment by one character (the speaker) on the skill of the other character (the actor) in performing a described action (e.g., playing golf). The wording of the remark was manipulated to be either literally true (consistent) or literally false (inconsistent) with respect to the performance described in the vignette (e.g., a literally true comment would be, ''You're a really good golfer'' when the actor is described as playing golf well). The vignettes were presented in the auditory modality; all participants were presented with vignettes recorded with natural prosody. However, the final utterance was devoid of any particular prosodic cues that may have cued any particular pragmatic interpretation. Kaplan et al. (1990) employed this manipulation so as to force participants to rely on context to discern speaker attitude. While the vignettes were prerecorded, questions to all participants were read aloud by experimenters. After each narrative was presented, participants were first required to answer questions regarding the nature of the relationship between speaker and actor as well as the actual performance of the actor in the vignette. The experimenters did this to ensure that the participants understood the context inherent in the vignette. Participants were required to reread the vignette if they answered these questions incorrectly. Once experimenters were satisfied that participants understood the vignette's content, participants had to answer questions that tapped their ability to interpret the pragmatic intent of the concluding comment based on the text of the remark and the context in which it was spoken.

For statements that were consistent with the described performance of the actor (i.e., literally true comments), both control and RHD participants interpreted the speaker's final remark as being the truth. However, the two groups differed in their interpretations of inconsistent (literally false) statements. For these latter items, when the relationship between speaker and actor was qualified as friendly, control participants primarily interpreted statements inconsistent with performance to be jokes or consoling lies (i.e., told to spare the actor's feelings). When the speaker-actor relationship was qualified as hostile, controls predominantly interpreted inconsistent statements as sarcasm or as hurtful lies (i.e., because the final comments were clearly discrepant from the observed performance). By contrast, irrespective of the type of relationship observed, RHD participants were significantly more likely to interpret inconsistent comments as jokes or lies and not as sarcasm. This result shows that the interpretation of sarcastic comments may be especially problematic for persons with RHD and is consistent with the results of other studies (Giora et al., 2000; McDonald, 2000) with methods and research goals similar to those of Kaplan et al. (1990). One interpretation of these converging results is that the right hemisphere is

specifically involved in accessing or using pragmatic knowledge necessary to comprehend sarcastic statements. To further explore how pragmatic knowledge may contribute to the derivation of communicative intention, the present study employed Kaplan et al.'s (1990) task of pragmatic interpretation.

It is noteworthy that both the joke completion task (Brownell et al., 1983) and Kaplan et al.'s (1990) test of pragmatic interpretation largely require participants to interpret non-literal language forms. Moreover, the types of non-literal language that are presented in these two tests (i.e., humour, sarcasm, lies) are commonly-used forms of language in daily communication (Dews & Winner, 1999; Kreuz et al., 1996). The study of these language forms is thus relevant to studies of communication breakdown and social competence following stroke in the right hemisphere. It would be useful to compare participant performances on both Kaplan et al.'s (1990) and Brownell et al.'s (1983) tasks as studies involving RHD participants have typically only examined one type of non-literal language processing at a time, limiting direct comparison of how RHD affects comprehension of communicative intention for more than one non-literal language type. Hence, a main goal of this study was to test communicative intention comprehension in RHD participants for more than one non-literal language type using published materials that have not been administered concomitantly in prior studies. Testing a single group of RHD participants in these various conditions should extend the generalizability of previous findings. A further feature about the present study that distinguishes it from previous research will be the concurrent presentation of all the materials in the visual and auditory modalities, and the use of fully standardized, prerecorded materials as opposed to having the experimenter read some stimuli to participants during the testing session (Brownell et al., 1983; Kaplan et al., 1990; Shammi & Stuss, 1999).

It was anticipated that if RHD participants exhibit a specific deficit in generating inferences about communicative intention (e.g., Sabbagh, 1999), participants in the present study should exhibit relatively selective difficulties when responding to questions that require them to process non-literal language forms (i.e., humorous statements from the joke completion task and non-literal statements from the pragmatic interpretation task). However, RHD participants should perform at a comparable level to controls in the comprehension of literal language items (i.e., the story items from the story completion task or literal statements from the pragmatic interpretation task) because these items do not rely on implicit information or the need to revise analysis about communicative intention to be correctly understood.

