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Pragmatic communication deficits are among the most recognized deficits following right hemisphere brain damage (RHD). Deficits in one's ability to comprehend and produce appropriate language leads to conversational exchanges that are often unsuccessful. Research to explore the nature of these deficits has focused primarily on the influence of language comprehension deficits while language production deficits have been relatively unexplored. Questions are the most explicit avenue of gathering information. While ineffective question use has recently been observed in individuals following RHD, there are no known published studies that investigate question use specifically. The purpose of this study was to determine if people with RHD use questions differently than people with no history of brain damage (NBD) during structured tasks and, if so, in what ways. Chi-square and two-sample t-tests were employed to determine differences in question use. Correlation analyses were conducted to determine if the use of specific types of questions were associated with cognitive-linguistic performance and empathy. Results showed that participants with RHD used questions less frequently and differently than participants with NBD. There were significant group differences in the quantity and quality of questions used during structured discourse tasks. Moreover, the distribution of question types was different, especially with respect to the discourse tasks, suggesting that, in participants with RHD, the use of specific types of questions may vary depending on the task. No significant correlations were noted between question type and cognitive-linguistic performance measures or question type and empathy scores.

QUESTION USE FOLLOWING RIGHT HEMISPHERE BRAIN DAMAGE

by

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To Haielle Reese – You were, so I did.

APPROVAL PAGE

This dissertation has been approved by the following committee of the Faculty of The Graduate School at The University of North Carolina at Greensboro.

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CHAPTER I

INTRODUCTION

Effective person-to-person communication is needed to engage in a host of functional, every-day communication tasks. For example, forging new friendships, interviewing for a job, and sharing health information with the doctor necessitate the effective exchange of information. It is through the exchange of information that decisions are made and that relationships are established.

Various types and severities of acquired brain damage may hinder the effectiveness of information exchange. Whereas the basic aspects of speech and language (for example, syntax, morphology, fluency, and intelligibility) may be effected by injury to the left hemisphere of the brain, when right hemisphere brain damage (RHD) occurs the syntactic and lexical characteristics are typically preserved, resulting in fluent verbal output containing well-constructed, grammatically intact sentences. Herein lies the basis for the subtlety of communication deficits following RHD. In the presence of preserved syntax and morphology, communication following RHD is often perceived as unimpaired, on the surface. However, damage to the right hemisphere has been shown to affect subtle aspects of communication, such as pragmatics, contributing to impaired information exchange within a social context.

Pragmatics refers to the relationship between what is said, what is inferred, and the social context in which communication occurs (Bloom, Obler, 1998; Champagne, Stip, Joanette, 2005; Grice, 1975; Joanette & Brownell, 1990; Martin & McDonald, 2003; Prutting, 1982). In pragmatic communication, non-verbal and verbal information about the communicative environment, situation, and personal knowledge of the communication partners serve as a basis for language perception, comprehension, and production. Information is exchanged via implicit and

explicit channels during communication. Implicit information, for example, can be exchanged through facial expressions, gestures, body posture, and tone of voice, whereas the use of questions is an explicit avenue for gathering information.

Questions are one type of linguistic expressions used for gathering information to meet specific communication goals, to understand complex problems, and for learning (Flammer, 1981; Ram, 1991). Questions also serve illocutionary purposes of eliciting responses from an addressee (Chafe, 1972) and sustaining a conversation (Kearsley, 1976). For example, asking, "where are you from?" can be used to gain information about place of birth, to establish common knowledge, and to understand the reason for hearing differences in the articulation of vowels for a person from Boston versus Louisiana. Asking, "Are you okay?" can be used to obtain information about the personal status of a conversational partner, as an avenue for displaying empathy for either a known or unknown situation (e.g., death of a family member), or to convey perceived concern (e.g. an ill appearing individual).

Difficulty in asking questions may have a significant impact on functional communication and relationships—personal, social, rehabilitative, and vocational. However, there are no known published studies that have examined question use in individuals who have sustained RHD. Thus, the primary goal of this study is to expand our knowledge of communication deficits following RHD. More specifically, this study investigates question use in individuals with RHD. Knowledge gained from this study will add to the growing body of literature regarding communication disorders following RHD.

CHAPTER II

REVIEW OF THE LITERATURE

Right Hemisphere Brain Damage (RHD)

Language is the linguistic vehicle used to both convey and perceive meaning during communication (Clark, 1996). While damage to the left hemisphere has long been recognized as a contributor to an inability to produce and understand language in various modalities (written and spoken), the role of the right hemisphere in communication has a historic status of "non-dominant," "minor," and "cognitively silent" (Ornstein, 1997).

The earliest language related processes associated with the right hemisphere were perceptually-based. John Hughlings Jackson, an English physician, drew attention to the contribution of the right hemisphere to linguistic performance by suggesting mediation of more automatic components to language (e.g. perception) based on the description of two cases from the 1870's (Hughlings Jackson, 1932). The case describing Eliza T. (1876) included symptoms of poor recognition of people, an inability to name common objects, and difficulty remembering daily events (Harris, 1999). Case observations resulted in the association of "imperception," an inability to recognize people and places, to the right parietal lobe and dominance right hemisphere dominance for visual spatial functions (Harrington, 1987).

After WWII, the notion of the "minor" right hemisphere (Sperry, 1981) began to dissipate. Access to an increasing number of soldiers with brain damage contributed to the philosophical shift from hemisphere localization to hemisphere compensation. Supporting the hemisphere compensation philosophy, however, required that researchers use people with right hemisphere brain damage as controls in studies focused on language and communication following left

hemisphere brain damage. In doing this, researchers stumbled upon unexpected findings: Individuals with RHD had difficulty with some communication tasks suggesting that the right hemisphere contributed to processes unrelated to those associated with the left hemisphere. It was at this time that the old proposition of the 'cognitively silent' right hemisphere began to dissipate.

Insight into the specialized role of the right hemisphere was provided through a series of observations and lateralized testing of patients who had undergone a commissurotomy (Gazzaniga, Bogen, Sperry, 1965; Sperry, 1964; Sperry, Gazzaniga, and Bogen, 1969). In these studies, hemispheric visuospatial processes were examined using tachistocopic techniques for presenting stimuli to either hemisphere. Stimuli presented to the left visual field assessed the right hemisphere and vice versa. In one task, patients were asked to locate the visual target, a spot of light with a ½ inch diameter, presented to either hemisphere (Gazzaniga, Bogen, Sperry, 1965). Findings showed laterality of the motor response, in the form of pointing. Specifically, the left hand was responsive to stimuli presented to the left visual field while the right hand was responsive to stimuli presented to the right hemisphere. When, however, items (e.g. pictures, letters, or numbers) were simultaneously presented to both visual fields and no motor response was requested, the stimulus item in the right hemisphere was recognized through verbalization. Dominance of the right hemisphere for visual spatial processing was bolstered by completion of figure-copying tasks. Increased precision in object duplication was noted when images were copied with the left hand (right hemisphere) versus the right hand (left hemisphere).

Understanding the contribution of the right hemisphere to language-related processes increased with continued explorations by Sperry and colleagues (1969). Through descriptions of linguistic abilities examined in a number of visual, tactile, and auditory exercises, the right hemisphere was able to demonstrate understanding via non-verbal means. Patients were able to

point, trace, and match objects with written or spoken indefinite descriptions (e.g. a measuring instrument), and associate an object, picture, or list of names with the stimulus. For example, when presented with a picture of an object like an apple, in the left visual field, the patient was able to identify an unseen tangible object that matched the picture. Comprehension capabilities of the right hemisphere were demonstrated for auditory and written language. For example, unseen object retrieval was noted with the left hand when an object was named or described by an examiner. When patients were presented with written words in the left visual field, they were able to discriminate the named object from an array of objects via touch.

Observed motor and non-verbal responses by patients who had a commissurotomy substantiated the right hemisphere as a contributor to processes that were separate and independent, yet complementary, to the left hemisphere. Verbal descriptions were absent during the retrieval of objects presented to the left visual field. In contrast, verbal descriptions were present in response to stimuli seen in the right visual field. By the 1970's, the right hemisphere was deemed superior for visual spatial processing (Gazzaniga & Sperry, 1967; Levy and Sperry, 1970).

Soon after, observed difficulty capturing the gist of stories and conversation led to investigations that suggested deficits in comprehension (Eisenson, 1962; Gardner & Denes, 1973; Winner & Gardner, 1977). Gardner & Denes (1973) noted difficulty in connotative task completion by a group of six patients with RHD. For this task, participants were asked to match concrete nouns (e.g. woman, man), adjectives (e.g. rich, poor), and abstract nouns (e.g. male, female) to line configurations. Configurations were pairs of lines and shapes that varied on one dimension. For example, a pair of circles differed in color and a pair of lines with arrows differed in the direction of the arrow. Findings from this study, while not statistically significant, showed that the participants with RHD had difficulty ascribing the target words to abstract configurations.

Winner & Gardner (1977) also noted deficits in abstract language following RHD. In their study, twenty-two participants were asked to match a verbally presented metaphoric expression to an image. Response choices consisted of four colored images representing the meaning of the metaphor, the literal meaning of the metaphor, an adjective, and a noun in the metaphor. Findings showed that participants with RHD selected significantly more literal pictures in comparison to left hemisphere brain damaged participants and healthy controls.

Gardner and colleagues' studies were the foundation of our knowledge concerning comprehension deficits in RHD. In the last half-century comprehension deficits of lexical-semantic processing (Joanette & Brownell, 1990), figurative language comprehension (Brownell 2000; Lundgren & Brownell, 2006; Van Lancker & Kemplar, 1987), referential communication (Chantraine, Joanette, & Ska, 1998), and discourse comprehension (Beeman & Chiarello, 1998; Brownell, 1988) have been associated with RHD. Comprehension based inquiry has influenced theoretical accounts for the existence of deficits following RHD (Beeman, 1993; Lundgren, Brownell, Cayer-Meade, Milione, & Kearns, 2011; Tompkins, Baumgaertner, Lehman, & Fossett, 1997) and the development of treatment protocols (Lundgren et al. 2010; Tompkins, Blake, Wambaugh, & Meigh, 2011).

Researchers recognize the potential relationship between language comprehension and language production difficulties following RHD. While the effects of RHD on aspects of language comprehension have received much attention (Beeman & Chiarello, 1998; Winner & Gardner, 1977; Tompkins, Sharp, Meigh, Fassbinder, 2007; Lundgren, et al., 2011), fewer investigations have focused on language production (Kennedy, Strand, Edythe, Burton, & Peterson, 1994; Kennedy, 2000). Impairments that have been suggested to affect language production, following RHD, include difficulty integrating contextual cues (Myers, 1978), impaired cognitive-linguistic skills (Benowitz, Moya, Levine, 1990; Champagne-Lavau &

Joanette, 2009; Eisenson, 1962; Heilman, Scholes, & Watson, 1975; Lundgren & Brownell, 2010; Posner & Petersen, 1990; Tompkins, Bloise, Timko, & Baumgaertner, 1994), reduced inferencing (Brownell, Potter, Bihrle, & Gardner, 1986), difficulty comprehending implicit language (Myers & Linebaugh, 1981), and difficulty revising an initial interpretation when provided with new information (Winner & Gardner, 1977). These deficits, whether isolated or concomitant, can result in inaccurate interpretation of verbal and non-verbal communication in a variety of communicative contexts (Winner & Gardner, 1977) and may have common underlying causes that contribute to a communication impairment of a pragmatic nature, which can be detrimental to interpersonal communication.

Pragmatics

Pragmatics is a term established in the 1930s by C.W. Morris (1946), a philosopher, but developed as a subfield of linguistics in the late 1970's. The definition of pragmatics has taken a number of delineations across disciplines. According to Crystal (1985), it can be understood as "the study of language from the point of view of users, particularly of the choices they make, the constraints they encounter in using language in social interaction and the effects their use of language has on other participants in the act of communication (p. 240)." Thus, pragmatics explores the linguistic and extralinguistic skills and principles needed for appropriate language production and comprehension with respect to the speaker, the addressee, and the social context (Leech, 1983; Liu, 2000). Pragmatic competence (or sociolinguistic competence according to Hymes, 1972), then, is the ability to negotiate the appropriate manner to use language for various purposes (Chomsky, 1980). Determining the meanings of words, adhering to the social rules of conversation, and using the appropriate language for the communicative purpose, the listener, and the situation (Nofsinger, 1991) are essential pragmatic skills. Pragmatic communication and

competence are necessary for effective social communication (Nofsinger, 1991), such as conversation.

Conversation is the informal interchange of thoughts, through words, between two or more people with a mutual intention to communicate (Bogen, 1999; Clark, 1996; Crystal & Davy, 1975; Markel, 1977). During conversation, speakers use language to achieve goals: To strengthen friendships, obtain employment (or not), and participate in everyday familial interactions, for example. Therefore, messages conceived by the speaker must be formulated and produced for the purposes of conveying a particular message to a recipient. In turn, recipients of language must synthesize, interpret, and may choose to respond to messages presented by the speaker.

Effective communication in conversation requires that people must not only demonstrate adequate syntax, morphology, and semantics, they must also possess the ability to know when, where, with whom, and how to speak (Hymes, 1972). They must have pragmatic competence to have the most successful type of communicative interaction. Prosody, intonation, gestures, turn-taking, commenting, asking, and responding to questions are aspects of pragmatics that can be used in conversation to supplement language in order to achieve goals such as convincing, persuading, deterring, and misleading (Austin, 1962; Grice, 1975; Searle, 1969).

Pragmatic Communication Deficits associated with RHD

Pragmatic impairments are among the most recognized communication deficits following RHD (Gardner, Brownell, Wapner & Michelow, 1983; Brownell, Simpson, Bihrle, Potter, and Gardner, 1990; Hough, 1990; Tompkins, 1995; Myers, 1994). Conversation is one form of communication through which pragmatic skills can be observed. Inappropriate, tangential, and egocentric are commonly used to describe the communication of some people following RHD (Brownell & Martino, 1998; Myers, 1994; Tompkins, 1995). Yet, there are few published

investigations exploring how RHD affects aspects of conversation (Barnes & Armstrong, 2010; Brady, Mackenzie, Armstrong, 2003; Brady, Armstrong, MacKenzie, 2006; Hird & Kirshner, 2003; Kennedy et al., 1994; Kennedy, 2000).

Inappropriate and poorly maintained topic is among the most highly recognized behavioral change following RHD (Brady, 2006; Brady, Mackenzie, & Armstrong, 2003; Mackenzie & Brady, 2008; Gardner, Brownell, Wapner, Michelow, 1983; Myers, 1999; Rehak, Kaplan, & Gardner, 1992; Rivers & Love, 1980). It is not surprising then that topic coherence and maintenance have dominated studies examining conversation in the RHD literature (Brady et al., 2003; Klonoff, Shepherd, O'Brien, Chiapello, 1990; Kennedy, Strand, Edyth, Burton, & Peterson,1994; Kennedy, 2000). While each study had a common goal of investigating topic use, each used different elicitation procedures.

Brady, Mackenzie & Armstrong (2003) used semi-structured conversations in their study. Seventeen people with RHD (9 males and 8 females) between 61 and 82 years of age comprised the experimental population. Each participant with RHD was paired with three non-brain damaged (NBD) conversational partners matched by age, gender, education and handedness. The control group consisted of a 51 participants with NBD who conversed with the participants with RHD. Three ten-minute semi-structured conversations (a topic-directed interview; Ripich & Terrell, 1988) were used to elicit discourse. Discourse topics and elicitation cues included family, day, and health. The carrier phrase, "Tell me about X" was used to initiate the topic of discussion. Discourse samples were collected at 1 month and 6 months post stroke for each participant with RHD.

The topic coherence analysis was an extended version of Mentis & Prutting's (1991) multidimensional analysis. The extended analysis consisted of subdividing topics into sub-subtopics and sub-sub-subtopics. Within these extended divisions, topics were rated as new,

related, or reintroduced. Topic management analysis consisted of first categorizing each utterance as either on topic or off topic. On topic utterances were further coded as clear on-topic, on-topic filler (continuer), meta-statement (a clarification, task/performance, or meta-filler), and topic shading (aspect of subject, anecdotal, personal—comment/opinion; or topic-shading filler). Off topic utterances were coded as intrusive, replication, off-topic, off-topic filler, and external.

Kennedy and colleagues (1994 & 2000) explored topic and turn-taking through less structured means. In their study age- and education-matched participants, 12 participants with RHD and 11 participants with NBD, were engaged in a 12-15 minute first-encounter conversation with either a certified speech-language pathologist or trained graduate student in speech-language pathology. The first-encounter conversation was novel in that it was meant to symbolize the first meeting of two strangers. Scripted procedures were used to introduce the conversational partners to each other and emphasize that the task was not an interview. Participants were asked to try to "get to know" each other during each conversation.

The middle eight minutes of conversation was analyzed using conversational discourse parameters subsumed under two categories: topic skills and conversational turn-taking skills. Each turn of talk was coded using topic skill and turn-taking skill parameters. Topic parameters included: introduce, maintain, expand, shade, reintroduce, and terminate. Turn-taking parameters included: direct (indirect or direct request for information), express (psychological or emotional state), acknowledge (identify understanding or hearing), represent (assertion of fact or opinion), commit (indicate plan to do something in the future).

In a subsequent study, Kennedy (2000) analyzed topic skills in persons with RHD across the initiation, maintenance, and termination phases. Eight adults with RHD in the acute phase of recovery and seven age- and education-matched adults with NBD participated in first-encounter conversations with one of three female speech-language pathologists or graduate students.

Elicitation procedures were identical to the 1994 study. However, unlike the 1994 study, each conversation was divided into topic scenes, "an utterance or set of utterances dealing with a single topic having a common intent or goal occurring over one or more turns" (p.76). Each topic scene was coded as a member of a set of first encounter topic scenes (see Kellerman, Broetzmann, Lim & Kitao, 1989, for a review), an off list topic scene, or as a misplaced topic scene. Proportion and frequencies were calculated for total topic scenes, newly introduced topic scenes, and newly introduced topic scenes contributed.

