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# The Effects of Right Hemisphere Brain Damage on Question-Asking in Conversation

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ABSTRACT

**Background:** Right hemisphere brain damage (RHD) can cause challenges with information gathering. Cognitive processes aid in implicit and explicit information gathering, yet the relationship between these processes and question-asking, the most explicit avenue of information gathering, has not been explored. The purpose of this exploratory descriptive study was to test the hypothesis that adults with RHD differ from controls in the types of questions produced during a conversational discourse task and whether observed differences are associated with cognitive limitations.
**Method:** Adults with RHD ($n$ = 15) and controls ($n$ = 15) participated in a 5-min "first-encounter conversation" and were assessed for attention, memory, executive functioning (EF), visuospatial skills, and language domains using the Cognitive Linguistic Quick Test (CLQT). Questions produced during the conversation were coded and tallied by type: polar (yes/no), content (wh-), or alternative (A or B) using Computerized Language Analysis programs. Groups were compared on total questions used, use of questions by type, and CLQT domain scores; associations were computed between cognitive domain scores and question types.
**Results:** Compared with controls, adults with RHD used half as many questions overall and scored significantly lower on the attention, executive function, and visuospatial domains of the CLQT. For the RHD group, there was a significant correlation between EF scores and the production of content and polar questions.
**Conclusions:** The frequency of question-asking is important to understanding the communication profile in adults with RHD. Executive function, attention, and, to a lesser extent, visuospatial capabilities may contribute to question-asking behaviors in conversation in this population. The RHD Framework for Asking Questions is proposed to illustrate the potential areas of deficit in the question-asking process after RHD.

Conversational differences and challenges after right hemisphere brain damage (RHD) are well documented and clinically recognized (Ferré et al., 2012; Mackenzie & Brady, 2008; Parola et al., 2016). For example, some adults with RHD take more turns of talk (Chantraine et al., 1998; M. Kennedy et al., 1994), interrupt with poor timing, maintain eye contact poorly (Mackenzie et al., 1999), produce fewer fillers and back-channel behaviors (e.g., nodding; Brady et al., 2003; Van Lancker Sidtis & Postman, 2006), inappropriately select personal reference terms (Brownell et al., 1997), use fewer conversational continuers, and demonstrate a reduced ability to process and produce facial expressions (Blonder et al., 1991). Others may unsuccessfully integrate information from the communicative context and/or the communication partner

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(Benowitz et al., 1990), which can result in a failure to respond, contribute, or produce language that is appropriate for the conversation. A reduced ability to integrate information aligns with the premise that RHD communication deficits co-occur with cognitive deficits of executive function, attention, and memory (Blake et al., 2002). Given these interactional nuances, it is not surprising that adults with RHD may have challenges maintaining the conversation (Hird & Kirsner, 2003). Conversational discourse deficits have far-reaching consequences with real-world implications for the functioning of individuals with RHD (Hewetson et al., 2018, 2021), yet speech-language pathologists (SLPs) do not have tools for reliable assessment and treatment of discourse in RHD.

Communication of people with RHD is rarely differentiated from healthy adults in a consistent or quantifiable way; there is no single, agreed upon way to quantify characteristics that constitute a pragmatic language impairment or the specific ways in which conversation is affected (Blake, 2018). Conversation-based production studies have focused primarily on differences in turn-taking (M. Kennedy et al., 1994) and topic maintenance (Barnes & Armstrong, 2010; Brady et al., 2003; M. R. T. Kennedy, 2000). Both turn-taking and topic management require the use of implicit and explicit information (Peach & Hanna, 2021). While the literature shows that RHD affects gathering implicit information using facial expressions, prosodic variations, and figurative language (Ferré et al., 2012; Sheppard et al., 2020), it is less clear how RHD affects the most explicit avenue of information gathering, question-asking.

## Question-Asking and Conversation

Question-asking is essential and pragmatically important to sustaining a conversation (Kearsley, 1976). Questions may assist in initiating an interaction, establishing and organizing shared knowledge, eliciting unknown or specific information about a conversational partner, and clarifying or confirming information previously introduced (Boyd & Heritage, 2006; Flammer, 1981; Freed, 1994). Functionally, questions are important in several communicative contexts; questions may help to forge or strengthen relationships or fuel intellectual, vocational, and social exchanges.

