A chatbot to enhance digital anomia therapies by artificial intelligence and large language models: a preliminary report

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Introduction and aims

Aphasia frequently leads to anomia, or word-finding difficulties. This condition significantly impacts daily communication and well-being of persons with aphasia (PWA) (Biran et al., 2024). Effective anomia therapies require personalized training for each PWA, since therapy-induced improvements are often item-specific (Lavoie et al., 2017). Current evidence-based approaches encompass resource-intensive programs, which often prevent an optimal clinical implementation due to resource constraints (Code & Petheram, 2011). Technologies such as Artificial Intelligence (AI) and Large Language Models (LLMs) represent a promising avenue to increase therapy intensity and personalization by generating realistic therapeutic interactions (Adikari et al., 2024; Azevedo et al., 2024). Such AI-mediated therapy adapted to individual needs could save considerable time for speech and language therapists (SLTs) who otherwise manually create and tailor therapeutic materials. This study reports the development of a chatbot utilizing LLMs and explores its potential to generate therapeutic interactions, aiming to improve word-finding abilities in a novel and accessible way.

Methods

Population: Four individuals participated in a preliminary evaluation of the chatbot: two French-speaking PWAs and two SLTs. The PWAs presented with chronic mild anomia and had benefited from two years of speech and language therapy.

Materials and procedure: After having manually entered the target word to be found, the LLM-generated written dialogue provided hierarchical semantic and graphemic cues to the PWAs. The PWAs interacted with the written chatbot via the SLTs, who wrote down what the PWA said and read aloud what the chatbot replied. At the end of an interaction (i.e., when the target word was found), each utterance of the chatbot was rated for its accuracy and relevance independently by the PWAs and by the SLTs regarding: a) the input utterance produced by the PWA; and b) the LLM-generated response with respect to the target word. The overall interaction was also evaluated independently by the PWAs and the SLTs on a Likert scale from 1 (very dissimilar to a therapeutic interaction) to 5 (very similar to a

therapeutic interaction). The four participants were also asked to comment on their ratings with an open text box. These ratings were used to preliminary assess the effectiveness of the AI-generated chatbot to mimic real therapeutic inputs. A total of 20 interactions were tested.

Results

The chatbot-generated interactions were rated rather similarly by the PWAs (3.1 ±1.9) and the SLTs (3.3 ±1.9). PWAs and SLTs agreed on the rating for 65% of the interactions. The 35% of partial disagreement was mainly related to PWAs reporting that the first utterances of the chatbot were too vague, whereas SLTs rated them with a higher score since they provided a broad context before giving more specific cues towards the target word. PWAs indicated that 71.8% of the chatbot utterances were accurate and relevant, whereas SLTs' ratings reached 80.3%. All participants reported three main concerns:

- the chatbot gave the target word to the PWA too early (in 5 out of 20 interactions), sometimes even in the first utterance;
- the chatbot gave inaccurate semantic cues (in 6 out of 71 utterances);
- the chatbot did not correctly interpret the meaning of the target word (in 2 out of 20 interactions).

Discussion

This study represents a first development step towards a self-administered, AI-based and personalized therapy for word finding difficulties. The feedback from both PWAs and SLTs suggest that LLMs can be used to create meaningful therapeutic content in certain cases. These first results will serve to develop improved versions of the chatbot. For instance, the LLMs still need to learn:

- how to interpret the meaning of the target words, especially when they have multiple meanings (e.g., "bank": financial organization *vs* land along sides of a river) or when they refer to proper nouns;
- how to adjust to PWA's responses, i.e., giving positive feedback only when the correct target word is produced and providing the target word only after a few attempts of active searching;
- how to give perfectly accurate semantic cues (e.g., here the chatbot indicated that the sea bass was a bigger fish than a tuna, it did not correctly describe what are the core elements of the biathlon sport, it indicated that a plant was a type of plant, etc.).

Next steps include scaling the system to include larger user groups and refining the LLMs' capabilities. We believe that such an approach can expand the range of available anomia therapies to train large sets of words relevant to each individual and increase therapeutic dosage while improving accessibility and engagement in conversations.

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A Narrative Efficiency Score for Assessing Micro- and Macro-Linguistic Impairments in Patients with Acquired Brain Injuries

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Introduction and aims

Discourse production is fundamental to people's everyday communication. It requires the contribution of micro- and macro-linguistic processes that help to create a coherent and cohesive narrative text (Andreetta et al., 2012; Marini et al., 2011). The production of a narrative text involves the coordination of brain areas belonging to a large frontal-parietal network distributed bilaterally, with a greater contribution from the left hemisphere (Schneider et al., 2021). The occurrence of an acquired lesion to any brain area involved in this network can lead to difficulties at the micro- and macro-linguistic levels of language that are reflected in the inefficient production of narrative texts (Andreetta et al., 2012).

It is widely reported in the literature that after a stroke People With Aphasia (PWA) experience micro-linguistic difficulties (e.g., delayed word-retrieval), which also affect the macro-linguistic organization of discourse (e.g., leading to reduced discourse cohesion and coherence; Andreetta et al., 2012). Linguistic difficulties of People with Multiple Sclerosis (PwMS) have been less explored. Such difficulties may range from micro- to macro-linguistic processes and hinder effective and informative communication (Arrondo et al., 2009).

PwMS and PWA differ in the severity of their language impairments. While standardized tests can typically detect deficits in PWA—though not always comprehensively—these difficulties often go undetected in PwMS. For example, only the adoption of a Multilevel Linguistic Analysis (MLA; (Marini et al., 2011)) of discourse production was capable to reveal linguistic impairments in a group of PwMS (Gobbo et al. (under review)).

The MLA developed by Marini and colleagues is a procedure that provides a more detailed assessment of linguistic difficulties than standard tests across various clinical and healthy populations. This method yields a set of linguistic measures analysing lexical, grammatical, and discourse-level language processes.

In a recent study, Agmon et al. (2025) proposed a computational method for quantifying syntactic complexity in natural speech, incorporating multiple syntactic features into a composite score. Drawing inspiration from this approach, the present study aims to develop a composite Score of Narrative Efficiency. This score would allow to compare discourse

abilities across different clinical populations, quantify the level of impairment in conveying narrative messages, and help clinicians planning effective therapeutic approaches.

To compute a narrative efficiency score, six variables representative of the lexical, grammatical, and discourse levels will be extracted from the MLA and used as linguistic features of a Principal Component Analysis (PCA). This score will facilitate comparisons across populations and provide an overall measure of patients' efficiency in narrative production.

Therefore, the aim of the present study is twofold: 1) To develop a composite score that joins both micro- and macro-linguistic abilities, integrating them into a comprehensive measure of narrative functional efficiency; 2) To apply the narrative efficiency score to clinical populations with distinct severity of linguistic impairments (e.g., PWA and PwMS) and assess whether it varies accordingly.

Methods

Participants

A total of 340 participants were retrospectively included in this study. Participant belonged to three different groups: HC (n° = 194), PWA (n° = 28), and PwMS; n° = 18. The group of HC on which the PCA will be applied has been selected to be representative of a wide population ranging from young adults to older adults.

MLA analysis and PCA computation

Narrative samples were elicited using a picture description task. Participants' verbal productions were audio-recorded and transcribed verbatim. The transcribed narratives were analysed using the MLA described in Marini et al. (2011).

Six key linguistic variables characterizing distinct levels of language processing were considered, namely: lexical (i.e., phonological and lexical errors), grammatical (i.e., grammatical completeness), and discourse (i.e., lexical appropriateness, cohesion and coherence errors) processes (Figure 1).

A PCA was conducted within the HC group on the six linguistic variables. Following the methodology adopted in Agmon and coll. (2025), from this analysis a composite score was derived reflecting the narrative efficiency of healthy adults. The factor loadings obtained from the PCA on the HC group were subsequently projected on the patient groups, allowing for direct comparison of narrative efficiency across populations.

The first principal component accounted for 48.5% of the sample variability, while the second and third components were limited to 23.7% and the 12.5% of variability, respectively. Following Agmon et al. (2025), the first principal component was selected as the primary index of narrative efficiency, as it explained the largest proportion of variability in the dataset. The linguistic variables loaded onto the first principal component with the

following weights: phonological errors -0.31; lexical errors -0.45; grammatical completeness 0.42; lexical appropriateness 0.47; cohesion errors -0.41; coherence errors -0.37.

These weights were applied to patient data (i.e., PWA and PwMS) to compute the Narrative Efficiency Score of these populations and facilitate the comparisons of narrative alterations across patients.

Results

The differences in the Narrative Efficiency Scores were tested between the HC and the patient groups through a linear regression model where the HC group was the reference. Controls scored higher than both PwMS ($p=0.02$; $\beta = -1.21$; CI =[-2.18, -0.23]) and PWA ($p=<0.001$; $\beta = -5.71$; CI =[-6.46, -4.95]) (Figure 2). PWA showed the most altered narrative efficiency score. Score differences according to Group ages are reported in Figure 3.

Discussion

The present study introduced a composite score that incorporates both micro- and macro-linguistic variables into a single measure of Narrative Efficiency. A representative sample of HC was used to compare the overall narrative efficiency of healthy adults to that of clinical populations with acquired brain impairments. The Narrative Efficiency Score was effective in detecting differences from HC and highlighting the varying severity between PwMS and PWA. This score could be useful for comparing the severity of narrative difficulties across other clinical groups and monitoring narrative improvements following treatment aimed at enhancing narrative abilities.

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Abstract Poster_Heiming-Al Yosef

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Use of Sentence Repetition Task in Identifying Production of Inflectional Markers in Post-stroke Aphasia

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Introduction

Grammatical inflections are morphological markers that change words to convey grammatical meanings, such as case, gender, number, tense etc. The correct use of inflections enables us to understand the correct grammatical and syntactic context. Post-stroke aphasia can lead to difficulties with different linguistic domains, for example, syntax, lexicon, morphology. In addition, aphasic impairments can manifest differently in different types of aphasia, such as in non-fluent aphasias, impairments present themselves in form of short sentences, missing words or omitted inflections. In contrast, in fluent aphasia

impairments present in form of long utterances, excessive number of words and no overt problem in generating inflections. Difficulties with grammatical inflections remain one of the main features in non-fluent aphasia.

Language production tasks allow the observation of an individual's language output. There are tasks, which provide very controlled settings of language production, as they provoke a certain language output, for instance the sentence repetition task or the argument structure production task. On the other hand, there are tasks, which provide less controlled settings and allow observation of a wider, more naturalistic language production, like the connected speech task. The quantity and quality of grammatical inflections produced would likely vary depending on the tasks utilised to assess language production as well as on the type of aphasia. However, the current literature does not systematically document whether these factors (i.e., task type, aphasia type) in post-stroke aphasia influence the production of grammatical inflections. The sentence repetition is an integral part of aphasia examination (e.g., WAB-R, Kertesz, 2006; BDAE, Goodglass & Kaplan, 1972) or as measure for memory and sentence complexity (Eom & Sung, 2016). However, sentence repetition has not been used to identify inflectional difficulties in aphasia. Our research focuses on a sentence repetition task, the Litmus Sentence Repetition Task (Marinis, Chiat & Armon-Lotem, 2012).

Aim

The aim is to investigate whether the sentence repetition task can identify production errors of inflectional markers in aphasia.

Methods

Participants

For this preliminary investigation, five people with aphasia (PwA) and five healthy controls (HC) were recruited. Type and severity of aphasia was determined by the Western Aphasia Battery (WAB-R, Kertesz, 2006), as can be seen in Table 1. The HCs had no background in neurological disease and all presented as normal in the Montreal Cognitive Assessment (MoCA, Nasreddine et al., 2005).

Table 1. Demographic details of the participants. PWA = person with aphasia, HC = healthy control, WAB = Western Aphasia Battery (Kertesz, 1979)

Participant ID	Participant group	Age	Sex	Aphasia Quotient (WAB)	Aphasia Type
103	PwA	48	M	64,9 (severe)	Broca's
105	PwA	72	M	88,5 (mild)	Anomic
112	PwA	65	M	77,1 (mild)	Anomic
121	PwA	55	M	81,8 (mild)	Anomic
117	PwA	82	M	78,9 (mild)	Conduction
Mean (SD) PWA		64,4 (SD=12)		78,24 (SD 7,7)	
Mean (SD) Controls	HC	62,5 (SD=3,8)			

Task

The participants performed the Litmus Sentence Repetition Task (Marinis, Chiat & Armon-Lotem, 2012) via ZOOM. The SRT is sensitive to sentence length and structural complexity, meaning that it can reflect whether inflectional mistakes are more likely to occur in longer and more complex sentences (Bogliotti, Aksen & Isel, 2020). The task contains 30 sentences with different sentence types. These are: auxiliary modal, passive, who/what/which object questions, sentential adjuncts and object relative clauses (Marinis, Chiat & Armon-Lotem, 2012).