Despite the different elicitation strategies for investigating topic use, the studies yielded similar results. Neither of these studies showed significant differences in topic use per se. However, all indicate differences in topic management and turn-taking skills. For example, in Brady et al.'s (2006) study participants with RHD produced fewer fillers and more off-topics comments and meta-statements than clear on topic utterances. In Kennedy and colleagues' (1994) study, the participants with RHD performed significantly more turns of talk and produced more words per turn and more misplaced topic scenes. When considering the type of turns taken, Kennedy et al. (1994) note that the participants with RHD produced more assertions of fact or opinion and fewer requests for information.

Confounding factors in each of these studies include the use of speech-language pathologists and graduate students as communication partners, and use of parameters that were not operationally defined. Nevertheless, each provides key information pertinent to understanding pragmatic communication deficits following RHD. These studies have shown that while topic use, a deficit often observed following RHD, is relatively preserved and similar to people without brain damage, the management of topics within a communicative exchange is impaired.

Managing topics in communication requires the use of implicit and explicit information. However, the majority of documented deficits following RHD are implicit and largely comprehension based. For example, in some individuals with RHD, facial expressions (Heilman, Scholes, & Watson, 1975), emotional prosody (Pell, 2006), turn-taking (Klonoff et al. 1990), and figurative language (Lundgren, Brownell, Cayer-Meade, Milione, & Kearns, 2010) are among the well documented deficits that can affect use of implicit avenues of gathering information. Impairment in the acquisition of information, when communicating, regardless of how explicit or implicit, can result in diminished understanding when considering the intent of communication partners. Lack of implicit avenues for gathering information, in some people with RHD, suggests that perhaps more explicit avenues of gathering information may be beneficial as a compensatory strategy for enhancing perceived pragmatic competence.

Pragmatic Communication and Questions

Effective pragmatic communication necessitates the gathering and use of information. Some avenues for the gathering of information include personal history with a communication partner, perceived purpose of communication, interpretation of gestures, and use of questions. Questions are the most explicit avenue of information gathering. The pragmatic function of questions depends on the social context (Freed, 1994; Hayashi, 2010; Kearsley, 1976; Stivers, 2010; see Figure 1). Questions may be used to initiate a conversation or a joke, facilitate a debate, elicit novel information, persuade, promote a particular action, and demonstrate interest or knowledge. When questions are not appropriately used but are expected in communicative exchanges, perceived pragmatic inappropriateness or incompetence may result. For example, it is perceived as insensitive or self-centered if a friend does not ask questions about you during a communicative exchange.

Information gathering questions are necessary to elicit information that may not be inferred or retrieved through shared knowledge (Flammer, 1981), facial expressions, or prosodic cues. According to Freed's (1994) taxonomy of question function, information gathering questions can elicit four broad classes of knowledge based on the information sought and conveyed (see Figure 1). These classes include (1) external questions: questions that elicit factual and novel information; (2) talk questions: questions that seek information about the conversation; (3) relational questions: questions that seek unconstrained information about the relationships (e.g. social or communicative) between the speaker and listener; and (4) expressive style: questions that convey information rather than request information.

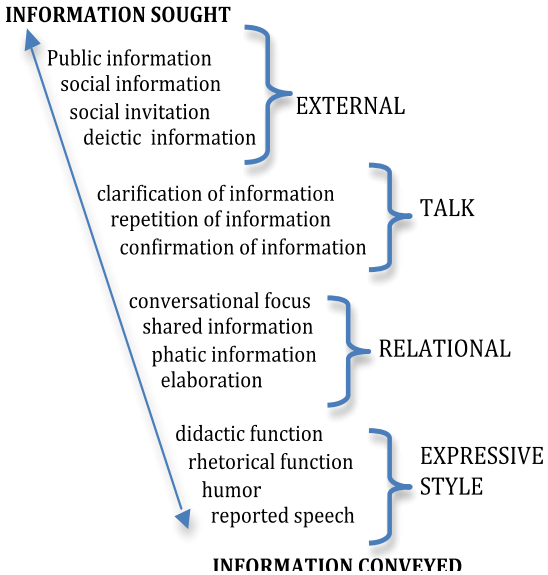


Figure 1. Taxonomy of Question Functions (Freed, 1994)

Based on this taxonomy, questions serve the social function of establishing shared or mutual knowledge, ensuring that a listener is following a line of thought, orienting the listener to the speaker's point of view (as in rhetorical questions), and creating humor (e.g. using a question to begin a joke). Information gathering questions may also serve to clarify information, elicit public or partner specific information, and request and confirm information (Boyd & Heritage, 2006; Freed, 1994; Stivers, 2010).

According to Stenstrom (1984) and Weber (1993), there are three types of questions that can be used to gather information: content questions (Q-word), polar questions, and alternative questions. Each type of question is dependent on the communicative context. Content (Q-word) questions contain the words what, when, who, where, why, or how as a function of specifying the type of information sought. For example, the question "where are you from?" presupposes that the speaker does not know where the addressee is from and that the speaker desires to know the particular location. Polar questions contain propositions that affirm, confirm, or disconfirm based on two potential answers. For example, when asked "Are you from New Jersey?" the answer is either 'yes' or 'no'. Polar questions may include tags (e.g., "So you enlisted in the army before you moved to New Jersey, right?"), or be declarative in form ("Aren't you a Mets fan?"). Alternative questions contain wording that serves to restrict the possible responses by proposing a closed set of answers within the question structure. This type of question is described in the literature as a question that combines both polar and content questions. There are two traditional forms of alternative questions: (a) *A or B* where the questioner provides a choice between two distinct propositions (e.g., "Did you attend UNC-Chapel Hill or Duke?") and (b) *A or not A* where the questioner presents choices that differ in truth value (e.g., "Are you a Tar heel fan or not?").

Although there are numerous studies examining the different types of questions, research focusing on the purpose of asking questions is limited (Stenstrom, 1984; Weber, 1993). Flammer (1981) proposed a theory for asking questions. Based on this theory, questions are produced in response to unknown, missing, or contradictory information desired by the speaker and that a listener is presumed to possess (Flammer, 1981; Stenstrom, 1984). For example, in a situation where a receptionist has stated a date/time for a follow-up appointment, the decision to use a polar (yes/no) question like, "Is my appointment on Tuesday, at 9 a.m.?" is better suited for the communicative situation than a content (q-word) question as in "When is my appointment?" Therefore, the decision to pose a question (i.e. the uncertainty about the date/time of an appointment) and the semantic structure (i.e. yes/no versus Q-word) is influenced by the available and desired knowledge (Kearsley, 1976).

Conversational analysts and linguists have examined the utility of questions and responses in conversation (Sacks, Schegloff, & Jefferson, 1974; Clark & Schaefer, 1987; Enfield, Stivers, & Levinson, 2010). Enfield and colleagues (2010) examined the design and use of question-response sequences in people without brain damage across a number of languages and countries. Question-response sequences were extracted from multiple videotaped corpora of natural dyadic and some multi-party conversations between familiar people in familiar surroundings. Results of this study indicate that Polar questions (questions soliciting a yes/no response) were dominant in the conversational exchanges of study participants. Specifically, participants used declarative questions (e.g. "you wanna do that?") 87% of the time. Declarative questions elicited information that the conversational partner was presumed to know (Stivers, 2010).

Questions related to prior conversations, objects, or events were phrased as "what" questions, while inquiries of personal states were "how" questions. Approximately 1/3 of the questions initiated in conversation were used for conversational repair (e.g. What? or Huh?) and 1/5 of the questions initiated were confirmation requests (e.g. So you're coming TONIGHT?).

Question Use in Populations with Pragmatic Communication Disorders

Research focusing on question use in people with pragmatic communication disorders is scant. Inquiries are limited to geriatric populations (Denney & Denney, 1973), people with frontal lobe damage (Klouda & Cooper, 1990; Marshall, Harvey, Freed, & Phillips, 1996; Upton & Thompson, 1999), and children with autism (Alderson-Day, 2012; Hurtig, Ensrud, and Tomblin, 1982; Kanner,1943).

Geriatric and Adults Frontal Lobe Damage

Studies exploring question use in these populations employ a 20-questions format (Denney & Denney, 1973; Klouda & Cooper, 1990; Marshall, Karow, Morelli, Iden, et al., 2003; Upton & Thompson, 1999). In this format, participants are asked to determine an examiner-identified target picture by asking questions, usually of the polar type. The task requires deductive reasoning based on categories and examiner feedback; thus, the primary aim of inquiry is to understand problem solving ability. Elicited polar questions are characterized as constraint seeking, pseudo-constraint seeking, or hypothesis scanning (also referred to as hypothesis seeking), terminology coined by (Mosher & Hornsby, 1966). Constraint-seeking questions are the most effective strategy and serve to eliminate two or more targets. For example, "Is it a living thing?" can eliminate half of the stimulus objects in a field where half of the objects are living. Pseudo-constraint seeking questions partially constrain the potential targets, but are specific to the features or characteristics of a single object. For example, "Does it meow?" is a pseudo-constraint seeking question specific to a house cat. Finally, hypothesis-seeking or scanning questions

(Denney and Denney, 1973) merely guess the identity of the object (e.g. Is it the cat?). In addition to identifying the proportion of each type of polar question, most studies calculate the total number of questions needed for task completion.

Some 20-questions experimental formats use an array of pictures to elicit questions (Alderson-Day, 2012; Denney & Denney, 1973), while others did not (Klouda & Cooper, 1990; Upton & Thompson, 1999). Denney & Denney (1973) examined question use in a group of 10 middle aged (ages 26-46 years) and 10 elderly (ages 75-90 years) women with no brain damage. Participants were closely matched for age and occupation. Forty-two pictures of common objects were used during task administration. Findings showed that participants that were middle aged used significantly more constraint-seeking questions than participants that were elderly. And participants that were elderly primarily used hypothesis-seeking questions. As a consequence, participants that were elderly required more questions to meet the goal of the task than participants that were middle aged.

Klouda & Cooper (1990) and Upton & Thompson (1999) examined question use following frontal lobe damage. Klouda & Cooper (1990) used a non-picture based 20 questions task in their investigation of information search strategies. In this approach, participants are provided with a verbal introduction and description of the 20-questions task. The statement, “I am thinking of an animal” is used to elicit questions, thus the context is reduced at the onset of the task. Participants were 5 participants with focal frontal lobe damage (age 49.8 years) and a 5 participant with no brain damage (age 47.6 years). Half of the questions used by participants with frontal lobe damage were constraint seeking while the other half were pseudo constraint seeking. Constraint-seeking questions were used 80% of the time by the control group. Participants with cortical frontal lobe damage used fewer constraint-seeking questions than participants with

subcortical frontal lobe damage. Participants with bilateral frontal lobe damage used constraint-seeking questions minimally, as compared to healthy controls.

Upton & Thompson (1999) duplicated Klouda & Cooper's study in a larger population. Participants were 88 epilepsy patients with damage to various frontal lobe loci (42 with left frontal, 32 with right frontal, and 14 with bifrontal frontal lobe damage), 57 participants with temporal lobe damage (31 with left temporal lobe damage and 26 with right temporal lobe damage), and 28 non-brain damaged participants. No significant differences were noted in sex, age, education, intellectual, or occupational history of group participants. Findings are consistent with Klouda & Cooper in that participants with bifrontal lobe damage produced more hypothesis seeking and pseudocontraint seeking questions than any other group and required more questions to complete the task than any other group. Non-brain damaged controls used constraint seeking questions more than participants with bifrontal lobe damage and right frontal lobe damage. It is suggested that participants with right frontal lobe damage were more impaired on the task than participants with left frontal lobe damage.

In 20-question tasks, polar questions are an avenue for reducing the potential targets by way of semantic deduction based on categorization. As mentioned, polar questions serve to affirm, confirm, or disconfirm information. Collectively, findings suggest that information seeking behaviors may be affected in both people that are elderly (Denney & Denney, 1973) and people with frontal lobe damage (Klouda & Cooper, 1990; Upton & Thompson, 1999). The use of constraint-seeking questions, an optimal strategy for the task, occurred less frequently than hypothesis-seeking questions in comparison to control groups for each population. While the utility of the 20-questions task is evident, little information is gained when polar questions are used for information seeking as compared to Q-word questions (e.g. who, what, when, where,

how, why) in dynamic communication. A limitation, then, to studies using 20-questions tasks is the emphasis on a single type of question with a dichotomous response—polar questions.

Children with Autism

Questions may serve illocutionary purposes outside of information gathering for some people with autism (Hurtig, Ensrud, and Tomblin, 1982; Kanner, 1943). In most children and adults with autism, questions are not used, used inappropriately, or used infrequently. Hurtig et al. (1982) explored the pragmatic function of questions in a group of six children with high functioning autism, 5-12 years of age, with a history of excessive questions use. The children were engaged in a dyadic four-choice response manipulation paradigm with an experimenter during play. In this paradigm, the experimenter responded either by providing only the information requested, the information requested and either new information or a question related to the topic, or a request that the child answers the question by restating it or saying, "Tell me." The children's responses to the experimenter were coded for appropriateness. Results show that 28% of the questions used did not serve the purpose of gathering information and that the children knew the answers to the questions posed 50% of the time suggesting that questions were not consistently posed to gather information. The investigators concluded that, in this small group of high-functioning children with autism, questions were used as a strategy for initiating and maintaining social contact rather than eliciting information.

In others with autism, questions are absent or used infrequently (Hurtig et al.,1982; Wetherby & Prutting, 1984). For these people, there have been focused efforts to enhance question use for gathering information, initiating, and maintaining a conversation (Doggett, Krasno, Koegel, Koegel, 2013; Koegel, Bradshaw, Ashbaugh, Koegel, 2014; Koegel, Camarata, & Valdez-Menchaca, Koegel; 1998; Koegel, Koegel, Green-Hopkins, Barnes & Armstrong, 2010; Palmen, Didden, & Arts, 2008; Shillingsburg, Valentino, Bowen, Bradley, & Zavatkay, 2011).

Generally, studies focus on the feasibility of acquiring the skills necessary to effectively request information using questions and the generalization of skills to conversation.

Teaching strategies have concentrated on a specific type of information seeking questions. Koegel et al (2010) conducted a multiple baseline investigation to assess the acquisition and use of "where is it?" in response to motivating stimuli. Three preschool children (3-4 years of age) with autism who possessed a verbal vocabulary of 50-200 or more words but no functional use of "where" were engaged in a hidden object and retrieval communication task. During this task, child preferred objects were hidden and participants were provided prompts with fading to use the target question. A significant increase in use of the trained question, "where is it?" was noted for all participants without prompts. Participants did not use the question prior to intervention but began to use the question, on average, 28 times per session for child 1, 40 times per session for child 2, and 33 times per session for child 3.

Other researchers have investigated the concurrent acquisition of multiple questions in conversation (Doggett et al., 2013; Koegel, Bradshaw, Ashbaugh, & Koegel, 2014; Palmen, Didden, Arts, 2008; Shillingsburg et al., 2011). Doggett et al (2013) used small group trainings to target the use of what, where, and who questions in the context of conversation during a self-management intervention. Participants were two elementary school age children (ages 7:6 and 9:10) with an average MLU of 5-6 words. Explicit explanations for the use of the target question types were provided at the onset of intervention. For example, the children were informed that "what" was used to ask about a thing. Trainers provided leading topic sentences to elicit each of the target questions. For example, "I went some where really fun last evening" was used to elicit "where." Written cue cards reminding the participants of when to use the target questions were provided during the training. Increased use of wh-questions was noted in both participants. Specifically, appropriate use of what, where, and who for participant 1 increased from 9-14% to

70-100% and from 50% to 76-100% for participant 2. Gains, for both participants, were maintained during conversations with a familiar adult.

Palmen et al. (2008) trained nine adolescents (ages 17-25 years) with autism to use questions. Each participant had the ability to speak in complete sentences and a history of diminished question use. In this study, group training (3 participants per group) included evaluation of simulated conversations and participation in conversational role-play. Each simulated conversation had three components (1) topic introduction, (2) use of a question by one participant, and (3) response to a question by another participant. Participants indicated the appropriateness of questions produced in response to a particular topic as either correct or incorrect. Trainers provided feedback in response to each evaluation. After hearing simulated conversations and gaining experience with determining the appropriateness of question types, participants were engaged in a game-like role-play exercise designed to elicit questions. Each participant was provided with a game-board with 50 boxes and pawns. The trainer initiated a topic with each group member followed by 5 seconds of silence to provide an opportunity for use of questions. When questions were used appropriately and other group members were correct in determining the appropriateness of the question produced, participants were permitted to advance a pawn on their game board. Results indicate a significant increase in the use of questions between baseline and intervention.

Improvements in question asking were noted for participants in each study with generalization of use in non-experimental environments (Koegel et al., 2013; Doggett et al., 2013; Palmen et al., 2008). Therefore, training people with autism in the appropriate use of questions may contribute to improved social communicative behaviors. Similar to people with RHD, the communication difficulties in people with autism are often pragmatic (Prizant,1982). For children

and young adults with autism, inappropriate question use contributes to delays in language development, knowledge acquisition, and social communicative competence, which can ultimately affect relationships.

Adults with RHD

It has been noted that the pragmatic characteristics of people with RHD may be similar to people with autism (Martin & McDonald, 2003; Ozonoff & Miller, 1996; Sabbagh, 1999). The basis for comparison may be due to shared areas of deficit. For example, just as in the behavior of people with RHD, some well documented pragmatic deficits in people with high-functioning autism include impaired topic maintenance (Simmons & Baltaxe, 1975; Hale & Tager-Flusberg, 2005), inappropriate turn-taking in conversation (Hurtig, Ensurd, Tomblin, 1982), an inability to understand non-literal language (Ozonoff & Miller, 1996; Van Bourgondien, & Mesibov, 1987), and diminished prosodic interpretation and use (McCann, Peppe, Gibbon, O'Hare, Rutherford, 2007) in the presence of preserved language. Despite the pragmatic similarities between people with high functioning autism and people with RHD, there is no known published research examining question use following RHD.