The most common use of questions is to elicit information that cannot be inferred or retrieved through shared knowledge (Siemund, 2017). Information-seeking questions are characterized at semantic levels (Huddleston, 1994). Semantically, there are three types of information-seeking questions used in conversation: content, polar, and alternative (Stivers, 2010). Each question type is distinguished by the set of its possible answers. Content questions are open interrogatives that do not restrict the number of possible responses and may include *who*, *where*, *what*, *when*, *how*, or *why* (Enfield et al., 2010). For example, the question "Where are you from?" is a content question that contains the location indicator "where" and has any place (e.g., country, state, city, neighborhood) as a possible response. Polar questions are questions that elicit a response that is either *yes* or *no*, and alternative questions are those that restrict the response set to *A or B* or *A or not A* (Bolinger, 1978). Polar and alternative questions are closed questions because they restrict the response to a finite set of choices. For example, the polar question "Are you from North Carolina?" and the alternative question "Are you from the southern or the northern part of the state" have two possible responses: yes or no and southern or northern, respectively.

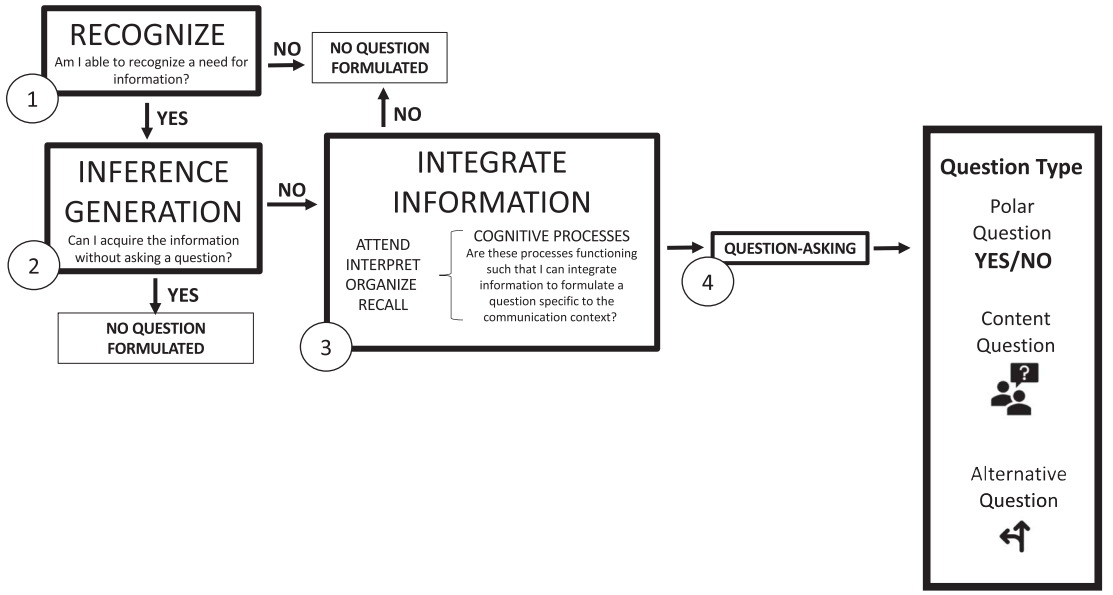
Studies of English speakers have shown that 75% of questions produced during conversation are polar (Enfield et al., 2010; Siemund, 2017). The pervasive production of polar questions during conversation is consistent with Levinson (2012) social economics model of conversation, which holds that asking questions is socially costly to speakers. Social costs of questions include relinquishing control of the conversation, acknowledging that the elicited information is unknown, and suggesting the right to know the requested information while placing the responsibility to provide the solicited information on the listener (Levinson, 2012). To manage the social costs, when speakers need to ask direct questions, polar questions should be produced more than content questions (Flammer, 1981). To the degree that any question must be asked at all, polar and alternative questions lessen the social costs by minimizing the information requested (Levinson, 2012).

If questions are not asked in situations where they are expected, as in the case of meeting a person for the first time, conceivable social consequences include reduced communicative interactions, perceived communication ineptness, and social oddity. In other situations, such as work or doctor visits, the result of not asking enough questions or the right kinds of questions can have economic or health-related consequences.

## Pragmatically Compromised Populations and Question-Asking

For adults with RHD and other pragmatically compromised populations, focusing on explicit information gathering with questions can be an important and impactful therapy target to compensate for impairments in implicit information gathering. Individuals with autism and those with cognitive-linguistic deficits secondary to traumatic brain injury (TBI) have been shown to use questions inappropriately, infrequently, or not at all (Doggett et al., 2013). Like adults with RHD, some adults with TBI disproportionately focus conversation on topics of

**Figure 1.** RHD Framework for Asking Questions (R-FAQ). RHD = right hemisphere brain damage.




their own interest and demonstrate difficulty managing and maintaining conversation (Bogart et al., 2012; Dahlberg et al., 2006). Question-asking has been targeted to improve topic development after TBI (Sim et al., 2013). Empirical work on question-asking in autistic[1] individuals has focused on interventions to enhance the use of questions for gathering information with some demonstration of improvement in conversational interactions and with job-related social skills (Huskens et al., 2013). No such focus on assessment and treatment of question-asking exists in the literature on RHD.