Method

Participants

There were two groups of participants: the RHD group consisted of ten participants (five males, five females) with single infarcts confined to the right cerebral hemisphere following thromboembolic cerebrovascular accident; and the control group consisted of ten participants matched for age, gender, and level of education who presented no neurological impairment. All participants were right-handed native speakers of English as determined through self-report. Participants with brain lesions were recruited from rehabilitation centres in the Montreal region whereas control participants were recruited from an existing database of volunteers. RHD participants were tested at least three months post-onset of their stroke. Participants with evidence of concurrent neurological disease or other

complicating illnesses (e.g., major depression) as recorded per medical reports were systematically excluded. Given the visual requirements of the study, all persons with RHD who were considered for the study were screened for visual neglect using the Behavioural Inattention Test (Wilson, Cockburn, & Halligan, 1987); all participants accepted into the study achieved the required minimum score of 129 (the lower end of the normal distribution). All participants passed a hearing screening of 35 dB HL at the frequencies of 0.5, 1, and 2 kHz in the better ear.

Tests of auditory short term memory and auditory working memory were administered to all participants in addition to the experimental tasks. To monitor for potential deficits in basic memory processes, tests of word span and verbal working memory capacity were conducted following Tompkins, Bloise, Timko, and Baumgaertner (1994). A t-test of word span level obtained revealed no significant differences between controls and RHD participants, although accuracy on the working memory measure significantly differentiated the two groups $(t(18)=2.12, p=.005)$. A full summary of participant characteristics is provided in Table I.

Stimuli and apparatus

All participants completed two tasks: the Joke and Story Completion task (JSC, Brownell et al., 1983); and a task tapping participants' ability to judge pragmatic intent (Kaplan et al., 1990). Experimental stimuli consisted of the original items (single sentences or short paragraphs) taken from these reports, presented concurrently to participants in both the visual and auditory modalities. Visual text stimuli were presented from the monitor of a laptop computer in 32-point size font while response alternatives were presented on paper. Paper stimuli were at a visual distance of approximately 30 cm while computer text was at a distance of approximately 50 cm. Auditory stimuli were always presented free field from a

Table I. Clinical and demographic characteristics of participants.

RHD Participants	Gender	Age (Years)	Education (Years)	**WM Score/ 42	Word Span/ 7±2	Post-onset (Years)	Lesion Information
1	M	72	12	27	5	4	Right parietal
2	F	60	13	29	5	10	Right posterior communicating artery
3	M	88	11	20*	5	4	n/a
4	F	66	13	29	4	6	Right internal capsule, right basal ganglia
5	M	71	14	23	4	4	Subcortical right thalamus
6	F	43	9	29	4	4	Right MCA territory
7	M	80	11	26	3	4	Right fronto-temporo-parietal
8	F	35	13	28	5	4	Right parietal
9	F	82	12	29	5	2	Right occipito-parietal
10	M	64	11	41	5	1	Right corona radiata
Total	5 m; 5f						
Mean (SD)		68.7 (14.5)	11.9 (1.7)	26.1 (3.5)	4.3 (.8)	5.1 (2.3)	
Controls Total	5 m; 5f						
Mean (SD)		67.7 (9.2)	12.0 (1.8)	33.3 (5.5)	4.4 (.7)		

*Score falling two standard deviations below the control mean. **WM=working memory; words recalled.

portable compact disc player at a volume comfortable for the participant. The auditory stimuli were recorded as follows: sentences or short passages were read by an adult male native-speaker of English and recorded onto digital audio tape (DAT) in a sound attenuated booth. The DAT recordings were then sampled into a computer, segmented, and edited (format: 48 kHz, 16 bit, stereo). As mentioned previously, the present approach differs from that employed in previous studies because of the concurrent presentation of the materials in the visual and auditory modalities, and the use of standardized, prerecorded materials as opposed to having the experimenter read the stimuli to participants during the testing session (Brownell et al., 1983; Kaplan et al., 1990; Shammi & Stuss, 1999).

Experimental tasks

Task 1: Joke and Story Completion (JSC). The JSC test (used with permission from Brownell et al., 1983) consisted of a joke completion (JC) and a story completion (SC) condition. The JC condition was designed to tap into participants' ability to appreciate humorous stories whereas the SC condition was included to control for participants' ability to integrate information in highly comparable narratives that did not contain surprising elements (Birhle et al., 1986; Shammi & Stuss, 1999; Wapner, Hamby, & Gardner, 1981).