Failure to use questions to request information is one recognized pragmatic behavior in the conversations of people with RHD (Kennedy et al., 1994; Minga, Lundgren, Brownell, Cayer-Meade, 2008). In a case study, Minga et al. (2008) examined the contributions of a 60-year-old right-handed man during a pre and post treatment first-encounter conversation. The participant was six years post a right middle cerebral artery stroke with a high-school education and occupational history of a mechanic. The participant was enrolled in a Metaphor Training Program (MTP) (see Lundgren & Brownell, 2011 for specific treatment information) that focused on improving understanding of novel metaphors. As part of the protocol, the patient participated

in two first encounter conversations (Kennedy et al., 1994), a pre-training and a post-training, with a graduate student naive to the purpose of the study.

Each 20-minute first-encounter conversation was videotaped, either in a home or clinical setting, and transcribed using standard orthography for later analysis. Once transcribed, the middle ten minutes of the discourse sample was parsed into conversational turns by participant and then analyzed with a focus on the type of turn taking and more specifically, contribution to discourse by the participant. Each conversational turn was coded according to the specific contributions to the discourse topic. One intriguing outcome of this investigation was that the quantity of questions tripled after participation in treatment: Seven questions were produced before and 24 questions were produced after participation in the training despite this not being a focus of the training

Understanding the pragmatic communication problems present in some people with RHD can be difficult without first understanding the purpose of the conversation. Take the following sample from a conversation between a person with RHD and a non-brain damaged (NBD) communication partner:

> RHD: But the doctor giv- help me out with the people here at home.
> NBD: Mm-hm
> RHD: He told me look, this dog was bred to hunt ducks
> NBD: Mm-hm
> RHD: And any kind of fowl, ducks, and geese and at that time I don't know if you remember or not the geese were coming down from Canada

In this conversational excerpt, the participant was engaged in a first-encounter conversation. In this communicative context, questions can serve a number of purposes, but one explicit purpose of questions for first-encounter conversation is to gather information about the conversational partner. Asking questions contributes to achieving the designated goal of "getting

to know" another person. However, the person with RHD did not ask questions to "get to know" his conversation partner. Instead, the turns of talk were focused on topics that were not directly related to the conversational goal. Moreover, through a retrospective analysis of the questions produced by the RHD participant, Minga and Lundgren found that the questions posed did not always serve the function of gathering information. This observation gave impetus to further inquiry concerning question use in RHD.

In a follow-up study, Minga and Lundgren (2012 & 2013) examined the questions produced by three individuals with RHD and three individuals with no brain damage during a first-encounter conversation (Kennedy et al. 1994). Similar to Kennedy and colleagues' study, participants were given instructions to "get to know" their conversational partner. The middle ten minutes of the discourse sample were parsed into conversational turns. Next, the conversational turns were coded using the Discourse Contribution Measure, developed for this study (Minga, Lundgren, Brownell, Cayer-Meade, 2008). Question-response sequences were isolated from three first-encounter interactions. Utterances identified as questions elicited a response and/or possessed a morphosyntactic form that may elicit a response (Stenstrom, 1984). Each identified question was coded using the first eleven dimensions of Stivers & Enfield's coding scheme (2010), as seen in Table 1.

Findings of this analysis show that only 26% (9/35) of questions used by people with RHD were information seeking. This is compared to 69% (29/42) of information seeking questions produced by the conversational partners. Confirmation seeking questions were 37% (13/35). For example, questions like "On the on the fourth fourteenth floor?" and "It's the floor with the rugs on it?" appeared to be asked by the participant with RHD as a way of confirming that he and the conversational partner were talking about the same location.

Table 1.

Question-Response Dimensions

For All Question		*For Polar Questions*		*For Content Questions*	
1	Is the utterance formally a question?	5	Is the polar question marked with a 'turn-final element'?	9	What type of Q-word question is produced?
2	Does the question have lexical, morphological, or syntactic marking?	6	Is the polar question negatively marked?	10	Is the question functionally a question?
3	What is the logical semantic structure of the question?	7	Is the polar question dubitative ("maybe") marked		
4	Is the question a "through-produced" multi-question?	11	Is the polar question a declarative question?		
8	What social action is the question doing?				

Finally, 60% (21/35) of questions asked by people with RHD were polar questions often in declarative form (e.g., "You been to the ocean?"). Questions of the declarative form did not hold to the purpose of the conversation and seemed to serve a self-directed function of supporting a future utterance or topic selection. While the conversation partners produced a similar percentage of polar questions, 57% (24/42), the function was most often next-turn repair initiation. For example, "But he wrote on the card that you had had an epileptic seizure, no?" or "How old was he when you got him?" Observed differences in the type and function of questions following RHD compared to people without brain damage suggest the need for further exploration of question use following RHD.

The goal of a first-encounter conversation is to "get to know" an unfamiliar person. Typically, utterances produced during first-encounters are requests for specific information that fill gaps in knowledge as a basis for meeting the communicative goal (Athanasiadou, 1990; Freed, 1994). Some people with RHD, however, do not produce questions to gather information in structured "get to know you" tasks (Minga & Lundgren, 2013).

The reason for the disproportionate production of information gathering questions during the first encounter conversations is unclear; however, three potential contributors were suggested. First, people with RHD may lack the ability to formulate specific types of questions. That is, there may be a linguistic basis for diminished question use in conversation. Second, in the presence of intact formulation, people with RHD may lack the cognitive skills needed to initiate or appropriately use language to gather information. Decisions about what to say, when to say it, and for what purpose is determined, in part, by the information gathered from the communicative context and situation. Effective use of questions to gather information requires a host of cognitive capabilities including recognizing the need for information (Taylor, 1962), an ability to attend, interpret, and organize new information and recall information from the past (Kearsley, 1976). Thus, the cognitive areas associated with poor performance following RHD: attention, executive functioning, memory, and problem solving, (Cherney, Drimmer, & Halper, 1997; Moya et al., 1986; Tompkins, 1995) may mediate such capabilities. Consequently, some people with RHD may be devoid of the ability to process and integrate contextual-based nuances needed in communicative situations (Meyers, 1978). If there is deficiency in gathering and using information from the communicative context, this may result in language that is inappropriate.

Finally, deficits in the social-cognition may affect the use of explicit avenues of information gathering, like questions. Theory of mind (ToM) and empathy are two important and cooperative aspects of communication (Shamay-Tsoory, Tomer, Berger, Aharon-Peretz, 2003; Shamay-Tsoory, Tomer, Berger, Goldsher, & Aharon-Peretz, 2004) that contribute to gathering implicit information needed to understand others. Theory of mind is a term used to describe the ability to understand the thoughts and beliefs of another (Baron-Cohen, 1991; Decety & Lamm, 2007; Lundgren & Brownell, 2010). While theory of mind has a long-standing history in the field of psychology (Sellars, 1956), the contribution of theory of mind to the pragmatic communication

of disordered populations is less established (Wimmer & Perner, 1983 & Baron-Cohen, Leslie, and Frith, 1985). Associations have been made between ToM and pragmatic interpretation abilities (Winner, Brownell, Happe, Blum, Pincus, 1998; Lundgren & Brownell, 2010; Martin & McDonald, 2003), and discourse production (Champagne-Lavau & Joanette, 2009). Moreover, ToM has been postulated as an underlying contributor to pragmatic communication deficits (Martin & McDonald, 2003). While ToM deficits following RHD have received increasing attention by researchers (Griffin, Friedman, Ween, Winner, Happe, Brownell, 2006; Lundgren, Brownell, Cayer-Meade, Spitzer, 2007; Lundgren & Brownell, 2010; Siegal, Carrington, Radel, 1996; Tompkins, Scharp, Fassbinder, Meigh, & Armstrong, 2008; Weed, McGregor, Feldbaek, Roepstorff, & Frith, 2010), there are no known studies in the RHD literature investigating the effects of empathy on pragmatic communication. This is despite knowledge that the right hemisphere may mediate social and emotional processing (Adolphs, Damasio, Tranel, Damasio, 1996; Borod, 1992; Heilman, Bowers, Speedie, Coslett, 1984) and affective empathy, specifically (Leigh, Oishi, Hsu, Lindguist, Gottesman et al 2013).

Contributions of Empathy to Pragmatic Communication

Empathy is at the core of implicit information gathering and may contribute to emotional comprehension (Haxby, Hoffman & Gobinni, Haxby, Hoffman, et al. 2000) and establishing relationships (Pederson, 2008). Empathy is the ability to share the experiences, feelings, and emotions of another (Davis, 1983; Decety & Lamm, 2007; Singer, 2009) through reasoning, observation, memory, and knowledge (Ickes, 1997). Researchers have differentiated two facets of empathy: affective empathy and cognitive empathy. Cognitive empathy is conceptualized as an intellectual process that contributes to the ability to take another's perspective, and to

understand the thoughts, motivations, and feelings of another person (Davis, 1994). Affective empathy entails the capacity to emotionally identify, share, and appropriately respond to the feelings of another person (Hoffman, 2008).

Dependent relationships exist between cognitive and affective empathy. An understanding of the intentions and motivations of others, or perspective taking, is dependent on emotional perception (Levenson & Ruef, 1992). However, affective empathy is not dependent on understanding why the emotion is taking place (Rankin, Kramer, & Miller, 2005). For example, recognition of downward contoured lips coupled with the presence of a vocal tremor may indicate a change in emotional state. From an intellectual stance, a change is recognized. Identifying the features associated with changes in emotional state (e.g. vocal tremor, change in lip contour, and brows etc.) serve as an antecedent to understanding or at least presuming the feelings of the person. This in turn, may prompt the observer to use a particular type of question to request information, to confirm a hunch, or disaffirm the presumption that something is wrong and to respond appropriately to the situation. In this way, shared experiences and feelings foster empathetic behaviors (Decety & Lamm, 2007) that may reduce egocentric behavior and motivate person tailored behaviors (Davis, Conklin, Smith, & Luce, 1996).

The ability to understand (or at least acknowledge and relate to) the desires, intentions, beliefs, and feelings of another is needed for effective pragmatic interaction. Such understanding can be captured under the social-cognitive constructs of Theory of Mind (ToM) and Empathy. Failure to identify, understand, and respond appropriately to the emotions of another person may affect the appropriateness of language in communication. The lack of ability to process facial expression, body gesture, and prosody following RHD is well documented in the literature (Adolphs, Damasio, Tranel, Damasio, 1996; Borod, 1992; Heilman et al. 1984; Myers, 1994; Ross, 1981; Shamay-Tsoory et al. 2003) substantiating the right hemisphere as a mediator of

empathetic processing (Shamay-Tsoory, et al. 2005). However, there are no known studies in the right hemisphere literature that specifically examine the effects of social-cognition on question use.

Cognitive-Linguistic Contributions to Pragmatic Communication

Cognitive-linguistic deficits have been postulated as underlying contributors to pragmatic communication deficits following RHD (Martin & McDonald, 2003; Meyers, 1994; Tompkins, 1995; Tompkins, 2012). Attention (Heilman, Scholes, & Watson, 1975; Posner & Petersen, 1990), memory (Tompkins, Bloise, Timko, & Baumgaertner, 1994), visuospatial processing (Benowitz, Moya, Levine, 1990; McDonald, 2000), executive functioning (Bartels-Tobin & Hinckley, 2005; Champagne-Lavau & Joanette, 2009; Douglas, 2010) and Theory of Mind (Lundgren & Brownell, 2010; Martin & McDonald, 2003) are just a few of cognitive-linguistic skills affected by damage to the right hemisphere.

The literature suggests that cognitive-linguistic and pragmatic deficits can and do co-occur in some people with RHD. Notable associations have been documented in narrative discourse. For example, correlations between visuospatial processes and narrative recall (Benowitz et al.,1990) and visuospatial processes, attention, and narrative production (Bartels-Tobin & Hinckley, 2005) have been noted. Findings suggest that the recall and production of narratives may require the use of common cognitive-linguistic domains.

While there is evidence to suggest associations between cognitive-linguistic processes and procedural and narrative discourse, there are no published studies that have examined the influence of cognition on the use of questions following RHD. Cognitive-linguistic processes are essential to gathering the information needed to understand (or at least acknowledge and relating to) the desires, intentions, beliefs, and feelings of another during communication. This understanding, in turn, is needed for effective pragmatic interaction. Insight into the co-

occurrence of cognitive-linguistic and communication impairments following RHD is still evolving. There is a need to understand if associations exist between cognitive-linguistic processes that underlie aspects of pragmatic deficits following RHD (Martin & McDonald, 2003). Advancing this research agenda may lead to techniques to remediate one pragmatic aspect of conversation, question use, following RHD.

Statement of the Purpose

Decades of research have focused on comprehension deficits following RHD. However, pragmatic communication deficits and more specifically, the contribution of the right hemisphere to the production of appropriate language in conversation have been examined minimally. While comprehension focused research provides a solid foundation for exploring and understanding communication breakdowns following RHD, more research is warranted to increase knowledge of communication breakdown related to conversational skills. Many of the communication deficits observed in people with RHD have been defined as pragmatic. Deficits in pragmatic skills may include reduced ability to initiate and maintain eye contact, impaired turn-taking, and reduced perspective taking.

An unexplored aspect of communication following RHD is language production, more specifically question formation and use. Such processes are important in effective pragmatic communication. Question use has many functions in conversation. One function is to gather information. An inability to appropriately use questions may contribute to some people with RHD being perceived as insensitive and egocentric, and may diminish understanding of reasons for performing therapeutic tasks and compensatory strategies, a pivotal component of rehabilitation engagement. Impaired question use may also affect social relationships in all aspects of life including personal, social, rehabilitative, and vocational.

Following RHD, strategic use of explicit avenues of information gathering, like asking questions, may be particularly beneficial in acquiring information, especially if one has difficulty gathering information from other pragmatic channels like facial expressions, gestures, and prosody. Understanding whether and in what ways people with RHD use questions for gathering information may be beneficial for expanding knowledge of communication deficits in this population. Moreover, gaining insight into underlying causes for differences in question use, if they exist, can contribute to strengthening theories postulated to account for pragmatic deficits following RHD.

Specific Aims & Research Questions

The primary aim of this investigation was to determine if and in what ways the use of questions by people with RHD differs from those without brain damage. Two studies were conducted to achieve these goals: Study 1 was a survey designed to identify pictured objects that could be used for Study 2 and to assess the types of questions non-brain damaged participants produced when an object was unfamiliar. Study 2 was designed to assess question use during structured tasks, compare the question use of a RHD group to a non-brain damaged (NBD) group, and assess potential cognitive-linguistic contributions to questions asking.

Study 1

Question # 1: *What unfamiliar pictured objects do responders rate as unfamiliar?*

Hypothesis 1: All stimulus items will be rated as unfamiliar.

Questions #2: *When a pictured object is rated as unfamiliar, does the participant generate a range of questions that could aid in increasing knowledge of the object's purpose?*

Hypothesis 2: Participants will generate information-seeking questions in at least four categories for all pictured objects rated as unfamiliar.

Study 2

Question # 1: *Is the distribution of questions within linguistic categories different between the two groups during the Question Production Discourse tasks?*

Hypothesis 3: The distribution between content, polar, and alternative questions is different between the two groups.

Hypothesis 4: Mean differences will not be maintained across condition. Specifically, people with RHD will produce questions differently during the hypothetical unfamiliar condition as compared to the familiar condition.

Questions #2: *Is the number of questions within specific categories different between groups during the Unfamiliar Object task?*

Hypothesis 5: Group differences will exist in the quality and quantity of questions produced for unfamiliar objects based on mean. Specifically, participants with RHD will produce fewer questions for each object and more polar and alternative questions than Q-word questions.

Question #3: *Do mean standard scores differ between the two groups on the DKEFS 20-Question task?*

Hypothesis 6: Mean standard scores will differ based on group membership.

Questions #4*: Is there a relationship between the question type and CLQT cognitive domain scores for participants with RHD?*

Hypothesis 7: Relationships will exist.

Question #5*: Is there a relationship between the question type and empathy score for participants with RHD?*

Hypothesis 8: Relationships will exist.

CHAPTER III

METHOD

Two studies were conducted to test the stated hypotheses. A survey design was employed for Study 1, the Object Familiarity Rating Study. In this study, the independent variables were the objects presented for the familiarity judgment. The levels of the independent variables were the familiarity ratings: familiar and unfamiliar. The dependent variables were the ratings assigned to each object and the type of questions produced in response to an unfamiliar object. In Study 2, the Question Production Study, a between-subjects descriptive research design was used. The independent variable was brain damage designation: right hemisphere brain damage or no brain damage. The dependent variables were the quantity and quality of questions produced during the QPB and mean group score for each cognitive domain on the Cognitive-Linguistic Quick Test, the mean group score on the Toronto Empathy Questionnaire, and the mean group score on the DKEFS 20- Questions Task.

Participants

After obtaining approval from the University of North Carolina at Greensboro (UNCG) Institutional Review Board (IRB), permission to post and distribute flyers was obtained from administrators, support group directors, and clergy in the community. Eligibility for participation in the studies was determined after completion of a brief screen. For Study 1, participant eligibility was established as part of the survey. If eligibility requirements were met, participants consented and completed the survey. For Study 2, a brief telephone eligibility screen was provided. If eligibility requirements were met during the phone screen, a study session was scheduled. All participant consents were in accordance with the UNCG IRB.

Study 1

Participants were 20 people who met the following inclusion criteria by self-report: (1) 40-65 years of age, (2) native speakers of American English; (3) obtained a high school diploma or equivalent; (4) normal to corrected vision; (5) no history of developmental or learning disorder; and (6) no history of neurologic or psychological impairment.

Study 2

Participants were recruited from hospitals, rehabilitative settings, churches, community centers, and support groups in North Carolina, Virginia, Georgia, and South Carolina. Twenty-three people (11 with right hemisphere brain damage [RHD] and 12 with no brain damage [NBD]) consented to participate in this study. All participants were compensated for their participation.

Participants with RHD sustained a single stroke to the right hemisphere at least six months prior to study enrollment as evidenced by a neurological imaging report. Six participants were female and 5 participants were male. Participants with RHD were between 45-64 years of age (M = 52.8, SD = 5.5) with an average of 5.9 years post stroke. Seven of the participants with RHD reported obtaining an undergraduate degree and 4 reported obtaining a graduate degree. Participants with NBD had no history of traumatic brain injury, stroke, neurological impairment, substance abuse, psychological disorder, psychiatric disorder, or intellectual deficits by self-report. Eleven of the participants were females and 1 participant was a male. Participants with NBD were between 41-61 years of age (M = 51.2, SD = 6.9). Eight of the participants reported obtaining a graduate degree and 4 participants reported obtaining an undergraduate degree. Demographic information for all participants is presented in Table 2.