Transcription and analysis

The production was recorded and manually transcribed verbatim. The verbal and noun inflections of the target sentence were determined and the produced inflections of the participant were compared to the target sentence. Target sentences that did not contain any verbal or noun inflections were not included in the analysis (19/30 sentences were included). For each participant, the inflectional index was calculated (number of correctly produced inflections / number of inflections in the target) and averaged for all the included sentences, whereby an inflectional index of 1 represents a perfect match of the produced inflections with the target. The type of inflectional error (Omission, Substitution, Addition)

was also classified.

Results

The results presented in Figure 1, indicate that as a group PwAs showed overall lower inflectional index scores than the HC, with considerable individual variability amongst the PWA. One PwA with mild anomic aphasia shows a lower inflectional index compared to the PwA with severe Broca's aphasia, while one PwA with mild anomic aphasia presents a high index, close to the one of the HCs' mean index. All PwA showed omissions of inflectional markers as the most frequent inflectional error.

Figure 1: The inflectional index scores for the individual PwA and the group means of the PwA and HC (PwA= person with aphasia, HC=healthy control)

Discussion

The results provide preliminary evidence that the SRT is a useful task to capture the production of inflectional markers in PwA. The results indicate that the PwA group show greater difficulties with the correct production of inflectional markers within the sentence repetition task, compared to the HCs. Overall, the results show that PwA with increasing aphasia severity, show decreasing values for the inflectional index, which is in line with the hypothesis that post-stroke aphasia leads to difficulties with the production of inflectional markers. The high variability of the inflectional indexes within the mild anomic aphasia group, might indicate, that there are more factors besides the aphasia severity and type that influence the production of inflections. It might also imply that anomic aphasia leads to a heterogenic profile in the production of inflections. Omissions were the most common error throughout the PwA population, which could lead to the assumption that the production of any inflectional marker is challenging for PwA. In further research, we aim to repeat the analysis with a larger number of participants and also with different language production tasks, i.e. the argument structure production task and connected speech tasks. We are continuing to collect and analyse more data on a variety of aphasias and expect to present data from a larger sample of PwA and HC in the conference.

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Adapting the Mini-Linguistic State Examination (MLSE) to Norwegian and Co-Developing the 'Living with PPA' Questionnaire

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Introduction and aims

Primary Progressive Aphasia (PPA) is a group of language-led dementias, characterised by a gradual decline in language capabilities, significantly impacting communication and quality of life (Belder et al., 2024; Ruggero et al., 2019). Despite the growing demand for language-specific tools to assess and monitor language impairments, outcomes, and quality of life in persons with PPA, there are currently no tools specifically for PPA in Norwegian. Existing tools are often translations of assessment tools developed for English-speaking populations, which limits their applicability in non-English-speaking contexts. Furthermore, to our knowledge, no tools exist for assessing well-being tailored explicitly for people with PPA, highlighting the need for instruments that address well-being and coping.

This study addresses these gaps by adapting the *Mini-Linguistic State Examination* (MLSE; Patel et al., 2021) to Norwegian and developing a new questionnaire to assess the impact of living with PPA. These tools represent a significant step toward improving the assessment and support available for individuals with PPA in Norway.

Methods

This study is twofold: adapting the MLSE tool to Norwegian and developing a questionnaire.

The Mini-Linguistic State Examination (MLSE)

The MLSE is a 20-minute screening test for language impairments in PPA. It includes tasks such as naming, repetition, comprehension, reading, writing, and picture description, assessing five language domains: motor, phonology, semantics, syntax, and working memory (Patel et al., 2021). The MLSE, already available in English, Italian, and Spanish, has been shown to be a reliable and valid tool with high diagnostic capacity (Fernández-Romero et al., 2024) and is currently being adapted into several other languages.

The adaptation process involved translating the MLSE from English to Norwegian (MLSE-N), incorporating linguistic and cultural features while maintaining fidelity to the original.

Linguistic variables such as frequency, word structure, and syllable length were carefully considered. Items from existing aphasia assessment tools in Norwegian were excluded, and new illustrations were commissioned. A pilot version of the MLSE-N was administered to 15 individuals (7 female, mean age 65.2, mean education 12.2 years), and norming of the final version is ongoing.

"Living with PPA" questionnaire
To capture the broader impact of PPA on well-being and coping, a new questionnaire was developed in collaboration with three co-researchers, each diagnosed with a recognised variant of PPA. These co-researchers participated in four meetings with the research team to discuss the effect of PPA on their daily lives. Their insights informed the creation of the "Living with PPA" questionnaire, which seeks to capture the personal and social dimensions of living with PPA. This tool aims to provide valuable insights into the condition's impact on daily life.

Results

The Mini-Linguistic State Examination

Name agreement ratings for the newly commissioned illustrations were obtained from 50 individuals over two rounds. These ratings informed the selection of final items for the MLSE-N. Following the pilot phase, adjustments were made to refine the tool. Data collection for norming is underway to ensure the tool's reliability and validity.

"Living with PPA" questionnaire

The co-researchers contributed to developing a 28-item questionnaire covering five topics: Language, Activities, Help and support, Feelings and Emotions, and Other. This tool provides a comprehensive framework for understanding the psychosocial impact of PPA.

Discussion

The development of Norwegian-specific tools for assessing PPA represents a significant advancement in managing individuals with PPA in Norway. Data collection is underway, with the aim of involving 50 neurologically healthy adults and a minimum of 20 individuals with a PPA diagnosis. The Norwegian versions of the Montreal Cognitive Assessment (Nasreddine et al., 2005) and a short version of the Comprehensive Aphasia test (Swinburn et al., 2021) serve as control measures.

This study marks the first development of tools for assessing language and well-being in Norwegian-speaking individuals with PPA. Preliminary findings from the norming process will provide insights into the tools' reliability and diagnostic utility. Once completed, these tools will be valuable in diagnosing and classifying the different subtypes of PPA, monitoring disease progression, and ultimately enhancing clinical care and research for Norwegian-speaking individuals with PPA.

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Agrammatism in Bengali: Insights from an Indo-Aryan Language

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Introduction

Cross-linguistic research in agrammatism has led support to the assumption that typological variation of language impacts linguistic symptoms in agrammatism. It has been proposed that the core deficit in agrammatism is manifested through an interrelated triad of symptoms: fragmented utterances and sentences, deficits in functional morphology, and scarcity of verbs (Bastiaanse & Thompson, 2012; Faroqi-Shah, 2023; Menn & Obler, 1990). The literature on agrammatism has been overwhelming from English-speaking individuals. Therefore, it remains to be seen if these triad of symptoms replicates in typologically distinct languages.

Menn and Obler's (1990) seminal work on agrammatism with 14 different languages and in recent years research by Bastiaanse and colleagues, and others (Swahili, Indonesian, Thai, Greek, Turkish, Tagalog, Greenlandic, Persian) have given further credence to the idea that specific agrammatic characteristics would depend on the structure of each language (Grodzinsky, 1991; Paradis, 1988). This research reports the first comprehensive characterization of agrammatism in Bengali speakers with non-fluent aphasia.

Bengali (*Bangla*) is an Indo-Aryan language and is spoken by an estimated 272 million people as a first or second language globally. It is the sixth most commonly spoken language in the world. Bengali is a pro-drop language with flexible word order and rich inflectional morphology. Bengali exhibits rich case systems with non-nominative subjects, reduplication and echo-words, complex predicates, postpositions and rich verb agreement. Bengali adopts a more fluid word order with SOV (Subject-Object-Verb), as its canonical form and has characteristics of an agglutinative morphology with extensive, complex and systematic inflectional morphology (Thompson, 2010). In terms of lexical distribution, Bengali has fewer closed-class words (pronouns, postpositions, indeclinables, versus English: prepositions, determiners, pronouns, conjunctions, modals, auxiliaries). As a pro-drop language, Bengali allows for context-based omission of pronouns in the subject position.

These linguistic characteristics would likely to manifest distinctively in connected speech characteristics, especially in the domains of syntax and morphology.

Aim

To provide a comprehensive characterization of connected speech for agrammatic features from Bengali speakers with non-fluent aphasia in the domains of speech production, syntactic and grammatical features, lexical features, and morphological features.

Methods

Participants

There were two groups of Bengali-speaking participants: three individuals with post-stroke aphasia (BWA1, BWA2, BWA3) with moderate Broca's aphasia and a group of eight age-, education- and sex-matched healthy controls. The primary inclusion criteria for People with Aphasia (PWA) was aphasia following a left CVA, and clinically presenting "agrammatic by clinical standard". That is, "moderately non-fluent, having slow and halting speech, with three or four words being the usual maximum uninterrupted string" (Menn & Obler, 1990). Participant details are presented in Table 1.

Task

Narrative samples were elicited for all participants using the wordless picture book, "Frog, where are you?" (Mayer, 1969). This task has shown to be relevant, culturally appropriate and elicits richer language samples with a greater sensitivity to capture language-specific distinctions compared to single-picture descriptions (Bose et al., 2022).

Transcription and analysis

Samples were transcribed manually verbatim, segmented, and analyzed using and augmenting the Quantitative Production Analysis (QPA; Berndt et al., 2000; Bose et al., 2022) to capture the agrammatic features. Following variables were calculated for each domain: 1) Speech rate (words per minute); 2) structural and syntactic measures (mean sentence length, proportion of well-formed sentences, embedding index); 3) lexical measures (proportion of nouns, proportion of verbs, proportion of closed-class words, proportion of pronouns); 4) morphological measures (noun inflection index; verb inflection index). We implemented single-subject statistical method of comparing a single case to a small control group to identify statistically significant differences between each BWA and controls (Crawford et al., 2010).

Results

Table 2 presents the results of the connected speech analyses of the Frog Story for the

three BWA. Grey shading indicates values significantly different from the controls.

The key findings from the analyses of the connected speech samples for the three agrammatic Bengali speakers were as follows. All three BWAs evidenced reduced speech rate and syntactically impoverished productions. BWAs showed shorter (smaller MLU) and structurally simpler sentences, smaller proportion of well-formed sentences (BWA1, BWA2), thus implying large number of ungrammatical constructions as well as lower embedding index. Lexically, BWAs showed preponderance of content words, with higher proportion of nouns than verbs (only for BWA1 and BWA3), and limitation with closed class words (only for BWA1 and BWA3), no pronouns were produced by any BWA. In contrast to English agrammatic speakers who typically demonstrate difficulty in verb and noun inflections, the Bengali agrammatic participants showed intact verb inflections (although limited variety of tokens) but impaired noun inflections.

Discussion

The profile revealed by our analyses suggests Bengali agrammatic features show both similarities (speech rate, syntactic characteristics and lexical distribution) and differences (in inflectional properties) from English agrammatic properties reported in the literature. It appears then that amongst the core triad of symptoms suggested in the literature, Bengali agrammatic does show difficulty in “fragmented utterances and sentences”. There remain distinct differences in functional morphology and verbs. Of the three BWA, BWA2 did produce similar proportion of verb compared to the controls, as well as not higher production of nouns compared to controls. Difficulty with verb inflection is a salient feature in English speakers with agrammatism. However, this was not the case for our Bengali speakers. None of them showed any error in verb inflections, and all verb tokens were produced correctly. However, they did show a limited variety of inflectional paradigm. It would be prudent to assume that Bengali agrammatic might have difficulty with verb morphology, but it is not expressed in terms of errors but rather limitations in production of different types of inflections. Lack of pronouns in their narrative samples seemed to be a characteristic feature amongst all three of the BWA. It could be related to the pro-drop nature of Bengali. The findings highlight that certain features remain universally affected in agrammatism across languages; whilst inflectional properties revealed language-specific differences in Bengali. We would discuss our results within the framework of cross-linguistic comparison of narrative features and the importance of developing language specific markers.