A revealing study by M. Kennedy et al. (1994) identified differences with question-asking after RHD in the context of conversation. During a first-encounter conversation with either a certified SLP or graduate student as a conversational partner, parameters of topic skills or conversational turn-taking skills were assessed. Although there was no specific analysis of question types conducted, M. Kennedy et al. (1994) noted that some adults with RHD asked fewer questions to request information or manage topics during the conversation. Participants with RHD also took significantly more turns, produced fewer words, and talked more about themselves.

In a structured task of question-asking, Minga et al. (2020) elicited questions from adults with RHD ($n$ = 29) and controls ($n$ = 21) using the Unfamiliar Object task of the RHDBank protocol (see Minga et al., 2021, for protocol details). Participants were shown an unfamiliar object (e.g., jolly kneeler) and instructed to ask questions to determine the purpose of each object. Findings show that while adults with RHD produced the number of questions requested (at least three), they produced polar questions (*yes/no*) less often than content questions (wh-questions). This was the first study to show group differences in the distribution of question type during a constrained task in RHD. Based on the findings from that study, we conceptualized the RHD Framework for Asking Questions (R-FAQ) to illustrate potential areas of deficit after RHD (see Figure 1).

The R-FAQ begins with the recognition of the need for information and then proceeds to inference generation and then, if necessary, to an explicit attempt to meet the information need by asking a question. According to this framework, if the need for information is not recognized or gathered through implicit means (e.g., generating inferences, nonverbal behaviors, etc.), the act of asking a question does not occur. When implicit means are unsuccessful in meeting the information need, then cognitive processes are recruited to integrate the contextual information needed to conceptualize and formulate a question that is appropriate for the communicative context. Impairments in any of these cognitive areas can result in a difference in the profile of questions produced such that while controls produce polar, content, then alternative questions, respectively regardless of the task goals, adults with RHD may have a different profile that is task specific. For the pragmatically simplified unfamiliar object task, a task that asks for questions to determine the purpose of objects that have an everyday purpose that is not readily apparent by physical appearances. In this task, the need to recognize and generate inferences was removed by the explicit task

[1]Person-first language is not used to reference autistic individuals consistent with identity-first language.

instructions to "ask questions." Using the R-FAQ, we hypothesized that the integration of information may differentially affect the type and frequency of questions asked during discourse. While these findings are significant to understanding utterance level nuances that may go unnoticed after RHD, the findings are not necessarily representative of question-asking during conversation. It is unclear whether differences in question-asking behaviors during conversation would look similar to that of a constrained task.

This study extended the examination of question-asking to conversation to further understand the communication deficits seen adults with RHD. Its purpose was twofold. First, we sought to replicate the use of M. Kennedy et al.'s (1994) first-encounter conversation with the goal of measuring the types as well as frequencies of questions used during the conversation. Second, we tested the hypothesis that the frequency of specific types of questions by individuals with RHD is different than controls during conversational interactional, as observed on unfamiliar object task, and that the use of particular question types would be related to attention, memory, executive functions, and visuospatial processes. Specifically, we examined the following questions. (a) Do adults with RHD ask fewer questions and different types of questions than controls during a conversation? (b) Is there an association between question type and cognitive processes?

## Materials and Method

### Participants

The study sample included 15 adults who sustained a single right hemisphere stroke (as evidenced by radiology report) and 15 controls from the Minga corpus of RHDBank (https://rhd.talkbank.org; Minga et al., 2021). All participants in this study spoke English as their primary language, were at least 6 months post stroke, had no history of alcohol or drug abuse, had no history of learning disability, and had functional hearing and vision, by self-report. Control participants had no history of stroke, psychiatric, or neurological impairment. Participant characteristics are reported in Table 1. There was a significant difference in the mean age between groups with the control group being slightly younger then the RHD group. The Institutional Review Board of North Carolina Central University approved this study.