Table 2.

Participant Details for Question Production Study

	RHD						NBD				
ID	Age	Sex	Education	Lesion Site	Yrs. Post	Race	ID	Age	Sex	Education	Race
101	51	F	UG	Internal Capsule	10	White	102	41	F	UG	Black
104	56	F	UG	Intraparenchymal	3	Black	103	51	F	UG	White
109	50	F	GRAD	Frontoparietal & Lateral Basal Ganglia	3	Black	105	45	M	GRAD	Black
110	51	M	UG	ICA	5	White	106	60	F	GRAD	Black
113	52	F	GRAD	Frontoparietal & Temporal	5	White	107	60	F	UG	White
115	45	F	UG	ICA & MCA	4	White	108	53	F	GRAD	White
116	46	M	UG	MCA	2	White	111	52	F	UG	Black
117	61	M	UG	MCA	8	White	112	46	F	GRAD	White
119	50	M	GRAD	MCA	5	White	114	48	F	GRAD	White
120	55	F	GRAD	ICA	15	White	118	46	F	GRAD	Black
122	64	M	UG	MCA	5	White	123	63	F	GRAD	White
							124	51	F	GRAD	Black

Gender: M=Male, F=Female; Education: UG=Undergraduate, GRAD=Graduate or Advanced Degree; Group: 1=RHD, 2=NBD; ICA=Inter Carotid Artery; MCA= Middle Cerebral Artery

Materials

Study 1

A survey was developed to identify a group of unfamiliar pictured objects that could be used for Study 2 and to assess the types of questions used to increase one's familiarity with the items. It was developed in six stages: (1) an eligibility screen was created, (2) potential stimuli were gathered, (3) a working set of potential stimuli was established, (4) feedback from a group of American Speech-language and Hearing Association (ASHA) certified speech-language pathologists was obtained, (5) stimulus items were finalized, and (6) the final survey was designed.

Eligibility questions were designed to target participants with NBD between 40-65 years of age with normal to corrected vision and hearing and at least a high-school diploma. The eligibility screen contained 5 questions soliciting the following information: age range, gender, highest level of education, hearing, vision, psychological, and intellectual history. Display logic was used to eliminate respondents that did not meet the eligibility criteria. Next, stimulus items (i.e. pictured objects) were gathered through a garden and home gadget image search on the internet. Two types of stimulus items were obtained: unfamiliar pictured objects and familiar pictured objects. Unfamiliar pictured objects were included in a working set of stimulus items if two criteria as determined by the PI: (1) the item had a unique look, and (2) the item served an everyday purpose (e.g. slicing bananas). Familiar pictured objects were 9 items (e.g. comb: see APPENDIX B) randomly placed amongst unfamiliar pictured objects to obscure the primary variables of interest. A working set of pictured objects was created. Selected pictured objects were copied and pasted into the survey software. Question prompts were provided to elicit ratings, for each object, and questions, if the object was rated 4 or 5. The final survey consisted of two sections: (1) an eligibility screen and (2) the Object Familiarity Rating Survey (see

APPENDIX C). The Object Familiarity Rating Survey consisted of 19 pictured objects, 10 of which were the unfamiliar pictured objects. Four ASHA certified speech-language pathologists took the survey and provided feedback with respect to the objects and overall survey format prior to survey distribution. Changes were made to the survey based on their feedback.

Study 2

After consenting to participate in this study (UNCG IRB # 13-0039), screening measures were administered to confirm eligibility requirements reported during initial telephone screen. Screening measures included: (1) a pure-tone hearing screen, (2) a vision screen, and (3) the Edinburgh Handedness Screen (Oldfield, R.C., 1971).

The pure-tone hearing screen and vision screen were used to ensure that each participant had intact hearing and normal to corrected vision. For the hearing screen, an audiometer was used to present pure tones at an intensity of 25db to each ear at three different frequencies: 1000, 2000, and 4000. Scoring consisted of indicating whether the participant heard the tone using +/- on the scoring form. Vision was assessed using a revised Snellen Chart. Participants were asked to read the smallest row of text visible. An acuity rating was determined by the smallest visible row of text.

The Edinburgh Handedness Inventory is a quantitative measure used to assess hand dominance in daily activities. It is a 10-item self-report inventory requesting the hand preference for daily activities using a single (+) in either a column labeled ‘right hand’ or ‘left hand’. In instances where there is a strong preference for one hand over the other, a double (+) may be used. Dividing the difference between ticks in the right hand column and left hand columns by the total tick and multiplying by 100 results in a laterality quotient. A quotient > 40 indicate right hand dominance.

If participants passed the screenings, assessment measures were administered. Assessment measures included the (1) Toronto Empathy Questionnaire (TEQ; Spreng et al., 2009), (2) Cognitive-Linguistic Quick Test (CLQT; Helm-Estabrooks, 2001), and (3) Question Production Battery (QPB).

The Toronto Empathy Questionnaire (TEQ; Spreng et al., 2009), a 16-item self-report questionnaire, was administered to assess emotional empathy. It examines a number of attributes commonly associated with empathy including perception of emotional state, altruism, helping behaviors, and sympathy. Scoring is conducted on a five-point likert scale, where some questions are scored on an inverse scale. That is, a question rated as '1' by a participant may be scored as a '5' in the calculation of an empathy score. This measure was selected because of the high internal consistency, internal validity, and strong convergent validity (Spreng et al. 2009) and administration time. The TEQ administration time is appropriate for people who may be sensitive to extended testing time and fatigue that may result from lengthier measures (Spreng et al., 2009). Researchers examining social cognitive disorders and right hemisphere function have used this measure (Cusi, MacQueen, Spreng, & McKinnon, 2011).

The Cognitive-Linguistic Quick Test (CLQT; Helm-Estabrooks, 2001) was designed to assess five cognitive domains: attention, executive function, memory, language, and visual spatial skills. These cognitive domains are assessed using 10 tasks. For each task, a stratified score is used to obtain a severity rating (e.g. normal, moderate, or severe) across each of the five cognitive domains. The CLQT is a criterion-referenced screening measure with an administration time of 15-30 minutes. This tool has been used as a cognitive measure in studies examining language cognition and social skills in populations of individuals with right hemisphere brain damaged (Bartels-Tobin & Hinckley, 2005; Lundgren et al., 2011; Turkeltaub, Coslett, Thomas, and Faseyitan, 2012).

Finally, the Question Production Battery (QPB), designed for this study, was administered. The QPB consists of 3 different types of tasks used to elicit information seeking questions: (1) a Question Production Discourse Task (Condition 1 and Condition 2), (2) an Unfamiliar Object Task, and (3) the 20-Questions Task, a subtest of the Delis-Kaplan Executive Function System (D-KEFS, Delis, Kaplan, &Kramer, 2001). An iPad 2 with a 9.5 x 7.31 inch screen was used to present the pdf formatted pictured objects or text during the Question Production Discourse Task and the Unfamiliar Object Task. For all tasks, the iPad was placed on a table in the participant's central field of vision. Pictured objects in pdf files were accessed through the Bookshelf app, an app that allows access to pdf formatted documents on an iPad.

The Question Production Discourse Task was administered under two conditions: Condition 1 and Condition 2. In Condition 1 (familiar person), participants were asked to pose at least 10 questions that they might ask to get to know either Michael Jordan or Oprah Winfrey. A 7x8 headshot of the selected celebrity was presented on an iPad 2. In Condition 2 (unfamiliar person), participants were asked to pose at least 10 questions that they might ask to get to know a hypothetical person during a meeting for the first time. The text 'unfamiliar person' was presented in 48 Cambria font on an iPad 2. In the Unfamiliar Object Task, participants were shown color images of 9 unfamiliar pictured objects (see APPENDIX A) and 9 familiar pictured objects (see APPENDIX B). Images were enlarged to 7x7, cropped, and saved as a pdf file. Participants were instructed to generate 10 questions that they might ask to determine the purpose each object.

Question produced in each task were recorded, transcribed, and then analyzed using a modified subset of Stivers and Enfield's 24-dimension Question-Response Coding Scheme. Although this coding scheme was designed for dyadic and multi-participant interaction, the first 11 dimensions are specific to question typology, as seen in APPENDIX D. This feature made the coding scheme particularly relevant to the purposes of this study. Each dimension is in the form

of a question and consists of either binary variables (e.g. yes/no) or categorical variables (e.g. who, what, where) with rating scales ranging from 0 to 9. For example, dimension 1 asks, "Is the question formally a question?" Coding responses are '0' for no and '1' for yes. One modification was made to this coding scheme to account for the type of data produced by participants with RHD. Specifically, a code of 'other' was added to the third dimension, "What is the semantic structure of the question?"

The purpose of the DKEFS 20-Questions Task is to measure categorical processing and the ability to formulate abstract yes/no questions with examiner feedback. Participants were presented with a 5x6 page in a spiral notebook filled with 30 color drawings of common objects subsumed into various categories and subcategories. Categories include living things, animals, and birds. Standardized instructions request that participants ask the fewest number of yes and no questions needed to identify a target. Therefore, appropriate category identification can assist in reducing the field of common objects and questions needed to identify the target. This task has clinical utility in populations of individuals with brain damage or brain differences including autism spectrum disorder and traumatic brain injury.

Procedure

Study 1

Adults with no reported brain damage (NBD) were asked to complete a familiarity judgment and question production survey. This study was conducted to meet two objectives. The first objective was to determine how familiar participants are with a group of pictured objects. The second objective was to assess the specific types of questions produced when a pictured object was rated as unfamiliar.

Interested participants were provided with a brief summary of the research, the study rationale, and a link to access the online survey. After accessing the survey, participants

completed an eligibility screening. When participants selected criteria that did not meet eligibility requirements, they were directed to the end of the survey, participation was terminated, and a statement of gratitude was provided. Specifically, after termination the following text was presented, "We thank you for your time spent taking this survey. Your response has been recorded." If, however, eligibility criteria were met, participants were asked to consent to participate in the study. After consenting, participants were directed to the survey instructions, as seen in Table 3. Participants were asked to rate their familiarity with 9 unfamiliar pictured objects and 10 familiar pictured objects using a 5-point Likert scale (Likert, 1932).

Table 3.

Instructions for Study 1

The purpose of this task is to determine how familiar you are with a number of objects and what types of questions you could ask to determine the use of the objects. Some of the objects will look very familiar, while others may not. Each object will appear at the top of the monitor. Below each gadget you will find a 5-point scale with the labels 'unfamiliar' and 'familiar'. As you can see on the scale 1=unfamiliar, while 5=familiar. *(image of pictured object item here)* 1 2 3 4 5 Unfamiliar Familiar If the object is unfamiliar, then you would choose a rating somewhere on the left side of the scale. If the object is familiar, then you would choose a rating on the right side of the scale. If an object is neither unfamiliar no familiar, then you would choose a rating towards the middle of the scale. To make your judgments you will click the [box or circle] below the number. There are no or wrong answers for this task.

Each participant completed a total of 19 familiarity ratings for pictured objects. A 1-point rating indicated that the participant was unfamiliar with the pictured object, while a 5-point rating indicated that the participant was familiar. When ratings of 1 or 2 were assigned to a pictured object, participants were asked to generate two questions that they might ask to determine the purpose of the item (see APPENDIX G). A rating of 4 or 5 was followed by a request that participants identify the purpose of the object.

Data Preparation

For each pictured object, the mean group rating and standard deviation were calculated. Questions produced in reference to each pictured object rated as unfamiliar were copied and pasted into an excel document. Each question was then coded using the content (Q-word) dimension, which is dimension 9 of Stivers and Enfield's Question-response Coding Scheme. In dimension 9, Q-word questions are coded as one of 8 question subtypes based on semantic grounds. That is, the type of information elicited by the Q-word questions determined the category placement. For example, a Q-word question such as "Would this object be useful for a specific job type or career?" was coded as a "who" Q-word question.

The PI and three ASHA certified speech-language pathologists (Coder 1, Coder 2, and Coder 3) coded 100% of the questions produced for the three objects rated most unfamiliar. The PI coded questions produced for the remaining 6 objects. Inter-rater reliability was calculated by dividing the total agreements by the sum of agreements and disagreements and then multiplying by 100. Unfamiliar pictured objects were considered for inclusion in the question production task of Study 2 when two criteria were met when: (1) a mean rating within the criterion range of > 1 and < 2.5; and (2) elicit Q-word questions in at least 4 of the 8 categories.

Study 2

A participant identification number (PIN) and order was randomly assigned to participants as they met inclusion criteria. An odd identification number was assigned to Order 1, while an even numbers were assigned to Order 2 (see APPENDIX E). The assigned order served to determine the administration sequence of the Question Production Battery (QPB). Two pdf files were created: one for Order 1 and another for Order 2. Administration of the informed consent, screening measures, scales, and cognitive-linguistic assessment was standard for all participants regardless of the order.

Vision and pure-tone hearing screens and an assessment were administered. A vision screen was conducted using a Snellen chart that was held at a distance of 9 feet from the participant's seat. Participants were then asked to read the smallest line visible, corrected or uncorrected. Following the vision screen, participants were asked to listen for and indicate when they heard tones presented at 25db to both ears at three different frequencies: 1,000 Hz, 2,000 Hz, and 4000 Hz. Acuity and hearing status were documented on the participant questionnaire. Next, participants completed the Edinburgh Handedness Screen. If screens confirmed eligibility requirements, participants were then asked to complete the Toronto Empathy Questionnaire. Verbal instructions for completing each were given by the PI and the same instructions were printed at the top of each questionnaire. Finally, the Cognitive-Linguistic Quick Test was administered following the standard protocol.

A brief description of the study tasks was provided (see Table 4.) after screening and assessing each participant. All participants were asked to complete the Question Production Battery (QPB) consisting of three tasks: (1) the Question Production Discourse Task (Condition 1 and Condition 2), (2) an Unfamiliar Object Task, and (3) the DKEFS 20 Questions Task. An iPad

was provided with a page for each task. Each page was consistent with task order and had either a printed text describing the task or images of pictured objects (see APPENDIX F).

Table 4.

General Instructions for Question Production Tasks

This experiment is designed to understand how people use questions to gather information in a short period of time. I'd like you to participate in four tasks of gathering information. You will have to ask questions to finish each task. I will provide specific instructions for each task. It will take about an hour to complete all of the tasks. If at any point you do not wish to continue, please let me know. A video recorder will be used. Do you have any questions? Let's begin.

Data Preparation

Standard scoring procedures were used for the screening measures, CLQT, TEQ, and DKEFS 20-Questions Task. Scores were tabulated and placed in a spreadsheet for later analysis. Questions produced during the QPB were transcribed orthographically in a word document named as the assigned PIN. An excel document was created to compile all questions produced. Tabs were created to correspond with each task, group, and condition, when applicable. The Question Production Discourse Task tabs were labeled QPDunf and QPDfam, while the Unfamiliar Object Tasks was labeled UnfOb. An extension denoting group membership (NBD or RHD) was added to each tab to distinguish the questions produced by participants with RHD and participants with NBD. For example, questions produced by the RHD group and NBD group during the familiar condition of the Question Production Discourse Task were labeled, QPDRHD and QPDNBD, respectively. The top row of each spreadsheet was divided into 14-15 columns. Each column was labeled as follows: PIN, Question, Q1-Q11, to parallel with the 11 coding scheme dimensions,

Order, and Object, for the UnfOb task. For the QPB, participants were responding to a single request for information, whereas in the UnfOb task, each participant produced questions in response to 9 different objects. Transcribed questions from the QPB were copied and pasted into the excel document, under a column labeled 'question,' in the tab corresponding to the task during which the questions were produced.

The PI coded 100% of the transcripts. Coder 1 and Coder 2 served as raters for half of the data set. Raters were blind to group inclusion. An introduction to the coding scheme was provided during a 1:1 meeting with the PI. During this meeting, each coder was provided with an article describing the coding scheme and an excel document with half of the data set. Step-by-step description of each coding dimension was provided. The coder was also asked to rate 2 sample questions pulled from data not included in the coder's partial data set. Consistency with the rating of the PI signified an understanding of the coding scheme. Coders were permitted to ask questions of clarification concerning the coding scheme. Independent coding of each set of data was completed within 2 weeks of training. Both coders indicated that the coding scheme was "straight-forward." Inter-rater reliability was calculated by dividing the total agreements by the sum of agreements and disagreements and then multiplying by 100.

CHAPTER IV

RESULTS

The aim of this investigation was to determine if people with damage in the right hemisphere of the brain use questions differently than people with no history of brain damage. To this end, questions produced during structured tasks by a group of people with RHD and a group of people with NBD was examined. This chapter is divided into two sections, Study 1 and Study 2, which parallel with the studies conducted to address the aim of the investigation. Analysis of participant demographics and results, as they pertain to the specific research questions, are presented sequentially.

Study 1: Object Familiarity Ratings

Participant Demographics

The aim of Study 1 was to identify a set of unfamiliar pictured objects that would generate a range of content (Q-word) questions when presented in picture format. Twenty people completed the survey. Of the respondents, fifteen were women. The educational achievement of participants varied from high school graduates to graduate education. Collectively, all participants were 40-65 years of age with at least a high-school diploma or some college education. The distribution of participant education level is provided in Figure 2.

Object Familiarity Ratings

Pictured objects were selected for inclusion in the Question Production Battery (QPB) when two criteria were met: (1) a mean rating within the criterion range of > 1 and < 2.5 was obtained on the Object Familiarity Rating Survey; and (2) a range of information seeking questions was generated in response to an identified unfamiliar pictured object. Survey data were

analyzed to determine the mean familiarity rating of each of the 9 pictured objects. It was hypothesized that all of the pictured objects would be rated as unfamiliar with a rating of < 2.5. This hypothesis was substantiated. Unfamiliar pictured objects 3, 8, and 10 were rated most unfamiliar with ratings of 1.3, 1.39, and 1.67, respectively. All familiar pictured objects were rated $\geq$ 4 and their purpose identified with 100% accuracy by all participants (see Table 5.).