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An Investigation on Simulation Sickness During a Head-mounted-based Mixed-Reality in Aphasia Rehabilitation (ICMR-MiRAR) Program in People with Aphasia

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Abstract

INTRODUCTION

Recently, Head-mounted displays (HMDs) have been commonly used in rehabilitation sciences (Saredakis et al., 2020). However, usage of such devices is not common in people with stroke-aphasia (PWA) compared to other clinical populations like those with phobias, for instance. Aphasia causes communication disturbances due to impaired language following a brain injury. Recent trends of including digital therapeutic technologies in aphasia rehabilitation have improved the quality of service delivery in people with aphasia (PWA) (Repetto et al., 2021). Among them, the ICMR-MiRAR (Indian Council of Medical Research-Mixed Reality in Aphasia Rehabilitation) program, which mixes augmented and virtual realities (i.e., MR: AR + VR), is a recent technology that can mimic the real-world environment in a simulated manner (Shenoy et al., 2024; Krishnan et al., *submitted*). Due to this advantage, this technology is expected to be helpful for clinicians intervening with functional communication approaches for PWA (Shenoy et al., 2024). However, the MR device could induce simulation sickness like any other HMD, such as a VR headset. These include nausea, oculomotor disturbances, and disorientation (Kennedy et al., 1993). Slater et al. (1997) state that simulated or virtual environments can have several physiological and psychological effects, such as simulator sickness. The simulation sickness in PWA has not been investigated while experiencing the MiRAR program deployed in the Microsoft HoloLens, an HMD.

Aim:

In the current study, we compared the simulation sickness between PWA and healthy participants after a Mixed Reality experience deployed through the Microsoft HoloLens, an HMD, using the Simulation Sickness Questionnaire (SSQ, Kennedy et al., 1993).

METHOD

The ICMR-MiRAR program (Shenoy et al., 2024) is an application implemented through Microsoft HoloLens. It incorporates various 3D virtual scenarios (e.g., a Restaurant) and allows the users to interact with 3D characters (e.g., a waiter in a Restaurant). Using an observational study design, we examined the Simulation Sickness associated with exposure to the MiRAR program in groups of PWA (N = 15) and healthy participants (N = 50). This study was conducted at Pauranik Health Care Centre, Indore, India, and at the Department of Speech and Hearing, Manipal College of Health Professions, Manipal, India.

In Group 1, we screened all persons with stroke aged between 18 and 75 years for aphasia using the Hindi Aphasia Indore Screening Test (HASIT) and identified 15 people with aphasia. We conducted the screening between May and December 2024. All the participants were medically stable with adequate functional vision and hearing. We confirmed that all participants had adequate cognitive skills using Raven's Progressive Matrix (N=15). The investigator explained the study details and obtained informed consent from all participants before the commencement of the procedure.

In Group 2, we recruited healthy right-handed participants aged between 18 and 75 years. All had functionally normal (or corrected) vision and hearing acuity. We confirmed that all participants had adequate cognitive skills using Raven's Progressive Matrix. None of the participants had any complaints or history of neurological conditions.

Procedure

Each participant was individually exposed to the mixed reality environment using the MiRAR program (e.g., a Restaurant scenario) to assess simulation sickness. The participants were seated in a quiet room, and the investigator performed the necessary settings (including the internet connection) on the MR device before putting it on the participants. They were instructed to interact with the 3D avatars in a communicative scenario for 15-20 minutes. After completing the session, the participants were required to self-rate their simulation sickness using the SSQ (Kennedy et al., 1993). The investigator marked the participants' responses in Group 1 for those who had difficulty marking their responses due to hemiparesis.

Results

We analyzed the SSQ ratings from the two groups of participants on the three domains (i.e., nausea, oculomotor, and disorientation) and the total scores (TS) following Kennedy et al. (1993). The descriptive statistics median value was 0 for all the domains and total scores for both groups. The interquartile range (IQR) was 0 for all the domains and 1 for the TS in Group 1. IQR in Group 2, except for oculomotor (5.69) and total (3.74) scores, the rest of the domains were 0. The Shapiro-Wilk test revealed that the data from the two groups are not normally distributed across all domains (all p-values < 0.05). The between-group comparisons (Mann-Whitney test) showed that the two groups did not differ significantly

from each other on any of the domains (Nausea: z = 345, p = 0.27; Occulomotor: z = 322, p = 0.262; Disorientation: z = 360, p = 0.728; Total: z = 339, p = 0.468).

Discussion

The finding that the two groups did not differ from each other on any of the domains of the Simulation Sickness Questionnaire is promising, and it adds confidence for future clinicians and clients in the usage of the MiRAR head-mount device (HMD-Microsoft HoloLens) in rehabilitating people with aphasia. However, it may be noted that the Microsoft HoloLens is a non-occlusive HMD, unlike most Virtual Reality (VR) headsets. During the data collection period, we observed a few minor symptoms, such as difficulty focusing, fullness of the head, and general discomfort while being exposed to the Mixed Reality experience. However, such minor symptoms were seen in both groups of participants. Thus, we propose that stroke-aphasia is not a deterrent to the use of unocclusive HMDs like the MiRAR. Further, we observed that most participants enjoyed the experience. Importantly, some participants reported that this device is novel, and they remembered their early 3D experience. Considering that both groups reported some sickness in our study, we believe some precautionary measures should be followed while using the HMD-based programs, such as 1) the program should not be used continuously for more than 30 minutes, 2) the visor (glass) of the MiRAR device (Microsoft HoloLens) can be opened if any sickness is reported during the training period, and 3) the brightness of the display shall be adjustable based on the users' preference (5). A few sessions of acclimatization with the MiRAR device may be beneficial before the intervention in PWA.

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Artificial intelligence to detect chronic post-stroke aphasia from natural speech

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Introduction and aims

Aphasia assessment often relies on isolated tasks using single phonemes, words or sentences, which lack ecological validity. It is therefore recommended to add natural speech tasks to aphasia assessment. However, this has been limitedly applied due to the time-consuming nature of manual transcription and a lack of knowledge on what features to extract from these data. Recent advances in artificial intelligence can overcome these issues. This study investigates (1) the performance of automatic speech recognition (ASR) for aphasic speech, (2) the utility of semi-automatically extracted natural speech features to detect aphasia and their relative importance across different linguistic tasks and (3) the time-efficiency of this AI-based approach.

Methods

Four natural speech tasks were administered in 100 persons with chronic post-stroke aphasia and 58 neurologically healthy older persons. The natural speech tasks included (1) sequential picture description using the Main Concept Analysis, (2) single picture description from the Comprehensive Aphasia Test, (3) responsive speech elicited with the ANELT and (4) free speech. Transcripts were obtained using a Dutch ASR model. This model was trained on 270 hours of speech from the Spoken Dutch Corpus and finetuned on nine hours of natural speech from eighteen Dutch-speaking cognitively healthy older persons. Next, Montreal Forced Aligner was used to calculate word- and phone-level timings. We extracted both manually and automatically determined acoustic and linguistic features capturing different components of language. These features were provided as input to a nonlinear support vector machine (SVM) classifier to detect aphasia at the individual level. Finally, we investigated the relative importance of each natural speech feature across tasks.

Results

Based on a single picture description, the classifier detected persons with aphasia with an accuracy of 86.55%. The SVM had a sensitivity of 79.03% and a specificity of 94.74% for aphasia. Fluency features had the strongest discriminative power, followed by grammatical and semantic features. Our ASR model outperforms earlier ASR models applied to aphasia with a word error rate of 24.50%. Importantly, this AI-based semi-automated approach is four times faster compared to a manual approach. Results for the other three tasks will be discussed during the presentation.

Discussion

Natural speech features are useful to distinguish persons with aphasia from neurologically healthy older persons using an ecologically valid assessment. The proposed ASR model and semi-automatic feature extraction are promising tools to enable natural speech analysis in a time efficient manner in clinical settings.

Assessing discourse macro and micro-structural properties and their white matter neural correlates in Spanish speakers with aphasia

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Introduction and aims

Discourse is a meaningful multiword language unit beyond the sentence level (Ulatowska & Olness, 2004) which can be produced spontaneously or semi-spontaneously across diverse elicitation methods. Assessing discourse abilities in people with aphasia (PWA) can help to identify their language production and communication deficits, to design individual treatment plans accordingly (Kong, 2009), and to determine treatment effects on real-world communication (Stark, 2019). Picture description tasks such as the Cookie Theft are commonly used in aphasia assessment, and could facilitate the comprehensive evaluation of macro and micro-structural discourse properties. However, research and assessment methods addressing spoken discourse in Spanish-speaking PWA are rather limited. We aimed to (i) develop a Spanish main concept (MC) checklist for the Cookie Theft to assess informativeness, a macro-structural discourse metric; (ii) compare the discourse performance of PWA to that of neurotypical controls (NC) at both the macro- and micro-structural levels; (iii) determine whether macro- and micro-structural discourse properties are associated with language-related white matter tract volumes in PWA.

Methods.

We recruited 37 NC (age= 59.57±8.56 years; education= 15.76±4.68 years) and 19 PWA (age=57.21±10.50 years; education= 9.11±4.15 years; time post-stroke onset= 25.63±10.84 months). All participants completed the Cookie Theft. Their speech samples were transcribed and underwent inter-rater reliability on transcription and segmentation

procedures (>35% speech samples/group). We followed previous research (Dalton et al., 2024) to develop the Spanish MC checklist for the Cookie Theft using the NC speech samples. We then evaluated discourse informativeness in NC and PWA to obtain macro-structural discourse metrics that captured the presence, accuracy and completeness of each MC in each speech sample. We further obtained micro-structural discourse metrics including measures of (i) word-class production (nouns and verbs), (ii) semantic complexity (production of heavy and light verbs), (iii) syntactic complexity (noun-verb ratio), and (iv) structural complexity (number and percentage of narrative words). NC and PWA were compared on all discourse metrics using the Mann-Whitney test. Finally, manual deterministic tractography was performed on four language-related white matter tracts: the Arcuate Fasciculus (AF) (all three segments); the Inferior Longitudinal Fasciculus (ILF); the Inferior Fronto-Occipital Fasciculus (IFOF), and the Uncinate Fasciculus (UF). Tract volume was obtained for each tract in each hemisphere. Spearman correlations (corrected for multiple comparisons) were conducted between discourse metrics and the tract volume data available (n=15 PWA) for just the white matter tracts that could be reconstructed for over 50% of the participants.

Results.

Transcription and segmentation procedures were reliable (proportion agreement between raters for NC: all ≥ 0.91; PWA: all ≥ 0.77). We identified 79 relevant concepts produced by the NC. Seven of them produced by >33% of the NC were included in the final MC checklist. PWA performed significantly below the NC in most MCA-derived metrics (all p ≤.002) except for the number of Inaccurate/Complete codes (p =.415). Similarly, PWA performed worse than the NC in all micro-structural discourse metrics (all p ≤.002) except for the noun-verb ratio, percentage of heavy verbs, and percentage of light verbs (all p ≥.291).

Spearman correlations between left hemisphere white matter tract volumes and macro-structural discourse metrics were non-significant. In the right hemisphere, higher ILF volumes were associated with lower occurrence of absent MCs (r =-.724, p =.003) and better overall informativeness (MC composite scores) (r =.735, p =.003). Correlations between left hemisphere white matter tract volumes and micro-structural discourse metrics revealed that higher volumes of the left posterior-AF were associated with greater production of verbs (r =.686, p =.030) and lower noun-verb ratios (r =-.648, p =.036). Correlations between right hemisphere white matter tract volumes and micro-structural discourse metrics were non-significant.

Discussion

Our Cookie Theft Spanish MC checklist resulted in 7 MCs consistent with similar English MC checklists (Dalton et al., 2024). The Cookie Theft can effectively assess discourse in Spanish-speaking PWA, since it is sensitive to discriminate between PWA and NC in most micro-structural discourse properties and discourse informativeness metrics. These findings underscore the clinical value of our MC checklist and the overall Cookie Theft task to provide quantifiable discourse metrics which can be compared to a normative population providing a comprehensive view of individual ability. The associations between micro and macro-linguistic discourse abilities and the tract volumes of the left PS-AF and the right ILF respectively, suggest that white matter structural connectivity in the left and right hemisphere differentially contribute to linguistic and functional aspects of discourse in chronic aphasia.