To evaluate participants' ability to resolve humour (the JC condition), participants were presented with 16 narrative stems followed by four alternate endings. The endings included one that made the narrative a joke, an alternative that rendered the stem a cohesive but unfunny narrative, an ending that was absurd or slapstick, and a thematically associated but unrelated ending. Participants had to complete each narrative by selecting the ending that made the narrative a joke.

An example of a stem was: ''Mable walked into a pastry shop. After surveying all the pastries, she decided on a chocolate pie. 'I'll take that one' Mable said to the attendant, 'the whole thing'. 'Shall I cut it into four or eight pieces?' the attendant asked''. Possible endings for this stem included (a) ''Well, there are five people for dessert tonight, so eight pieces will be about right'' (story completion ending); (b) Mable said, ''You make the most delicious sweet rolls in town'' (thematically associated but unrelated ending); (c) ''Then the attendant squirted whipped cream in Mable's face'' (slapstick ending) and; (d) Mable said, ''Four pieces, please; I'm on a diet'' (joke completion ending—correct response).

In the SC condition, participants were asked to complete the same 16 narrative stems by selecting an alternative that rendered the whole a cohesive but unfunny narrative as opposed to a funny joke. The funny punch line ending from the JC condition was replaced by a non-sequitur ending in the SC condition. Hence, possible endings for the SC condition were (a) ''Well, there are five people for dessert tonight, so eight pieces will be about right'' (story completion ending—correct response); (b) Mable said, ''You make the most delicious sweet rolls in town'' (thematically associated but unrelated ending); (c) ''Then the attendant squirted whipped cream in Mable's face'' (slapstick ending); (d) ''My son just graduated from law school'' (non-sequitur ending).

The order of administering the SC and the JC conditions to the participants were randomized and counterbalanced. The accuracy of each participant's responses to the 16 test questions in the JC and SC conditions was recorded. Testing for the JC condition was separated from testing for the SC condition by 1 week in order to mitigate excessive exposure to the stems as they were repeated in both conditions.

Task 2: Pragmatic Interpretation (PI). The PI task was used (with permission from Kaplan et al., 1990) in order to evaluate participants' ability to interpret a speaker's intended or pragmatic meaning within short narratives, as a function of contextual or affective information. Vignettes describing two people engaged in everyday activities were presented to participants, followed by four questions about the depicted events. An example of a vignette was: ''Al and Rob were taxicab drivers for the same company. Al had just moved to the city, and Al and Rob were becoming good friends. Rob knew his way around the city very well, drove well, and got lots of big tips. One day Al said to Rob, 'You are a really good taxicab driver'''. Each narrative could be manipulated along three separate dimensions relevant to the interpretation of pragmatic meaning. First, the nature of the relationship between the two characters was explicitly qualified in the vignette as being ''friend'' or ''enemy'' (Type of Relationship factor). Second, each vignette described the performance of one person, the ''actor'', on a task as ''good'' or ''bad'' (Task Performance factor). Finally, every vignette concluded with a comment by the second person, the ''speaker'', who judged the actor's performance to be good (positive comment) or bad (negative comment). This last manipulation was the Quality of Comment factor. Note that the quality of the final comment was independent of its truthfulness which, depending on the combination of factors present, was ''literally true'' or ''literally false'' with respect to the actor's performance. Depending on the relationship between speaker and actor, literally false contexts could be interpreted as sarcasm, jokes, or lies (Kaplan et al., 1990). Factorial combination of the three factors yielded eight different versions of six discourse items for a total of 48 stimulus vignettes. The order of presentation of the 48 vignettes was randomized. Because of its length, the PI task was presented over two sessions, each comprised of four blocks of six vignettes.

Following presentation of each vignette, participants were asked four questions. The first two questions referred to factual information contained in the vignettes and required true/false judgments. These questions were all of the form ''Did [the speaker] like or dislike [the actor]?'' and ''Did [the actor] [perform well or poorly] at [the task]?'' As with Kaplan et al.'s (1990) original study, these questions were included as a means of ascertaining whether participants understood the context in which the vignettes unfolded. The third question was a multiple choice question that assessed participants' comprehension of the pragmatic intent of the speaker's final comment in the narrative (choices: telling the truth; joking; being sarcastic; or purposefully lying). The number of response alternatives used here was modified from five to four by eliminating one interpretation that was virtually never selected by the participants in the original study (''saying something wrong by mistake''; Kaplan et al., 1990). A final question required participants to subjectively evaluate the effect that the speaker's statement had on the actor in the narrative. Specifically, participants were asked, ''How do you think [the speaker's] comment made [the actor] feel—better or worse?'' (see Kaplan et al., 1990, for further details).