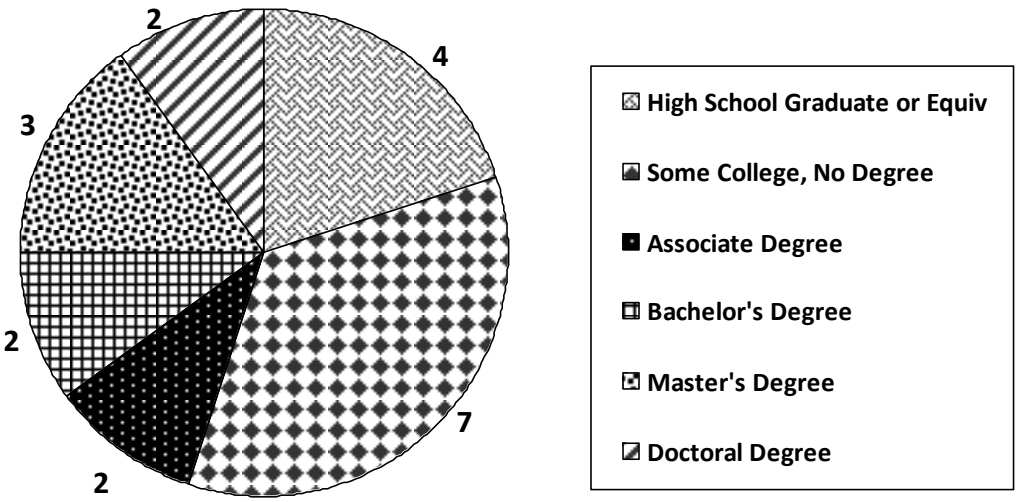


Figure 2. Degrees Represented in Survey Respondent Pool (Raw Data)

Table 5.

Mean Familiarity Ratings of Unfamiliar Pictured Objects and Purpose

	Object 1	Object 2	Object 3	Object 4	Object 5	Object 6	Object 7	Object 8	Object 9	Object 10
Mean Rating (SD)	1.9(1.45)	1.76(1.19)	1.67	1.85(1.31)	1.89(1.33)	1.9(1.41)	2.47(1.74)	1.39(1.06)	1.76 (1.03)	1.3
Purpose	pick up popcorn	slice bananas	organize computer cables	removes core from cupcake	removes corn from cobb	measure portions for 1-4 servings	remove corn from cobb	Mount ipad or iphone	add moisture to room air	Provide cushion while kneeling in the garden

Table 6.

Mean Familiarity Ratings of Familiar Pictured Objects

	Object 11	Object 12	Object 13	Object 14	Object 15	Object 16	Object 17	Object 18	Object 19
Mean Rating (SD)	4.11(1.57)	4.65 (.70)	4.82(.73)	4.9 (.31)	5.0 (0.0)	5.0 (0.0)	5.0 (0.0)	5.0 (0.0)	5.0 (0.0)

Question Production Analysis

An analysis of the questions produced in association with each of the unfamiliar pictured objects was conducted. All questions were categorized using six broad question types: (1) what, (2) how (explicit), (3) who, (4) when, (5) where, and (6) why in accordance with the third dimension of Stivers and Enfield's question-response coding scheme. Coding was based on semantic grounds. That is, the type of information elicited by the question determined the category placement. For example, the question "What profession would use it most often?" was categorized as a "who" question. The PI coded 100% of the questions and three ASHA certified speech-language pathologist coded 100% of the questions produced for the three objects rated most unfamiliar. Inter-rater reliability for placing questions into the appropriate category type was 91%.

It was hypothesized that participants would produce a range of content (Q-word) questions to determine the purpose of unfamiliar pictured objects. As seen in Table 6., each of the unfamiliar pictured objects elicited a variety of questions. For each item, questions were generated for at least four of the six categories. Questions categorized as "what" and "why" whereas the fewer questions were categories as "when" and "where." The most frequent question across objects was "what is it?" Questions produced for each object are in APPENDIX G.

Stimulus Preparation

Pictured objects rated as unfamiliar were enlarged to 7x8 size to display a full-screen view on an ipad during Study 2 task completion. Although ten pictured objects were chosen for this task, unfamiliar pictured object 1 became distorted when the image was enlarged. The distortion was such that this item was removed from the stimulus pool. A total of 9 items were selected and used during the Unfamiliar Object Task of Study 2.

Table 7.

Q-word Questions Produced for Unfamiliar Pictured Objects (Raw Data)

Stivers' Content (Q-word) question coding	Object 1	Object 2	Object 3	Object 4	Object 5	Object 6	Object 7	Object 8	Object 9	Object 10
WHAT (explicit)	7	7	7	10	11	10	6	7	8	7
HOW (in what manner)	6	8	4	6	5	5	3	8	5	6
WHO (which person)	4	4	2	4	6	3	1	4	3	4
WHEN	0	2	2	0	0	1	0	2	3	0
WHERE (which place)	5	4	1	0	1	2	1	4	2	5
WHY (for what reason)	12	8	12	6	8	3	7	8	2	12
Total Questions	34	33	28	26	31	24	18	33	23	34

Notes. Each participant was asked to generate two questions, but not all complied with this request. There were also instances of compound questions. Thus, there is variation in the total number of questions produced for each pictured object.

Study 2: Question Production Discourse Battery (QPB)

Participant Demographics

The aim of Study 2 was to determine if and in what ways the use of questions by people with RHD is different from people with NBD during structured question production tasks. Twenty-four people (RHD, N=11; NBD, N =12) participated in this study. No significant age differences exist between the group of RHD participants (Group 1, *M* = 52.81, *SD* =1.66) and NBD participants (Group 2, *M* = 51.17, *SD* = 2.00, p = 0.532). The distribution of age by group in graph and Q-Q plot format is presented in Figure 3. Five participants from each group were assigned to Order 2, whereas 6 participants with RHD and 5 participants without brain damage were assigned to Order 1. Inter-rater reliability coding reached 98.9% for Coder 1 and 98.3% for Coder 2.

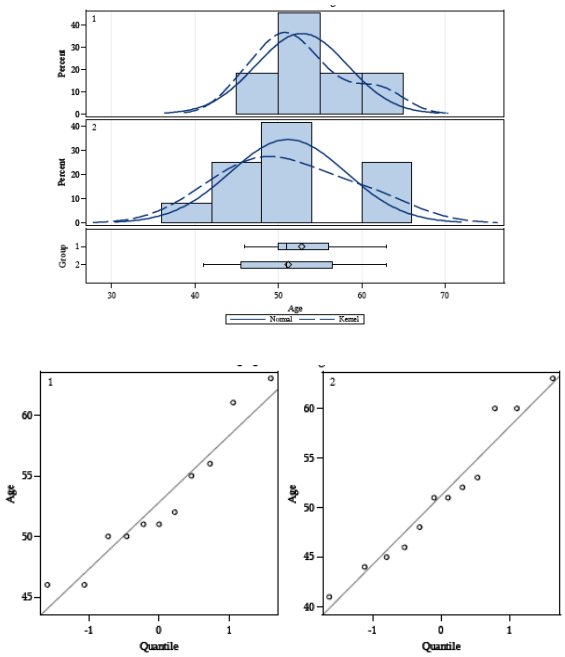


Figure 3. Frequency Distribution and Q-Q Plot of Age for Study 2 Participants. (in the left top corner) 1= RHD; 2 = NBD. There was no significant group difference in age Study 2 participants.

Question Production Discourse Tasks

Participants produced questions under two conditions: an unfamiliar condition and a familiar condition. In the unfamiliar condition, participants generated questions that they might ask to "get to know" a hypothetical person, whereas in the familiar condition, participants selected a familiar person to get to know: Michael Jordan or Oprah Winfrey. Both groups had a preference for getting to know Oprah Winfrey, X^2 (1, N = 237) = 41.6, $p < .01$. Group descriptive statistics are provided in APPENDIX I-L for each question type.

Distribution of Questions

It was hypothesized that group differences in the distribution of polar, content, and alternative questions and that these differences would not be maintained across conditions. Participants with RHD produced fewer questions (QPDunf = 117; QPDfam = 93) than participants with NBD (QPDunf=169; QPDfam = 144). Significant differences between groups in the use of polar, content, and alternative questions during the unfamiliar QPD condition, X^2 (3, N = 286) = 17.43, $p < .01$ and the familiar QPD condition X^2 (1, N = 237) = 19.89, $p < .01$) were apparent. In addition, there were differences between groups in the distribution of questions based on condition.

Polar Questions

The participants with RHD used fewer polar questions than participants with NBD in both conditions, as seen in Table 8. and APPENDICES I-L. Participants with RHD produced a larger proportion of polar question in the unfamiliar condition (25/117; M = 2.18, SD = 1.94) than the familiar condition (10/93; M = .91, SD = 1.22). Participants with NBD also produced a larger proportion of polar questions during the unfamiliar condition (71/169; M = 6, SD = 4.90) than the familiar condition (40/14; M = 3.33, SD = 3.34). There was no significant group difference in the

use of turn final elements, negatively marked, dubitative, or declarative polar questions. Thus, the data suggest that the overall semantic structure of the polar questions was equivalent across groups.

Content Questions

Content (Q-word) questions comprised the majority of the question sample for both conditions. Participants with RHD used content (Q-word) questions differently than participants with NBD in the unfamiliar condition, X^2 (7, N = 286) = 16.79, $p < .01$, but not in the familiar condition, X^2 (7, N = 237) = 3.35, p =.85. In the familiar condition, the question responses for both groups were categorized in each of the 7 content question types. Participants with RHD produced fewer content questions (M = 6.55, SD = 2.47) than participants without brain damage (M = 8.5, SD = 3.42). Questions categorized as what, where, why, and how were among the most used questions for both groups. While the distribution of questions was not as varied for participants with RHD during the unfamiliar condition, there was little mean difference in the quantity of total content questions used for task completion (RHD; M = 8.09, SD = 3.91 and NBD; M = 8, SD = 3.38). Questions used by participants with RHD in the unfamiliar condition were categorized as only four of eight types (see Table 7). Specifically, participants with RHD did not ask questions that were categorized as who, when, why, and how many/much in the unfamiliar condition. For both groups, what and where questions were used most frequently while who and when questions were used minimally.

Alternative Questions

Alternative questions were used by four participants with RHD: 101(3), 104 (1), 110 (1), and 119(3). In this subset of participants, the distribution of alternative questions use was equal for both the unfamiliar condition (M = .36, SD = .92) and the familiar condition (M = .36, SD = .92). This is compared to (1/169) alternative questions used by the NBD group in the unfamiliar

condition. The use of alternative questions by RHD participants in the unfamiliar condition was strongly correlated with the use of content questions, r(8)= .51, p < .05, and polar questions r(8) = .65, p , .05 in the familiar condition. There was also a modest correlation between the use of alternative questions and polar questions in the unfamiliar condition for participants with RHD, r(8) = .51, p < .10 (see Table 12).

Other Questions

In the familiar condition, participants with RHD produced more non-question responses than participants with NBD (see 'other' examples below). For example, one participant stated, "Tell me about the school you started in Africa." This type of response did not occur in the unfamiliar condition. Significant effects were noted in the use of through-produced questions in the familiar condition X^2 (1, N = 237) = 4.70, p =.03), as seen in Table 8. Through-produced questions are defined as two or more questions delivered in a single query. The group of participants with RHD used a total of 3 through-produced questions in the familiar condition as compared to the NBD group who did not produce any. This type of response did not occur in the unfamiliar condition for either group.

All question produced in the unfamiliar condition for both groups performed the social action of requesting information, as seen in Table 8. In the familiar condition, however, questions produced by participants with RHD met three social action criteria: requests for information (73.12%), other initiation repair (8.6 %), and other (18.28%). Questions characterized as "other" were requests for information that did not have a syntactic indicator of a question. Two examples of questions coded as "other":

1. Tell me about the school you started in South Africa.
2. Tell me about your religion and church you go to if you belong to one.

Table 8.

Frequency and p-values of Binary Dimensions for Question Production Discourse Tasks

	Conditions									
	Unfamiliar Condition					Familiar Condition				
Dimension	No (0)		Yes (1)			No (0)		Yes (1)		
	RHD	NBD	RHD	NBD	p-value	RHD	NBD	RHD	NBD	p-value
1	0	1	117	169	0.40	7	2	86	142	0.016*
2	0	1	117	169	0.40	6	2	87	142	0.04**
4	117	169	0	0	0.0005*	90	144	3	0	0.03**
10	0	1	117	168	0.40	9	2	84	142	0.003*

Note: *significant at <.01; ** significance at <.05

Table 9.

Frequency Distribution and p-values of Dimensions 3 & 9 for Question Production Discourse Tasks

		Conditions					
Dimension	Question Type	Unfamiliar			Familiar		
		RHD	NBD	p-value	RHD	NBD	p-value
3				0.0015*			0.0002*
	Polar	25	71		10	40	
	Content	89	96		72	102	
	Alternative	3	1		4	0	
	Other	0	1		7	2	
9				0.018*			0.851
	Who	3	1		6	6	
	What	50	50		29	41	
	Where	25	29		8	13	
	When	0	1		1	1	
	Why	0	3		9	13	
	How	10	3		17	22	
	How many/much	0	11		2	3	
	N/A	29	71		21	25	
	Total Questions	117	169		93	144	

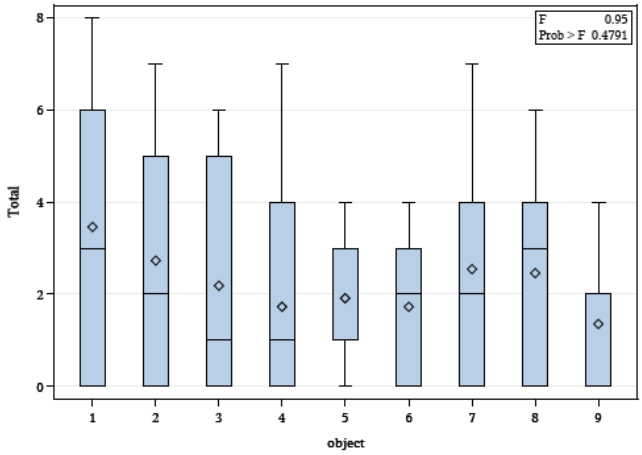
Note: * significant at $p < .01$

Unfamiliar Object Task

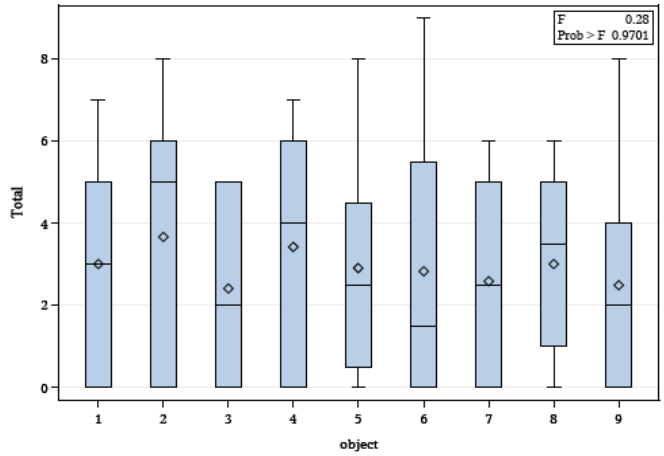
Nine unfamiliar pictured objects (see APPENDIX A) from Study 1 were used to elicit questions. Group variance is assumed to be unequal; therefore, a Satterthwaite approximation of each t-statistic is reported. Order 2 participants (5 with RHD and 5 with NBD) produced more questions (M = 7.45, SD = 3.43) than Order 1 participants (M = 9.05, SD = 3.71, t (199.56) = -.27, p = .79. Order 1 participants (6 with RHD and 5 with NBD) produced more polar questions (M = 5.38, SD =3.40) and alternative questions (M =1.13, SD = 0.1.79, t (123) = 4.21, p < .01) than Order 2 participants. No significant differences were noted in the use of content questions based on order, t (200.14) = -0.18, p = 0.85.

Distribution of Questions

As hypothesized, participants with RHD produced fewer questions, (M= 7.7, SD = 3.75, t (198.37) = -2.00, p = .04) and more alternative questions, t (114.3) = 6.17, p < .01, than participants with NBD (see Table 10, Table 11, and Figure 4). Contrary to the hypothesis, RHD participants produced fewer polar questions than participants with NBD, t (200.76) = -4.16, p < .01. There was a significant difference noted in the total number of content questions used, t (198.15) = -2.06, p = .04 and more specifically, in the use of questions coded as 'why,' t (159.26) = 2.13, p = .03. No significant differences were noted in the use of content questions, t (198.15) = -1.6, p = 0.11 (see Table 11). Across condition comparisons show that the use of alternative questions, in the unfamiliar condition, correlated with the use of content and polar questions in the familiar condition and the use of polar questions in the unfamiliar condition (see Table 12).



NBD



RHD

Figure 4. Total Questions Produced for Each Pictured Object

Table 10.

Average and Total Number of Questions Produced for Each Pictured Object by Group for Unfamiliar Object Task

		Object 2	Object 3	Object 4	Object 5	Object 6	Object 7	Object 8	Object 9	Object 10
RHD	Polar	3.91	3.64	4.45	3.74	3.64	3.55	4.36	5.00	4.91
N=99	Content	1.91	2.18	1.73	2.64	2.45	1.36	2.82	2.00	3.55
	Alternative	1.46	1.55	1.09	0.82	0.82	1.27	1.46	1.73	1.27
	Total	7.27	7.36	7.27	7.09	6.91	6.18	8.81	8.72	9.73
NBD	Polar	6.17	7.08	4.58	5.00	5.70	3.55	7.08	5.83	6.64
N=105	Content	1.92	2.66	2.75	2.58	3.0	1.36	2.66	3.50	3.00
	Alternative	0	0.83	0.33	0.25	0	1.27	0.08	0	0.18
	Total	8.08	9.833	7.67	7.83	8.70	6.18	9.25	9.33	9.82

Table 11.