**Table 1.** Participant characteristics by group.

| Variable | | NHC ($n$ = 15) | RHD ($n$ = 15) |
|---|---|---|---|
| Age, mean (*SD*)* | | 45.69 (11.66) | 52.01 (9.60) |
| Education, mean (*SD*) years | | 16.66 (2.24) | 17.06 (3.26) |
| Sex, *n*(%) | | | |
| | Female | 11 (73%) | 12 (80%) |
| | Male | 4 (27%) | 3 (20%) |
| Race, *n*(%) | | | |
| | Black | 7 (47%) | 7 (47%) |
| | White | 8 (53%) | 8 (53%) |
| | Other | 0 | 0 |
| Years post stroke, mean (*SD*) | | | 5.2 (3.27) |

*Note.* NHC = neurologically healthy controls; RHD = right hemisphere brain damage; *SD* = standard deviation.

*$p < .05$

### Procedure

The Cognitive Linguistic Quick Test (CLQT; Helm-Estabrooks, 2001) was administered to all participants to allow for the examination of links between cognitive domains (i.e., attention, memory, executive functioning, visuospatial skills, and language) and question-asking in conversation. As part of the larger RHDBank discourse protocol, the first-encounter task (M. Kennedy et al., 1994) was used to collect data on conversational interactions where participants were asked to get to know a new conversational partner. The conversational partners were all female graduate students in speech-language pathology. The following instructions were provided to students prior to the conversation: "This is not an interview. This is an opportunity for the two of you to get to know each other. Just converse as you would with anyone you are meeting for the first time. But please — this is very important — be sure to allow time for your partner to initiate topics, even if this ends up creating some long pauses." The instructions to participants were "'I'd like you to meet one of my students.' (Note: If administered by a student clinician, say: 'I'd like you to meet another student here.') I don't think you've met her before. This is a chance for you to get to know each other. This is not an interview, so she doesn't have a list of questions to ask you. See what you can get to know about her." There was no list of questions for the conversation task nor were the participants instructed to ask questions to meet the task goal. Each first-encounter conversation was video-recorded either in the participant's home or in the Speech and Hearing Clinic at North Carolina Central University.

Two graduate students were trained to transcribe and code the language samples using Codes for the Human Analysis of Transcripts format (MacWhinney, 2000; https://talkbank.org/manuals/CHAT.pdf) and the Discourse Contribution Measure (DCM; Minga & Lundgren, 2011). The DCM consists of seven operationally defined parameters that describe the type of contribution of an utterance (see Table 2). Utterances coded as questions using the DCM were further coded using a portion of Stivers (2010) question response coding scheme: polar, content, or alternative. Next, all content questions were coded based on the specific wh-word (what, who, where, when, why, etc.) and

**Table 2.** Discourse Contribution Measure coding parameters with definitions (Minga & Lundgren, 2011).

| Contribution type | Definition |
|---|---|
| Elaboration | An utterance that expands or provides greater detail about something that was discussed. |
| Novel Information | A spontaneous utterance presenting new information, not previously discussed. |
| Continuer | An utterance indicating that new information has been received ("oh," "really," etc.) or a vocalization (laughter) that does not contribute to the topic but allows the conversation to continue ("Mm-hm," "Yeah"). |
| Clarification | An utterance marked by elucidation of an idea, comment, or question or a correction. |
| Question | An utterance of inquiry. Coded using three categories: polar, content, and alternative. |
| Response to Question | An utterance that is a direct response to a question and addresses an information request. |
| Comment | An utterance of opinion, feeling, or thought. |

polar questions were coded as either positive (e.g., *Did you grow up in North Carolina?)* or negative wherein a negative polar question contains a negative clitic and an auxiliary verb (e.g., ***Didn't*** *you grow up in Pittsburgh?;* ***Isn't*** *she your cousin?*). Students independently transcribed randomly assigned language samples. Two student transcribers independently reviewed and coded each transcript, making line-by-line comparisons of each utterance and code for reliability. Twenty-five percent of the language samples were subjected to a third review by a certified SLP who is trained and experienced with the DCM. Point-to-point agreement was 98% for coding. Forced-choice agreement on any discrepancies led to 100% agreement with coding.

### Data Analysis

Group comparisons for question type and frequency were completed using exact Mann–Whitney *U* (Mann & Whitney, 1947). Exact significance, *Z*, and effect size estimate *r* (Rosenthal, 1991) with interpretation are also reported (small: > .1, medium: > .3, large: > .5). A mixed analysis of variance (ANOVA) was used to make group comparisons of CLQT domain scores. Significant main effects of domain scores were examined using independent *t* tests with corrected values based on Levene's test for equality of variances as appropriate. Kendal's tau was used to determine associations between question use behaviors and cognitive domains.

