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Assessment of cognition in aphasia: Perspectives from clinicians and researchers

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ABSTRACT

People with aphasia may present with cognitive impairments beyond language. In this population, reliance on language-based assessments of cognition may lead to unreliable metrics of cognitive performance across clinical and research settings. We investigated the underlying philosophy and practice of assessing cognition in people with aphasia. An e-survey was developed for multidisciplinary clinicians and researchers. Snowball sampling was used to recruit international participants. The e-survey comprised 29 items (a mix of multiple-choice and open-ended items) addressing definitions of cognition, assessment of cognition, tools used to assess cognition and participant demographics. Data were analysed using descriptive statistics and thematic analysis. 291 respondents participated from a range of disciplines and countries. Over 80% of respondents considered it important to assess attention, executive functions, learning and memory.

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The main barrier to assessment was the lack of appropriate tools available for people with aphasia. Responses indicated that whilst professionals felt that understanding the interaction between language and cognition in aphasia was important for providing optimal care. This study highlights the need for better awareness and training in the assessment of cognition in people with aphasia, and for psychometrically robust assessments, appropriate for the assessment of cognition in the presence of aphasia.

Introduction

In addition to impaired linguistic abilities, people with aphasia may present with non-linguistic cognitive difficulties, such as those affecting memory, attention or executive functioning (Fucetola et al., 2009; Gilmore et al., 2019; Mayer & Murray, 2012; Murray, 2012). As such, comprehensive cognitive assessment in people with aphasia is recommended in research settings (Kuzmina & Weekes, 2017; Murray, 2012; Murray, 2017). The need for such testing, either directly or indirectly, is also included in the most recent clinical guidelines for healthcare professionals (e.g., American Speech-Language Hearing Association, 2024; Australian Aphasia Rehabilitation Pathway, 2024; Australian and New Zealand Clinical Guidelines for Stroke Management, 2024; Canadian Stroke Best Practice, 2020; National Clinical Guideline for Stroke for the UK and Ireland, 2023). Disentangling linguistic and other cognitive impairments and residual abilities is essential for understanding the extent of the non-linguistic cognitive difficulties people with aphasia may face, how these interact with their linguistic impairment, and how they might impact intervention planning and prognosis (Brownsett et al., 2014; Diedrichs et al., 2022; Fonseca et al., 2019; Simic et al., 2020). The influence of non-linguistic cognitive ability on a person's response to therapy is also not understood. Whilst some studies have reported an absence of a relationship between residual cognitive abilities and therapy response (e.g., executive control: van de Sandt-Koenderman et al., 2007; for a review see Diedrichs et al., 2022), others have drawn attention to the relevance of cognitive abilities, beyond language, in aphasia research and clinical practice (Brownsett et al., 2014; LaCroix et al., 2021; Schumacher et al., 2019, 2022b; Varkanitsa et al., 2023), and have demonstrated that better cognitive abilities are associated with a greater response to therapy (e.g., executive control: Simic et al., 2020).

Relatively large-scale studies ($n > 40$ participants with aphasia) from different countries have investigated memory, attention, and executive functions more broadly, using non-linguistic cognitive tests. These studies have highlighted a variable prevalence of non-linguistic cognitive impairments across different cognitive domains (e.g., El Hachioui et al., 2014 – the Netherlands; Fama et al., 2024 – USA; Fonseca et al., 2019 – Portugal; Yao et al., 2020 – China;

Marinelli et al., 2017 – Italy; Olsson et al., 2019 – Sweden; Seniów et al., 2009 – Poland). For example, Olsson et al. (2019) examined non-verbal executive function in people with severe aphasia using subtests of the cognitive screener, the Cognitive-Linguistic Quick Test (Helm-Estabrooks, 2001). Mean performance across all subtests (symbol cancellation, symbol trails, design generation, mazes) showed that 79% of the sample were below neurotypical performance. In individual subtests, 70% of individuals were impaired in design generation, whereas only 38% of participants were impaired in the mazes subtest. Diverse performance patterns were also reported by Fonseca et al. (2019). For example, immediate recall for faces (tested with the Wechsler Memory Scale) was unimpaired in all of their 48 participants, whereas in the five-objects memory test (immediate recall condition), 54% of participants were impaired. In symbol cancellation, a test of visual attention, only 20% of the sample were impaired. We should note that control participants were people who had suffered a left-hemisphere stroke but did not present with aphasia. Fama et al. (2024) focused on non-linguistic inhibitory control using experimental tasks such as the Simon and Go/NoGo tasks (rather than published psychometric tests). They also found mixed performance profiles with some people scoring within normal limits, while others scored within impaired ranges (relative to neurotypical controls).

The findings of these and other studies in this literature highlight several issues which are relevant to researchers and clinicians who work with people with aphasia alike, over and above the clear variability in cognitive skills in people with aphasia. Even prototypically verbal cognitive tests such as the Hayling or word fluency can be interpreted as reflecting components of cognition, initiation/suppression, generation/switching respectively (Schumacher et al., 2022a). They underscore the need to invest time in cognitive testing beyond language to discern strengths and weaknesses in people's profiles which could have prognostic implications (cf., El Hachioui et al., 2014) and implications related to goal setting, monitoring, and measuring outcomes in rehabilitation (e.g., Nicholas & Tabor Conor, 2017). However, they also show that some cognitive tests are more sensitive than others in revealing the presence and severity of cognitive problems in addition to language. Furthermore, in the studies mentioned in the previous paragraph, it was not always clear what motivated assessment selection by those researchers. This issue is partly addressed in the present study, and we will return to it in the Discussion.

Another line of research with relatively large sample sizes ($n > 30$) has explored non-linguistic as well as linguistic executive function measures and their relation to fundamental aspects of language (e.g., spoken naming, sentence comprehension). Using principal component analyses (PCA) of 16 language and two non-verbal cognitive measures (Brixton test, Raven's test), Butler et al. (2014) found dissociable factors among cognition, phonology, and semantic abilities. The cognition factor was derived primarily from the

Brixton and Raven's tests. Using the same participants, in a follow up study, Halai et al. (2017) explored connected speech measures (e.g., words per minute, utterance length) as well as other language measures. Like Butler et al., the Brixton and Raven's tests clustered separately from connected speech measures and the latter separately from phonological and semantic abilities. Moreover, Schumacher et al. (2022a) argue that verbal cognitive tests (Stroop, Hayling, semantic word fluency) which are often challenging for people with aphasia, do retain their cognitive-related construct validity and that severity of aphasia alone does not explain performance in those tests.

Despite the evidence of variability in non-linguistic cognitive impairment, aphasia research does not consistently test or report on cognitive abilities. Indeed, our review of published data between 2010 and 2020 showed that nearly half (47.5%) of studies in the aphasia literature did not report assessments of cognition (Tessaro et al., 2024). Furthermore, it is also unclear to what extent this lack of reporting also reflects a lack of cognitive assessment in clinical settings, even though aphasia care typically involves a range of healthcare professionals with varying skills and experience in neuropsychological testing (Block et al., 2017).

There are a few reasons why the reporting of cognitive testing and abilities might be limited. First, clinicians may be unsure which non-linguistic abilities are important to assess in aphasia. For example, there is little consensus regarding which cognitive functions should be evaluated when establishing decision making capacity in aphasia (see Kim et al., 2020). Clinicians and researchers may also lack clear guidelines on the most suitable assessment tools available (Fonseca et al., 2016; Simic et al., 2019), and who, within the multidisciplinary team, should be responsible for conducting and interpreting these assessments.

If clinicians and researchers are able to reach consensus on how best to assess cognition in people living with aphasia, this will guide clinical decision-making and management to ensure appropriate diagnosis, and optimized management. In addition, it will support researchers working across these domains to better understand the concomitant contribution of different impairments, how these might interact, as well as differential diagnosis, and recovery and rehabilitation. Without a clear understanding of how cognition and language interact, and dissociate, clinical and research disciplines are unable to tease out the different essential ingredients of therapeutic targets. If consensus is unable to be obtained using existing tools, this will serve as an important motivator for the research and clinical communities to collaboratively develop an optimized tool, or series of tools, that specifically address this clinical problem (see Schumacher et al. (2022b) for an example of this approach).

The present study aimed to identify current practice, including clinical and research requirements, relating to assessment of cognition in aphasia. This was achieved by surveying healthcare professionals and researchers from diverse disciplines on their philosophy and practice of assessing cognition in

people with aphasia. To establish a clear working definition of cognition in this context, we first surveyed respondents regarding their understanding of cognition. We then probed their opinions about the importance of assessing cognition in aphasia, and which cognitive constructs they felt needed to be assessed. Furthermore, given the lack of consensus as to which assessment tools should be used (Fonseca et al., 2016), we probed which tools were being used, how they were selected, what aspects of cognition they aimed to assess, and any barriers faced when assessing cognition in aphasia. Finally, we also asked respondents' opinions about whose role it is to assess cognition and convey assessment results to people with aphasia and their carers and/or family members.

Materials and methods

This research was approved by the Research Ethics Committee of Newcastle University, School of Education, Communication & Language Sciences. The study used a cross-sectional online survey design. To ensure best practice in survey methodology, the Checklist for Reporting Results of Internet E-Surveys (CHERRIES) was used as a guideline (Eysenbach, 2004). LimeSurvey, a free and open-source on-line survey tool, was used to design and host the survey. The survey was open, voluntary and accessible via a web link. The survey began with a brief introduction of its purpose. Respondents could read the full participant information sheet by clicking on a hyperlink that opened a PDF containing detailed information about the study, the investigators, the purpose of the study and expected duration of the study. Consent was provided by informing participants that continuing with the survey (i.e., clicking "next") they agreed to take part. Responses were timed and anonymized (responses did not have the IP address logged), and participants could save a partially finished survey and return to it at a later date. Participants were not able to go back to earlier pages and responding to all questions was not mandatory. All data were collected from April to July 2021. No incentives were offered to complete the e-survey.