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Assessing oral and written production in minority language speakers with aphasia: the case of Catalan

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Introduction and aims

Individuals with aphasia (IWA) present deficits in oral and written production, which are often assessed through description tasks. However, assessing speakers of minority languages is challenging considering that such languages do not have or have not always had institutional recognition. This is the case for Catalan, a language that was not officially taught in schools until the late 1970s. The result is that some native speakers have difficulties writing in their language, with frequent interference from Spanish. Previous studies (e.g. Berhns et al. 2009, Vandenborre et al. 2018) on the written and oral production abilities of IWA have overlooked this type of populations.

The present study aims to analyse the production abilities of IWA who are speakers of Catalan, but attended school in Spanish, compared to those of control subjects; we also aim to investigate whether there are any differences between their written and oral skills.

Methods

Participants
One hundred and nine non-brain-damaged individuals as control subjects (mean age = 50, 65 females), and twenty-seven individuals with different types of aphasia (mean age = 66, 13 females) after suffering a left-hemisphere brain injury, all with different educational backgrounds. All the participants reported that they were bilingual speakers of Catalan and Spanish, but that the former was their dominant language.

Materials and procedure
We administered the oral and written picture description tasks from the Catalan version of the *Comprehensive Aphasia Test* (CAT-CAT; Swinburn et al. 2004, Salmons et al. 2021). In these tasks, participants are asked to describe a picture that depicts several events (e.g. a cat climbing on a shelf to catch the fish in a fishbowl, causing some books to fall on a woman’s head…). The scoring system takes into account the number of relevant nouns, verbs and events mentioned and uses a Likert-type scale to assess grammaticality (well-formedness of utterances), complexity (variability of syntactic constructions), and fluency in oral descriptions. Hence, both measures of form and content are considered.

Results

IWA obtained lower scores than the controls on all variables (see Table 1). The two groups differed significantly in oral ($W = 570$, $p < .001$) and written ($W = 405.5$, $p < .001$) descriptions. Interestingly, the two groups performed significantly worse in the written task than in the oral subtest (controls: $V = 3724$, $p = .009$; IWA: $V = 267$, $p < .001$). The effect size between the two subtests was larger in the control group ($Z = -71.85$, $r = -6.88$) than in the experimental group ($Z = -13.98$, $r = -2.69$). This is also evident if we look at the descriptive results: controls showed more variability in the written task.

Although all participants stated that Catalan was their dominant language, one control participant and one IWA wrote their descriptions in Spanish. On the other hand, two IWA replied orally and in writing in Spanish. All of them replied in Catalan in other subtests. Answers in Spanish were scored 0. Interferences of Spanish at different levels, such as words in Spanish, were observed in both groups' replies. In addition, eleven IWA were not able to write anything in the description task. Even if we excluded these subjects, the difference between the two groups was still significant ($W = 570$, $p<.001$ for oral descriptions and $W = 385.5$, $p =.007$ for written descriptions).

Discussion

Our findings are consistent with the previous literature in showing that individuals with aphasia often present deficits in oral and written production, to which description tasks such as the ones used in the present study are sensitive. Their performance, as expected, was less productive, since they produced a smaller number of nouns and verbs, but also less efficient, as the proportion of relevant content units was smaller than that found for control subjects. Similarly, their performance on form variables was significantly lower than that of controls.

However, contrary to what has been suggested in previous literature on monolinguals (Vandenborre et al.), our findings indicate that the assessment of writing abilities is less sensitive for the diagnosis of aphasia in Catalan-speaking individuals. Even though the performance of IWA in the written description subtest was worse than that of control participants and, in fact, also significantly worse than the IWA's own oral descriptions, the same pattern of response (and greater intersubject variability) was observed in the control group. Both the scores and the analysis of the written descriptions by control subjects revealed the interference of sociocultural factors that need to be considered when evaluating speakers of a minority language, which would also partially explain the large number of IWA who were unable to complete the written test in Catalan. For instance, unlike in oral descriptions, several participants expressed their insecurities and difficulties in writing in a language that they had not been taught to write. This was confirmed by the

Pearson correlation analysis, which revealed significant moderate associations between the written task and age (r = -0.47, p<.001) as well as education (r =.32, p<.001) in the control group. The result was that many control subjects produced a smaller number of relevant nouns and verbs and, hence, their written descriptions were less productive and even telegraphic, as exemplified in (1) with the normative orthographic transcription in brackets.

(1) *la sañora asta durmin [La senyora està dormint.]*
the woman is sleeping
al gat asta jugan al nen plora, ya una nina [El gat està jugant. El nen plora. Hi ha una nina.]
the cat is playing the boy cries there is a doll
un cuchet unas gafas una taula una radio [Un cotxet, unes ulleres, una taula i una ràdio.]
a little car some glasses a table a radio

The results emphasise the importance of considering sociocultural aspects of the assessed languages and linguistic communities, especially in the case of minority languages in multilingual settings. For languages like Catalan, the assessment of oral skills is more reliable than the assessment of writing, particularly in older subjects and those with lower education levels.

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Assessing word production with referential tasks: From isolated to contextual item presentation

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Structured abstract only

Introduction and aims

Language impairment affects one third of acute stroke patients (Brady et al., 2016), leading to a consequent impact on health-related quality of life (Hilari et al., 2012). People with aphasia (PWA) are referred to speech and language therapists (SLTs), who conduct batteries assessing language skills at the different linguistic levels in production and comprehension (Sheppard & Sebastian, 2021). Anomia for instance is mostly assessed with referential tasks by asking PWA to name drawings of items, presented one after the other on neutral slides or sheets. Often, patients complain that naming an object or retrieving a word in real life seems more impaired than in such artificial assessment tasks: for instance, asking for cherries in the context of a market can be challenging for a person with aphasia, while he/she can name a cherry in a standard assessment task.

There are several possible reasons causing the enhanced difficulty in real life, among them the interference by the semantic context and by an increased attentional demand.

semantic context impact has been extensively studied in the last decades in literature through several context paradigms (Abdel Rahman & Melinger, 2009). Picture-naming interference tasks showed longer latencies in naming when a semantically related written word was presented simultaneously, in contrast to an unrelated word (Schriefers et al., 1990). Blocked-cyclic picture-naming demonstrated a semantic interference effect with increased latencies when participants were asked to repeatedly name objects in sequences of other semantically related items, in comparison with a semantically heterogenous context (Belke, 2017; Schnur et al., 2006). Although this experimental background conditions gives us interesting arguments for language production models, it seems remote from real-life conditions. Apart from those paradigms, few researches have examined the effect of a semantic environment on a picture-naming task. The only two studies focusing on this question used priming scenes, and both demonstrated a facilitation of picture-naming when the priming-cue was congruent, in contrast with the incongruent condition (Palmer, 1975; Rogalski et al., 2011). To our knowledge, a single study explored the implication of simultaneous scene background in picture-recognition, measured by naming performances . They reported that a consistent context facilitated object identification and enabled shorter

naming latencies. These studies raise the hypothesis that the context surrounding an item presented for naming has an influence. In addition to that, while in the setting of a standard assessment the person can entirely focus his/her attention on the language task, in real life the use of language is usually embedded in other aims and with other actions or stimuli going on concurrently, meaning that attention cannot be entirely dedicated to language processes. It has been shown that when attention is captured by other tasks performance in the language task is reduced in PWA, even without active actions towards secondary tasks/stimuli (Demierre et al., 2024).

As speech and language therapists regularly observe a dissociation between standard assessments and everyday abilities in people with aphasia performances, it remains relevant to explore deeply the specifics of lexical retrieval in conditions closer to real-life settings. The preliminary study presented here is part of a larger project in which we aim at investigating the assessment of language with immersive virtual reality. Here we investigate the impact of a complex market scene with related and unrelated distractors on picture-naming as compared to a standard picture naming task wit objects presented in isolation in neurotypical adults and PWA.

Methods

We started recruiting French-native speaker participants and aim at involving 20 neurotypical adults and 5 PWA with stroke-related mild to moderate aphasia. The experiment consists in a blocked-cyclic picture-naming task. Twenty-four items were chosen to form six homogeneous blocks (corresponding to 6 taxonomic categories). Four items belonging to different categories were grouped to constitute six heterogenous blocks. In total, 192 trials were recorded (4 items repeated across 4 cycles, through 12 blocks). This protocol was developed in two conditions: (a) a single 3D drawing was presented on a white screen, (b) the item presented was included in a background market scene, surrounded by three other distractor items. All participants will undergo the same assessment starting by (1) the isolated condition or (2) the contextual presentation, in a counter-balanced order. During this contextual condition, the target item was surrounded by a yellow frame to ensure a quick identification of the object.

Analyses will be carried out by comparing the classical cyclic naming effects (homogeneous versus heterogeneous blocs across cycles) between the standard presentation and the contextual presentation.

Results and Discussion

We expect that the classical semantic interference effect is observed also in a blocked-cyclic paradigm with a contextual condition where all the competitors from a related semantic category remain visible with longer latencies in neurotypical participants and increased errors in PWA compared to the unrelated condition between cycle 1 and 2. We expect that

performances would suffer from the interference of the scene distractors, leading to increased interference at least from cycle 2 during the “contextual presentation”. Moreover, if semantic interference is increased by the addition of distractors, cycle scopes would turn out steeper between cycle 1 and 2 in the more distractive condition.

The results of this preliminary study will guide the conceptualization of our main study aimed at assessing language in PWA in a close to real life setting using immersive virtual reality.

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Assessment of perioperative language abilities of individuals with brain tumours: The role of linguistic tests and spontaneous speech analysis

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Topic: Cognitive neuroscience of language

Introduction and aims Recently exploring the language and cognitive skills of individuals with brain tumours has proved a valuable undertaking due to the increased life expectancy of these individuals after tumour resection. Research findings point to the inadequacy of standardised neuropsychological measures to capture the exact status of the linguistic and/or cognitive abilities of these patients. Satoer et al. (2018) showed that spontaneous speech variables can reveal otherwise undetected language deficits. Notably, Rybka et al. (2024) reported that preoperatively, tumor patients experience language and memory deficits which impact on their quality of life. These findings indicate that linguistic impairment is evident in these individuals and warrants further exploration. The aim of this study is two-fold. First, to provide a detailed pre- and post-operatively assessment of language abilities of Greek speaking tumour patients; second, to contribute to the assessment practices per se. Overall, we explore whether there are robust linguistic markers indicating deficiency in these patients.

Methods

This study was approved by the Research Ethics Committee of Aristotle University of Thessaloniki (204986/2020). *Participants*

The tumour patients (TP) [N=6, women=3; Mean chronological age (CA):=46.8 years; Range CA:=18-73; Years of education (YoE) Mean:11.7 years; Range YoE:=6-18] were admitted at the 1st Neurosurgery Clinic of AHEPA University Hospital where all their resections were performed and their perioperative assessments were administered by the first author of this study. They are all monolingual native Greek speakers except one who is Greek-Albanian bilingual with Greek as his dominant language. Four (TP1-TP4) out of six patients had aggressive, high grade (3-4) tumours in the left hemisphere-LH; the other two had low grade (1) tumours, one in the LH and the other in the right hemisphere-RH.

We included a control group comprising healthy participants (N: 15; 2-3 controls for each patient), matched the patients in sex, age, years of education and spoken languages (Greek for monolinguals and Greek-Albanian for the bilingual patient).

Materials and Procedure The TP were

assessed 1-3 days preoperatively and 4-16 months (mean=10.5 months) post-operatively. The assessment protocol comprised a wide range of materials:

Standardized neuropsychological measures -Boston Diagnostic Aphasia Examination-Short Form^{GR}-(BDAE) (Messinis et al.2013). Language tests of morphology and syntax, widely used for Greek speaking individuals, for which there are normative data. -Perfective Past Tense Test (PPTT) for past tense elicitation (see for example Clahsen & Stavrakaki, 2009) -Syntactic Comprehension Test (SCT) assessing comprehension of complex relative clauses, passive verb and reflexive verb structures (see for example Talli & Stavrakaki, 2020). Spontaneous speech

A spontaneous speech analysis protocol was applied. At least 300 words of uninterrupted running speech were taken from each patient (Prins & Bastiaanse, 2004). Alternatively, we accepted three to four minute talks if the participants had difficulty in talking (TP4 postoperatively). The following quantified variables were included (most of which in Satoer et al., 2018): *Lexical Variety; Self-Corrections; Repetitions; Speech & Language Errors* including sub-variables for phonemic, morphological, syntactic, semantic and production errors; *Speed of Oral Speech Production* (calculated in words of spontaneous speech per minute); *Incomplete Sentences.*

Results

We performed between-group (patients vs. controls) analysis with a non-parametric test (Mann-Whitney, significance level: $p< 0.05$). Due to individual variation, we performed individual data analysis by comparing each patient's performance to Typical Mean (TM).