## Results

### Frequency and Questions Types

The boxplots in Figure 2 display the distribution of questions by type and group, and Table 3 shows results by group, question type, and question subtype. Both groups asked polar and content questions most frequently than alternative questions. Adults with RHD used half as many questions as controls overall (median of 7 for adults with RHD vs. a median of 16 for controls).

### Cognition and Question Types

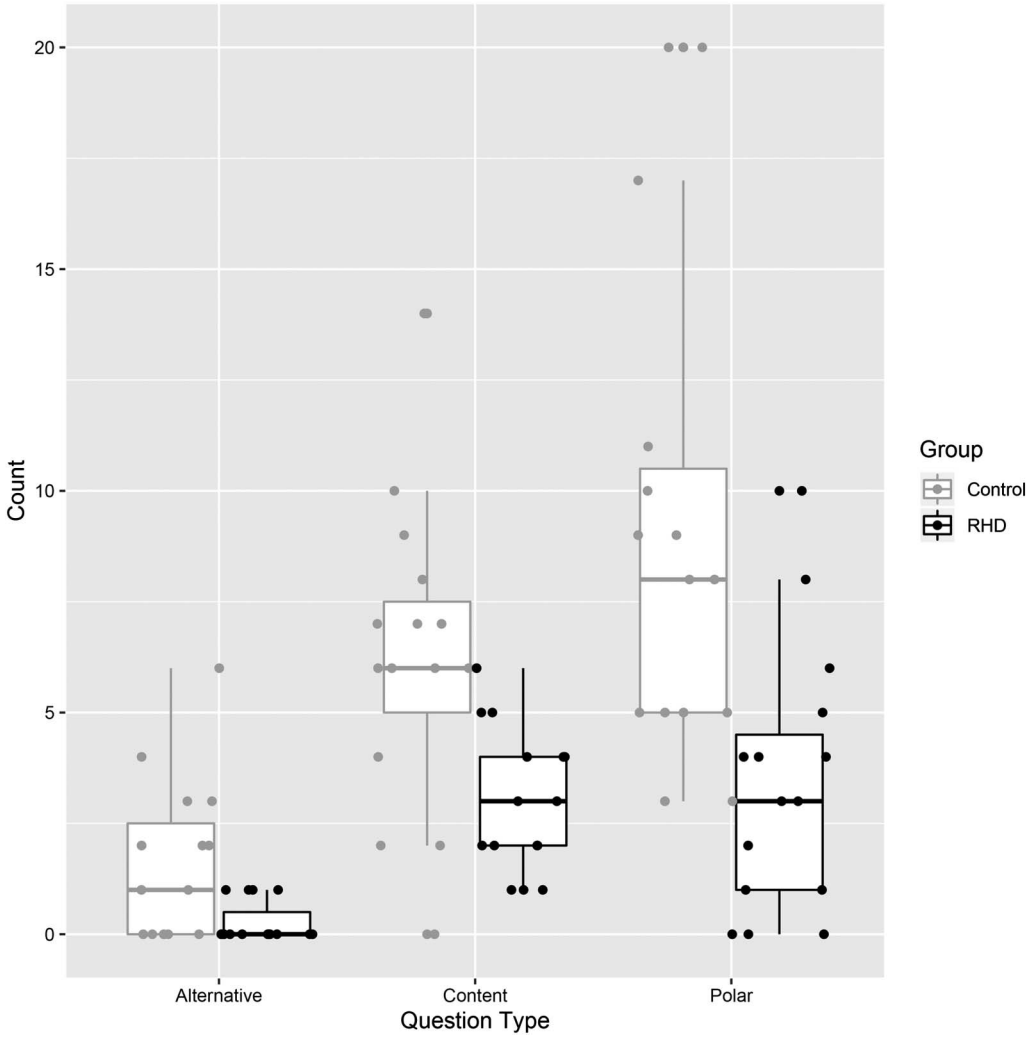
A mixed ANOVA comparing the two groups' performance on the five CLQT domains demonstrated a main effect of domain (Mauchly's $W = .007$, $p < .001$; Greenhouse–Geisser corrected, $F(1.57, 43.86) = 1{,}261.23$, $p < .001$, $\eta_P^2 = .98$, and group, $F(1, 28) = 6.82$, $p = .01$, $\eta_P^2 = .20$, and a marginally significant interaction between the two, $F(1.57, 43.86) = 3.60$, $p = .046$, $\eta_P^2 = .11$. There was a group effect for attention, executive function, and visuospatial domains, but no significant difference for language and memory domains. Table 4 displays Cohen's *d* effect size estimates of significant main effects, showing that the RHD group had significantly lower performance scores on domains of attention, executive function, and visuospatial domains. Table 5 displays Kendall's $\tau$ coefficients for CLQT domains and question types, showing a strong association ($|\tau b| \geq 0.35$) between executive function and the production of content and polar questions for adults with RHD and a moderate association between visuospatial function and polar questions.[2] These results were significant using an uncorrected *p* value of $p < .05$.