Survey structure and content

The survey comprised 29 questions organized into four sections: Section 1 – definitions of cognition in aphasia (2 questions), Section 2 – assessment of cognition in aphasia (10 questions), Section 3 – tools to assess cognition in aphasia (7 questions), and Section 4 – participant demographics (10 questions) (for specific questions see Supplementary Table 1). Multiple choice, yes/no, open-ended (free text), and Likert scales response types were used. Following the introduction and consent page, the survey contained 5 pages with all questions from the same section on the same page, except that the section "Definition of cognition in aphasia" was split over two pages.

Given ambiguity around the extent to which language is considered a component of cognition, with language often excluded from the operationalization of cognition, we wanted to understand respondents' definitions of cognition, prior to asking more specific questions about the assessment of cognition. Therefore, the first section included two questions regarding the definition of cognition in aphasia. An open-ended question "What does the term cognition mean to you?" (Question 1) was first asked, then a second question asked respondents to indicate, from a list provided, the domains that they considered fell under their definition of cognition (Question 2).

The second section included ten questions that aimed to gather respondents' opinions about assessment practices in the context of aphasia. Six questions required forced choice answers or ratings, and four questions free text responses. Questions 3, 6, 7 required respondents to select options from a list provided, with question 3a, 4a, and 5a providing an opportunity to expand using free text responses. Questions 4 and 5 required a Likert scale response, asking to rate the importance of assessment of cognition, and the domains of cognition that should be assessed respectively. Question 8 required yes/no responses, and 8a asked respondents to "list in rank order list any barriers you have experienced find in assessing cognition in aphasia." If respondents indicated in Section 2 that they never assessed cognition in aphasia, then they were instructed to skip Section 3 and move to Section 4.

The third section included seven questions regarding the tools used by clinicians and researchers to assess cognition in aphasia (free text Questions 9 and 10), what the difficulties were (if any) in this assessment (Questions 10 (open-ended), 11 (yes/no), 11a (open-ended)), and if they changed their approach when assessing cognition in aphasia as compared to individuals without aphasia (Questions 12 (yes/no), 12a and 13 (open-ended)).

The fourth section comprised demographic questions about respondents' country of practice, age group, professional identity, work setting, and experience of working with people with aphasia.

Participant recruitment

The survey was disseminated through mailing lists (aphasia associations, research groups, professional societies, university departments), newsletters, and/or posting on social media pages. A snowball sampling approach was used with e-mail invitations sent to professional contacts of the authors, asking that they both complete the survey and forward it to relevant people and/or mailing lists. To increase participation from non-English speaking countries, whilst the questionnaire was only available in English, we allowed responses in languages other than English. Responses that were not in English (i.e., French, Spanish and German) were translated by speakers of the respective languages (SH, SB, CP).

Pilot survey

The survey was developed by iterative discussion by the author team. Eight professionals working with people with aphasia were invited to complete a pilot version of the survey. As we aimed to survey a multidisciplinary team, given that the initial survey was designed by speech and language therapists, we ensured that we selected other professionals to complete the pilot. Specifically, respondents were two neuropsychologists, three occupational therapists, one physiotherapist, and two neurologists. Of these, two identified as clinicians, two as researchers and four as both clinicians and researchers. Two respondents had more than 10 years of experience working with people with aphasia and six respondents had between four to 10 years of experience. They provided feedback on the survey structure. Following their feedback, changes were made to reduce the length of the Introduction and consent page. Given that no changes were recommended to the survey items themselves, the pilot data were included in the final analysis.

Data analyses

Survey items were analysed based on response type. Accordingly, quantitative methods were used to analyse data from multiple-choice, yes/no, and Likert scale responses (Questions 2-5, 6-9, 11-12). Qualitative methods were used to analyse data from open-ended questions (Questions 1, 3-5, 8, 11-12).

Descriptive statistics were computed in R Core Team version 4.2.1 (2022) for multiple-choice questions (i.e., Questions 2, 6-7, 9). A qualitative approach, described below, was used to analyse the open-ended question (i.e., Question 1). Mixed qualitative and quantitative analyses were performed for yes/no, multiple choice, and Likert scale questions that were combined with an open-ended question (i.e., Questions 3-5, 8, 11-12).

Qualitative analysis

Thematic analysis (Braun et al., 2019; Braun & Clarke, 2006; Clarke & Braun, 2017) was used to analyse the text data from the survey. Codes were created by identifying and labelling discrete segments of data that captured a single idea of interest relevant to the research question (Braun et al., 2019). Themes were then created by identifying an idea or concept that summarized recurring patterns of codes across the data (Braun & Clarke, 2009).

There were three steps to this analysis:

Step 1 – identification: one author (BT) created codes based on the responses to each question and identified possible themes. Each code was revised by checking the responses assigned to it and, if needed, the name of the code was refined to better reflect the responses under that code. At this stage, some codes were either combined into a single code (if sufficiently similar to

the same code) or divided into more than one code (if sufficiently different to justify the creation of one or more additional codes). Responses were re-checked against the assigned codes.

Step 2 – codebook revision: one author (SB), who also participated in the pilot stage, reviewed and revised the codebook, indicating if they agreed with the name of the codes, the code structures (relationships between higher – e.g., "Materials" in the responses to the question targeting barriers to assessing cognition in aphasia, and lower-level codes – e.g., "Access to assessments and resources" for the same question), and the examples for each code. Suggested revisions were reviewed (BT, CS, SH), via consensus, to determine which should be implemented. The data were recoded using the revised codebook.

Step 3 – interrater reliability: an interrater reliability measure to assess the rigour and transparency of the analysis was calculated following the guidelines of O'Connor and Joffe (2020). Following initial coding (BT), second rater (TS), blinded to the initial coding, coded 25% of the dataset (25% of the responses to each question) according to the revised codebook. Interrater reliability was calculated in two ways: percentage agreement (PA), the percentage of the content where the two raters agreed on the coding, and Cohen's Kappa coefficient, a statistical measure of inter-rater reliability which considers the amount of agreement that could be expected to occur through chance. Kappa values below 0.40 indicate poor agreement, values between 0.40 and 0.60 indicate moderate agreement, values between 0.61 and 0.80 indicate substantial agreement and values over 0.81 indicate almost perfect agreement (Landis & Koch, 1977).

Reliability

The inter-rater reliability of the final coding (see Supplementary Table 3) showed very high (>97%) percentage agreement on all questions, and Cohen's Kappa co-efficient showed moderate to almost perfect agreement between raters. As such, no further coding revisions were considered necessary.

Results

504 survey attempts were made, and, of these, 205 surveys were completed, providing a completion ratio of 0.41. One attempt was excluded because the respondent identified as a person with aphasia, for a total of 204 survey respondents. The average time spent responding to the survey was 32.6 min (SD = 172.2, median = 12.5), including pauses.

Respondents' demographic characteristics

Most respondents (52%) were located in European countries, followed by North America (28%), Oceania (15%), Asia (3.9%), Africa (0.5%), and South America

(0.5%). Most of the sample (62.6%) were aged between 18 and 44 years, with 37.4% aged 45 or older (see Supplementary Table 2).

Most respondents indicated they were Speech and Language Pathologists (SLPs) (64%), followed by neuropsychologists (13%) and occupational therapists (8.3%). About half of respondents identified as clinicians (51%), followed by those that identified as both clinician and researchers (35%), and researchers (14%).

About half the sample (53.4%) indicated that they had more than 10 years of experience working with people with aphasia, and 35.3% reported having between 4 and 10 years of experience. Most of these professionals reported working with people with aphasia three or more days per week (58%), with 7.5% reporting variability (e.g., "depending on the research project I am engaged in"). 5% indicated they were not currently working with people living with aphasia (PWA).

Qualitative analysis

First, 294 codes encompassed by the responses were identified and created. Next, 222 of 244 suggested revisions to the codebook reached consensus for revision and were incorporated in the revised codebook. The following sections discuss each question in turn and summarize the main themes identified from the codes, providing some illustrative responses. Quantitative and qualitative results for each survey question are summarized, in turn below.

Section 1: defining cognition in the context of aphasia

The first question asked respondents to define cognition. Three main themes were identified in the responses: (1) how the concept of cognition was referred to, (2) the processes that cognition allows, and (3) cognitive domains listed as part of cognition. For example:

> *The (thought processes)$_{[1]}$ that allow us (to understand and interact with our environment)$_{[2]}$.*

> *Cognition is a broad term comprising of (memory, language, attention, thinking, reasoning, executive functions)$_{[3]}$ which are important in daily functioning.*

Most respondents defined cognition as a set of skills, mental processes and brain functions that allow individuals to think, problem solve, learn, plus process and integrate information. They also indicated that cognition allows individuals to perceive, navigate and interact with the environment, and to reason and plan. Most responses listed domains that the respondents would include as part of cognition (e.g., memory, attention, executive functions, language).

In Question 2, respondents were given a list of several cognitive domains and were asked which fell under their definition of cognition. Most respondents

indicated they would include attention, memory, executive functions, learning, processing speed, social cognition, visuoperceptual and visuoconstructional abilities, and language (see Figure 1). Whilst only 14 people (11%) included motor function and praxis in their definition of cognition in Question 1, on this second question 160 respondents (54%) indicated that they considered praxis to be part of cognition. Specifically, 148 respondents included praxis in their multiple-choice definition of cognition, but not in their open-ended response to Question 1. Thirty-one respondents (24%) commented that constructs such as praxis and social cognition were composite abilities reliant on other abilities such as language, attention and memory.