Procedure

All participants were tested individually in a quiet room of their home (RHD participants) or in a laboratory setting (controls). Each participant was tested in two sessions, with the sessions separated by at least 1 week. The average duration of each session was 75 minutes, including frequent breaks between blocks of trials. The first session always began with administration of the various screening tests. Each participant then completed half of each of the two experimental tasks per testing session (i.e., either the JC *or* SC conditions of the

JSC task and four blocks of vignettes from the PI task). Each participant was given the test sections in a unique pseudo-randomly determined sequence to ensure counterbalancing; sequences were matched between groups. All responses were gathered verbally and recorded by hand by the experimenter.

Results

The JSC and PI tasks were analysed separately. In all cases, posthoc analyses of significant interactions were done using the Tukey HSD method (Tukey $\alpha = .05$).

Joke and story completion (JSC) task

Table II presents the accuracy scores of each participant in the JC and SC conditions of the JSC task. These data represent the proportion of items for which the correct punch line (for the JC condition) or correct narrative ending (for the SC condition) was selected. Comprehension of humorous stories versus narratives by each participant group was examined using a 2×2 mixed-design repeated measures ANOVA involving Group (controls, RHD) and Task (JC, SC). There was a significant main effect of Task (F (1, 18) = 5.16, p = .04) that was explained by the overall poorer performance of both participant groups on the JC relative to the SC condition. No significant main or interactive effects involving the Group factor emerged from this analysis although there was a trend for the participant with RHD to have more difficulties than control participants in the JC condition (F (1, 18) = 3.54, p = .076).

Inspection of individual patterns of performance variation in the JC condition revealed that, of five participants whose accuracy scores fell below two standard deviations (SD = .13) of the control mean, four belonged to the RHD group (Participants 3, 4, 6, and 7). In contrast, in the SC condition, only two RHD participants and no control participants had accuracy scores that fell below two standard deviations (SD = .05) of the control mean in the SC condition (Participants 2 and 7). The larger number of RHD participants who scored markedly lower on the JC versus the SC condition, coupled with group trends in the

Table II. Proportion of correct responses in the Joke Completion (JC) and Story Completion (SC) tasks by group (16 total items per task).

PARTICIPANTS	JC TASK		SC TASK	
	Control	RHD	Control	RHD
1	1.00	1.00	1.00	.88
2	.88	.94	.88	.63*
3	.94	.56*	.94	.94
4	.94	.44*	.88	.94
5	.94	.75	.88	1.00
6	.75	.13*	1.00	.94
7	.81	.44*	.94	.69*
8	.81	.94	.88	1.00
9	.56*	.69	.94	.94
10	1.00	1.00	.94	.94
Mean	.86	.70	.93	.89
SD	.13	.28	.05	.11

*Scores falling two standard deviations below the control mean.

data, offer a hint that joke completion was more difficult for some of the RHD participants. However, three of the RHD participants (1, 8, and 10) performed at near ceiling levels on both conditions, implying that humour appreciation was spared in a subset of the participants with RHD (review Table II).

Pragmatic interpretation (PI) task

The PI task required participants to answer a series of four questions following the presentation of short stories; half of the questions required the participants to recall factual information presented in the narrative, whereas the other half required them to make an inference about the speaker's pragmatic intent to answer the question.

Identification of factual information. The number of correct responses each participant made to the 96 factual questions was entered into a t-test comparing the groups. As expected, no significant group differences were found (RHD M=90, SD=7.6 and control M=92.5, SD=3.7; t(18)=.94, p>.05).

Identification of speakers' pragmatic intent. Question 3 required participants to choose one of four pragmatic interpretations to characterize the speaker's final comment: telling the truth, joking, being sarcastic, or purposefully lying. The first analysis was a $2 \times 2 \times 2 \times 2$ ANOVA involving Group (controls, RHD), Task Performance (good, bad), Quality of Comment (positive, negative), and Type of Relationship (friend, enemy) applied to proportions of "telling the truth" responses (i.e., responses on the "literally true" contexts in which a speaker in a vignette make a comment that is consistent with the performance of the actor). This ANOVA was conducted to verify the expectation that RHD participants would not differ from control participants. The ANOVA yielded a significant three-way Task Performance × Quality of Comment × Type of Relationship interaction (F(1, 18)=7.29, p=.015). Posthoc analyses revealed that participants interpreted a comment as being truthful when actors' performance was literally consistent with speakers' comments (i.e., good performance coupled with positive comment; bad performance coupled with negative comment). Participants were also significantly more likely to interpret positive comments on good performance as being truthful when speakers and actors were friends as opposed to enemies.