## Discussion

In this study, we examined the use of questions during a first-encounter conversation and found that adults with RHD produced fewer questions overall than did controls. In terms of question types, both polar and content questions were used less frequently than adults with RHD. Alternative questions were not frequently used by either group. Executive function, attention, and visuospatial domain scores were significantly lower in the RHD group, and significant associations were found between two cognitive processes and the use of polar and content questions in adults with RHD. Although these preliminary

[2]The indices of attention, executive function, and visuospatial of the CLQT overlap for three tasks: the symbol trails, mazes, and design generation.

**Figure 2.** Boxplot of questions produced by each group by type. RHD = right hemisphere brain damage.




results should be cautiously interpreted due to the small sample size and large number of comparisons, the results allow for greater insight into an important aspect of pragmatic behaviors in RHD.

## Questions and Conversation

The relative utility of questions in conversation has been explored by linguists for decades and used as a means for improving social interactions in populations of adults with TBI and autistic individuals (Doggett et al., 2013; Koegel et al., 2014). When considering question types, speakers have a tendency to use polar questions with greater frequency during conversation (Enfield et al., 2010). Minga et al. (2020) found that adults with RHD used polar questions less frequently during a structured task; however, until this study, there were no specific details concerning question-asking during conversation. Observation of a reduced frequency in questions used to "get to know" an unfamiliar person by people with RHD may be partly due to production differences related to polar questions in people with RHD. The use of polar questions is also grounded in linguistic models of speech production. For example, one may initiate a topic of discussion with a polar question (e.g., *Are you a native of North Carolina?*), then move to a content question to elicit greater elaboration on the subject (e.g., *What brought you here? When did you move here? What's your favorite thing about North Carolina?*). The polar question in this situation serves to affirm, confirm, or disconfirm assumptions based on two potential answers (yes/no), which then prompts the use of content questions to build the conversational context.

Our findings conform with and expand upon the previous work by M. Kennedy et al. (1994), who reported that the relative use of questions in conversation was

**Table 3.** Comparisons of question type use by group.

| Question type | | All ($N$ = 30) | RHD ($n$ = 15) | Control ($n$ = 15) | $U$ | Z | $p$ | $r$ |
|---|---|---|---|---|---|---|---|---|
| Alternative* | | 0.0 (6) | 0.0 (1) | 1.0 (6) | 61.00 | –2.37 | .03 | .43, M |
| | Alternative | 0.0 (4) | 0.0 (1) | 1.0 (4) | 70.50 | –2.04 | .08 | .37, M |
| | Incomplete | 0.0 (5) | 0.0 (1) | 0.0 (5) | 67.00 | –2.45 | .06 | .45, M |
| Content** | | 4.0 (14) | 3.0 (5) | 6.0 (14) | 41.50 | –2.97 | .002 | .54, L |
| | Who | 0.0 (1) | 0.0 (0) | 0.0 (1) | 105.00 | –1.00 | .78 | .18, S |
| | What | 1.5 (7) | 1.0 (5) | 3.0 (7) | 68.00 | –1.88 | .07 | .34, M |
| | Where | 0.0 (3) | 0.0 (2) | 0.0 (3) | 97.50 | –0.68 | .54 | .12, S |
| | When | 0.0 (2) | 0.0 (0) | 0.0 (2) | 90.00 | –1.79 | .37 | .33, M |
| | Why | 0.0 (1) | 0.0 (0) | 0.0 (1) | 90.00 | –1.80 | .37 | .33, M |
| | How* | 1.5 (3) | 1.0 (3) | 2.0 (3) | 58.80 | –2.33 | .02 | .43, M |
| | Incomplete | 0.0 (1) | 0.0 (1) | 0.0 (1) | 112.50 | 0.00 | 1.00 | .00, S |
| Polar | | 5.0 (20) | 3.0 (10) | 8.0 (17) | 90.00 | –1.26 | .37 | .23, S |
| | Positive** | 5.0 (20) | 3.0 (8) | 8.0 (17) | 34.50 | –3.25 | .001 | .59, L |
| | Negative | 0.0 (3) | 0.0 (3) | 0.0 (3) | 91.00 | –1.21 | .39 | .22, S |
| | Incomplete | 0.0 (1) | 0.0 (0) | 0.0 (1) | 97.50 | –1.44 | .54 | .26, S |
| Total** | | 9.5 (35) | 7.0 (15) | 16.0 (31) | 45.50 | –2.80 | .004 | .51, L |