When asked to define cognition (Q1, 260 respondents), or comment on the language domain (Q2, optional, 35 respondents), 16% of respondents (47/295 responses) mentioned that language and cognition possibly interact. Nine respondents indicated they did not consider language to be part of cognition, and two respondents (0.7%) mentioned that they believed cognition was not dependent on language. Two further respondents commented that they were aware that language and cognition can be selectively impaired:

> *This [language] is hard to tease out from cognition, but there are people who are profoundly affected in their ability to receive and convey symbols who nevertheless are functional otherwise.*

Twenty-six respondents (9%) suggested that while both domains are inextricably linked, they may still be considered discrete functions. Finally, eight

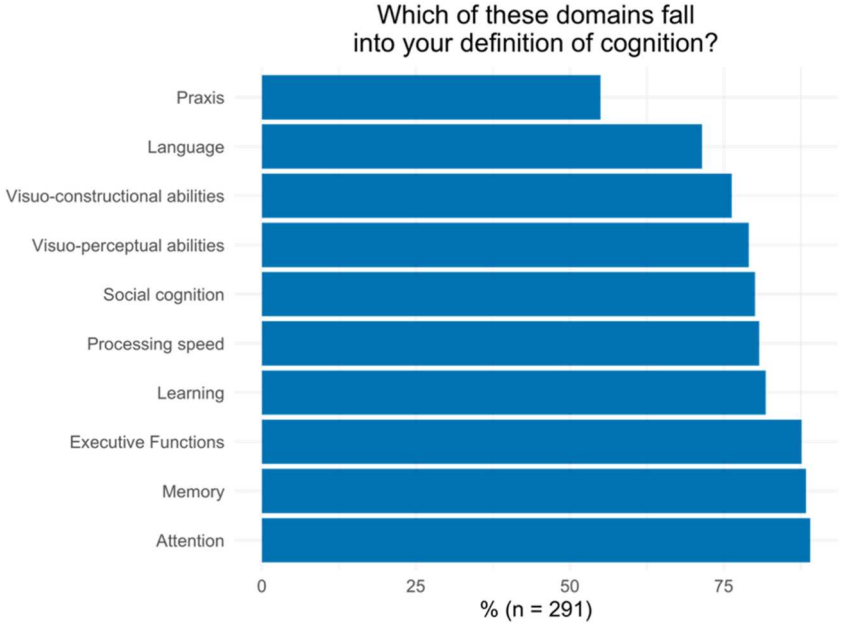


Figure 1. The cognitive domains that respondents indicated they included in their definition of cognition.

respondents shared that they considered language to be part of cognition, and how this is reflected in clinical practice:

> *I find it unfortunate that clinical tools, especially assessments, often dichotomize language and cognition.*

Section 2: current practice in the assessment of cognition in aphasia

This section comprised questions that sought to gauge current practices regarding the assessment of cognition in aphasia, focusing on the reasons that influence the decision to assess cognition in people with aphasia (Question 3, 3a, 4, 4a), which aspects of cognition should be assessed (Question 5, 5a), which professionals should be responsible for assessing cognition and discussing assessment findings (Question 6), and identifying any barriers to assessment (Question 8, 8a).

Question 3: what considerations influence your decision to assess cognition in PWA?

This question asked which factors influenced the decision to assess cognition, but as it was a multiple choice question, respondents did not indicate how the decision was influenced. As shown in Figure 2, the greatest numbers of respondents indicated that their decision to assess cognition in aphasia was influenced by reports of cognitive deficits by the person with aphasia or their

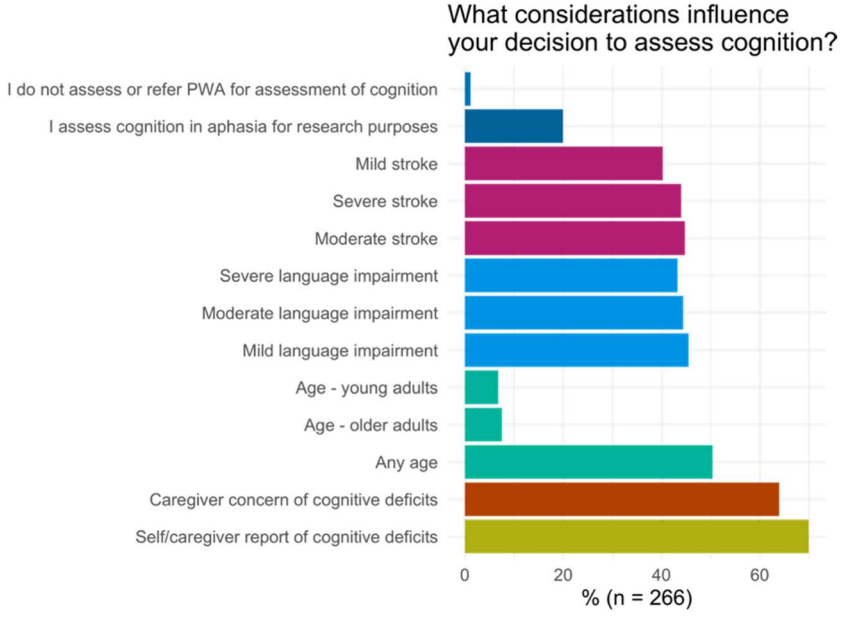


Figure 2. Considerations that influence respondents' decisions to assess cognition in aphasia.

caregiver (69.9% of 266 respondents), and/or when caregivers reported concern about the cognition of people with aphasia (63.9%).

Half the respondents indicated that age did not influence whether they would assess cognition (50.4%), with relatively small numbers indicating that older (7.52%) and younger (6.8%) age would influence their decision to assess cognition. Nearly half of respondents indicated that stroke severity influenced their decision to assess cognition, with similar numbers for severe (45%), moderate (44.7%) and mild (40.2%).

Language impairment was also considered by slightly less than half of the respondents: 45.5% responded that they assessed cognition for people with mild, 44.3% with moderate, and 43.2% with severe language impairment. Twenty percent of respondents reported that they assessed cognition in aphasia for research purposes. Only 1.1% (2 respondents) indicated that they did not assess or refer people with aphasia for cognitive assessment, noting that they lacked training in completing cognitive assessments, and a lack of appropriate time and resources.

Question 4: how important is the assessment of cognition for specific purposes?

Respondents were asked to rate the importance of each of a list of potential reasons for assessing cognition in aphasia (Figure 3). Overall, most respondents (>60%) considered it important, or very important, to assess cognition for treatment planning and rehabilitation, to facilitate return to employment, to provide education about cognitive function and impairment, to recommend strategies

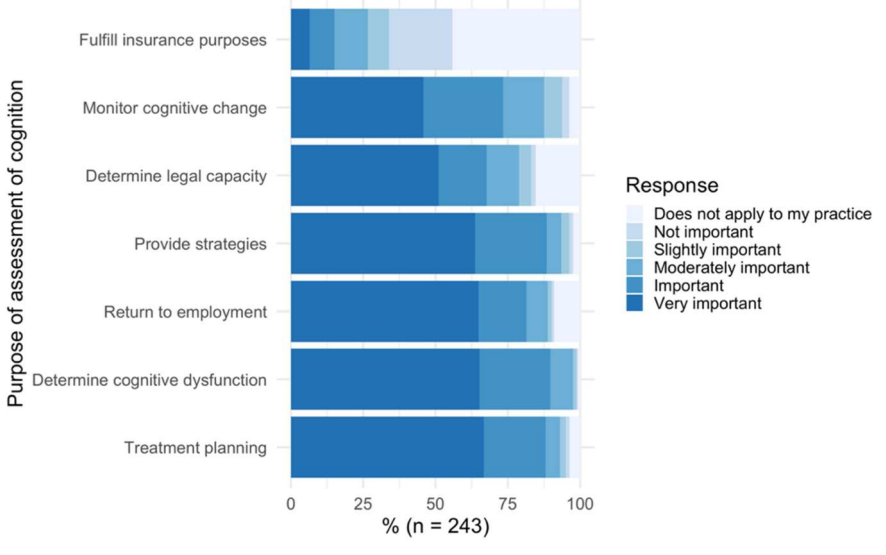


Figure 3. Respondent's ratings of the importance of assessing cognition for specific purposes.

for patients and/or caregivers, to determine legal capacity, and to determine the level of cognitive impairment beyond language. Assessing cognition for insurance purposes applied to the practice of about half the respondents, with 15% of these respondents considering this important, or very important.

In response to an open-ended optional follow-up to Question 4 (Question 4a), 66 participants listed other reasons to assess cognition not listed in the response options. Three themes emerged from these responses (Supplementary Table 4): discharge and intervention planning, understanding of cognition in aphasia, and determining cognitive status.

Comments related to assessing cognition for discharge and intervention planning mostly referred to returning to activities of daily living, such as driving and returning to work. Respondents reported assessing cognition to help determine the best treatment options for people with aphasia, and how to provide better multidisciplinary support. Other reported purposes of cognitive assessments included to determine the impact of language and cognition on activities of daily living, provide information on cognitive status, monitor change, plan neurosurgery, and determine research inclusion criteria.

Question 5: which aspects of cognition should be assessed in aphasia?

This question aimed to gauge the perceived importance (not important, slightly important, moderately important, important, very important) of assessing each aspect of cognition. Participants were asked the level of importance of assessing nine different cognitive domains: attention, executive functions, learning, memory, praxis, processing speed, social cognition, visuoconstructional, and visuoperceptual processing.

All domains were considered at least moderately important by at least half of the respondents. The domains of attention, executive functions, learning and memory were considered important or very important by over 80% of respondents. Over half of the respondents indicated that attention (55%) and executive functions (51.2%) were very important. These were followed by about 60% of respondents indicating that the assessment of praxis, processing speed, social cognition and visuoperceptual abilities were important or very important. Half of the respondents considered visuoconstructional abilities important, or very important to assess.