Literally false contexts involve inconsistencies between the actor's performance in the vignette and the quality of the speaker's comment biasing non-literal interpretations such as "being sarcastic", "joking", or "telling a lie". Following Kaplan et al. (1990), a dependent variable, "lie or sarcasm" (LS), was computed by subtracting participants' "sarcasm" responses from their "lie" responses in the context of poor Task Performance/positive Quality of Comment, independently for "friend" and "enemy" conditions (i.e., friends are likely to tell each other consoling lies in the context of poor performances while enemies are likely to make sarcastic comments, see Kaplan et al., 1990 for a discussion and rationale). The data for this variable consisted of proportions and ranged in value from −1 to 1. Computed difference scores helped isolate responses to these two interpretations for this specific context; positive scores indicated that participants favoured a "lie" interpretation while a negative LS score indicated participants to have preferred a "sarcasm" interpretation of speaker comments. LS scores were entered into a mixed 2×2 ANOVA involving Group (controls, RHD) and Type of Relationship (friend, enemy) (see Table III). The analysis yielded a main effect of Type of Relationship (F (1, 18)=42.98, p<.001), but

Table III. Interpretations of ''literally false'' final utterances in the context of bad performance-positive utterance (LS variable) across relationship types. Range for dependent variable: −1 to 1.

| | DEPENDENT VARIABLE: Lie or Sarcasm (LS) (lie - sarcasm) | | | |
| | Friendly speaker-actor relationship | | Hostile speaker-actor relationship (Enemies) | |
PARTICIPANT	Controls	RHD	Controls	RHD
1	.333	.500	−.500	−.333
2	.667	.667	.167	.167
3	.833	.500	−1.000	.000
4	.333	−.333★	−.833	−.667
5	−.333★	−.167	−.833	−.833
6	.167	.333	−.833	.000
7	1.000	−.333★	−.667	−.167
8	.333	1.000	−.666	−.667
9	.333	.333	.000	.167
10	.667	.833	−1.000	−1.000
Mean	.433	.333	−.617	−.333
SD	.378	.471	.401	.430

Note: For LS, positive scores indicated that participants favoured a ''lie'' interpretation while a negative LS score indicated participants to have preferred a ''sarcasm'' interpretation of speaker comments. ★Scores falling two standard deviations below the control mean.

no main or interactive effect of Group was found. The main effect of Type of Relationship was accounted for by participants significantly interpreting non-literal comments as lies when the speakers and actors were characterized as friends; when speakers and actors were characterized as enemies, participants reliably interpreted the statements as sarcastic utterances. Inspection of individual performance on the LS measure revealed that there was considerable variability across participants in each group for this measure, although variability between groups was highly comparable in range as an index of the Type of Relationship factor (see Table III). It was noted that two of the RHD participants (Participants 4 and 7) and only one healthy control (Participant 5) performed below two standard deviations (SD=.378) of the control mean on this measure (review Table III).

Also following Kaplan et al. (1990), a second dependent variable, ''joke or [lie or sarcasm]'' (JLS), was constructed by subtracting the combined proportions of ''lie'' and ''sarcasm'' responses from the proportion of ''joke'' responses in the literally inconsistent context of good Task Performance and negative Quality of Comment (values for this variable are detailed in Table IV). As with LS, data for this variable were proportions and ranged in value from −1 to 1. In this context, Kaplan et al. (1990) noted that control participants were more likely to perceive speakers' comments to be ''jokes'' if the speaker and actor were friends. On the other hand, the comments were interpreted relatively equally as ''lies'' or ''sarcastic'' statements if the relationship were hostile. A mixed 2×2 ANOVA involving Group (controls, RHD) and Type of Relationship (friend, enemy) for JLS yielded a main effect for Type of Relationship ($F(1, 18)=72.07$, $p<.001$) and a Group $\times$ Type of Relationship interaction ($F(1, 18)=17.00$, $p=.001$). Both RHD and control participants were significantly more likely to make a ''joke'' interpretation for the comment when the speaker and actor were friends than when they were enemies/hostile. However, RHD participants were significantly less likely than controls to interpret a comment as a ''joke'' when speaker and actor were characterized as friends. Inspection of individual data reveal a lack of differentiation of responses by RHD participants in one of