Impaired performance was considered the following: (i) 1.5 Standard Deviation (SD) below *the correct* TM; and (ii) 1.5 SD above *the incorrect* TM when numbers of errors were calculated in spontaneous speech variables. Neuropsychological measures:

The BDAE^{GR} showed that only one patient (TP4) showed aphasic performance preoperatively and postoperatively while for all others language impairment was not detected. Language Tests:

Morphology: Between-group analysis showed no significant differences. Individual analysis revealed that in the PPTT both in the pre- and post-operative assessment, the same three TP (TP1, TP5 and TP6) showed impairment. Notably, TP1 had particularly impaired performance.

Syntax: In the SCT, in the preoperative assessment three patients (TP1, TP5, TP6) showed impaired performance, while in the post-operative assessment four patients (TP1, TP3, TP4, TP6) showed impairment.

Spontaneous Speech: Between-group analysis revealed significant differences for the following variables: *Self-Corrections*; *Repetitions*; *Speech & Language Errors*; *Incomplete Sentences*; *Lexical Variety.* Individual analysis revealed impairment in *Self-Corrections* and *Repetitions* for almost all patients with P5 being impaired only postoperatively in them. All patients were significantly impaired in

Incomplete Sentences while they showed increased *Speech & Language Errors* except P1 preoperatively. In *Lexical Variety* TP2 and TP5 were behind controls only preoperatively while TP4 only postoperatively. Only patients 4 and 5 were behind controls in *Speed of Oral Speech Production* both preoperatively and postoperatively while the *Speed of Oral Speech Production* was affected in P1 only postoperatively.

Discussion

In this study, in addition to a standard neuropsychological assessment for language, we performed detailed linguistic analysis by employing tools designed to assess specific linguistic abilities in morphology tasks (past tense) and in complex syntax. Furthermore, we collected spontaneous speech data and provided a detailed linguistic analysis.

The results indicated that there were linguistic deficits in morphology and syntax captured by the specialized linguistic tests. These deficits were evident when individual analysis was performed. Our findings suggest that sophisticated linguistic materials of morphology and syntax can illuminate the linguistic abilities of tumour patients. The spontaneous speech analysis revealed between-group differences (patients vs. controls) in addition to individual analysis that showed significant impairment. More specifically, almost all patients were impaired *in Self-corrections, Repetitions, Speech & Language Errors and Incomplete Sentences* as shown by individual analysis. Notably, these variables were also found to significantly differ in the between-group analysis. In this respect, in line with other researchers (Collée et al., 2024), we claim that these variables constitute robust markers of language impairment in these patients. Concluding, our study indicates the significance of sophisticated linguistic materials in the assessment of tumour patients in addition to spontaneous speech and reveals robust markers of language difficulties.

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Associative paraphasias as a strategy in the face of word-finding difficulties?

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Introduction and aims

Individuals with aphasia (IWA) can produce a range of semantic errors. Associative paraphasias are semantic errors with an associative relationship to the target (e.g.,. ambulance -> hospital). Jefferies and Lambon Ralph (2006) proposed that, as opposed to coordinate errors (e.g., tulip -> rose), associative paraphasias result from an impairment of controlled semantic cognition (but see Tessaro et al., 2023). Alternatively, Tessaro et al. (2023) showed that the semantic properties of the words (such as number of coordinates) determine the production of associative rather than coordinate errors in aphasia. A third hypothesis stems from Budd et al. (2010) who observed that, within patients with diverse acquired word-finding impairments, those who produced more associative paraphasias had preserved semantics. Budd et al. suggested that these errors were the sign of compensation strategies in the face of word-finding difficulties. If this is the case, then associative errors in IWA may serve a communicative purpose and should be found more at chronic stages of aphasia, that is, when the individual has had more time to adapt to the condition. In addition, associative paraphasias should co-occur with other compensation strategies. The present study aims to investigate this hypothesis empirically, by analysing errors produced by a large set of IWA, and their relationship with time post-aphasia onset and the production of circumlocutions (as another type of compensation strategy).

Methods

Participants

A large database of aphasic picture naming data (MAPPD: Mirman et al., 2010) was used. Participants (N = 294, aged 22-86) were recruited in Philadelphia (USA) one to 381 months post-stroke and had a range of aphasia types and severity (WAB-Q range : 27.2-99.3)

Materials

Picture naming data consisted in performance on the 175 items of the Philadelphia Naming Test (Roach et al., 1996). For 78 of the participants, performance on the PNT was recorded more than once (and up to eight times), several months apart.

Error coding

Semantic errors were recoded manually to distinguish associative errors from other semantic error types (e.g., coordinates). This recoding (including the calculation of inter-rater reliability) is still underway. A second coding used a free association norms database (SWOW, de Deyne et al., 2018) to determine the associative status of a target-error pair.

Analyses

GLMMs are underway for the two types of associative error coding. Analyses investigate the probability of producing an associative error relative to that of, 1) a correct response, 2) another error of any type, and 3) any other type of semantic error. Predictors include, a) the number of months post onset, and b) the number of circumlocutions produced by the IWA.

Results

Preliminary results based on the associative norms coding showed the following:

For the effect of months post onset:

- A significant effect on the probability of producing a correct error versus an associative error (odds ratio = 1.32, t = 6.88, p < .001): IWA were more and more likely to produce a correct response compared to an associative error.
- A significant effect on the probability of producing an associative error versus any other error type (odds ratio = 0.82, t = -5.20, p < .001).
- No evidence of an effect on the probability of producing an associative error versus another type of semantic error (p = .119).

For the effects of the number of circumlocutions produced by the IWA:

- A significant effect on the probability of producing a correct error vs an associative error (odds ratio = 0.66, t = -8.37, p < .001): IWA who produced more circumlocutions were more likely to produce an associative error.
- No evidence of an effect on the probability of producing an associative error versus any other error type (p = .494).
- No evidence of an effect on the probability of producing an associative error versus another type of semantic error (p = .906).

Discussion

Over time, IWA were more and more likely to produce a correct response compared to an associative error: this is not surprising given that as IWA recover, picture naming accuracy is likely to get better. However, even when errors decreased overall, when compared to other errors, associative errors were more likely to occur as time post-stroke increased. This finding shows that as naming gets better, associative errors follow a different trajectory compared to other errors and tend to increase in proportion. In addition to this finding, the fact that IWA who produced more circumlocutions were more likely to produce an associative error than a correct response compared to IWA who produced fewer circumlocutions suggests that, as hypothesised by the "strategy" account, associative errors serve a similar communicative function as circumlocutions. However, the number of circumlocutions in an IWA did not predict the occurrence of other errors when compared to associative errors. More analyses are underway to further investigate the specificity of associative errors when compared to coordinate errors, namely, and their respective

potential strategic origin. This line of research invites researchers and clinicians to reconsider the origins of aphasic errors: errors are often thought as being involuntary and the direct consequence of specific impairments, however in some cases, they may also reflect the use of intact compensation abilities in the face of word-finding difficulties.

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Attitudes towards people with neurogenic communication disorders

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Structured abstract only

Introduction and aims

Previous studies have shown that people with neurogenic communication disorders, especially dysarthria (e.g., Fox & Pring, 2005; Schölderle et al., 2019) and aphasia (Harmon et al., 2016), are often perceived with negative attitudes (e.g., underestimated cognitive skills, unfavorable personality characteristics). Attitudes towards persons with apraxia of speech (AOS) have been neglected so far, though the prosodic and segmental characteristics of their speech may trigger negative attitudes as well.

The purpose of the present study was to investigate and compare attitudes towards people with aphasia, apraxia of speech and dysarthria. Samples of descriptions of the modern Cookie Theft picture from these patients were presented to “laypersons”, i.e., listeners unfamiliar with individuals with speech and language disorders, who estimated the presumed competence of the speakers in regard to cognition, language and participation.

Methods

Questionnaire. We developed a list of 15 statements on competences in cognition (e.g, ‘This person is trusted to solve complex problems, e.g. in their profession’), participation (e.g., ‘This person is trusted to do a lot with friends and acquaintances’) and language production and perception (e.g., ‘This person is trusted to understand the news on the radio’). Agreement with these statements was rated on a 6-point Likert scale (1 = totally agree, 6 = do not agree at all).

Speakers and Speech samples. Fourty-five persons with three types of neurogenic communication disorders participated (14 female; mean age 61,3 years, range 26–86): 23 with AOS with or without coexisting aphasia; 12 with aphasia without AOS (APH), 10 with hypokinetic dysarthria in Parkinson’s disease (PD). Furthermore, fifteen neurologically healthy speakers (7 female; mean age 61,2 years, range 24–77) were examined.

Speech samples from all speakers were obtained using the modern Cookie Theft picture (Berube et al. 2019). The following clinical measures were also assessed in the patients: (1) Stroke and Aphasia Quality of Life Scale (SAQOL-39, Hilari et al. 2003), (2) CETI

questionnaire (Communicative Effectiveness Index, Lomas et al., 1989) in the original proxy version and in an adapted patient version, (3) Oral naming of nouns (LEMO 2.0, Stadie et al., 2013) and (4) Verbal Communication score assessed by experts on the basis of the Cookie Theft description.

Listeners and Listening task. Thirty listeners who had no earlier experience with persons with speech or language disorders took part (15 female; mean age 44,4 years, range 20–67).

In the listening tasks, audio recordings of the first 90 seconds of the Cookie Theft picture descriptions were presented, and listeners started to fill in the questionnaire while listening to the presentation. Each speaker was rated by a subgroup of five listeners, and each listener group rated 15 different speakers. A subsample of six speakers was rated by all listeners to ensure the agreement between listener groups.

Results

Listener agreement calculated across the ratings of all 30 listeners on a subsample of the speakers was high (ICC=.98). The internal consistency of the questionnaire was excellent (Cronbach's alpha = 0.99).

A linear mixed effect model was calculated to estimate the effects of speaker group, item category, and listener group on the ratings, with nested random effects of listener group : listener, item category : item, and speaker group : speaker. Ratings for all three patient groups were significantly worse than those for the healthy speakers ($p < .001$ each). Within the patient groups, individuals with DYS were scored significantly better than those with APH ($p < .05$). Item category had no overall effect, but there were significant interactions of Item category with speaker group: The AOS group was rated relatively more unfavorably than the APH group on the PARTICIPATION ($p<.05$) and the LANGUAGE ($p<.01$) as compared to the COGNITION items. The DYS group, though rated most favorably overall, was perceived relatively less competent on the participation ($p<.05$) and relatively more competent on the LANGUAGE items ($p<.01$).

Within item categories, there was considerable variability between items. For example, the statement 'This person is trusted to attend a family celebration' was rated comparatively well for all groups, while the statement 'This person is thought to be able to work in a large team' was rated comparatively poorly (see Figure 1 for mean scores and 95% confidence intervals).

Weak to moderate negative correlations with the questionnaire sum score were found for the CETI scores (self assessment: $r = -0.42$, proxy-assessment: $r =-0.50$, each $p < 0.001$) and the SAQOL communication subscore ($r = -0.40$, $p < 0.001$). In addition, a moderate negative correlation was achieved for the verbal communication score ($r = -0.62$, $p <$

0.001).

Discussion

The study shows that listeners perceived the speakers of all clinical groups to have more limited cognitive and language skills and lower abilities to participate in social and professional life than neurotypical speakers. Our findings confirm previous research documenting unfavorable attitudes towards people with dysarthria and aphasia. Our study is the first to show negative attitudes regarding the abilities of people with apraxia of speech. This finding supports the assumption that the perception of deviations in the audio samples is closely linked to negative evaluations of cognitive and participation skills in the understanding of laypersons (Schölderle et al., 2019). In the patient groups, listeners also seem to infer from the deviations in speech production that the speakers have poorer speech perception compared to the healthy speakers. Our study also shows that self-assessment, proxy-assessment and expert assessment of communicative abilities (which can serve as a measure of the severity of communicative impairment) appear to be related to laypersons` judgements.