A follow-up optional question asked respondents to indicate any other aspects of cognition they believed should be assessed in aphasia. There were 42 responses to this question, but with very little consensus on the additional areas including: insight and awareness ($n = 4$), mathematical skills ($n = 3$), self-monitoring and/or self-correction ($n = 5$), emotional issues and/or mood ($n = 3$), non-verbal cognition ($n = 2$), visual processing ($n = 2$), working memory ($n = 2$), abstraction ($n = 1$), flexibility ($n= 1$), inhibition ($n = 1$), orientation ($n = 1$), processing speed ($n = 1$), reasoning ($n = 1$), set-shifting ($n = 1$), and social ability ($n = 1$).

Eleven respondents indicated the importance of individually determining assessments:

> *It depends on why the person is tested. I seldom test learning and processing speed because these functions normally are very reduced in my patients. Instead, I inform patients and relatives about how to take this into account. If the question is whether the patient can drive a car again, I test processing speed.*

One respondent highlighted the important point that an overview of all cognitive abilities of the person with aphasia is crucial for both diagnosis and treatment:

> *I think it is ill-considered to treat aphasia in isolation, as if it is 'just' a language deficit. If you don't have a big picture overview of cognitive functioning, you cannot properly treat or understand the aphasic patient.*

Questions 6 and 7: who should assess cognition in aphasia and discuss the results?

In Questions 6 and 7, participants were asked about whose role it was to assess cognition and discuss results with caregivers and/or family members of people with aphasia (Figure 4). Respondents could choose as many professions as they felt were applicable, and hence the responses do not reflect the opinion that only a single professional group should assess cognition in people with aphasia. Around 80% of respondents indicated that neuropsychologists should assess and discuss cognitive functioning in people with aphasia, and a similar percentage of respondents indicated the same for SLPs. This was

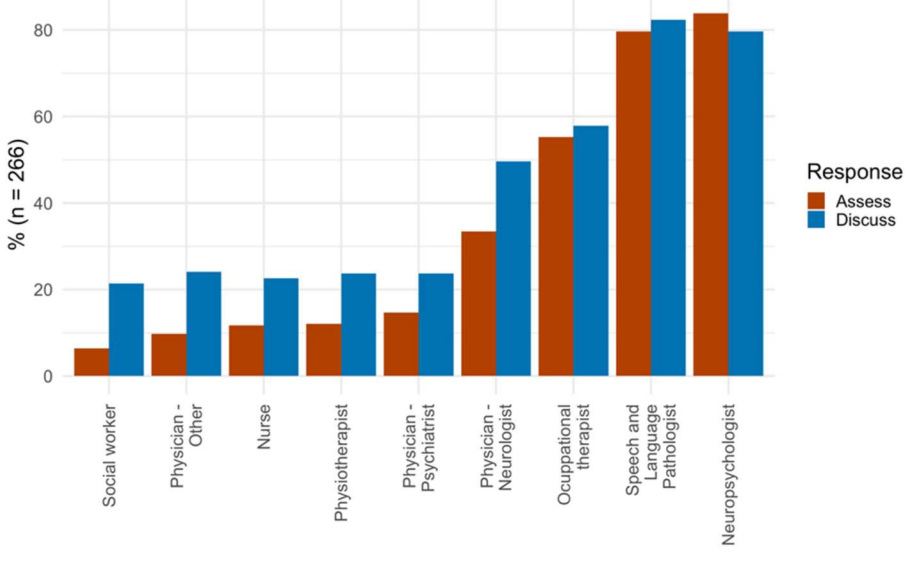


Figure 4. Responses to multiple-choice questions: "Who should assess cognition in aphasia?" and "Who should discuss the results?"

followed by around 56% of respondents indicating that it could be the role of occupational therapists. A third of respondents (33%) felt that neurologists should be responsible for assessing cognition in aphasia, but half suggested that neurologists could take the role of discussing the results.

Respondents were also given the opportunity to comment further and specify additional professionals. Most of these comments highlighted that both the assessment of cognition and discussion of results should be carried out by a multidisciplinary team. Others noted that the professional carrying out the assessment would vary across cases, and that the professional discussing the results should either have performed the assessment or be involved in their rehabilitation. Some respondents stated that both assessment and discussion should be carried out by professionals trained in the assessment of cognition, and that assessments also required a professional who had specific experience working with people with aphasia. Two respondents indicated that the discussion should have SLP support.

Question 8 and 8a: what are the barriers to assessing cognition in aphasia?

Question 8 (yes/no question) aimed to gain insights into any barriers experienced when assessing cognition in aphasia. Some respondents indicated that this was not applicable to their professional role (6.8%) and/or workplace (10.4%). Of the remaining respondents, over half had experienced barriers in their professional role (68.9%) and/or in their workplace (64.6%). 158 respondents specified these barriers in open-ended responses to Question 8a (431 barriers), which were classified into five themes: barriers related to materials (39.2%), professional role (26.9%), professionals' knowledge and skills (17.2%), the people with aphasia (11.8%) and other reasons (4.9%). These themes are explored further in Table 1.

Materials: Barriers related to materials were most prominent and included a lack of appropriate assessments and resources for use in aphasia (especially severe aphasia), and lack of access to test materials that did exist. Respondents were concerned that materials were highly dependent on language skills, and that there was a lack of appropriately normed, standardized, and functional assessments. Other reported barriers to assessing cognition in people with aphasia included: restrictions in the use of certain assessments (e.g., psychologists only), the prohibitive cost of assessments, a lack of assessments in multiple languages, the complexity of test instructions, an over reliance on formal scoring, and a lack of consensus on which tests to use.

Professional role: In a clinical setting, the lack of clarity of professional roles was a common theme. Respondents indicated that it was often unclear which professionals were responsible for cognitive assessment in aphasia. They also reported that the assessment of cognition was not considered within their

Table 1. Barriers to assessing cognition in aphasia reported (n of respondents = 158).

Theme (Number of responses)	Sub-themes (Number of responses)	Illustrative quotes
Materials (169)	Appropriateness of assessment and resources (67)	*"Lack of appropriate tests/resources."*
	Access to assessments and resources (29)	*"Sometimes, it is not accessible to me to get the means for a relevant evaluation."*
	Materials are highly dependent on language (26)	*"Concerns which tests might be appropriate to assess cognitive functions in people with aphasia since most tests are heavily based on language."*
	Lack of normed and standardized materials (16)	*"Having tools available that are normed and adapted for people with aphasia."*
	Restrictions on use of assessments (7)	*"No access to psychology services which would be helpful to analyse assessment results."*
	Lack of functional assessments (5)	*"Inability to assess patient functionally in a clinic setting (how they do pointing to safety hazards in a picture may not reflect their own judgement/safety out in the community)."*
	Cost of assessments (5)	*"Availability of measures and tools (and training in them). Barriers include 'we don't have that in our department and don't plan to get it' to too expensive to some publishers' restraint of trade, limiting use to neuropsychologists or others with at least a doctorate."*
	Especially for severe aphasia (4)	*"Standardised accessible cognitive and linguistic assessment for severe aphasia."*
	Multilingual assessments (4)	*"Availability of test batteries in different Indian languages."*
	Complexity of test instructions (3)	*"Using standardised assessment as outlined in manual can mean that the instructions are too complex for someone with aphasia. Modifying / simplifying the instruction can allow the person to answer the question / carry out the task but this impacts on the standardisation / validity of the result."*
	Over reliance on scores of formal tests (2)	*"Overreliance on some cognitive tests which do not adequately look at aphasia."*
	Lack of consensus (1)	*"Lack of a widely agreed upon test or tests to use for this purpose – CLQT may come closest to filling this purpose."*
Professional role (116)	Clarity of MDT roles (43)	*"Lack of understanding of colleagues – misconceptions that you can't assess cognition effectively in people with aphasia. I find this in particular comes from neuropsychologists who leave these patients in the 'too hard basket' for the OTs and SLTs to assess."*
	Time limitations (32)	*"Lack of time and have to prioritize between language and cognition for sake of evaluation report."*
	Skills limitations (12)	*"Not having the knowledge and skills to assess as here it is the Occupation Therapists domain."*
	Access to neuropsychology (10)	*"No access to psychology services which would be helpful to analyse assessment results."*
	MDT communication (12)	*"Understanding the person with cognitive communication profile is the foundation to making progress, once you have achieved awareness you really start to make progress – getting the whole team on the same page really helps the person with cog communication."*
	Insurance constraints (4)	*"Insurance does not pay that practice to a speech therapist."*
	Occupational Therapists access cognition (4)	*"Cognitive assessment is the territory of Occupational Therapists in my workplace."*
	Staff availability (4)	*"I am under resourced (staffing/competing workload priorities) to seek an increased role in cognitive assessment."*

(*Continued*)

Table 1. Continued.