*Note.* Comparisons are presented as median (max). RHD = right hemisphere brain damage; S = small (> .1); M = medium (> .3); L = large (> .5).
*$p$ < .05. **$p$ < .01.

lower for adults with RHD. Although adults with RHD produced half as many questions as the controls, both groups had a similar profile of question-asking during conversation. Each group most frequently produced polar questions followed by content questions *what* and *how*, which mirrors the question-asking profile of healthy adults described by Enfield et al. (2010). This finding is consistent with the subtlety of the RHD communication impairment—on the surface, adults with RHD appear to function similarly to neurotypical adults. The magnitude of production is, however, significantly lower for adults with RHD than controls.

Reduced production of questions in RHD may have a significant pragmatic effect on the communicative interactions. Some adults with RHD are not capable of gathering information implicitly; therefore, they may miss nonlinguistic behaviors that help to fill gaps in knowledge like gestures, eye contact, and intonational variation or may fail to recall past history with the communication partner. In considering the context of the first-encounter conversation, there is an expectation that requests for specific information allow a person to fill gaps in knowledge to meet the communicative goal (Athanasiadou, 1991; Freed, 1994). When questions are not asked with adequate frequency, the contextual information needed to compose language specific to the interaction may be affected and the interaction may cease to continue, as an extreme case. Our observation of reduced question use is due, in part, to reduced polar question use and, likely, to deficits in aspects of cognition.

## Questions and Cognition

The communication disorder associated with right hemisphere stroke has been designated as a cognitive-communication impairment (Hewetson et al., 2017). In this study, question-asking by adults with RHD was strongly associated with executive function domain scores and moderately associated with visuospatial domain scores from the CLQT. These two cognitive processes monitor, organize, and integrate information that is gathered in the communicative context (Ye & Zhou, 2009).

**Table 4.** Cognitive domain performance comparison by group.

| Cognitive domain | RHD ($n$ = 15) | Control ($n$ = 15) | $t(df)$ | $p$ | $d$ |
|---|---|---|---|---|---|
| Attention* | 182.00 (33.96) | 203.00 (7.71) | 2.34 (15.44) | .03 | 0.85 |
| Memory | 168.87 (14.98) | 172.60 (11.01) | 0.78 (28) | .44 | 0.28 |
| Executive function* | 28.00 (5.76) | 32.13 (4.85) | 2.13 (28) | .04 | 0.78 |
| Language | 32.60 (3.16) | 33.93 (2.22) | 1.34 (28) | .19 | 0.49 |
| Visuospatial** | 84.73 (14.31) | 96.73 (6.29) | 2.97 (19.21) | .006 | 0.71 |

*Note.* Scores are presented as mean (*SD*).
*$p$ < .05. **$p$ < .01.

**Table 5.** Correlations between CLQT domain scores and question types by group.

| Variable | Attention | Memory | EF | Language | Visuospatial |
|---|---|---|---|---|---|
| Alternative | –.02 | .02 | .15 | .03 | .13 |
| Control | –.25 | .02 | .15 | .06 | .12 |
| RHD | –.09 | –.09 | .06 | –.26 | –.06 |
| Content | .27* | .12 | .39** | .25 | .34* |
| Control | .12 | .10 | .26 | .32 | .12 |
| RHD | .30 | .11 | .52* | .13 | .38 |
| Polar | .23 | .18 | .35* | .23 | .31* |
| Control | .14 | .16 | .17 | .26 | .09 |
| RHD | .09 | .33 | .45* | .19 | .20 |
| Total | .23 | .15 | .41** | .22 | .35** |
| Control | .09 | .15 | .29 | .28 | .22 |
| RHD | .16 | .28 | .44* | .11 | .27 |

*Note.* CLQT = Cognitive Linguistic Quick Test; EF = executive functioning; RHD = right hemisphere brain damage.

*$p < .05$. **$p < .01$.