T-statistics and p-values of Dimensions 3 & 9 for Unfamiliar Object Task

Dimension	Question Type			DF	t-statistic	p-value
3	Polar			200.7	-4.14	< .0001*
	Alternative			114	6.17	<.0001*
	Content (Q-word)			199	-1.61	.109
9	Who			129.53	-1.89	.06
	What			198.47	-1.26	.21
	Where			196.15	1.13	.246
	When			141.1	1.40	.16
	Why			165.27	-2.51	.01*
	How			189.86	-1.20	.23
	How many/much			200.12	.34	.73
	N/A			201.99	-.74	.46
	Total	RHD	99	198.5	-2.06	.04**
		NBD	105			

Note. * p < .01; ** p < .05; Total = total questions produced per group

Cognitive-Linguistic Performance and Question Use

Significant group differences were noted in two cognitive domains: executive function and visuospatial functioning. Participants with RHD scored lower on the Cognitive-Linguistic Quick Test (CLQT) subtests of executive functioning (t = -3.14, df = 15, p = 0.0068), M = 27.91, SD =5.02) and visuospatial skills (t = -3.14, df = 15, p = 0.0068, M = 85.85, SD =12.79), as seen in Figure 5. No significant group differences were noted for the cognitive domains of memory, attention, or language. There was no significant group difference in the standard scores of the DKEFS 20-Questions Task, as seen in APPENDIX H. There were no significant correlations between measures of executive function and question type for participants with RHD, as seen in Table 12. However, the relationship between content question use and executive function and content question use and visuospatial performance is trending toward a moderate correlation (see Table 12).

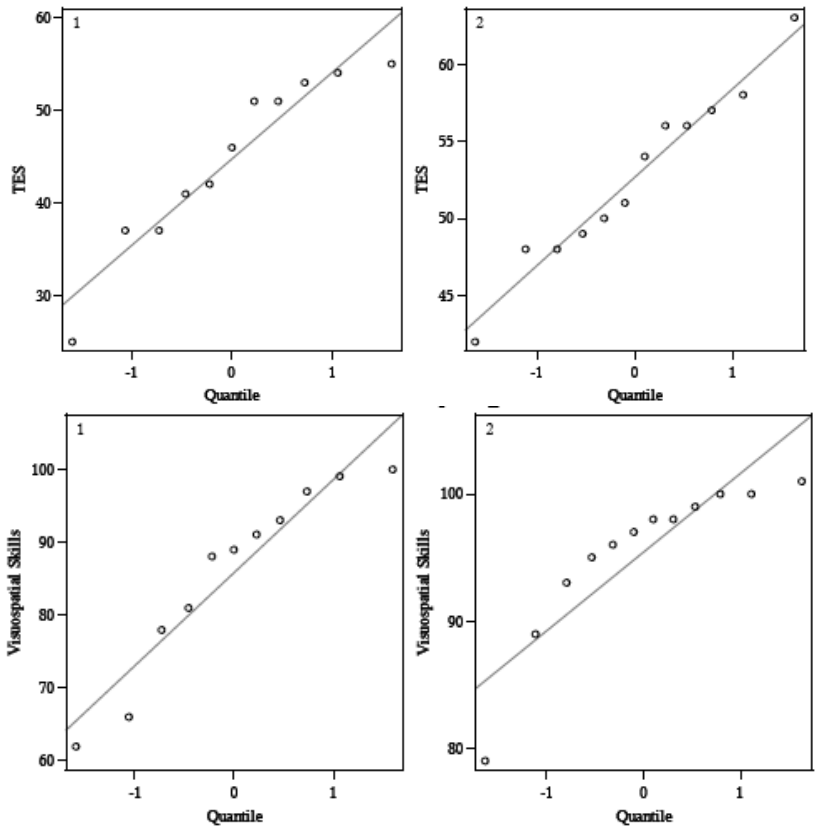


Figure 5. Proportion of Executive Functioning (EF) and Visuospatial Performance Scores by Group. Significant group differences exist.

Table 12.

Correlation Analyses of Cognitive-Linguistic Performance and Question Type for the Question Production Discourse Tasks for Participants with RHD

	Executive Function	Visuospatial Performance	Alternative (Fam)	Content (Fam)	Polar (Fam)	Alternative (Unf)	Content (Unf)	Polar (Unf)
Executive Function	1	-.31	-.4	.18	.04	-.4	.19	.03
Visuospatial Performance		1	-.17	.14	.08	-.10	.14	.08
Alternative(Fam)			1	-.4	.20	-.02	.38	.29
Content(Fam)				1	.45	.51**	.13	.56
Polar(Fam)					1	.65**	.25	.34
Alternative (Unf)						1	.14	.51*
Content (Unf)							1	.14
Polar(Unf)								1

Note. (Unf) = Unfamiliar Condition; (Fam) = Familiar Condition of Question Production Tasks. * significant at $p < .01$; ** Significant at $p < .05$

Empathy and Question Use

Significant group differences were noted in affective empathy (t = -2.49, df = 16.3, p = 0.0267). The proportion of scores can be seen in Figure 6. The participants with RHD scored lower on the Toronto Empathy Questionnaire (TEQ; M = 44.73, SD = 9.33) than the participants with NBD (M = 52.6, SD = 5.71). No significant correlations were noted between the number of each question type and the TEQ score, as seen in Table 13. However, the data are trending towards a moderate correlation for alternative questions and empathy in the unfamiliar condition of the Question Production Task.

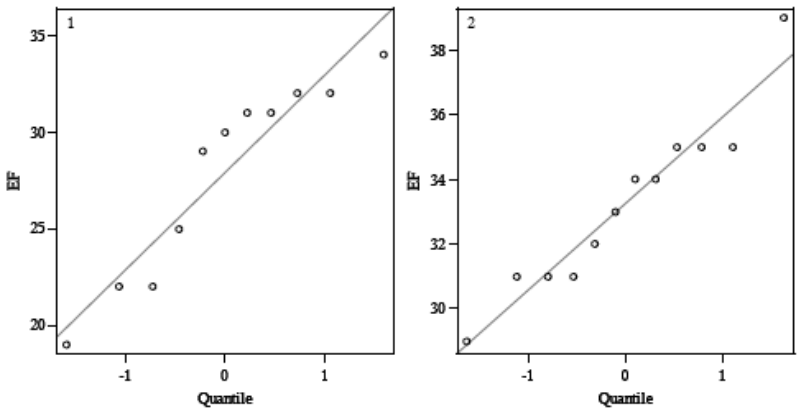


Figure 6. Proportion of Toronto Empathy Questionnaire Scores (TES) by Group. Significant group differences exist. 1= RHD group; 2 = NBD group

Table 13.

Correlation Analyses of Empathy and Question Type for Question Production Discourse Tasks for Participants with RHD

	Empathy	Alternative (Fam)	Content (Fam)	Polar (Fam)	Alternative (Unf)	Content (Unf)	Polar (Unf)
Empathy	1	.19	.01	.10	.23	.09	.14
Alternative(Fam)		1	-.4	.20	-.02	.38	.29
Content(Fam)			1	.45	.51**	.13	.56
Polar(Fam)				1	.65**	.25	.34
Alternative (Unf)					1	.35	.51*
Content (Unf)						1	.14
Polar(Unf)							1

Note. (Unf) = Unfamiliar Condition; (Fam) = Familiar Condition of Question Production Tasks.
* significant at $p < .01$; ** Significant at $p < .05$

CHAPTER V

DISCUSSION

The purpose of this study was to determine if people with right hemisphere brain damage use questions differently than people without brain damage. Two studies were conducted to achieve this goal. For Study 1, the hypotheses that the unfamiliar pictured objects would be rated as unfamiliar by survey respondents and elicit at least four categories of information seeking questions was supported. For Study 2, the hypotheses that participants with RHD use questions differently than participants with no brain damage was supported as the results show group differences in the quantity and quality of questions used during structured discourse tasks. Moreover, the distribution of question types was different, especially with respect to the discourse tasks, suggesting that in participants with RHD, the use of specific types of questions may vary depending on the task.

Another study aim was to gather preliminary information about the contribution of cognitive-linguistic performance and empathy to question use. While significant group differences were noted in empathy and the cognitive-linguistic domains of executive functioning, visuospatial processing, no significant relationships were noted between these domains and specific types of information seeking questions in the RHD group. After a discussion of findings related to the hypotheses for each of the studies, clinical implications, limitations, and direction for future research are offered.

Study 1: Object Familiarity Ratings

The mean rating of all 10 unfamiliar pictured objects as unfamiliar was an expected result. Questions produced in response to an unfamiliar rating suggest that each unfamiliar pictured object had characteristics that were not easily placed contextually. Thus, the use of Q-word information seeking questions was particularly important in narrowing the context to facilitate meeting the task goal of identifying the object purpose.

Questions coded as 'what' and 'why' were used 75% of the time to meet the task goal. Survey respondents explicitly asking, "What is this?" or "What is the purpose of this object?" to meet the task goal 48% of the time (136/283) and posed questions requesting information related to why an object is used 25% of the time (78/283). According to Kearsley (1976), Q-word questions serve to elicit contextual information. Questions most frequently used by survey respondents request concrete contextual information of the object specification, for 'what' and abstract contextual information concerning an explanation for the object use, for 'why.' The use of 'what' and 'why' for nearly 75% of responses suggest that survey respondents may have determined that these two types of questions provide sufficient information to meet the task goal.

As a group, the unfamiliar pictured objects were successful in eliciting a range of Q-word questions. The unfamiliar objects were used to develop the Unfamiliar Object Task for Study 2. Whereas the traditional 20-questions task examines the use of yes/no questions, the Unfamiliar Object Task examines the use of Q-word questions. To our knowledge, a task of this sort does not exist. The Unfamiliar Object Task may be particularly beneficial for investigations of Q-word questions.

Although the hypotheses were supported, two observations warrant consideration for improvement. First, when Object 1, the popcorn fork, was enlarged, the picture became distorted. This distortion resulted in excluding the popcorn fork from the Unfamiliar Object Task of Study

2. Second, Object 3, the cordies, Object 8, the spider podium, and Object 10, the jolly kneeler were rated most unfamiliar. Interesting, the unfamiliar pictured objects rated most unfamiliar had a similar presentation: Pictures selected for each of these objects could be perceived as one-dimensional or images that did not provide dimensional depth, as compared to the other unfamiliar pictured objects. Increased ratings of unfamiliar may have resulted due to the quality and specificity of the pictured selected. This task may be improved upon by using high definition pictures of each object from various vantage points—front, back, and side--such that the observer can see the full dimensions of the object.

Study 2: Question Production Discourse Battery (QPB)

Question Production Discourse Tasks

Both groups produced more questions in the unfamiliar condition than the familiar condition. Increased question use is expected in situations that are unfamiliar. In such situations, the use of questions can serve to establish a contextual basis for the exchange of information and commonalities among communicators when the discourse is dyadic (Clark, 1997; Kearsley, 1976). Thus, there is fundamental relationship between the use of Q-word questions to gather contextual information (Kearsley, 1976), information sought, and the knowledge available (Flammer, 1981).

Similar to studies investigating conversational discourse following RHD (Kennedy et al., 1994; Minga et al., 2008; Minga & Lundgren, 2011), in this study, participants with RHD produced fewer questions than participants with NBD for each task. Differences in the quantity of questions were nearly equal for both conditions. The group of participants with RHD produced 51 fewer question in the familiar condition (NBD, N= 144; RHD, N=93) and 52 fewer questions (NBD, N= 169; RHD, N= 117) than the group of participants without brain damage in

the unfamiliar condition. This finding suggests that the experimental conditions of unfamiliar and familiar did not contribute to diminished use of questions as compared to participants with NBD.

Rather than a conditional basis for the number of question used, a global discourse contribution deficit may contribute to the observed differences in quantity of questions. People with RHD may have paucity of speech or may be verbose (Klonnoff, Myers, 1999; Tompkins, 1994). Although the tasks used in this study were structured, there was an expectancy to verbalize responses. Thus, the decreased use of questions may be related to the overall tendency of the participants with RHD to demonstrate reduced verbal output.

Polar Questions

In this study, both groups produced more polar questions in the unfamiliar condition than the familiar condition. Participants with RHD used polar questions 21% of the time in the unfamiliar condition and 11% of the time in the familiar condition, whereas participants with NBD used polar questions 42% of the time in the unfamiliar condition and 21% of the time in the familiar condition.

Increased use of polar questions in the unfamiliar condition suggests that the use of polar questions, in this unfamiliar discourse task, was considered advantageous. Stivers (2010) found that polar questions are used 70% of the time in conversation. In conversation, polar questions can be used as requests (Can you help me?), rhetorical questions, invitations (e.g. Do you want a drink?), to begin a conversation (e.g. Did you hear about the level-1 Ebola alert?), and when drawing inferences (e.g. Are you married?) (Bolinger, 1978).

While the use of polar questions can result in the recipient of the question divulging information to meet the task purpose of getting to know an unfamiliar person, using this approach seems inefficient. During a dyadic conversation, the question recipient may have to infer that the person posing the polar question wants to know more and move beyond a response of yes or no.

The Question Production Discourse Task, however, is not dyadic. Thus, the fact that the percentage of polar questions used by both groups is far less than that reported by Stivers & Enfield (2010) may be due to the nature of the task. Although there exists commonality amongst the two groups with respect to the structure of the polar questions used, participants with RHD used polar questions significantly less than participants with NBD. This finding may be a reflection of the overall reduced use of questions by the RHD group mentioned earlier.

Content Questions

The group of participants with RHD used content questions similar to participants with NBD in the familiar condition, but not the unfamiliar condition. The most glaring difference in these two tasks is context. Results from some studies suggest that the ability to effectively use context is deficient following RHD for comprehension-based tasks (Beeman, 1993; Rehak, Kaplan, Weylman, Kelly, Brownell & Gardner, 1992) while others do not (Blake & Lesniewicz, 2005; Brownell, Potter, Bihrle & Gardner, 1986; Leonard, Baum, and Pell, 2001). In the current task, context can embody common knowledge about the subject. In the familiar condition, participants were asked to 'get to know' either Michael Jordan or Oprah Winfrey, two highly publicized celebrities, whereas participants were asked to 'get to know' a hypothetical person during a first-time meeting during the unfamiliar task. In this way, the participants possessed background knowledge as a basis for posing questions in the familiar condition, whereas no contextual information was provided for the unfamiliar condition. The lack of this knowledge may have increased the cognitive processing needed to generate questions, which may have resulted in a reduction in the quantity of questions for participants with RHD.

According to Kearsely (1981), the specificity of questions is related to available information. While the quantity of content questions did not distinguish the groups, content questions varied based on the question type, as evidenced by APPENDIX I-L. Participants with

RHD produced a reduced range of questions in the unfamiliar condition. Interestingly, the majority of questions used in the unfamiliar condition elicited concrete information. Forty-three percent of the questions were coded as 'what' and 21% were coded as 'where.' This is compared to 21% of questions coded as 'what' and 8.6% of questions coded as 'where' in the familiar condition. Observed differences in the distribution of question types between the two conditions are indeed interesting and warrant further consideration.

Alternative Questions

Participants with RHD used alternative questions more than participants with NBD. Specifically, four participants: 101(3 questions), 104(1 question), 110(1 question), and 119(3 questions) in the RHD group used 8 alternative questions while the NBD group used only one. Although the number of alternative questions was small, alternative questions serve to provide the listener with a set of possible answers and therefore, restrict the possible responses. Thus, assertions are made when these types of questions are used. According to Flammer (1981) questions are formulated or contextually situated to reduce the range of acceptable answers of the respondent based on expectations about missing knowledge. For alternative questions, the implication is that one, and only one, of the presented options is possible (Kaurtman & Peters, 1976): The specificity of the question should correlate with the known information.

The decision to use alternative questions is probably based on strong presuppositions, with respect to a response: Potential responses are constrained to mutually exclusive choices (Biezma & Rawlins, 2012; Kaurtman & Peters, 1976). That is, the person asking the question may have an idea of what the response may be, but provide options that are neither preferred nor dispreferred by the speaker (Koshik, 2005). Given both the task goal of "getting to know" someone, for both conditions, and lack of background knowledge in the unfamiliar condition, there is no apparent basis for using alternative questions.

Equal distribution of alternative questions across conditions, for participants with RHD, suggests that background knowledge was not a factor in the use of alternative questions. There are at least four possible interpretations for the use of alternative questions by participants with RHD. First, the alternative questions may have been used as a repair strategy repair (Koshik, 2005). In this instance, a polar question may precede an alternative question. For example, "Do I use this in the house?" followed by "Do I use this in the kitchen or bathroom?" This, however, is not the case for the participants with RHD. Alternative questions were not preceded by a polar question. Moreover, the use of alternative questions seems less felicitous when getting to know another person. Second, alternative questions used by participants with RHD in this study may have been a substitute for asking Q-word questions. For example, "Do you live in Durham or a surrounding area?" may be perceived as an alternative question that has the same meaning as "Where do you live?" and "Did you want to be a racecar driver or soccer player or anything else?" requests information related to the Q-word questions "What other sports are you interested in?" Another interpretation could stem from the fact that some people with RHD have difficulty managing information in complex situations (Beeman & Chiarello, 1998). Alternative questions, then, may be a strategy for reducing the amount of information received in order to facilitate greater understanding. Lastly, participants with RHD may be using their own contextual basis to formulate choices in alternative questions; thereby, demonstrating another aspect of egocentric behavior (see Piaget, 1959, p.197 for similar proposal in child language literature).

There seems to be no indication of a pattern of performance upon closer examination of the cognitive-linguistic performance and empathy scores of the four participants with RHD that used alternative questions. Performance on the cognitive-linguistic subtests were within normal

range for all of these participants except participant 119 who had a mild executive function severity range. Further examination of alternative questions is warranted to delineate situation use.

Other Questions

Participants with RHD produced more non-question responses than participants with NBD. These utterances occurred only during the familiar condition and were in the form of "Tell me about X." As mentioned, the majority of participants selected to get to know Oprah Winfrey. It is possible that the two participants with RHD that used this format (participants 113 & 119) were placing themselves in an interviewing position, as Oprah, when making "Tell me" statements. If this behavior were a consequence of taking on the position of Oprah as an interviewer, the influence of ToM may be suggested.