The differences in the ratings of the three patient groups suggest that the listeners responded in differentiated ways to the presence of atypical speech signs in the recordings. To investigate the specific impact of individual symptoms, further analysis will focus on the specific symptoms associated with the different syndromes (e.g., phonetic errors; prosodic errors; a range of linguistic symptoms such as word finding difficulties and grammatical errors; abnormalities in voice quality).

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Auditory-Motor Synchronization in Individuals with Aphasia and Neurotypical Older Adults

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Auditory-Motor Synchronization in Individuals with Aphasia and Neurotypical Older Adults

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Introduction and Aims

Speech perception involves aligning neural oscillations in the auditory cortex with the temporal structure of the acoustic signal. The speech signal has a quasi-rhythmic envelope structure with distinct acoustic cues across different linguistic levels like syllable or phrases. Previous research suggested that auditory and motor cortices are coupled, with the speech-motor cortex functioning as a neural oscillator that entrains to the envelope structure, thereby supporting perception of rhythmicity and prosody (Poeppel & Assaneo, 2020). This auditory-motor coupling is evident in movement synchronization with external rhythms and can be assessed using two different paradigms: Tapping tasks measure domain-general synchronization with metronome or musical stimuli (Anglada-Tort et al., 2022), and the speech-to-speech synchronization task assesses domain-specific auditory-motor coupling (Assaneo et al., 2019).

In speech-to-speech synchronization, neurotypical individuals show a bimodal distribution, with high synchronizers exhibiting stronger auditory-motor coupling and enhanced degrees of synchrony compared to low synchronizers (Assaneo et al., 2019). Individual differences in non-linguistic auditory processing of rhythm and pitch, linguistic prosody, and musical expertise may relate to variability in auditory-motor synchronization (Mares et al., 2023; Zipse et al., 2014). Additionally, synchronization may also depend on task demands, auditory input (metronome, music, speech), and motor output (tapping vs. whispering) (Mares et al., 2023).

Individuals with aphasia (IWA) can experience deficits in auditory processing and sensorimotor integration, contributing to impaired speech perception. These deficits manifest, for example, as greater variability in tapping tasks indicating impaired domain-general synchronization (Zipse et al., 2014). However, speech-to-speech synchronization in aphasia has not been systematically studied yet, nor has a direct comparison been made

between domain-specific and domain-general synchronization across different paradigms within the same participants. Furthermore, the interplay of auditory comprehension, aphasia severity, speech fluency, and speech-motor skills for synchronization in aphasia remains unexplored.

This study, therefore, aims to 1) assess the ability of IWA to synchronize their motor output to an auditory signal compared to neurotypical controls in two different paradigms, and 2) examine within- and between-group variability, considering individual differences in auditory, prosodic, musical, and language abilities.

Methods

Participants

Forty-eight native speakers of German participated in this study: 16 IWA and 32 neurotypical controls (CTR). Groups were matched for age (50-80 years), education, handedness, and hearing thresholds. IWA had unilateral left-hemisphere lesions, a post-onset time of >3 months, and varied in aphasia severity, speech fluency, and speech-motor skills. Auditory comprehension was assessed to ensure basic task understanding.

Experimental Design

Participants completed two experimental paradigms: In the tapping task, they listened to three metronome and six musical stimuli through headphones and tapped in phase on a sensor using their (pre-morbidly) non-dominant hand. In the speech-to-speech synchronization task, they completed two runs where they listened to a rhythmic train of auditorily presented syllables and were explicitly instructed to simultaneously whisper “ta” for 80 seconds at the same rate as the incoming syllables, which increased step-wise from 4.3 to 4.7 Hz. Additional tests assessed non-linguistic auditory processing (rhythm and pitch discrimination), linguistic prosody (sentence type identification), and musical expertise (demographic questionnaire).

Data Analysis

This study was pre-registered on OSF: https://osf.io/nmhs6. In the tapping task, we measured mean and standard deviation (SD) of asynchrony and inter-tap-intervals, and used circular statistics to calculate mean vector length, providing a more accurate analysis for low synchronizers. In the speech-to-speech synchronization task, we computed phase-locking values (PLV) to quantify the degree of synchrony between the perceived and produced signals and classify participants as high or low synchronizers (Lizcano-Cortés et al., 2022). Using linked linear mixed models, we examined both tasks in relation to auditory, prosodic, and musical abilities. As a next step, we will explore how individual differences in auditory comprehension, aphasia severity, speech fluency, and speech-motor skills relate to

task performance in IWA.

Results

Descriptively, in the tapping task, IWA showed overall higher variability in asynchrony, indicating lower synchronization accuracy and tapping consistency compared to CTR. This was particularly evident in SD asynchrony, but also reflected in inter-tap-intervals and mean vector length. Additionally, both groups showed lower variability in the metronome vs. music task (CTR: metronome = 30.7, music = 41.7; IWA: metronome = 64.7, music = 95.8; SD asynchrony).

In the speech-to-speech synchronization task, 11 out of 16 IWA successfully performed the task and met pre-defined inclusion criteria (see: OSF pre-registration), along with 24 CTR. While CTR performance suggested the expected bimodal distribution of high (M = 0.68, SD = 0.11; mean PLV; n = 18) and low (M = 0.27, SD = 0.09; mean PLV; n = 6) synchronizers, the small sample of IWA limited the validity of further classification in high and low synchronizers (Fig. 1).

Statistical analysis using linked models revealed the following results: In the tapping task, we found a significant main effect of *group*, with IWA showing higher SD asynchrony than CTR. Additionally, *linguistic prosody* was significantly associated with synchronization ability, as higher sentence type identification accuracy correlated with lower SD asynchrony. In the speech-to-speech synchronization task, we found a significant main effect of *run*, with higher mean PLVs in the second compared to the first run, indicating increased synchronization ability over the course of the task. Additionally, *rhythm discrimination* and *linguistic prosody* were significantly associated with synchronization ability, with higher accuracy in these tasks corresponding to higher mean PLVs. Crucially, a significant effect of *predicted SD asynchrony* (tapping task estimates) on mean PLVs indicated that lower predicted variability in tapping performance was associated with higher speech-to-speech synchronization.

Discussion

Results suggest that individuals with aphasia exhibit greater variability in auditory-motor synchronization compared to neurotypical controls, with more stable tapping linked to better speech-to-speech synchronization. Auditory processing of rhythm as well as prosodic abilities are significantly associated with domain-specific synchronization, highlighting the interplay between auditory and linguistic skills in auditory-motor coupling and offering further insights into individual differences in unimpaired as well as impaired speech perception.

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Automatic detection of Mild Cognitive Impairment and Alzheimer's Diseases using Machine Learning

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Introduction

Dementia is a progressive cognitive impairment associated by a general decline in cognitive abilities and everyday activities performance. Dementia affects more people each year as the average lifespan increases. The most common dementia cause is Alzheimer’s Disease (AD), which causes decline in language abilities, memory problems, disorientation, etc. Frequently, AD is preceded by Mild Cognitive Impairment (MCI). MCI is marked by modest clinical decline and viewed as the transitional stage between age-related cognitive decline and early-stage dementia (Petersen, 2016). At the same time, individuals with MCI do not necessarily progress to AD. Current conventional diagnostic methods for dementia and MCI are labour intensive and require extended periods to achieve an accurate diagnosis. At the same time, an early delivery of interventions is important as it might delay the onset of dementia.

Recent advances in machine learning and natural language processing (NLP) have demonstrated promising potential for the automatic detection of Alzheimer’s Disease (AD). Given that individuals with AD and Mild Cognitive Impairment (MCI) exhibit poorer language performance compared to Healthy Controls (HC) (Taler & Phillips, 2008), linguistic features extracted from spontaneous speech offer a valuable avenue for identifying these conditions. Despite this potential, most research in this area has concentrated on distinguishing AD from HC (e.g., Sirts et al., 2017), with limited attention given to MCI, apart from a few exceptions (e.g., Fraser et al., 2019). Furthermore, studies focusing on MCI often restrict their scope to classifying MCI versus HC, neglecting the inclusion of the AD class. To our knowledge, no research has systematically explored automatic classification across all three groups — MCI, AD, and HC.

In the present study we focus on extracting and applying linguistic features to detect the presence of MCI using machine learning. Additionally, we investigate how sensitive are NLP-based approaches in detecting MCI and AD compared to the clinical gold standard, Mini-Mental State Examination (MMSE).

Methods

We used data from DementiaBank to perform classifications. The dataset consists of

descriptions of the Cookie Theft picture produced by patients diagnosed with AD or MCI and HC individuals. Only speech samples for which MMSE data is available were used. In result we got 32 MCI, 235 AD, and 182 HC transcribed speech samples.

We used three different models namely, Random Forest (RF), Support Vector Machines (SVM), and Logistic Regression (LR) to classify MCI vs. AD, MCI vs. HC, AD vs. HC, and MCI vs. AD vs. HC tasks. Since data was imbalanced across groups and we aimed to improve predictions for underrepresented MCI class, we used F1 Macro as a metric, 10-fold stratified cross-validation to train and test the models. Firstly, we used only MMSE data, and then only the extracted linguistics features, and then a combination of the two to classify the three groups.

The linguistics features, which were based on previous research (e.g., Tsantali et al., 2013; Ahmed et al., 2013; Sirts et al., 2017; Fraser et al., 2019; Kurdi 2024), included the following: word-level Mean Length of Utterance, Average Number of Stop Words (by stop words we mean high frequency words that do not bear significant meaning), Average Sentence Tree Depth, Average Number of Verbs with Inflections, Average Number of Nouns with Determiners, Average Semantic Idea Density, Average Semantic Idea Efficiency, Average Propositional Idea Density, Maas Index, Frazier Score, Average Number of Words per Clause, Average Pairwise Sentence Embeddings Distance. Additionally, we extracted Average Number of Onomatopoeias, Average Number of Interactions/Interjections and total counts of short, middle, and long pauses, since that information was already annotated in the dataset.

Results

In three of four classification tasks (MCI vs. AD, MCI vs. HC, MCI vs. AD vs. HC) adding linguistic features to TF-IDF and MMSE data lead to performance improvements. The results are presented in Table 1 and Figure 1.