Table IV. Interpretations of final utterances in the context of good performance-negative utterance (JLS variable) across relationship types. Range for dependent variable: −1 to 1.

| | DEPENDENT VARIABLE: Joke or [Lie or Sarcasm] (JLS) (joke – [lie+sarcasm]) | | | |
| | Friendly speaker-actor relationship | | Hostile speaker-actor relationship (Enemies) | |
PARTICIPANTS	Controls	RHD	Controls	RHD
1	1.000	.500	−.333	−.333
2	.666	.167	−.834	−.167
3	.166	.666	−.834	−.334
4	1.000	−.167	−.167	−.167
5	1.000	.500	.000	−.167
6	.833	−.333★	.000	−.167
7	1.000	−.333★	.000	−.166
8	.666	.666	−.334	−.334
9	−.334★	−.500★	−1.000	−.333
10	.666	.000	−.500	−.500
Mean	.666	.117	−.400	−.267
SD	.438	.445	.379	.117

Note: For JLS, positive scores indicated that participants favoured a ''joke'' interpretation while a negative JLS score indicated participants to have preferred a ''lie ''or ''sarcasm'' interpretation of speaker comments. ★Scores falling two standard deviations below the control mean.

the conditions (i.e., hostile speaker-actor relationship) relative to controls on the JLS measure; there was little variability among the RHD participants for this measure in this context as the RHD participants appeared to perceive weaker negative comments to enemies (see Table IV). For the JLS variable, nearly one-third of the RHD participants (Participants 6, 7, and 9) but only one control participant (9) had scores that were less than two standard deviations below the control mean (SD=.438).

Identification of emotional impact of speaker comment on the actor

The proportion of times that participants selected one of the two possible alternatives for Question 4 (''Do you think the speaker's comment made the actor feel better or worse?'') was calculated and data representing ''feel better'' response were entered into a $2 \times 2 \times 2 \times 2$ ANOVA involving Group (controls, RHD), Task Performance (good, bad), Quality of Comment (positive, negative), and Type of Relationship (friend, enemy) (see Table V). The ANOVA yielded no group differences or interactions but produced a

Table V. Mean proportion ''the comment will make the actor feel better'' responses on Question 4 (''Do you think the comment will make the actor feel better or worse?'') as a function of Task Performance (Bad, Good), Quality of Comment (Negative, Positive), and Type of Relationship (Enemies (E), Friends (F)).

| | Bad | | | | Good | | | |
| | Negative | | Positive | | Negative | | Positive | |
Group	Enemies	Friends	Enemies	Friends	Enemies	Friends	Enemies	Friends
Control	.02 (.05)	.02 (.05)	.10 (.12)	.57 (.32)	.12 (.31)	.56 (.29)	.80 (.31)	.90 (.32)
RHD	.07 (.16)	.00 (.00)	.13 (.17)	.41 (.29)	.18 (.34)	.48 (.29)	.92 (.09)	.98 (.05)

significant Type of Relationship × Task Performance × Quality of Comment interaction (F(1,18)=27.76, p<.001). Posthoc analysis revealed that a positive comment in response to good performance was interpreted by participants as making the actors feel better, regardless of speaker-actor relationship. However, when the speaker-actor relationship was friendly, participants were significantly more likely to infer that positive comments would make the actors feel better. Additionally, positive comments by friends (as opposed to enemies) on bad performances were significantly more likely to be construed as making an actor feel better. Participants inferred that negative comments made actors feel better only when performances were good and the speaker-actor relationships were friendly.

Discussion

In a departure from previous studies, this study presented two distinct tasks that tapped processing of various forms of non-literal language to gain greater insight into possible areas of communicative failure associated with RHD. On the joke and story completion task, there was a large amount of heterogeneity on the joke completion portion within the RHD group, which was considerably greater than for the control participants. This heterogeneity may account for the lack of significant group differences on this task, although there was a trend in the data (p=.076) that is consistent with previous studies, indicating that RHD participants are likely to have significant difficulties with respect to humour appreciation.