Theme (Number of responses)	Sub-themes (Number of responses)	Illustrative quotes
	Importance of cognitive assessment (3)	*"Difficulty justifying importance/role of cognitive assessment to MDT."*
Knowledge and skills (74)	Knowledge and experience with assessment (29)	*"Insufficient training/education in the multidisciplinary team to understand reports and evaluation results."*
	Differential diagnosis in the presence of aphasia (20)	*"The presence of aphasia makes it difficult to determine whether any concerns are due to language or cognition."*
	Understanding of cognition (13)	*"A lack of agreement on the state of cognition in aphasia and the relationships that exist."*
	Understanding of aphasia (7)	*"Healthcare providers not being sufficiently educated about aphasia."*
	Awareness of comorbidities (5)	*"Reduced awareness and understanding by other professionals of cognitive difficulties for people with aphasia, particularly attention skills."*
People with aphasia (51)	Impact of aphasia on assessment of cognition (33)	*"Severity of aphasia which may impair verbal responses for cognitive assessment instructions."*
	Awareness of deficits (4)	*"Presence of poor insight into an aphasia in early stroke can make engagement in cognitive assessment challenging."*
	Engagement with assessment (3)	*"Severely depressed and/or apathetic subjects."*
	Fatigue (3)	*"Fatigue. This is a big issue. Often one cannot assess for longer than 30 min at a time in the early stages after stroke."*
	Impact of motor deficits on assessment of cognition (3)	*"Other stroke deficits affecting deficits e.g., if dominant hand is affected can't hold a pen, or if there is a limb apraxia may affect gestural use or assessment on a motor or functional task."*
	Knowledge of cognition (3)	*"Patient's and caregiver's knowledge and understanding of aphasia and cognitive impairments."*
	Unilateral spatial neglect (2)	*"Hemi attention / unilateral spatial neglect."*
	Estimating pre-morbid abilities (3)	*"Sometimes difficult to access families and therefore know about the patient's prior interests and capacities."*
	Location of assessment process (3)	*"Many cognitive functions are best assessed in the patients known environment (at home) and I meet them at the hospital"*

Notes: Numbers in brackets denote number of responses that were coded at each sub-theme. This question elicited 260 responses, but each response can be coded at more than one theme. Please note that the illustrative quotes may also have been coded at other themes and sub-themes. [1]17 responses were classified as unclear; MDT: Multidisciplinary team; CLQT: Cognitive Linguistic Quick Test; SLT: speech and language therapist; OT: occupational therapist.

scope of practice (five of the 12 responses were from SLPs, the remaining seven did not indicate their professional identity), and that it was considered the occupational therapist and/or neuropsychologist's role.

Time constraints were mentioned as a major barrier, due to the need to prioritize language assessments given the limited time often available to work with people with aphasia. A minority of responses included insurance constraints and staff availability as barriers. Three respondents indicated that they found it difficult to explain to other professionals the importance of assessing cognition in people with aphasia (two responses from SLPs, the remaining respondent did not indicate their professional identity).

Knowledge and skills: Some of the responses suggested that another barrier was their own lack of knowledge and experience with cognitive assessments.

Some professionals identified a further barrier as being that some (non-SLP) professionals had limited awareness that non-linguistic cognitive deficits might also be present in aphasia.

Difficulties disentangling linguistic impairments from non-linguistic cognitive impairments using many of the available assessments was also mentioned, along with a limited understanding of aphasia amongst non-SLP professionals and limited understanding of cognition amongst SLPs.

Aphasia and comorbidities: This theme related to barriers inherent to aphasia and its associated co-morbidities. The negative impacts of both aphasia and motor deficits on the assessment of cognition were indicated by some respondents. These deficits impacted on the task demands of the assessment (i.e., understanding test instructions, writing test responses). Personal factors, such as self-awareness of aphasia, engagement or fatigue were reported as barriers.

Section 3: tools for assessing cognition in aphasia

The third part of the survey comprised open-ended questions about the tools respondents used to assess cognition in aphasia (Q9), the cognitive constructs they aimed to measure (Q9), the factors influencing the choice of tools (Q10), and perceived difficulties in choosing tools (Q11).

Question 9: the tools used to assess cognition in aphasia

Table 2 provides a summary of the tools cited by 10 or more respondents (see Table 4 in Supplementary Materials for all responses and their classifications). The most frequently used tool reported (26.8% of the 164 respondents) was the Cognitive Linguistic Quick Test (Helm-Estabrooks, 2002), followed by the Trail Making Test (16.5%; Reitan, 1992), the Montreal Cognitive Assessment (15.8%; Nasreddine et al., 2005), and Raven's Colored Progressive Matrices (12.2%; Raven, 1962).

Responses varied as to how respondents named the tools available, both in the constructs that they thought the tools measured, and in the terminology that they used to refer to these constructs. For example, across respondents, the Rey Complex Figure test (Osterrieth, 1944) was reported to measure the following range of constructs: visual memory, memory, executive functions, visuospatial, visual memory, visual attention, visual perception, construction, planning, visuoconstructional abilities/memory, constructional praxis, short term and episodic memory, recognition and learning. To address the variation in terms used to describe constructs, we mapped the suggested constructs from responses onto cognitive domains using a widely used framework that adheres to the DSM-5 approach (i.e., Sachdev et al., 2014), these included: complex attention, executive function, learning and memory, language, social cognition and perceptual-motor function.

Table 2. Assessment tools used and constructs measured reported by respondents.

Tool	Test frequency[1]	Complex attention	Executive functions	Learning and memory	Language	Perceptual-motor function	Social Cognition
Cognitive Linguistic Quick Test[2]	44	24	22	23	9	16	0
Trail Making Test[3]	27	13	18	0	0	2	0
Montreal Cognitive Assessment[4]	26	4	2	4	3	2	0
Raven's Coloured Progressive Matrices[5]	20	0	16	0	0	3	0
Mini Mental State Examination[6]	14	3	1	4	2	2	0
Rey Complex Figure[7]	14	1	5	10	0	10	0
Comprehensive Aphasia Test[8]	13	2	4	6	1	3	0
Oxford Cognitive Screen[9]	12	4	2	6	5	6	0
Test of Everyday Attention[10]	12	10	1	1	0	0	0
The Butt Non-Verbal Reasoning Test[11]	12	0	8	0	0	0	0
Test of Attentional Performance[12]	11	9	3	0	0	2	0
Weschler Adult Intelligence Scale[13]	11	0	3	0	0	0	0
Wisconsin Card Sorting Test[14]	11	1	10	1	0	0	0
Informal assessment	14	7	3	6	0	3	1

Notes.[1]The number of times each test was indicated by respondents. The numbers in each cognitive domain may not sum up to the numbers in [1] as not all respondents indicated which construct they aim to measure with the cited tool. [2]Helm-Estabrooks (2002). [3]Reitan (1992). [4]Nasreddine et al. (2005). [5]Raven (1962). [6]Folstein et al. (1975). [7]Rey (1941). [8]Swinburn et al. (2005). [9]Demeyere et al. (2015). [10]Robertson et al. (1994). [11]Butt and Bucks (2002). [12]Zimmermann and Fimm (1994). [13]Wechsler (1997). [14]Berg (1948).

Question 10: which factors are considered when choosing tools?

Question 10 asked respondents to outline, in an open-ended response, practical, clinical and/or theoretical factors considered when selecting tools to assess cognition in aphasia. Responses were classified into four main themes: tools, impairment, person with aphasia, and assessment (Figure 5).

Assessment tool-related factors: The major factor related to tool selection was task administration, which included consideration of the suitability for people with aphasia in terms of the language demands of the task itself, and of the task instructions. Another influential factor was reported to be the amount of time that the assessment took to perform (and how much time was available to the clinician and/or researcher) with some respondents indicating a preference for assessments that were less time consuming. For example:

> *Some tests (i.e., Wisconsin Card Sorting Test) are time-consuming and some aphasic persons have problems to understand the rules of the game. This is particularly true is [sic] persons with moderate-to-severe comprehension deficits.*

The availability of tests within the researcher's and/or clinician's context was the third most frequently reported factor concerning administration, followed by the complexity of administration, appropriateness given the person with aphasia's background (language, culture, age, etc.), and the possibility for remote administration.

Respondents also mentioned factors that related to test construction and psychometrics such as validity (i.e., the extent to which a tool accurately measures a construct), reliability (i.e., how consistent a tool is if administered on different occasions) and the availability of normative data for different age groups, and educational and cultural backgrounds. Some respondents reported prioritizing evidence-based tools in their practice.

A small proportion of respondents (5.3%) indicated a preference for using assessments of functional activities due to their ecological validity:

A few respondents (4.0%) indicated that, to better understand therapy outcomes, they prioritized tools that provided a comprehensive picture of an individual's cognitive abilities (such as the Cognitive Linguistic Quick Test (Helm-Estabrooks, 2002), or the Montreal Cognitive Assessment (Nasreddine et al., 2005)), and primarily assessed domains that they believe most closely interact with language:

> *We choose the assessment tests considering those cognitive functions that may play a relevant role in language performance and its response to treatment. The selection also seeks to strike an appropriate balance between the need for a comprehensive assessment and not too time-consuming for people with aphasia.*

Factors related to the person with aphasia: Respondents reported factors related to both the clinical profile of the person with aphasia ("Impairment" in Figure 5) and also broader considerations ("Person with aphasia" in Figure 5).

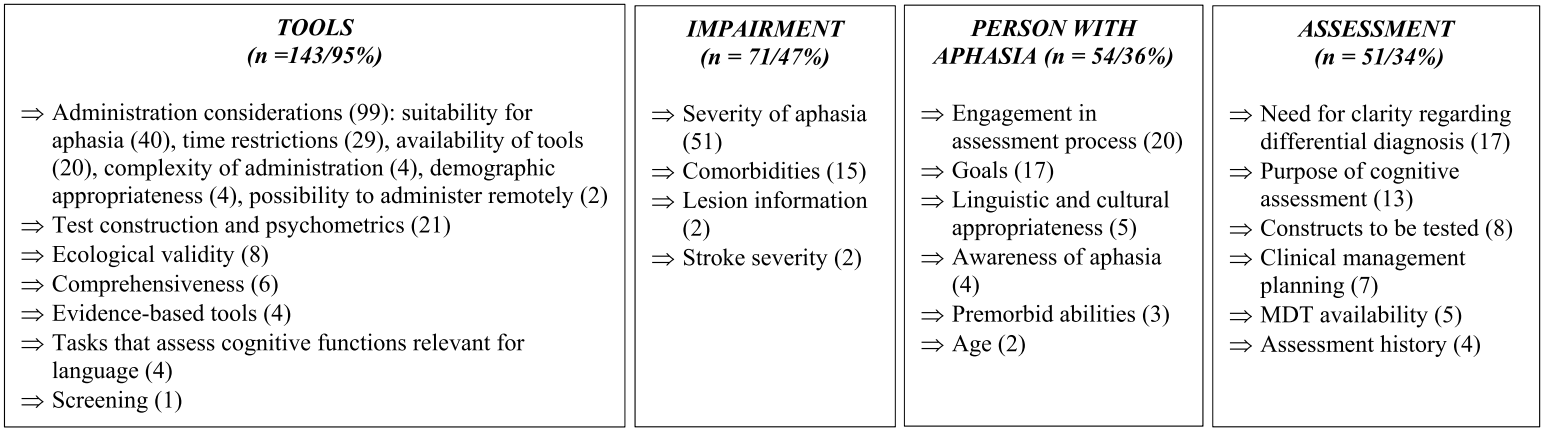


Figure 5. Summary of responses to the question "What factors do you consider when choosing tools to assess cognition in aphasia?" (n of respondents = 150).