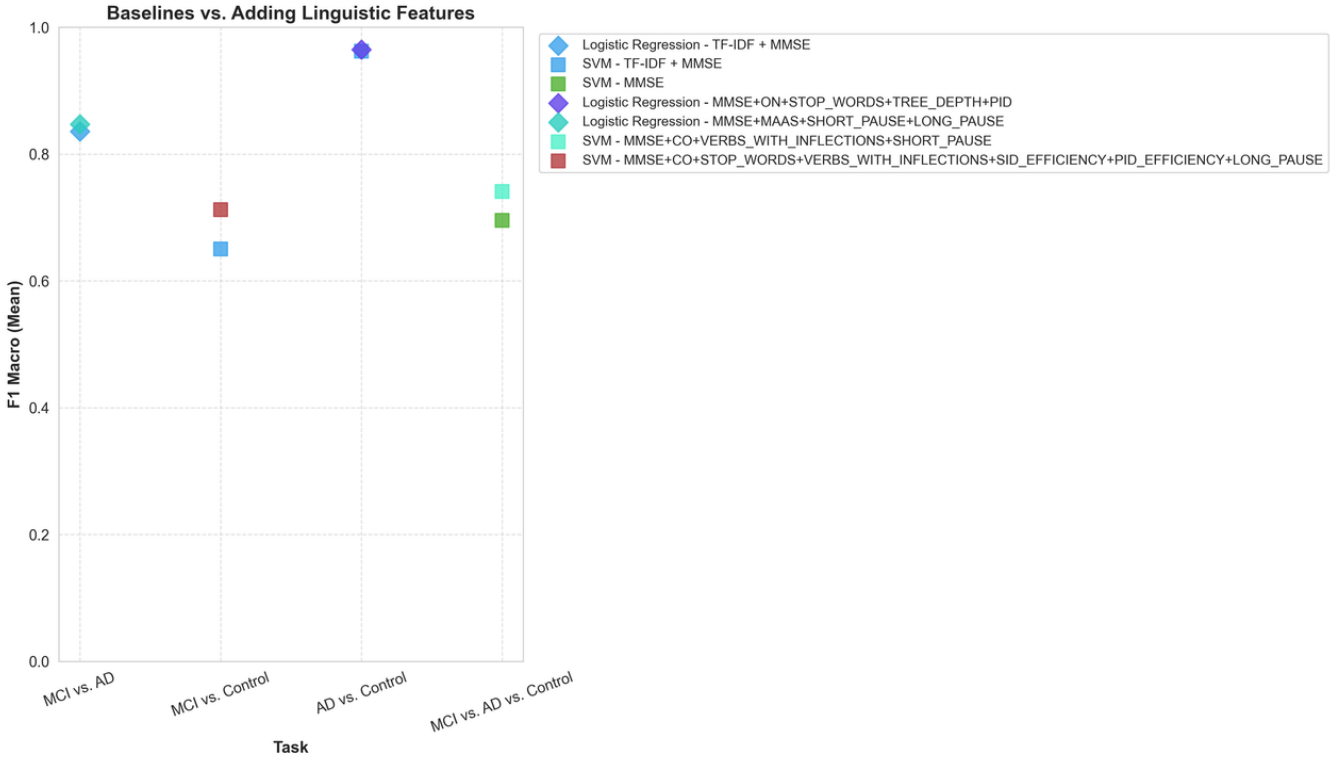
For the MCI vs. AD classification task, the best result of *0.846* F1 macro score (compared to the baseline result of *0.835*) was achieved by adding Maas Index, short and long pauses counts in the LR model.

For the MCI vs. HC task, addition of Average Number of Interactions/Interjections, Average Number of Stop Words, Average Number of Verbs with Inflections, Average Semantic Idea Efficiency, Average Propositional Idea Efficiency to the SVM model, and long pauses count gave F1 macro score of *0.712* (compared to *0.650*).

For the AD vs. HC task, the best result of *0.964* F1 macro score was achieved by adding Average Number of Onomatopoeias, Average Number of Stop Words, Average Sentence Tree Depth, Average Propositional Idea Density to the LR model. This insignificantly improved the baseline result of *0.961*.

For the MCI vs. AD vs. HC task, adding Average Number of Interactions/Interjections, Average Number of Verbs with Inflections, short pauses to the SVM model count helped to reach F1 macro of *0.750* (compared to *0.695*).

Figure 1. Visualisation of Classification Results



Discussion

Adding linguistic features to TF-IDF and MMSE helped to significantly outperform the baseline in MCI vs. AD, MCI vs. HC, and MCI vs. AD vs. HC classification tasks. In each task a different set of features lead to improvements. However, some features overlap in two of three tasks (e.g., long pauses count for MCI vs. AD and MCI vs. HC). This deserves closer attention since it might contribute to a better understanding of language performance differences between MCI, AD, and HC.

In conclusion, the results demonstrated that language performance could significantly improve detection of MCI and AD patients beating results of the gold clinical standard MMSE. At the same time, MCI vs. HC and MCI vs. AD vs. HC classification tasks showed poorer performance than MCI vs. AD and AD vs. HC tasks. Future research should be conducted to investigate ways of improving results in these tasks via linguistic features.

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Between Languages: Clinical Realities and Needs in Multilingual Aphasia Therapy

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Introduction: Bilingualism and multilingualism present unique challenges in the assessment and rehabilitation of individuals with aphasia. Research shows that aphasia symptoms and recovery patterns often differ between languages and therapy processes are significantly more complex for bilingual and multilingual individuals compared to monolinguals (Fabbro, 2001; Paradis, 2001). Factors such as language dominance, age of acquisition, usage frequency, and the emotional relevance of each language can all influence impairment and recovery trajectories (Goral et al., 2006; Green, 2005; Kuzmina et al., 2019). In many countries, including Turkey, linguistic diversity is increasing due to both historical multiculturalism and recent migration (Dewaele et al., 2003; Garakhanova, 2023; Turkish Statistical Institute, 2024). This demographic trend highlights the urgent need to address the specific clinical and practical issues encountered by speech and language therapists working with bilingual and multilingual aphasia cases. Recent findings indicate that clinicians perceive assessment and therapy with this population as more challenging and demanding than with monolingual clients (Norwik et al., 2022). Understanding the experiences and perspectives of speech and language therapists regarding bilingual and multilingual aphasia is therefore essential. Such insights can guide the development of effective, individualized therapy strategies and help improve clinical outcomes for this growing population.

Aim: This study aims to explore the experiences, perspectives, and recommendations of speech and language therapists who provide aphasia therapy to bilingual and multilingual individuals in Turkey. This study addressed the following research questions: 1) How do speech and language therapists experience and interpret the process of providing aphasia therapy to bilingual and multilingual individuals? 2) What challenges and needs do therapists encounter in the assessment and rehabilitation of bilingual/multilingual individuals with aphasia? 3) How do therapists evaluate their professional competence, training, and professional development strategies in this context? 4) What recommendations do therapists offer for improving aphasia therapy for bilingual and multilingual individuals?

Method: The present study was designed using a qualitative research approach, as it was considered most appropriate for addressing the research objectives. Specifically, a phenomenological research design was adopted. A total of 12 speech and language therapists (9F; 3M) took part in this study. Participants were recruited through a combination of convenience and snowball sampling methods. Invitations were distributed

via professional WhatsApp groups and through colleagues or acquaintances, who also referred other potential participants. Interviews were conducted via Zoom at a time convenient for each participant. Prior to data collection, a semi-structured interview guide consisting of seven questions was developed based on a review of the relevant literature. Thematic analysis approach was employed following the guidelines of Braun and Clarke (2006). Interview transcripts were read repeatedly to achieve familiarity with the data. Initial codes were generated inductively from the participants' responses. These codes were then organized into overarching themes and subthemes through an iterative review process. Final themes were refined and supported by illustrative quotes from the data. Several strategies were employed throughout the research process to enhance the credibility and trustworthiness of the study. The interview questions were developed with reference to the relevant literature and reviewed by two field experts for content validity. A pilot interview was conducted prior to the main study to ensure the clarity and appropriateness of the questions, and no major revisions were required. Participants were recruited to ensure diversity in experience, including both monolingual and bilingual/multilingual therapists and data collection continued until data saturation was reached. All interviews were video recorded. The transcripts were subsequently shared with participants for their review and confirmation (member checking), allowing for correction or clarification as needed. The coding and analysis process was conducted collaboratively by three researchers. In addition, an independent researcher reviewed the codes and themes to promote reflexivity and reducing individual bias.

Results: Thematic analysis of the interview data revealed four main themes. The first theme, *therapists' language proficiency and perceived professional competence*, encompassed participants' self-assessments of their language skills, their sense of adequacy in delivering bilingual and multilingual aphasia therapy, their training backgrounds, and the strategies they used for ongoing professional development. The second theme, *management and interpretation of multilingualism in aphasia therapy*, included therapists' strategies for language selection, their experiences with clinical differences and challenges across languages (such as code-switching or differential impairment), the impact of language dominance and usage frequency, and their approaches to handling linguistic complexity—including flexibility and collaboration with clients, families, or other professionals. The third theme, *family and professional support*, addressed the roles played by family members and other professionals (such as psychologists or co-therapists) as interpreters or language mediators in therapy sessions, as well as the practical and emotional support provided by these individuals and potential barriers related to their own language backgrounds. The fourth theme, *challenges, professional development and needs*, reflected general challenges encountered in assessment and therapy, the limitations of available assessment and therapy materials, therapists' efforts to adapt or create resources for different languages, barriers to professional development and participants' recommendations and best practices for improving therapy processes and resources.

Conclusion: This study highlights the challenges faced by speech and language therapists working with bilingual and multilingual individuals with aphasia in Turkey. The findings reveal that therapists work through complex clinical linguistic, and professional environments often with limited resources and formal training. Language selection, the adaptation of therapy materials, and collaboration with families and other professionals emerge as critical factors in the effective delivery of aphasia therapy. Despite barriers to professional development and resource availability, therapists demonstrate considerable initiative, adaptability and a commitment to improving their practice. These results show the need for more targeted training opportunities, culturally and linguistically appropriate materials and greater institutional support to enhance the quality and equity of aphasia therapy for diverse populations

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Convergence of ERP patterns in first and second language learning

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Structured abstract only

Introduction and aims

Recent psycholinguistic and neurolinguistic research has shown that grammars might consolidate at the end of grade-school or even up to young adulthood. Some aspects of language processing and grammar consolidation appear to be impacted by morphological regularity or salience (Cantiani et al., 2013; Dube et al., 2018) and thus show delayed consolidation during early and late teenager-hood. ERP patterns elicited in children who are still acquiring their first language (L1) can resemble that of second-language (L2) learners at these stages, for example eliciting N400s instead of adult-like LANs for grammatical errors (Clahsen et al., 2007; Dube et al., 2018; Tippmann et al., 2018). We present results from two ERP studies investigating agreement processing in French children, (pre-)teens, and adults.

Methods

Participants

All participants were native French-speakers living in Montreal, schooled in French and every-day users of French in school or at work. All signed written consents or gave verbal consent (in the case of children) to participate in the study. Both studies used audio-visual picture-sentence-matching ERP paradigms.

Gender agreement study

29 adults (18–35), 26 (pre-)teens (10–16) and 48 children (aged 4;06–7;11) participated in the study.

Subject-verb agreement study

29 adults (18–35),and 19 (pre-)teens (10–16) participated in the study.

Materials

In the agender agreement study, sentences were grammatically correct (*Je vois la clef grise* [gʁiz] *sur la* table 'I see the$_f$ grey$_f$ key on the table'), had gender errors on determiners (…**le clef grise* … 'the$_m$ grey$_f$ key'), or on adjectives which have irregular agreement patterns in French (… *la clef *gris* [gʁi] … 'the$_f$ grey$_m$ key').

In the subject-verb agreement study, sentences were all grammatical but could match or mismatch the visual stimulus (e.g., *The lion roars* presented with a picture of two lions roaring). Plural agreement on French verbs is either marked with an irregular or sub-regular consonant-final verb (e.g., *il rugit* [ilʁyʒi] 'he roars' vs. *ils rugissent* [ilʁyʒɪs] 'they roar'), or is marked with regular liaison between the pronoun and a vowel-initial verb (e.g., *elle aime* [ɛlɛm] 'she loves' vs. *elles aiment* [ɛl**z**ɛm] 'they love').

In both studies each trial started with the visual presentation of a stimulus, followed by the auditory sentence. All sentences, grammatical and ungrammatical, were spliced to avoid auditory cues from contaminating the stimuli. Analyses were run on target items at the point where the sentence became ungrammatical (for gender) or mismatched the picture (for number). Component analyses windows were established using cluster permutations. Averaged data by condition were fitted into mixed-linear effects models involving factors anteriority, hemisphere, and laterality, and other factors where relevant (see below).

Results

We observe changing patterns for error processing in children, teens and adults based on morpho-phonological regularity and salience.

Gender agreement

Adjective and determiner errors elicit distinct patterns in all groups. For determiner errors, both teens and adults elicit anterior negativities followed by P600s while children elicit no significant effects. Adjective agreement errors, elicit lateralized negativities followed by P600s in adults, N400-P600 patterns in (pre-)teenager, and N400 followed by small frontal and posterior positivities in children. However, these last patterns are dependent both on age and proficiency, with frontal positivities in low proficiency younger children (4;6–6 years old), N400-P600s emerging in higher proficiency younger children, and N400-P600s in all older children (aged 7-8).

Subject-verb agreement

Regular liaison processes elicit more adult-like ERPs than irregular ones in teens. Only in commission, the liaison condition elicits a LAN-P600 in adults and a late P600 in teens. No effects are found in either group for liaison omission. On consonant final verbs, patterns also varied according to salience. Commission errors elicit a biphasic N400-P600 in adults and an N400 in teens, while omissions elicit LAN/N400-P600s in adults, but a late P600 in teenagers.