Unfamiliar Object Task

The hypotheses that mean group differences would exist in the quality and quantity of questions used was partially supported. In contrast to findings from the question production discourse task, differences were only noted in the use of polar, alternative questions, and a specific content question, why. Increased use of alternative questions and decreased use of polar questions by participants with RHD is consistent with the question production discourse task suggesting that the quantity of these types of questions may differentiate people with RHD across tasks. Whereas, content question use was different across question categories in the question production discourse tasks and restricted to 'why' in the current task is interesting. According to Kearsley (1976) the question 'why' elicits contextual information that includes justification of reasons, puzzlement, and explanation. Based on the information needed to meet the task goal, the use of why questions would be particularly useful in determining the purpose of an object, yet participants with RHD were less likely to use 'why' to gather information. Reasons for the

diminished use of ‘why’ are not clear. Using ‘why’ may elicit a range of information that is not constrained to a subset of choices. Thus, this question has the potential to result in obtaining small and large quantities of information. If the hypothesis set forth with respect to the use of alternative questions is held, then the diminished use of the question ‘why’ could result from a desire to restrict the amount of information presented to assist in managing a complex situation. A second possibility is that participants with RHD could have been more focused on the physical attributes of the object rather than the task goal of gathering information to determine the purpose of the unfamiliar pictured object. Further inquiry is needed to obtain greater understanding of observed differences for unfamiliar pictured objects.

Cognitive-Linguistic Performance and Question Use

The relationship between cognitive-linguistic performance and question use was examined. The hypothesis that relationships will exist between question type and CLQT cognitive domain scores for participants with RHD was not supported. Significant differences were noted in the executive function and visuospatial performance of participants with RHD, two areas of deficit associated with pragmatic performance following RHD (McDonald, 2000; Zimmerman, Gindri, Rosa de Oliveira, and Fonseca, 2011). Correlations between content questions and executive function and between content questions and visuospatial performance were insignificant. This finding is consistent with a portion of McDonald’s (2000) results. In her study, visuospatial functioning, but not executive functioning, was correlated with pragmatic performance. Despite this finding, the data can be interpreted to suggest that executive function and visuospatial performance may account for a subset of the processes needed in the use of content questions.

The hypothesis that the mean standard scores on the DKEFS 20-questions task would differ based on group membership was not supported. During the 20-questions task participants with RHD required the use of more polar questions to complete the task and some became visibly

frustrated. This finding is, perhaps, related to the use of polar questions as the measure. As shown in this study, participants with RHD used fewer, but semantically similar, polar questions than participants with NBD. Due to the reliance of this task on polar questions, an interpretation could be that this measure may not have the sensitivity needed to highlight the subtleties of performance by people with RHD.

Empathy and Question Use

The right hemisphere is implicated in the modulation of empathy (Paradiso, Anderson, Boles Ponto, and Tranel, Robinson, 2011). While participants with RHD demonstrated diminished empathy as compared to participants with NBD, no significant relationship between empathy and question use was found in this study. The existence of a moderate insignificant relationship between empathy and the use of alternative questions in the unfamiliar condition of the discourse production task is interesting.

Explanations for the use of alternative questions have been previously outlined (see *Alternative Question section)*. One potential rationale was that the use of alternative questions was a communicative consequence of egocentric communication. For example, one participant stated, "Did you ride the bus or is someone waiting to pick you up?" in response to the prompt to get to know an unfamiliar person. This question can be characterized as egocentric because this particular participant mentioned riding the bus as a primary mode of transportation. Furthermore, the use of an alternative question suggests that the participant had a strong supposition that the recipient of the question only traveled by the two modes of transportation mentioned: bus or the vehicle of another person: There is no shared information on which to base this assumption.

Egocentric comments are among the communication behaviors that have been noted to distinguish people with RHD from those with no brain damage (Chantraine, Joanette & Ska, 1998; Mackenzie, Begg, Lees, & Brady, 1999; Blake, 2006). The use of inappropriately

personal, irrelevant, or tangential comments are the behaviors used to highlight the presence of egocentric communication following RHD (Blake, 2008). Thus, diminished consideration of the communication partner may be an indicator of egocentric communication. The current finding of a cursory relationship between alternative question use and empathy suggests the need for further explorations concerning the relationship between alternative questions use and empathy.

Clinical Implications

Important clinical implications can be drawn from the results, as this is the first known study to investigate the use of questions following RHD. The clinical utility of the QPB is, perhaps, the strongest implication. Like findings in other studies (Kennedy et al. 1994; Klonnoff et al.; Minga et al., 2008; Minga & Lundgren, 2011), this study demonstrates that people with RHD use questions differently and less frequently than people with NBD. By structuring the discourse tasks, however, this study was able to identify differences in types of questions used by participants with RHD and determine the conditions of use. Therefore, the sensitivity of the QPB is sufficient in combating the subtleties of pragmatic disorders following RHD by aiding in identifying pragmatic differences, while overcoming the influence of extraneous variables inherent in unstructured communication. Based on the study findings, question use may have a role in contributing to our knowledge of pragmatic performance following brain injury by enhancing our ability to identify and measure one aspect of pragmatic performance following RHD. Moreover, the clinical utility of the QPB is highlighted in its relatively short administration time of 10-15 minutes and use of pictured objects as stimulus items.

The availability of treatment protocols to improve pragmatic performance following brain injury is sparse. A handful of treatment programs have been proposed with respect to comprehension based pragmatic deficits (e.g. prosody and metaphor comprehension (Rosenbek, Rodrigues, Hieber, Leon, Crucian et al., 2006, Lundgren et al. 2011). However, even fewer

treatment protocols exist for that address the production of appropriate pragmatic communication. While it is premature to advance the current findings to a specific treatment protocol, the existence of a question production measure, the QPB, may be viewed as a first step in moving towards question production as a focus of assessment. Moreover, because questions are measurable, they may be particularly advantageous in understanding pragmatic communication disorders.

Limitations

There are several limitations to this study that warrant consideration. Although heterogeneity of pragmatic impairments is an inherent limitation to using a group of participants with RHD (Chantraine et al., 1998; Weed, 2011), one significant limitation of this study is that the sample size was relatively small. This was due to difficulty recruiting participants with RHD that met eligibility criteria. More than 20 people with RHD could not participate in this study because they did not meet the eligibility criteria either because they were too young, too old, or were unable to obtain a neurologic report. Increasing the sample size may have contributed to further differentiating group differences in question use. A multi-site study may be warranted.

There are a few limitations with respect to the study tasks. It is acknowledged that the use of structured tasks to examine the use of a pragmatic aspect of language is not equivalent to natural communicative environments. Thus, the organization of the task interaction (Sacks, Schefloff, and Jefferson, 1974) and the absence of a response to questions used may have affected participant responses. The use of tasks that elicit polar questions may have also affected participant responses. That is, there may have been a priming effect such that the use of polar questions during one task may have encouraged the use of polar questions in a subsequent task. However, this did not seem to affect the NBD group. Removing tasks that solely elicit polar

questions and establishing a basis of comparison between structured and unstructured tasks may contribute to reducing the methodological limitations.

The current study is exploratory in nature. Given that there was no prior knowledge of how the data would be represented, there was an unanticipated limitation with respect to the analyses. While appropriate statistical analyses were applied, it is recognized that more robust statistics are applicable to the data. For example, nonparametric analyses should be considered for future studies given that there are usually no assumptions of homogeneity, which is violated due to the use of participants with brain damage. A latent class analysis is another potential analysis that could be useful in associating question use patterns based on group membership. In this way, an understanding of the probability that specific types of questions will be represented in either group can be identified. Future studies employing more robust statistical analyses can complement the current findings and may contribute to greater understanding of group differences.

Despite these limitations, this study contributes to the growing body of literature concerning discourse impairments and the underlying basis for pragmatic communication deficits following RHD and may serve as a basis for future research.

Future Direction

Questions are the most explicit avenue for gathering information, often information that may have significant health or safety implications (e.g. when clarifying medication dosage and instructions). This study showed that even in hypothetical discourse situations differences arise between a group of people with brain damage in the right hemisphere and a group with no brain damage, specifically with the use of questions

While this study has initiated explorations of question use following RHD, there still remains the need to replicate and expand upon the study tasks and measures. We do not know if

participants are aware of their diminished use of question nor do we know the participants/communication style prior to having a stroke. A next step in the exploration of questions use, then, could be to explore awareness of question use and to collect information about prior communicative style as a basis of comparison.

Future studies should also focus on the investigation of question use in a larger sample. Given the difficulties of recruiting participants with RHD in this study, researchers may elect to engage in multisite investigations and longitudinal investigations. Multisite investigations will allow researchers to overcome the recurrent issues of small sample size in the RHD literature by compiling data from small subsets of participants into a single data set. Establishing contact with people with RHD while in the acute stage of recovery before discharge and community reentry may be key to increasing the number of study participants. Identifying people with RHD who consent to participate in research early in the rehabilitation process may foster the creation of a participant database; thereby, increasing study sample size and may also provide an avenue for identifying a communicative historian to provide information about premorbid communication behaviors. Knowledge concerning premorbid communication can assist in differentiating a communication disorder from communication style.

More information is needed with respect to identifying underlying contributors to diminished question use. The influence of domain specific cognitive-linguistic performance and empathy on question use was explored in this study. Although, no significant correlations were noted between these constructs and question use, significant group differences were noted in executive function, visuospatial processing, and empathy. The existence of significant group differences in these area suggest the need for further exploration to determine if these processes are influential in the use of questions. Manipulation of these processes during structured tasks of question use may be particularly insightful. For example, incorporating emotionally based

scenarios to the discourse production task may provide information on the impact of emotion on question use. The use of other cognitive-linguistic and social cognition measures may also prove to be valuable.

Finally, advances in neuroimaging are contributing to our understanding of the role that the right hemisphere has in language related processes (see Fonseca, Scherer, Rosa de Oliveira, and Parente, 2009 for a review). Future studies should consider incorporating functional neuroimaging during question production tasks to aid in advancing our understanding of brain and behavior relationships concerning question use.

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APPENDIX A

UNFAMILIAR PICTURED OBJECTS

Object 1 Popcorn Fork 	Object 2 Chef'n Bananza Banana Slicer 
Object 3 Cordies 	Object 4 Cupcake Corer 
Object 5 Corn Kerneler 	Object 6 Spaghetti Measure 
Object 7 Corn Zipper 	Object 8 Spider Podium 
Object 9 Tiny Swiss Hot Steam Humidifier 	Object 10 Jolly Kneeler 

APPENDIX B

FAMILIAR PICTURED OBJECTS

Object 11 Apple Slicer 	Object 12 Dolly 
Object 13 Mouse 	Object 14 Lug wrench 
Object 15 Comb 	Object 16 Toothbrush 
Object 17 Flashlight 	Object 18 Ladder 
Object 19 Scissors 	

APPENDIX C

OBJECT FAMILIARITY RATINGS SURVEY

Q1 What is your age?

- ❍ 20-39 (1)
- ❍ 40-65 (2)
- ❍ 65+ (3)

Q2 What is the highest degree or level of school you have completed? If currently enrolled, mark the previous grade or highest degree achieved.

- ❍ 8th Grade (1)
- ❍ High School, No Diploma (2)
- ❍ High School Graduate or Equivalent (e.g. GED) (3)
- ❍ Some College Credit, No Degree (4)
- ❍ Associates Degree (For example- AA. or AS.) (5)
- ❍ Bachelors Degree (For example - BS or BA. (6)
- ❍ Master's Degree (For example - MS, MED., MA., MBA, MSW) (7)
- ❍ Professional Degree (For example - MD.DDS) (8)
- ❍ Doctoral Degree (For example - PhD, EdD. (9)

Q3 Please indicated your gender

- ❍ Male (1)
- ❍ Female (2)

Q4 Do you have any visual impairments? If you wear glasses or contacts to improve your vision choose no.

- ❍ yes (1)
- ❍ No (2)

Q5 Do you currently or have you ever had any of the following

- ❍ Neurologic Disorder (For example-Multiple Sclerosis, Dementia, Parkinson's Disease) (1)
- ❍ Psychiatric Disorder (2)
- ❍ Brain Injury (For example- stroke, traumatic brain injury, concussion) (3)
- ❍ Learning Disability (4)
- ❍ Substance Abuse Disorder (5)
- ❍ None of the Above (6)

Q6 Is English your primary language?

- ❍ Yes (1)
- ❍ No (2)

The purpose of this task is to determine how familiar you are with a number of objects and what types of questions you could ask to determine the use of the objects. Some of the objects will look

very familiar, while others may not. Below an image of each object you will find a 5-point scale with the labels ‘unfamiliar’ and ‘familiar’. As you can see on the scale 1 = unfamiliar, while 5 = familiar.

	1	2	3	4	5
Unfamiliar				Familiar	

If the object is unfamiliar, then you would choose a rating somewhere on the left side of the scale. If the object is familiar then you would choose a rating on the right side of the scale. If an object is neither unfamiliar no familiar, then you would choose a rating towards the middle of the scale. To make your judgments you will click the circle below the number. There are no right or wrong answers for this task.

Q8

	Unfamiliar				**Familiar**
	1 (1)	2 (2)	3 (3)	4 (4)	5 (5)
Rate your familiarity (1)	❍	❍	❍	❍	❍

Q8.4 Please provide the name of this object and its purpose.

Display This Question:

If Unfamiliar Familiar **- 4** Is **Selected** Edit

Or Unfamiliar Familiar **- 5** Is **Selected** Edit

Q8.1 Please provide **two** questions that you could ask to determine the function of this object?

Display T

If Unfamiliar Familiar **- 1** Is **Selected** Edit

Or Unfamiliar Familiar **- 2** Is **Selected** Edit

APPENDIX D

STIVERS & ENFIELD'S QUESTION-RESPONSE CODING DIMENSIONS
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2.2. The coding dimensions

Each coder was supplied with an Excel template for which each question below was allocated a column and each question that met inclusion criteria was given an identification number and a row.

(1) *Is the utterance formally a question?*

0=No

1=Yes

See inclusion criteria above. Examples of utterances that are formally questions included any question with lexical, morphological, syntactic or prosodic marking appropriate to the language. Thus, rhetorical questions used to express a stance such as "Can you imagine going tuh school here?" and declarative questions with, for instance, sharply rising intonation, were included.

(2) *Does the question have lexical, morphological or syntactic marking?*

0=No

1=Yes

Lexical marking included, e.g., "Which" or "Who" questions; morphological marking included question particles or clitics; syntactic marking included inversion as in the Germanic languages. For a number of the languages too little was known about language specific prosodic marking to code this separately. However, for languages where coders felt confident, this could be derived from codes 1–2.

(3) *What is the logical semantic structure of the question?*

0=Polar Question

A polar question is any question that makes relevant affirmation/confirmation or disconfirmation. It contains a proposition with two possible answers in semantic terms: true/the case versus not true/not the case. The question might involve a question particle, inversion, or a tag. It did not necessarily involve formal interrogative marking (as in a declarative question). It could be positive or negative.

1=Content (Q-word) question

A content or 'Q-word' question (or 'WH' question) is where part of a proposition is presupposed, and the utterance seeks the identity of one element of the proposition. Thus, in 'Who stole my newspaper' it is presupposed that 'Someone stole my newspaper', and the purpose of the question (at least nominally) is to ascertain the identity of the person corresponding to this 'someone'. Variation in a language in the syntactic position of the Q-Word is not relevant to whether it is coded as such (cf. "Where do you work." or "You work where?").

Please cite this article in press as: Stivers, T. Enfield, NJ. A coding scheme for question–response sequences in conversation, Journal of Pragmatics (2010), doi:10.1016/j.pragma.2010.04.002

2=Alternative question

Alternative questions included the proposal of a restricted set of alternative answers in their formulation (e.g. "Were you drunk or were you sober." or "Do you want corn or flour tortillas."). Note that just having "or" in the question does not automatically make it an alternative question. "Do you want coffee or", for instance, was **not** coded as an alternative question because (1) the prosodic contour of these questions is recognizeable as a discrete way of asking a question, and (2) they are routinely treated as a practice for asking a polar question as evidenced by regularly receiving answers (cf. Lindström, 1996).

(4) *Is the question a "through-produced" multi-question?*

0=No (Just one question in the turn)

1=Yes (2 or more questions in a turn)

Two or more questions delivered as a single query were additionally coded as "through produced" multiple-question questions. These did **not** include cases in which a single question is followed by lack of uptake or a quizzical facial expression, and the questioner pursues with a second question. An example of a through-produced multi question is "So how'd you get them down there how many cars." This code allows for the exclusion of these questions from particular analyses which was necessary since some multi-questions combine polar and content or often the answer is to only one of the questions, so these types of questions must be considered separately.

For polar questions:

(5) *Is the polar question marked with a 'turn-final element'?*

0=No

1=Yes

9=N/A (non-polar questions)

These are declaratively formatted turns that assert a proposition and add a 'turn-final element' that marks questionhood; these turn-final elements include question particles (e.g., Japanese *ka*), lexical items (e.g., "Right" or "Yeah?") or 'tag' type clauses (e.g., "Don't ya think?" or "Did she?").

(6) *Is the polar question negatively marked?*

0=No

1=Yes

9=N/A (non-polar questions)

Negative marking was coded for negative interrogative questions where the negative is brought up to the front (in English "Isn't one of his jobs five days a week?" or "Haven't you been to Germany,"). But, it also included negative declaratives such as "You don't have to go downtown do you?". If negation was present in either the proposition or the tag, the question was considered negatively marked. Negative polarity items (e.g., "any" or "never") were not, in themselves, considered negative marking.

(7) *Is the polar question dubitative ("Maybe") marked?*

0=No

1=Yes

9=N/A (non-polar question)

Among polar questions, if the question had a marker of doubt/uncertainty in it (e.g., "I wonder if") then it was coded as dubitative. (This appears to be a grammaticalized way to do polar questions in some languages).