There were four main ways in which respondents were influenced by the nature of the person with aphasia's impairment when choosing cognitive assessment tools: aphasia severity, comorbidities, lesion information and stroke severity, for example:

> *I take into account the type of aphasia of the patient and the conserved language abilities, for example how is verbal comprehension, reading, image recognition … I also take into account the severity of the lesion and the deficits that the patient and adjust the choice of tests to these abilities.*

The severity and type of language impairment was the main reported consideration, with nonverbal tasks often preferred. Other comorbidities such as vision, hearing and physical impairments, and/or apraxia of speech were also taken into consideration. A few responses also reported considering lesion information and stroke severity.

In terms of broader considerations, the level of engagement and the goals of the individual with aphasia were also reported as important when choosing a tool to measure cognition, these included the individual's stamina (i.e., extent and rapidity of fatigue), and emotional status (i.e., level of frustration) during the assessment. Age, languages spoken and cultural background, prior level of function, awareness and insight into their aphasia were also identified as factors that were taken into consideration.

Factors related to assessment: This theme focused on considerations influencing the choice of assessment tools more broadly. This included the need to gain a better understanding of a person's cognitive abilities while being mindful of their linguistic impairment. This was followed by a need for careful consideration of the main goals of the assessment process, the constructs that were required to be measured, the relevance to treatment planning, the availability of other members of a multidisciplinary team who may have access to assessment materials or experience with cognitive testing, and finally a consideration of which assessments the patient had already completed.

Question 11: what are the perceived difficulties in choosing tools?

In response to Question 11, most respondents (75%) reported difficulties choosing appropriate tools to assess cognition in aphasia. Three themes emerged from the responses: difficulties associated with the appropriateness of assessment tools, with professional roles, and with the differential diagnosis of language and cognitive impairments (Supplementary Table 4).

Difficulties associated with the appropriateness of assessment tools: the most frequently reported difficulty was finding assessment tools that were appropriate for people with aphasia, mainly due to available assessment tools being over-reliant on language ability. A particular concern

was the availability of assessment tools with adequate psychometric properties, especially for individuals from diverse educational, linguistic and cultural backgrounds. The construction of assessment tools, in terms of stimuli, number of practice trials and validity was also indicated as a concern.

Furthermore, respondents reported finding it hard to find assessment tools that were suitable for people with aphasia with other comorbidities, such as motor deficits. A lack of available comprehensive cognitive assessment tools, as opposed to screening tools, was also mentioned.

Difficulties associated with professional roles: Issues concerning whose role it should be to assess cognition in aphasia and the lack of experience and knowledge with cognitive assessment were also evident in the responses. Some professionals also indicated they did not have enough time with people with aphasia to fit in a cognitive assessment.

Difficulties associated with the differential diagnosis of language and cognitive impairments: A final major difficulty reported, regarding assessment tools, was a lack of clear understanding of the interface between language and cognition, and the difficulty in separating them in order to understand the extent of cognitive and linguistic impairments.

Question 12: what are the changes made when assessing cognition in people with aphasia compared to people without aphasia?

In response to Question 12, the majority (88%) of respondents reported that they adapted their approach when assessing people with aphasia, compared to those without aphasia. For these respondents ($n = 155$), a subsequent open-ended question probed the changes that they made. Three main themes emerged from these questions: modifications to the task, selection of assessment tools, and the assessment conditions (Table 3).

Modifications to the task: Modifications to the tasks included reducing the linguistic load of the task by simplifying language, slowing speech rate and providing repetitions. Providing visual support or using supported conversation techniques and allowing for multimodal input were also reported as ways of adapting tools for use with people with aphasia. Respondents indicated that they modified and adapted instructions so that they could be understood by people with aphasia prior to commencing the test. Some respondents indicated that to ensure that people with aphasia could be assessed, task standardization procedures were not always followed (i.e., allowing participants more time to respond to a task that was permitted). Finally, some tasks were modified to accommodate comorbidities, (i.e., presenting the stimuli on the preferred side for people with hemianopia).

Selection of assessment tools: Differences in the selection of tools were reported, with respondents indicating that they tended to select tools that they believed were more appropriate for people with aphasia, that is, preferring

Table 3. Adaptions made when assessing cognition in people with aphasia as compared to people without aphasia (n of respondents = 155).

Theme (number of responses)	Sub-theme (number of responses)	Illustrative quotes
Modifications to the task (172)	Reduce linguistic load (34)	*"Talk less and more slowly and use shorter sentences and easier words."*
	Provide extra support (33)	*"Provide visual aids (e.g., number charts to point at/refer to when person is required to respond with a number)."*
	Modify instructions (28)	*"Aphasia-friendly instructions (reduce complexity, simplify syntax and vocab, repeat instructions as needed)."*
	Adaptation to testing methodology (14)	*"Often break standardization of assessment to ensure adequate comprehension of task."*
	Allow more time (12)	*"Repetition of commands, accept delayed responses if auditory comprehension is an issue."*
	Ensure understanding (6)	*"I take care ascertaining that they understand me well, I speak slowly, I make short sentences, I use a communication board or a notepad if needed, I use adapted tests."*
	Slow speech rate (5)	*"Slow speed at which instructions are given."*
	Pace the test (4)	*"Assessments divided into multiple sessions when attention and concentration affected."*
	Adaptations for other comorbidities (3)	*"Positioning visual stimuli on a preferred side, assuming the patient may have hemianopsia."*
	Multimodal input (3)	*"I may pair visual, verbal, and imitation techniques to facilitate comprehension."*
Selection of tools (67)	Aphasia-friendly assessment tools (41)	*"Select assessments that are appropriate to the client's language abilities. For instance, if a person has limited verbal output, then I select a nonverbal cognitive measure."*
	Functional assessments (15)	*"I tend to focus towards assessing cognition within everyday functional activities. This helps me to not highly depend upon an individual's language abilities."*
	Informal assessment (5)	*"Specific subtests may be omitted and/or informal assessment only may be employed."*
	Formal assessments (4)	*"My assessment would include more formalized test protocols."*
	shortened task versions (1)	*"If I´m using an experimental task, I usually use a shorten version (if possible) for persons with aphasia."*
	Patient needs (1)	*"Consider what the needs of the patient/caregivers are. This helps decide the test, the depth and the next steps."*
Assessment conditions (35)	Case specific requirements (15)	*"The protocol needs to be adapted to the language skills of the person with aphasia which will differ from person to person."*
	Consider aphasia in assessments interpretation (9)	*"I take into consideration how their language impairments may impact their responses or performance on a test."*
	Work with MDT (5)	*"Executive function and many other deficits – > ask the psychologist and/or OT for their opinions on strategies and relevance of therapy."*
	Avoid distractions (2)	*"Choose a space that had least distraction, try to engender a calm atmosphere."*
	Consider fatigue (2)	*"Degree of fatigue noted may also impact tests selected."*
	Face to face (1)	*"Add visuals, change pacing, face-to-face, block information, use writing, avoid distractions."*
	Support from caregiver (1)	*"Time, less planned, time of day, around meds, with family present."*

Notes: Numbers in brackets denote number of answers that were coded at each theme. MDT: Multidisciplinary team; OT: occupational therapist.

tests that were not as reliant on language abilities. Most respondents also indicated a preference for using functional assessments, while some indicated a preference for informal assessments over formal assessments.

Respondents reported considering patients' needs, a preference for shortened versions of tasks, and that, during test administration, they tried to accommodate the requirements of an individual by adapting task demands to be appropriate for residual language ability and considering the language impairment when interpreting the results. Respondents also indicated they often worked with the multidisciplinary team to find the best assessment and the optimal way to administer it.

Assessment conditions: Finally, respondents indicated they tried to minimize distractions during testing, paced the administration depending on the person's energy levels, prioritized face to face testing, and requested support from caregivers.

Discussion

Despite the prevalence of non-linguistic cognitive deficits in people with aphasia (Fucetola et al., 2009; Gilmore et al., 2019; Mayer & Murray, 2012; Murray, 2012), the best approach to assessing cognition, beyond language, in this population is unclear. This study aimed to gauge professionals' understanding of cognition and identify the approaches currently being used to assess cognition in people with aphasia.

Our international, multidisciplinary survey of professionals who routinely worked with people with aphasia highlighted, through analysis of respondents' perspectives, that (1) the assessment of cognition in this population is considered essential for effective clinical and research planning and management; but that (2) there is a dearth of research and guidance for determining how to reliably do this in both clinical and research environments, with most of the available assessment tools considered inappropriate for this population. In addition to identifying numerous barriers to assessing cognition in people with aphasia, this is the first study to probe the adaptations that are implemented in clinical and research settings to address some of these barriers.