Asking questions, like most aspects of communication, relies on multimodal input wherein what we see, hear, and recall has a direct influence on what is asked. To produce a question, one must gather and integrate information about the conversational partner, communicative context, and situational goals. Based on R-FAQ, reduced use of questions during conversation may be indicative of an impairment in recognizing the need for information, generating inferences, and/or integrating contextually based information. In this study, the need for information was central to the First Encounter task and would be hard to accomplish through inference generation. The decision to pose questions to meet the conversational goal and structure of the question (i.e., polar vs. content question) is influenced by the available and desired knowledge (Kearsley, 1976). Furthermore, the production of each type of question may require different cognitive demands. That is, the processes involved in formulating a polar question may be different than those involved in formulating a content question, which requires much less attention, recall, and information integration on the part of the speaker. For example, asking a polar question, "Are you from North Carolina?" during the first-encounter conversation employed during this study suggests that the speaker has, at a minimum, attended to some feature such as accent, dialect, and attire and has some knowledge of the possibility that this person (a student at university) may have lived elsewhere. This question also suggests that the speaker is able to recall specific details about the relationship between dialect and geographic location while planning to ask a question in a "get-to-know-you" conversation that is focused on the topic of "birth place." Asking "Where are you from?", on the other hand, does not make similar demands on attention, memory, shared knowledge, and executive functions. This postulate should be tested for empirical and clinical purposes of understanding the RHD communication profile.

## Limitations and Future Directions

This analysis was conducted on a relatively small sample. While the conversation was dyadic, it was situated in an experimental context that may have inadvertently influenced the responses. Specifically, task, context, and conversational partner familiarity are three factors that are known to influence social interactions. Nevertheless, our findings shed light on the use of a semistructured discourse task that approximates nonexperimental communicative interactions and highlights differences in a pragmatically important aspect of discourse production. These findings point to the need for future studies that can improve our understanding of changes in language production after RHD that may not be obvious to clinicians using existing assessment methods. It is worth noting that analyses were not corrected for multiple comparisons, and these preliminary results should be interpreted with caution. Future inquiry should systematically evaluate models of discourse formulation and question-asking for greater understanding of the right hemisphere contribution to language production, using a larger sample size with closely matched variables of interest (e.g., age, education, and sex). Studies should also continue to probe these relationships between cognitive processes and the communication profile of individuals with RHD in different contexts. As discourse models predict, multiple sources of information are needed to produce discourse (Sherratt & Bryan, 2012), with attention, memory, and executive function capabilities being essential to question-asking specifically (Kearsley, 1976; Levelt, 1999).

## Clinical Implications

There is growing interest in the use of conversation during clinical assessment (Barnes et al., 2019). This study

demonstrates how adults with RHD use questions differently than controls in that context. There are several possible clinical and empirical uses of the R-FAQ. Determining whether adults with RHD are aware of the need for information in the conversational context may be a first step in teasing apart the aspects along the framework that may go awry after RHD. Indeed, reduced awareness is linked to poor functional outcomes after RHD (Jehkonen et al., 2000), although awareness within the context of language production deficits and more specifically question asking after RHD has not been explicitly examined. Second, given the known deficits in inferential processes after RHD (Brownell & Martino, 1998; Tompkins et al., 2001), targeted treatments for inferencing may lead to changes in question-asking. Lastly, conversational interaction constitutes a complex discourse that requires a host of processes including visual and auditory attention, inferencing, organization, and the integration of information. Research focused on delineating the specific contributions of cognitive processes may also prove fruitful in enhancing our overall understanding of question-asking after RHD.

Questions are easy to distinguish from other utterances for purposes of measurement in assessment and treatment. Moreover, given the demonstrable benefits of treatment to improve question-asking for other pragmatically compromised populations as well as the overall functional importance of question-asking, SLPs could borrow and modify these approaches to target questions for diagnostic and treatment purposes in RHD. Clinicians might elect to administer the first-encounter conversation task of the RHDBank during their initial meeting with patients for diagnostic purposes. This task lends itself nicely to the general practice of developing rapport with patients early in the therapeutic process. Then, the proposed conceptual framework could guide a population-specific treatment program to ultimately increase the overall use of appropriate questions, and polar questions more specifically, during conversational discourse for adults with RHD.

## Conclusions

Conversational discourse deficits are pervasive and enigmatic after RHD. Reduced question use during social conversation can have a significant negative impact on the successful, productive outcome of the conversation and, consequently, on the quality of social relationships. While there is growing understanding of the specific ways in which these deficits manifest behaviorally, there is much to be learned about the characteristics of the RHD language production impairment. This work explores specific linguistic characteristics of question use that can be quantified for assessment and treatment to understand and address cognitive-communication impairments in RHD.

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