(8) *Is the polar question a declarative question?*

0=No

1=Yes

9=N/A (non-polar question)

If a polar question was judged to be a question but was lacking interrogative morphology or syntax and/or was marked as a declarative (e.g., with *ge* in ǂÃkhoe Hai‖om), then it was coded as a declarative question; for instance "But you're going." or "You paid them already?" Intonation was not criterial.

For content (Q-word) questions:

(9) Each content question was coded for which type of Q-word was used but this was done on semantic grounds. If the question was about naming the person whether that was done as "Who?" or "Which person", the question was coded as a "who-question"

Please cite this article in press as: Stivers, T. Enfield, NJ. A coding scheme for question–response sequences in conversation, Journal of Pragmatics (2010), doi:10.1016/j.pragma.2010.04.002

0=Who (note, it can be done as "which person")

1=What (note, it can be done as "which thing")

2=Where (note, it can be done as "which place")

3=When (note, it can be done as "how late" or "what time")

4=Why (note, it can be done as "for what reason")

5=How (note, it can be done as "in what manner")

6=How many/much

9=N/A (not Content Q)

General repair initiators such as "Huh?" in English or "Hé?" in Dutch were coded as "What" questions because they are functionally equivalent to, or elliptical for, larger statements such as "What did you say?".

(10) *Is the question functionally a question?*

0=No

1=Yes

See above under "Inclusion criteria."

(11) *What social action is the question doing?*

0=Request for information ("real" question)

Questions were coded as requesting information only if it seemed that there was no other primary action to be coded. Something ambiguous might be "Are you busy tonight?" where the action is arguably to find out whether the real invitation/request can be made (a pre-invitation/request). Thus, in such cases, coders were asked to code "Other" and list the action as pre-invitation. "Other" cases were subsequently tabulated and if there was a sufficient number a new category was created.

1=Other initiation of repair (OIR)

Questions including open class repair initiators ("Huh?" or "What?") as well as partial repeats ("He went where?") were coded as other initiations of repair. If it seemed that the repair was more a challenge than an initiation of repair, "Other" was coded and the action was listed as challenge.

2=Request for confirmation (non-OIR)

Questions (usually declarative although this was not criterial) that asserted a proposition for confirmation such as "So you're coming tomorrow night" were coded as requests for confirmation.

3=Assessment (stating evaluation; seeking agreement)

Evaluations that were formatted to seek agreement such as "Isn't it beautiful out today" or "She's such a pretty girl isn't she" were coded as performing an assessment.

4=Suggestion/Offer/Request

Questions that suggest, propose, or offer something to another as well as questions that request something from another were coded in a single category (e.g., "Did you want some? [about a breakfast cereal]). This was because there were insufficient numbers to warrant several discrete categories but these actions seemed to cohere in various ways.

5=Rhetorical question

Questions that may seek a response but do not seek an answer. For instance, questions that assert an opinion as in "Everything comes out in the wash doesn't it?" said by a husband to his wife after he has spilled something on the table cloth, were coded as rhetorical questions.

6=Outloud

Questions delivered to no one in particular often with lower volume and do not appear to be designed to secure a response (e.g., "Now where are my keys." while looking in a bag) were coded as outlouds.

7=Other

If the action did not fit into the other categories well, then contributors were asked to code "Other" and list, as specifically as possible, the social action that the utterance was being used for.

APPENDIX E

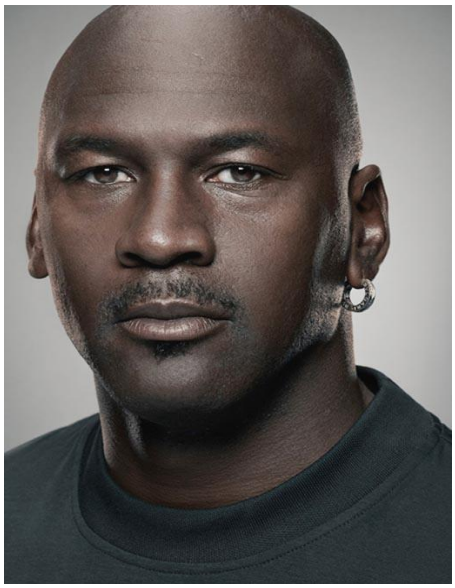
ADMINISTRATION ORDERS OF QUESTION PRODUCTION TASKS

ORDER 1	**ORDER 2**
Consent Form	Consent Form
Subject Questionnaire	Subject Questionnaire
Vision Screen	Vision Screen
Hearing Screen	Hearing Screen
Handedness Screen	Handedness Screen
Empathy Scale	Empathy Scale
CLQT	CLQT
Question Production (Unf)	DKEFS 20-Questions
Question Production (Fam)	Unfamiliar Object
Unfamiliar Object	Question Production (Fam)
DKEFS 20-Questions	Question Production (Unf)
Payment Form	Payment Form

APPENDIX F

QPB VISUAL STIMULUS ITEMS

20-Questions TASK



Unfamiliar Person

APPENDIX G

QUESTIONS PRODUCED FOR EACH UNFAMILIAR PICTURED OBJECT

Unfamiliar Pictured Object	Question 1	Question 2
CUPCAKE CORER	What is the purpose of this object?	How is this object used?
	Is that a container in the middle?	Is it used at a BBQ to hold a plate with a hole in the middle?
	What is this item?	Who uses it?
	What does one do with this object?	How is this object used?
	What is it?	What does it do?
	How is this object used?	What is this object used for?
	What is it?	How do you use it?
	What is it?	How do you use it?
	What is this object?	Who would use this object?
	How do you use this item?	What is the purpose of the colors and shapes?
	What is it?	What does it do?
	What type of item is this?	What is this item used for ?
	What is this object used for?	Who is likely to use this object?
	What would you use this object for?	How would you use this object?

	Question 1	Question 2
CORN KERNELER	How is this object used?	Why would this object be used?
	What is it used for?	Who uses it?
	Who chose this picture?	What is this item?
	What is it?	How is it used?
	WHERE AND WHY IS THIS OBJECT USED?	WHO USES THIS OBJECT?
	What is the purpose?	`What is the name of the item?
	What is this object used for?	Who would use an object like this?
	What is it?	Why use it?
	What is it?	How do you use it?
	What is it?	What's its purpose?
	What is this object?	Who uses this object?
	How is this item used?	Why would you need this item?
	What is it?	What does it do?
	What would you use this object for?	How would you use the object?
	WHO USES THIS ?	WHAT IS INSIDE OF THE OBJECT?

	Question 1	Question 2
CORN ZIPPER	What is it used for?	Why would you need to use it?
	How is this tool used?	Why is it used?
	What is it?	What is it used for?
	Why would I use an object like this?	What is this object used for?
	What is it?	How do you use it?
	What is it?	How do you use it?
	What is this object?	What is it used for?
	What is it?	What does it do?
	WHO WOULD USE THIS?	WHAT MATERIAL CAN IT BE USED ON?

	Question 1	Question 2
CORDIES	What purpose does this object serve?	Who would use this object?
	What is it used for?	Who typically uses it?
	Where is this item used?	How often is it used?
	How is this object used?	Who uses this object?
	What is it?	How is it used?
	WHO USES THIS OBJECT AND WHY?	WHAT IS THIS OBJECT USED FOR?
	What is the item used to do?	When and where would you utilize this object?
	What is this object used for?	Where would this object be used?
	What is it?	How do you use it?
	What is it?	How is it used?
	What is this object?	What is it used for?

	Question 1	Question 2
SPIDER PODIUM	For what purpose is this object used?	When would one use this object?
	What is it made out of?	What does it do?
	What is this tool?	Who uses it?
	What is it?	How does it function?
	What is it used for?	What could be used as a replacement for this?
	What is the name of the object?	How is it utilized?
	What is this object used for?	Who would use an object like this?
	What is it?	How do you use it?
	What is it?	What is it used for?
	What is this object?	What is it used for?
	How does this item function?	Why would this help someone?
	What is it?	What does it do?
	What is it used for?	When would a person be most likely to use it?
	What would you use this item to do?	Where am I most likely to find it?

	Question 1	Question 2
SPAGHETTI MEASURE	For what purpose is this object used?	Who might use this object?
	Who would normally use this?	What is it used for?
	What is this item?	Where is it used?
	What is it?	How is is used?
	What is the name if the object?	How is this tool utilized?
	When would I use an object like this.	How would I use an object like this.
	What is it?	How do you use it?
	What is it?	How do you use it?
	What is this object?	What is it used for?
	What is it?	What does it do?
	Who would use this item?	Where would I find it typically?
	WHAT DOES THIS FIT ON?	WHAT PROFESSION WOULD USE IT MOST OFTEN?

	Question 1	Question 2
HUMIDIFIER	Where is this used?	When is it used?
	What industry use this tool?	When is it used?
	What is it?	How does it work?
	When would I use this?	What is the purpose for this object?
	What is the name?	How is it utilized ?
	What is it?	How do you use it?
	What is it?	What is it used for?
	What is this object?	Who would use this object?
	Where would this item be useful?	Who would benefit from using this item?
	What is it?	What does it do?
	What is this object used for?	Why would one bring out this object?
	What is the actual size of this item?	How is it used?

	Question 1	Question 2
BANANA SLICER	What is the purpose of this object?	Under what circumstances would this object be used?
	Is it used to cut things?	Is it used to strip the outer coating off of cables?
	How is this item used?	Who uses this type of tool?
	What does the hole in the tool do?	Are there any moveable parts under the yellow cover?
	What do you do with this object?	How is this object used?
	What is it?	How is it being used?
	WHAT IS THIS OBJECT USED FOR AND WHERE?	WHO USES THIS OBJECT AND WHY?
	Who would utilized this item?	What is the name of the item?
	What is this objet used for?	How would I use this object?
	What is it?	How do you use it?
	What is it?	How do you use it?
	What is this object?	Who would use this object?
	What kind of situation would you be in to use this item?	How long would it take to accomplish the task from start to finish when using this item?
	What is it?	What does it do?
	What is it used for? (looks like an unusual hair clip or something...?)	Where is it typically used?
	When would you use this item?	What would you use this item for?
	HOW DO YOU OPEN THE OBJECT?	WHERE DO YOU USE IT?

	Question 1	Question 2
JOLLY KNEELER	What is the purpose of this object?	Why would one use this object?
	What does it do?	Why is it needed?
	Why is this object red?	How is it used?
	What is it?	What is it used for?
	Who would use this?	When would you use this?
	What is the name of the item?	Where is it used?
	What is this object used for?	Why would I use an object like this?
	What is it?	How do you use it?
	What is it?	What is it used for?
	What is this object?	What is it used for?
	Who would use this item?	Where would this item be stored?
	What is it?	What does it do?
	What is the purpose of this object?	Who might be seen carrying this object around?
	Who would use this item?	Where would I find it?

	Question 1	Question 2
POPCORN FORK	What is this object used to do?	Under what circumstances would this object be used?
	What is it used for?	Where is it used?
	Why is there a cap on the side of this object.	What is this item used for?
	What do the 2 pincers on the end pick up?	What does the cap cover?
	What do you do with this object?	Who uses this object?
	what is this object used for?	How is it used?
	WHAT IS THIS OBJECT USED FOR AND WHERE?	WHO USES THIS OBJECT?
	What is the name of this item?	What is the purpose of the item?
	What are they?	How do you use them?
	What is it?	How do you use it?
	What is it?	What is it used for?
	What is this used for?	Who would use it?
	What is it?	What does it do?
	What is this used for?	How is this item used?
	Where would you use this object?	How do you use this object?
	WHO WOULD USE THIS OBJECT AND WHERE IS IT USED?	HOW IS THE ITEM HELD AND ARE THERE ANY MARKINGS ON IT?

APPENDIX H

DESCRIPTIVE STATISTICS FOR COGNITIVE-LINGUISTIC AND EMPATHY MEASURES

Group	N Obs	Variable	Mean	Median	Minimum	Maximum	St. Dev
RHD	11	Age	52.8	51.0	46.0	63.0	5.49
		Empathy	44.7	46.0	25.0	55.0	9.32
		Attention	184.7	199.0	101.0	209.0	35.6
		Memory	178.0	176.0	137.0	256.0	28.8
		Executive Function	27.9	30.0	19.0	34.0	5.02
		Language	33.5	33.0	19.0	34.0	5.02
		Visuospatial Skills	85.8	89.0	62.0	100.0	12.80
		CLQT Composite	3.76	4.0	3.2	4.0	0.29
		20q Initital Abstraction	11.3	11.0	8.0	14.0	1.49
		20q Total Questions	9.36	10.0	3.0	14.0	3.0
		20q Total Weighted	9.72	10.0	3.0	14.0	3.0

Group	N Obs	Variable	Mean	Median	Minimum	Maximum	St. Dev
NBD	12	Age	51.2	51.0	41.0	63.0	6.9
		Empathy	52.6	52.5	42.0	63.0	5.7
		Attention	191.8	198.5	103.0	212.0	28.4
		Memory	164.8	177.0	123.0	1820	18.7
		Executive Function	33.2	33.5	29.0	39.0	2.7
		Language	33.8	34.0	30.0	37.0	2.16
		Visuospatial Skills	95.4	97.5	79.0	101.0	6.17
		CLQT Composite	3.8	4.0	3.0	4.0	.39
		20q Initital Abstraction	11.5	10.5	5.0	18.0	4.62
		20q Total Questions	11.25	11.5	9.0	13.0	1.29
		20q Total Weighted	11.8	12.0	9.0	15.0	1.47

APPENDIX I

DESCRIPTIVE STATISTICS FOR QUESTION USE IN QUESTION PRODUCTION DISCOURSE TASK: UNFAMILIAR RHD

PIN	POLAR	ALTERNATIVE	CONTENT	WHO	WHAT	WHEN	WHERE	WHY	HOW	HOW MUCH
101	6	3	5	0	2	0	0	0	3	0
104	2	0	16	0	11	0	1	0	1	3
109	2	0	8	0	4	0	4	0	0	0
110	0	1	6	0	1	0	5	0	0	0
113	1	0	8	0	5	0	3	0	0	0
115	4	0	14	1	8	0	4	0	0	1
116	3	0	3	0	1	0	1	0	0	0
117	0	0	7	0	6	0	1	0	0	0
119	4	0	10	0	5	0	4	0	0	1
120	2	0	7	1	4	0	2	0	0	0
122	0	0	5	1	3	0	0	0	1	0
N	24	4	89	3	50	0	25	0	5	5
Mean	2.18	0.36	8.09	0.27	4.5	0	2.27	0	0.45	0.45
StDev	1.94	0.92	3.91	0.47	3.01	0	1.80	0	0.93	0.93

APPENDIX J

DESCRIPTIVE STATISTICS FOR QUESTION USE IN QUESTION PRODUCTION DISCOURSE TASK: UNFAMILIAR NBD

PIN	POLAR	ALTERNATIVE	CONTENT	WHO	WHAT	WHEN	WHERE	WHY	HOW	HOW MUCH
102	5	1	9	0	2	1	4	1	1	0
103	15	0	5	0	4	0	1	0	0	2
105	1	0	9	1	4	0	2	1	0	1
106	8	0	16	0	13	0	2	0	0	1
107	11	0	10	0	5	0	1	1	1	2
108	6	0	4	0	1	0	2	0	1	0
111	13	0	7	0	4	0	1	0	0	2
112	3	0	8	0	3	0	4	0	0	1
114	3	0	5	0	2	0	3	0	0	0
118	1	0	10	0	3	0	5	0	0	2
123	6	0	9	0	7	0	2	0	0	0
124	0	0	4	0	0	0	2	0	0	0
N	72	1	96	1	48	1	29	3	3	11
Mean	6	0.08	8	0.08	4	0.08	2.42	0.25	0.25	1
StDev	4.90	0.29	3.38	0.29	3.38	0.29	1.31	0.45	0.45	0.89

APPENDIX K

DESCRIPTIVE STATISTICS FOR QUESTION USE IN QUESTION PRODUCTION DISCOURSE TASK: FAMILIAR RHD

PIN	POLAR	ALTERNATIVE	CONTENT	WHO	WHAT	WHEN	WHERE	WHY	HOW	HOW MUCH
101	3	3	11	0	2	0	3	5	1	0
104	3	0	8	0	5	0	1	0	2	0
109	1	0	9	2	3	0	0	0	3	1
110	2	1	5	0	1	0	3	0	1	0
113	0	0	5	1	4	0	0	0	0	0
115	0	0	9	0	3	1	0	1	2	2
116	0	0	7	1	3	0	1	0	1	1
117	0	0	4	0	3	0	0	0	1	0
119	1	0	3	1	1	0	0	0	1	0
120	0	0	5	0	1	0	0	2	2	0
122	0	0	6	1	3	0	0	1	1	0
N	10	4	72	6	29	1	8	9	15	4
Mean	0.91	0.36	6.55	0.55	2.64	0.09	0.73	0.81	1.36	0.36
StDev	1.22	0.92	2.46	0.69	1.29	0.30	1.19	1.54	0.81	0.68

APPENDIX L

DESCRIPTIVE STATISTICS FOR QUESTION USE IN QUESTION PRODUCTION DISCOURSE TASK: FAMILIAR NBD

PIN	POLAR	ALTERNATIVE	CONTENT	WHO	WHAT	WHEN	WHERE	WHY	HOW	HOW MUCH
102	5	0	0	0	2	1	4	1	1	0
103	0	0	0	0	4	0	1	0	0	2
105	4	0	0	1	4	0	2	1	0	1
106	8	0	0	0	13	0	2	0	0	1
107	9	0	0	0	5	0	1	1	1	2
108	2	0	0	0	1	0	2	0	1	0
111	7	0	0	0	4	0	1	0	0	2
112	1	0	0	0	3	0	4	0	0	1
114	0	0	0	0	2	0	3	0	0	0
118	0	0	0	0	3	0	5	0	0	2
123	4	0	0	0	7	0	2	0	0	0
124	0	0	0	0	0	0	2	0	0	0
N	40	0	102	1	48	1	29	3	3	11
Mean	3.33	0	8.5	0.08	4	0.08	2.42	0.25	0.25	1
StDev	3.34	0	3.42	0.29	3.38	0.29	1.31	0.45	0.45	0.89

APPENDIX M

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