Definition of cognition

In our data, respondents defined cognition as the skills, mental and brain processes responsible for thinking, processing and integrating information, problem solving and learning, with no major discrepancies between the definitions of cognition given. The aspects of cognition reported by our respondents aligned with the domains within current theoretical and neuropsychological assessment frameworks (Harvey, 2019; Helm-Estabrooks, 2002; Lezak et al., 2012; Sachdev et al., 2014b; Sternberg & Sternberg, 2012; Strauss et al., 2006) (i.e., attention, executive functions, memory, language, motor function and praxis, visuoperceptual and visuospatial abilities). However, responses focused on the abilities that make us human and that

cognition supports (e.g., to think, reason, remember, problem-solve, make decisions, do maths, plan, learn), rather than the cognitive function itself. The one point of divergence was whether language should be part of a definition of cognition.

A major difficulty endorsed by our respondents was the lack of clear understanding of the interface between language and cognition, and the challenges in separating them to disentangle cognitive and/ or language impairment. The inclusion of language as a construct of cognition has been debated for decades (e.g., Fodor, 1975; Nickels et al., 2024). There have been numerous theoretical approaches to understanding how linguistic impairment interacts with other cognitive domains in aphasia. For example, impaired attention (Hula et al., 2007; Hula & McNeil, 2008; McNeil et al., 2011), executive functioning (Thompson et al., 2018) and short-term memory (Minkina et al., 2018) have been proposed as, at least partially, explaining language difficulties in aphasia. However, language has also been shown to impact cognitive functioning (see for example, Alderson-Day & Fernyhough, 2015; Baldo et al., 2005; Granato et al., 2020).

Responses in our data highlight that defining cognition, and the contribution of language to cognition requires clarity in order to support professionals to provide optimal care for people with aphasia. Further empirical work is needed to understand the interaction between language and non-linguistic cognition, especially in people with aphasia.

Assessing cognition in aphasia is important

Our results illustrate that assessing cognition in aphasia is considered, by our respondents, to serve different, equally important, purposes, mainly related to discharge and intervention planning.

Overall, respondents felt that it was important to assess all cognitive domains, but particularly attention, executive functioning, memory and learning. Previous literature reviews have also suggested memory and executive functioning to be a main focus of non-linguistic cognitive assessment in aphasia research (Fonseca et al., 2016; Tessaro et al., 2024). On the other hand, while our respondents indicated assessing attentional skills in aphasia was very important, such assessments were not frequently reported in published research (Fonseca et al., 2016; Tessaro et al., 2024). It seems unlikely that this is because attention tasks involve more language processing than assessments of other domains, as Tessaro et al.'s (2024) analysis suggested that 71.6% of tasks that assessed attention did not have language requirements. Given that attention deficits have been reported in people with aphasia, and both researchers and clinicians agree their assessment is desirable, further investigation and/or reporting in the literature seems important (Murray, 2002, 2012).

Although most respondents in the present study agreed that cognitive assessment is important in aphasia, several barriers were indicated that prevent the assessment of cognition in the clinical setting, particularly lack of time, staff, training, and appropriate testing materials. However, because professionals recognize the importance of this assessment, there were many indications that informal assessments were performed with people with aphasia.

Assessment tools

Tool appropriateness

Current tools and materials for assessing cognition were generally considered by respondents to be inappropriate to use with people with aphasia. Given this, professionals working with people with aphasia face considerable challenges when assessing cognition beyond language given the reliance on language abilities in most of these cognitive assessments. For example, the Montreal Cognitive Assessment (Nasreddine et al., 2005), a commonly used cognitive screening tool that includes language tasks such as naming, repetition, and verbal fluency, uses tasks to measure memory skills that require unimpaired language abilities (e.g., retrieval of a list of words), which limits the feasibility of its use in aphasia (Barnay et al., 2014). However, Schumacher et al. (2022a) found that many of their participants with aphasia were able to perform verbal cognitive tests and argued that interpretation of those assessment findings was not majorly confounded by the participants' linguistic impairment.

Another assessment tool reported by respondents to be frequently used was the Cognitive Linguistic Quick Test (Helm-Estabrooks, 2002), an assessment designed to screen the five cognitive domains in adults with acquired neurological disorders. This tool was designed specifically with people with aphasia in mind and five of the ten tasks aim to minimize language load (symbol cancellation, symbol trails, design memory, mazes and design generation). However, the scoring and reporting process in this test is predominantly completed by cognitive domain (attention, memory, executive functions, and of course, language) and, with the exception of visuospatial skills, the composite measure of each domain includes tasks reliant on language skills (e.g., generative and confrontation naming, story retelling, recalling personal facts). This is despite the fact that the CQLT also provides the normative data for individual non-linguistic tasks (albeit standardized with an English-speaking population in the USA).

Our results support the findings from a systematic review (Tessaro et al., 2024) that indicated that over half (54%) of the tests used to assess cognition in aphasia had some degree of language load (i.e., verbal stimuli, responses requiring language production or required mapping stimuli to its meaning). This is also apparent in studies using Principal Component Analysis approaches where cognitive tests often also loaded on language components (e.g., Halai

et al., 2017, Figure 3: forward digit span loaded on components related to phonology and semantics, backward digit span on phonology and speech; Brixton spatial anticipation test onto semantics as well as executive function (in the subgroup)). Given the challenges evident in modifying, or creating, cognitive assessments, the research and clinical communities are advised to systematically consider the language load of each assessment when selecting assessment tools to be used with people with aphasia. Tessaro et al. (2024) provide details of whether each cognitive test included verbal stimuli, required language production and/or required mapping verbal stimuli to meaning. This could be a useful resource for clinicians and researchers, as could examinations of the extent to which cognitive (and linguistic) tests load on language (and non-linguistic cognition) using Principal Component Analysis (e.g., Halai et al., 2017).

Another issue which should guide choice of assessment tool in clinical practice and research is a cognitive tool's sensitivity in identifying cognitive problems. As we discussed in the Introduction, some tools that are considered non-linguistic are more sensitive than others in identifying attention, memory and broader executive function problems in people with aphasia (cf., Fonseca et al., 2019; Olsson et al., 2019). Similar findings have been reported in studies that have used linguistic and non-linguistic cognitive tests which tap into different components of hierarchically organized attentional domains. For example, Schumacher et al. (2022b) found that alertness was rarely affected in their participants, whereas selective and divided attention, which are assessed with more complex tasks, was impaired in about a quarter of their participants. A related issue around test sensitivity raised by Schumacher and colleagues is the difference in cut-off scores between neurotypical versus impaired performance which may relate to both the often small number of test items used by cognitive screeners and the difficulty of those items. For example, the non-verbal design memory subtest of the CLQT (Helm-Estabrooks, 2001) has only three test items, whereas a similar test such as the Benton Visual Retention Test (Sivan, 1992) has 10 items.

Tool adaptation

Our data illustrate that respondents felt that assessments require adaptations to make them more aphasia-friendly, with an overwhelming majority of respondents (88%) reporting that this was necessary. Whilst this will be no surprise to those working with aphasia, our survey has systematically identified that in clinical and research settings changes to assessments protocols are routinely implemented across all dimensions of the assessment process, from provision of test instructions to the interpretation of results. Previous work by Guo et al. (2014) demonstrated that Singaporean SLPs adapted and modified cognitive assessment tools when working with people with aphasia. Our data provide evidence that this process of adaption occurs internationally and across clinical and research disciplines.

We found that respondents reported that administration procedures were modified to adapt for assessment of persons with aphasia (e.g., allowing more time for the person with aphasia to respond, and/or providing visual supports to aid comprehension). Although typically performed by experienced clinicians and researchers, *ad hoc* adaptions and modifications can bring additional limitations to the assessment process. Deviating from standard administration procedures could impact on the accuracy and reliability of diagnosis when interpretation is based on normative data that have been established following standard administration procedures (Cicchetti, 1994). This presents as a major issue in clinical practice where the accuracy of tests scores assists in differential diagnosis, providing advice to affected individuals and possibly prognosis. Similarly, in a research setting, the accuracy of a test scores can be used to determine suitability of inclusion in a study, or the impact and efficacy of an intervention. An unreliable score can lead to unethical inclusion, or exclusion in a study, or even false statistical results. Moreover, any deviations from standardization invalidate comparisons across studies, limiting the possibility of study replication, the ability to conduct reliable meta-analyses and the generalisability of results to people with aphasia beyond the experimental group. Finally, *ad hoc* adaptations (which may vary from person to person, clinical, research or person with aphasia) may appear to facilitate administration but do not ensure that they will fully clarify the test requirements for the testee. Consequently, errors in a modified test may reflect a deficit in the cognitive ability tested, a misinterpretation of test requirements, or both.

Informal and functional assessments

The use of informal and functional assessments to evaluate the cognitive status of people with aphasia was mentioned by respondents throughout the survey. Examples of informal and functional assessments included self-report by the person with aphasia or carer about daily activities such as washing up, dressing, and cooking. The reported success on these tasks was then used as an indicator of cognitive functioning.

Informal observations of the person with aphasia by the clinician were also part of cognitive assessment in clinical settings. Whilst the responses in our survey were not specific enough to allow us to explore informal and functional assessment practices in detail, an informal approach may be a useful way to gather information on the difficulties and strengths of people with aphasia. However, Thomson et al. (2018) noted a lack of guidelines available for clinicians on conducting informal assessment, and that the success of an informal assessment is likely dependent on the clinicians' experience and skills. As such, although informative regarding a person's needs and strengths; informal assessments are limited by the idiosyncrasies of the tasks used and can be difficult to generalize across approaches.