One prior study that may be pertinent to the present discussion is that of Shammi and Stuss (1999). These authors found that it was their participants who had lesions confined to the right *frontal* lobe who had greatest difficulties with tasks of humour appreciation, or ''classical'' humour impairments in RHD. Relatively few of the RHD participants in the present study had lesions that substantially involved frontal regions cited as critical to humour processing by Shammi and Stuss (1999) (see Table I); thus, it may be that the RHD participants who participated in this study were able to appreciate humour as a group because the mechanisms that were necessary or at least influential to the processing of humour were still intact. While this possibility was not the focus of the present study nor of previous reports on RHD humour deficits which also studied individuals with relatively unselected lesions in the right middle cerebral artery distribution (Bihrle et al., 1986; Brownell et al., 1983; Dagge & Hartje, 1985; Wapner et al., 1981), the possibility that aspects of humour processing are critically reliant on right frontal regions is an idea that certainly merits further investigation.

RHD participants' performance on the pragmatic interpretation task was more consistent with previous findings (Giora et al., 2000; Kaplan et al., 1990; McDonald, 2000; Tompkins & Mateer, 1985). Neither group of participants had difficulty answering factual questions, nor were there group differences on the ''telling the truth'' interpretations; such results were expected as RHD typically either spares appreciation of factual or literal information (Myers, 1999) or biases interpretations toward the literal (Rinaldi, Marangolo, & Baldassarri, 2002; Winner & Gardner, 1977).

Analyses of non-literal utterances isolated in the contexts they are most likely to occur yielded some interesting results. While a significant interaction involving group membership of participants was found for the JLS variable (i.e., when ''joke'' interpretations were isolated from ''lie'' and ''sarcasm'' interpretations), this interaction was not significant for the LS variable (i.e., the isolation of ''lie'' interpretations from ''sarcasm'' interpretations). A likely possibility is that the present RHD participants had difficulties in making use of pragmatic information relating to relationships among the characters in the vignettes, a

possibility that is consistent with previous research showing RHD participants' tendency to have deficits in appreciating subtleties in conversations. Rehak et al. (1992) found their RHD participants had difficulties in detecting and repairing violations in conversations. Converging with this finding is Brownell et al.'s (1997) work showing their RHD participants to have particular difficulties in using pragmatic knowledge to modify their language use. In particular, it was found that the RHD group had difficulty relative to healthy control participants in adjusting the formality in referring to others (i.e., titles) based on familiarity between speakers and referents (Brownell et al., 1997). Both Rehak et al.'s (1992) and Brownell et al.'s (1997) results are consistent with the present results in ascribing difficulties to RHD participants in interpreting more complicated language forms and in making use of pragmatic information regarding relationships. Where the present results appear to add insight is in showing that RHD participants present with a subtle difficulty in interpreting the impact of the *valence* of relationships relative to healthy participants, even though the RHD participants appear sensitive to valence in a broad manner. These findings imply a role for the right hemisphere in the use of relationship information in interpreting interpersonal communication.

One possible reason that the RHD participants were more clearly impaired in the pragmatic interpretation task (rather than the joke and story completion task) is that in the joke completion task, the investigator explicitly stated to each participant the type of non-literal language that the participant would be presented with (jokes), whereas in the pragmatic interpretation task participants were required to identify the nature of non-literal statements; in the former case, the communicative intention of the language was given whereas discerning communicative intention was the task in the latter. It may be the case that the unequivocal identification of the stimuli in the joke completion task as jokes improved the performance accuracy of the RHD participants, as they have been known to present with difficulties discerning intention both in online and offline tasks (Siegal, Carrington, & Radel, 1996; Stuss, Gallup, & Alexander, 2001; Surian & Siegal, 2001; Winner, Brownell, Happe, Blum, & Pincus, 1998).

In story-based tasks similar to the present study's pragmatic intention task, RHD participants (relative to control participants or persons with left hemisphere damage) tend to have difficulties using explicit information as to what characters in vignettes are thinking to discern what the characters' intentions (Winner et al., 1998) or physical actions (Happe, Brownell, and Winner, 1998; Siegal et al., 1996) may be. Importantly, dissociations have been reported: these difficulties are significantly more pronounced among participants presenting with RHD than among participants with left hemisphere damage (Siegal et al., 1996; Surian & Siegal, 2001). Similarly, when participants with right frontal lobe damage are required to discern the pragmatic intentions of actual persons (as opposed to characters in vignettes), they are found to have the same types of difficulties as RHD participants in studies employing story-based tasks (Stuss et al., 2001). Specifically, it was found that in game situations with experimenters, RHD participants were impaired in making use of information about the knowledge of other game participants (i.e., the experimenters' confederates) in deciding whether the confederates were lying or telling the truth (Stuss et al., 2001). Thus, the results from the present study combined with previous research suggest that RHD impairs the deriving and use of information about communicative intention in communication (Joanette & Ansaldo, 1999; Myers, 2001; Sabbagh, 1999). Moreover, given the specific findings of the present study, explicitly providing persons presenting RHD with information about the communicative intention underlying language may significantly improve their comprehension in discourse.