Knowledge regarding the assessment of cognition in aphasia

One of the major barriers for assessing cognition in aphasia, reported by respondents, appeared to stem from a lack of knowledge of the cognitive assessments available. SLP respondents also reported that they lacked knowledge of cognition and/or training in administering cognitive assessments. This also related to professional boundaries and scope of practice (see below). That SLPs felt they lacked training in the evaluation of cognition has been discussed in research regarding decision-making capacity assessment (Suleman & Hopper, 2016). Conversely, whilst the assessment of cognition is often the domain of neuropsychologists and/or occupational therapists, our respondents (who included these professions) indicated that these professionals may lack knowledge about, and experience working with aphasia. There were also reports that the wider multidisciplinary team may also have a limited understanding of the complexities of language impairment in aphasia.

Our results highlight the critical importance of inter-professional learning and continuing professional development, as well as working within meaningful multidisciplinary teams in which professionals bring their own discipline-specific expertise to the assessment process. This inter-professional learning should be available through in graduate training programmes, national peak organizations, and best practice guidelines for aphasia and/or stroke. This would support SLPs in learning more about cognitive assessment, and non-SLPs in learning about aphasia and how it impacts cognitive assessment. Clarifying the scope of practice and ensuring any overlap of practice is rigorously taught across disciplines would support professionals to recognize their unique expertise and limitations when navigating the assessment of cognition in aphasia.

Whose role it is to assess cognition in aphasia?

The in-depth assessment of language is primarily conducted by SLPs. Our results showed that respondents felt that the professional role becomes less clear when the assessment of non-linguistic cognition in aphasia is indicated. Despite the clear advantages to multidisciplinary work, with it may also come an ambiguity of responsibilities within in a team; in our survey, professionals reported a lack of clarity in their own role, but they were also unsure of the scope of practice of other professionals within their multidisciplinary team.

For example, the national stroke guidelines of the Royal College of Physicians (2023) recognize the role of SLPs in interpreting language assessments in people with aphasia. However, the guidelines also recommend there is close collaboration with SLPs during neuropsychological assessment beyond language, implicitly acknowledging that neuropsychological assessments of broader cognitive abilities, typically the role of clinical (neuro)psychologists,

also involve language. These and other guidelines could be clearer about scope of practice so that the multidisciplinary team can provide mutual assistance to accurately interpret assessments of cognition bearing in mind their language content/bias.

As mentioned above, there was not only a lack of clarity regarding whose role it was to assess cognition, but also whose role it was to discuss the results of this assessment. Most participants (>80%) agreed that SLPs and neuropsychologists should both assess cognition and discuss the results of the assessments (see Figure 4, earlier). However, for other professions (e.g., neurologist, physiotherapist, psychiatrist) in general participants felt these professionals should have a role in discussing results rather than in performing assessments. For example, only a third of our respondents indicated that neurologists should assess cognition in people with aphasia, but half felt that neurologists should discuss the results with the person with aphasia and carers.

Echoing the broader findings by Rohde et al. (2013) that further improvement was needed within stroke multidisciplinary clinical guidelines, improved guidelines around professional roles are required to optimize the assessment of cognition and discussion of findings. This should ensure that the assessment of cognition is meaningful, appropriate and relevant, by empowering disciplines to develop their knowledge and practice, but also providing accountability and therefore minimizing the risk that cognition is either not assessed at all, or inappropriately assessed in people with aphasia.

Limitations

Our study collected and analysed a large number of responses, from a wide range of countries and professions. Whilst we deliberately sought participation from non-English speaking respondents, the majority of responses in our sample were from researchers and clinicians from developed and English-speaking countries. This limits the generalization of our findings across developing and non-English speaking nations.

While it was a strength that we gathered responses from different countries, aphasia practices vary across these countries due to different healthcare and educational systems, as well as heterogeneity within the same country due to differences in training. However, due to the relatively small number of observations per country it was not possible to evaluate these differences and compare and contrast responses within- and across countries.

In addition, when considering differences across professionals relating to cognition and its assessment with aphasia, the inclusion of a range of professionals who work with aphasia allowed our results to have an important multidisciplinary perspective. Nevertheless, more than half of our sample was composed of SLPs (64%). Although this was anticipated given that they are the main professionals working with aphasia, the non-SLPS represented a

large number of different professions, and this group was too heterogenous for cross-profession analysis to be possible. Future studies would benefit from a larger sample size in areas that were underrepresented in our data, this would allow further nuance in the analysis and interpretation of the data.

Apart from surveying clinical and research practice, clinical practice can be updated by drawing on findings from large-scale observational studies of different aspects of non-linguistic cognitive domains in aphasia rehabilitation[1] (e.g., El Hachioui et al., 2014; Fonseca et al., 2019; Marinelli et al., 2017; Schumacher et al., 2022b), and studies that have used cognitive tests with relatively low linguistic demands. However, before embracing such tests in clinical practice, consideration should also be given to the psychometric properties of such tests, especially measurement error and other indices of reliability and validity (cf., Murray et al., 2018).

Finally, as with any questionnaire, the multiple-choice options available must be carefully considered, with any categorization of options having a potential impact on subsequent analyses. For example, we chose to have stroke severity options (mild, moderate, severe), rather than having "stroke severity" as a single option. Our rationale for this was that the use of a single label was not precise enough to capture possible respondents' clinical perspectives regarding the potential for "severity" of impairment to impact on the accessibility of assessments (i.e., use of AAC vs compensatory strategies). However, in this example, categorizing stroke severity into multiple options, may have reduced the contribution of this factor in the analysis.

Conclusions

Although there have been many surveys on clinical practices in aphasia (for example, Aldous et al., 2014; Chang et al., 2018; Guo et al., 2014; Kiran et al., 2018; Rose et al., 2014; Suleman & Hopper, 2016; Verna et al., 2009), the few that relate to the assessment of cognition, have focused mostly on memory abilities alone (Greenspan et al., 2021; Salis et al., 2018). Therefore, our study provides novel insights into how aphasia researchers and clinicians define cognition, why and how they choose to assess cognition, what assessment tools they use, and the perceived barriers to assessing cognition in people with aphasia.

Our results have underscored the importance of assessing cognition in aphasia for a range of different purposes. Our data clearly highlights the perception, amongst respondents, that there is a lack of cognitive assessment tools that are appropriate for use with people with aphasia. Further research to develop appropriate assessment tools, and/or normative data specifically for this cohort is warranted (see Table 4). Similarly, both researchers and clinicians would benefit from expert consensus recommendations to provide guidance on the most appropriate assessment tools available for assessing cognitive function in people with aphasia.

Table 4. Actionable insights for the academic and clinical fields.

Finding	Insight/recommendation for the field	Key stakeholders involved
Respondents reported a lack of guidance for reliable assessment of cognition in people with aphasia (PWA)	Develop consensus guidance amongst international experts	People with aphasia, clinicians and researchers
Respondents reported current assessment tools are inappropriate/ to use with people with aphasia	Develop/update assessment tools that are suitable for people with aphasia	People with aphasia, clinicians, academic teaching staff and researchers
Respondents reported that people with aphasia are often excluded from research that requires cognitive assessments	Account for exclusion of PWA when reviewing evidence. Researchers should include new assessments developed for PWA	Researchers with people with aphasia
Respondents reported frequently adapting administration of assessment tools for PWA	Use caution when comparing performance to normative data. A*d hoc* deviations from standardization may invalidate comparisons across studies. Researchers must consider how this impacts study replication, meta-analyses and generalisability of results. Researchers and clinicians must consider the language load cognitive tools. Collect normative data for people living with aphasia.	Clinicians and researchers, academic teaching staff
Respondents reported a need for clarity around roles within the multidisciplinary team is needed	Update/create guidelines around scope of practice	Academic teaching staff, accrediting bodies, clinicians, researchers and people with aphasia
Respondents reported a perceived lack of appropriate training for conducting cognitive assessments in PWA.	Inter-professional learning on this topic should be prioritized during graduate training programmes, peak organizations, and best practice guidelines for aphasia and/ or stroke	Academic teaching staff, accrediting bodies, clinicians, researchers and people with aphasia

Whilst professionals in our study often reported relying on implementing pragmatic changes to the tasks in order to make them more suitable for people with aphasia, this lack of adherence to standardization procedures can manifest as a barrier to accurate interpretation of results, reliable diagnostics and may impact generalization of results across studies. To overcome this barrier, professionals expressed that they often use informal assessments to evaluate non-linguistic aspects of cognition in aphasia.

The lack of available materials and standardized administration appropriate for individuals with language impairment is also likely to contribute to the systematic exclusion of people with aphasia from stroke studies (Shiggins et al., 2022; Snaphaan & de Leeuw, 2007; Srikanth et al., 2003). Given that a third of stroke survivors experience aphasia, systematically excluding this population will impact on the generalisability of stroke research more broadly.

Moreover, our data suggests that across disciplines, there is a perceived lack of appropriate training for conducting rigorous and informative cognitive assessments in people with aphasia. Thus, there is a need to ensure that

appropriate training is provided to ensure all professions working with this population have a well-grounded understanding of cognition and an understanding of the consequences of aphasia when conducting cognitive assessment with those living with aphasia. Specifically, for the multidisciplinary team who work with people with aphasia, there is an urgent need to increase awareness about the importance of, and difficulties in, accurately assessing non-linguistic cognitive functions in people with aphasia.

Finally, we have demonstrated that to improve aphasia care, the relevant clinical guidelines for the many disciplines involved should clarify and specify the roles and contributions of the different professionals working with aphasia regarding the assessment of non-linguistic functions. To this end, in Table 4, we provide actionable insights for the field, that we hope will support academics and clinicians to progress these important findings.

Note

1. We would like to thank the editor, Professor Matthew Lambon Ralph, for suggesting this point.

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Data availability

Raw data were generated at Newcastle University. Derived data supporting the findings of this study are available from the first author [BT] on request.

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