When individual performance was evaluated across the different tasks, it is relevant to note that the RHD participant who performed consistently below the control group's range on each task (i.e, RHD Participant 7) also exhibited clearly right frontal lobe involvement. Of the two other participants who frequently exhibited impairments in non-literal comprehension (RHD Participants 4 and 6), it is likely that participant 6 may also have suffered right frontal damage as a result of a stroke in the middle cerebral artery distribution. While the present study was not explicitly designed to test whether right frontal lesions are a critical source of communicative symptoms associated with right hemisphere strokes, these data are nonetheless consistent with a role of the right frontal lobe in mediating humour appreciation and pragmatic interpretation. This notion is in line with conclusions drawn by researchers who have carefully controlled lesion locus in their investigations of RHD and the pragmatic aspects of communication (Shammi & Stuss, 1999; Stuss et al., 2001).

Another possibility that arises from these data is that a general cognitive deficit may be the source of group differences in the present study (i.e., group differences were revealed on the task that was perhaps more cognitively demanding). The present research, like most previous studies of communication involving participants with RHD, did not include a full and stringent evaluation of cognitive ability in the brain-damaged participants tested, rendering it difficult to test this hypothesis. However, the results of studies that have included such additional measures would appear to suggest that more basic cognitive abilities can be independent of processes involved in mediating the comprehension of non-literal information (Shammi & Stuss, 1999; Stuss et al., 2001). Shammi and Stuss (1999) found that while their brain-damaged participants did not differ from their healthy control participants on a multitude of cognitive measures—including but not limited to IQ levels, digit span, reading ability, and verbal fluency—they did nonetheless present with humour appreciation deficits (see also Stuss et al., 2001). With respect to the present data, it is noteworthy that no group differences were found for word span and that while group differences emerged on the working memory task, only one RHD participant (Participant 3) was seriously impaired in his verbal working memory capacity (i.e., more than two standard deviations below the control mean). However, this participant was not seriously impaired for either of the joke completion or pragmatic interpretation task, indicating a lack of correspondence between the cognitive and the communicative abilities studied here. Collectively, results suggest that a general decline in cognitive abilities did not appear to factor significantly on the performance of the RHD participants tested on the present tasks, although this possibility merits further study.

Conclusion

A humour appreciation task and a task tapping the ability to discern pragmatic intent were administered to a single group of RHD participants to gain more insight into the potential impact of RHD on non-literal language processing. No overall impairments by the RHD participants were found on the humour appreciation task, contrary to previous studies (e.g., Brownell et al., 1983; Shammi & Stuss, 1999). However, a statistical trend suggested that humour appreciation rather than story comprehension was more difficult for RHD participants as a group, and inspection of individual responses suggested that some of the RHD group were impaired on the joke completion task compared to the control group distribution. In the pragmatic interpretation task, RHD participants appeared to be sensitive to pragmatic information regarding relationships in general, although they could

not consistently use this information in certain pragmatic interpretations in ''literally false'' contexts (Kaplan et al., 1990). These results are consistent with previous findings that have revealed deficits among persons with RHD in using pragmatic information to fully comprehend the communicative contributions of others or to modify their own communicative contributions (e.g., Brownell et al., 1997; Rehak et al., 1992; Stuss et al., 2001). Present and past findings involving the pragmatic interpretation task provide a promising point of departure for discerning at least one potential deficit (i.e., reduced accuracy in using pragmatic information about interpersonal relationships) that underlies a possible key source of communication impairment faced by persons with RHD (i.e., the derivation of communicative intention). Ultimately, perhaps the key conclusion that one may draw from the results of the present study is that explicitly providing persons with RHD with the intended communicative intention of non-literal statements may facilitate communication in this population, as illustrated by the differences in RHD participant performance on the joke and story completion and pragmatic interpretation tasks. Group interactions arose in the task in which participants had to discern communicative intention but not in the task in which the communicative intention was explicitly detailed. This conclusion has both theoretical and clinical utility and should be explored further. Moreover, the results of the present study suggest that in future research, RHD participants should be compared across a number of tasks that have been previously administered in isolation.

Acknowledgements

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