Discussion

Our data reveal a pattern of grammar maturation from age 4 to 20 and beyond, with components being impacted by age, proficiency and linguistic properties such as

morphophonological regularity and salience, providing an intricate picture of language acquisition in L1 that has parallels with ERP patterns for L2 learning observed in adults (see e.g., Steinhauer, 2014). We will discuss a basis for shared ERP patters in L1 and L2 acquisition as a function of age, language proficiency and language structure.

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Cross-linguistic variation in agrammatic manifestation in post-stroke aphasia: Findings from South Asian languages

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Topic: Clinical and experimental work on aphasia and related disorders

Introduction

Cross-linguistic research in aphasia has led support to the assumption that typological variation of language impacts linguistic symptoms in agrammatism. The core deficit in agrammatism is manifested through an interrelated triad of symptoms: fragmented utterances and sentences, deficits in functional morphology, and scarcity of verbs (Bastiaanse & Thompson, 2012; Faroqi-Shah, 2023; Menn & Obler, 1990; Saffran et al., 1989). Menn and Obler's (1990) seminal work on agrammatism with 14 different languages (English, Dutch, German, Icelandic, Swedish, French, Italian, Polish, Serbo-Croatian, Hindi, Finnish, Hebrew, Chinese, Japanese) and in recent years research by Bastiaanse and colleagues, and others (Swahili, Indonesian, Thai, Greek, Turkish, Tagalog, Greenlandic, Persian) have given further credence to the idea that specific agrammatic characteristics would depend on the structure of each language (Grodzinsky, 1991; Paradis, 1988).

Despite these achievements, there remains a stark absence of detailed agrammatic characterization from South Asian languages, such as Hindi, Bengali, Tamil, Kannada, and Malayalam. Globally there are >1.3 billion speakers of these South Asian languages in their native countries and diasporas: Hindi (3rd most spoken language, ~609 million speakers); Bengali (7th most spoken language, ~273 million speakers), Tamil (19th most spoken language, ~86 million speakers) and several other languages situating them amongst the top 20 most spoken global languages (Ethnologue, 2024). Epidemiological studies suggest that the upcoming wave of neurological conditions will predominantly be in lower- and middle-income countries, such as India, Bangladesh, Sri Lanka (Banerjee & Das, 2016; Singh et al., 2021). This demographic shift necessitates research in documenting linguistic impairments in the speakers of these languages with findings will having implications for better theoretical understanding of agrammatism and for the development of linguistically valid and robust diagnostic and intervention tools for these populations.

In this research, we characterize agrammatic features from narrative production data from individuals with post-stroke aphasia from speakers of Indo-Aryan family (Hindi, Bengali) and

Dravidian family (Tamil). These three languages are typologically distinct but all are pro-drop with flexible word order and with rich inflectional morphology. They exhibit rich case systems with non-nominative subjects, reduplication and echo-words, complex predicates, postpositions and rich verb agreement. However, for several grammatical properties, there exist clear contrasts between the Indo-Aryan and Dravidian language families: Indo-Aryan has initial complementizers, Dravidian has final complementizers; Indo-Aryan has only nominal reflexives and reciprocals, while Dravidian has both nominal and verbal reflexives and reciprocals; Indo-Aryan has grammatical gender and biological gender, Dravidian has only biological gender. For verbal inflection, there are further distinctions within each of the language families. In Indo-Aryan languages, verbs are usually inflected for the noun agreement features, in contrast to Tamil which also encodes allocutive agreement. Further, there are intra-family differences in grammatical properties: Hindi has grammatical gender, but Bengali does not; Hindi verbs show person, number, and gender agreement, but Bengali verbs only show person agreement. In the context of agrammatism, these differences would be expected to influence the symptomology of agrammatism.

Aim

To identify language-universal and language-specific features of agrammatism amongst Hindi, Bengali and Tamil in the domains of speech production, syntactic and grammatical parameters, lexical features, and morphological features.

Methods

Participants

Table 1 presents participant details for the three languages. The primary inclusion criteria for People with Aphasia (PWA) was aphasia following a left CVA, and clinically presenting “agrammatic by clinical standard”. That is, “moderately non-fluent, having slow and halting speech, with three or four words being the usual maximum uninterrupted string” (Menn & Obler, 1990). Control participants were matched for age-, sex-, education- and language with the PWA group

Task

Narrative samples were elicited for all participants using the wordless picture book, “Frog, where are you?” (Mayer, 1969). This task has shown to be relevant, culturally appropriate and elicits richer language samples with a greater sensitivity to capture language-specific distinctions compared to single-picture descriptions (Bose et al., 2022).

Transcription and analysis

Samples were transcribed manually verbatim, segmented, and analyzed using and augmenting the Quantitative Production Analysis (QPA; Berndt et al., 2000) to capture language-specific micro-linguistic features for Hindi, Bengali and Tamil.

To arrive at language-universal and language-specific features, we created a percentage score for each feature for each language. If a feature is consistently present for all PWA in that language, then that feature would get 100% score. And if the score is 100% across language languages, then it is considered as a language-universal feature. A value of 100% for “Reduced speech rate, non-fluent, halting with prosodic difficulties” indicates all PWA in that language showed that feature (e.g., 8/8 in Hindi, 6/6 in Bengali). If there is a variation in percentage across the languages, we identified it as a language-specific feature. For example, a score of 75% in word order in Tamil means only 6/8 PWA showed this feature.

Results

Discussion

These results allow us to develop a preliminary profile of language-universal and language-specific agrammatic features amongst these three languages. In terms of language-universal features patients show consistent difficulties across languages in: speech rate and fluency, incomplete sentences and limited structural complexities, limitation in pronoun production, difficulties in noun inflection, omissions of noun inflections, limited paradigm of noun and verb inflections, limited variety of tense markings. In contrast, the language-specific agrammatic features align with the morphosyntactic and inflectional properties of the specific language: presence or absence of substitutions in case markings, proportion of verb inflections errors, differences in verb agreements. We illustrate this point through the example of verb inflection differences amongst the languages. Although for all three languages agrammatic speakers show limited variety of verb inflection, Bengali and Tamil speakers showed no obvious errors in verb inflection for the tokens they produced. This is in contrast with Hindi speakers who showed errors in number and gender ranging 25% to 50% of Hindi speaking agrammatic speakers showing these errors. Hindi language structure is complex in the agreement configuration. First, there is a difference between perfective/non-perfective. Second, there is ergative case. Both these factors play a role in agreement in Hindi. But in Bengali and Tamil, both these factors have no role in agreement. Therefore, agreement structure complexity inherent in a language impacts the language-specific agrammatism.

Our research provides first comprehensive cross-linguistic documentation of three under-researched languages. The findings show the importance of researching a wide range of languages across different language families to develop a deeper theoretical understanding of agrammatism, which can be used to improve assessment and intervention of in the users

of these under-served populations.

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Cumulative semantic interference in people with aphasia? Yes, but the effect vanishes with repeated testing

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Introduction and aims

The continuous naming paradigm is widely used in psycholinguistic research with healthy neurotypical speakers (e.g., Howard et al., 2006) but only few studies are available from people with aphasia (but see Riès et al., 2015; Stark et al., 2024). The paradigm produces stable semantic interference in picture naming, providing insights into lexical-semantic encoding and lexical selection in speech production (Abdel Rahman & Melinger, 2019). In the continuous picture naming task, members of different semantic categories, such as *cat*, *dog*, *mouse*, *rabbit*, and *hamster* for the category "mammals" are named in a seemingly random order, separated by 2 to 8 unrelated objects from other categories. Typically, participants' naming latencies increase with each additional member of a semantic category, that is interference accumulates within categories. This cumulative semantic interference usually survives multiple repetitions, that is while participants get faster with each repetition cycle of the experiment, cumulative semantic interference remains stable (Döring et al., 2022; Stark et al., 2024). In contrast to production, in the receptive version of the paradigm, in which participants semantically categorize pictures as natural or man-made, cumulative semantic facilitation is observed, that is participants' reaction time systematically decreases within categories (e.g., Belke, 2013).

In our study, participants with aphasia (PWA) with post-semantic deficits of lexical access and a group of age-matched neurotypical controls completed a continuous picture-naming and a continuous classification task. We target the question how lexical access deficits modulate cumulative semantic interference. In particular, we asked whether semantic interference effects would be weaker or stronger in PWA when compared to matched controls, and whether it survives multiple repetitions of the task. The classification task served as a control task.

Methods

Eighteen PWA and 18 neurotypical controls were included. All PWA suffered from mild word-finding difficulties, due to post-semantic deficits of lexical access. Target objects belonged to 18 different semantic categories with five members each and were intermixed

with fillers (n=90 targets, n=30 fillers). All participants completed a continuous picture naming task and a continuous semantic classification task. The two tasks were conducted on different days, separated by one week. In the latter they indicated via button-press whether the objects were man-made or natural entities (e.g., Belke, 2013; Döring et al., 2022). Both tasks were repeated to assess the stability of effects. Repeated testing was conducted in the same testing session, separated by short breaks. All picture-naming responses were recorded and transcribed, and speech onset latencies were determined offline.

Results

Continuous naming task

In both groups, picture-naming latencies increased within semantic categories, reflecting cumulative interference. However, this effect interacted with group and with repetition cycle (run of the experiment; ordinal position*group: $t = 2.312$, $p = 0.021$; ordinal position*group*run: $t = 2.469$, $p = 0.014$ [linear-mixed effects models]). While PWA and controls showed similar interference in the first run, the effect vanished with repeated testing in the PWA (see Figure 1). No cumulative semantic effects were present in the accuracy data.

< Figure 1 >

Figure 1: Mean picture-naming latencies for PWA (left) and controls (right) as a function of ordinal position and run. Ordinal position refers to the sequence of the five category members.

Note. Ordinal position effect (linear trend): ***p < .001; ** = p < .01, n.s. = not significant

Continuous classification task

In the classification task (see Figure 2), reaction times decreased with each category member. While the PWA were slower than the controls, the magnitude of cumulative semantic facilitation was comparable across groups (PWA: difference score (Ordinal position 5-1) = -166 ms; controls: difference score = -102 ms). This cumulative semantic facilitation survived repeated testing in both groups.

< Figure 2 >

Figure 2: Semantic classification task (man-made vs. natural): Mean reaction time for PWA (left) and controls (right) as a function of ordinal position and run. Ordinal position refers to the sequence of the five category members.

Note. Ordinal position effect (linear trend): ***$p < .001$; ** = $p < .01$

Discussion

For semantic classification, a similar facilitation effect in PWA and controls confirms largely preserved conceptual-semantic processing in our PWA. In contrast, PWA and controls showed different patterns of interference for production in the continuous naming task. When naming the pictures for the first time, both groups showed similar interference effects. This indicates a similar interplay of semantic priming and lexical competition in both groups. No cumulative semantic interference, however, was present in the PWA when the experiment was repeated, whereas the interference effect remained stable in the neurotypical controls, indicating differences in the interplay of repetition priming, semantic priming and lexical competition in PWA and healthy speakers. Notably, a recent online study reports stable cumulative semantic interference in PWA when tested repeatedly on different days (Stark et al., 2024). In contrast, in our study repeated testing of the experiment was only separated by short breaks in the same session. The data will be discussed in the framework of current accounts. To investigate how this pattern varies across lesions/ pathologies in PWA, the individuals' data will be presented, as well.

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Deficits in rapid word retrieval but not general executive function in very mild aphasia

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Introduction and aims

There is a group of left hemisphere stroke survivors who score within normal limits on the Western Aphasia Battery-Revised (WAB-R; Kertesz, 2007), despite self-reported communication deficits, which impact quality of life (Cavanaugh & Haley, 2020). This group has received different names in the literature, but here we will call them the Not Aphasic by WAB (NABW) group. We will refer to their aphasia as very mild.

Prior literature has demonstrated differences between the NABW and neurologically healthy controls in discourse measures (Fromm et al., 2017) and measures of verbal short-term and working memory (Silkes et al., 2021). Our prior work has also shown group-level differences across a variety of cognitive and language tasks. Specifically, we found that letter fluency tasks were sensitive and specific in classifying individual cases of very mild aphasia from healthy individuals (Laks et al., 2025). Our letter fluency tasks included single-letter trials with F, A, S and two-letter trials with Po and Ta.

Since letter fluency tasks require both word retrieval and executive functioning (Shao et al., 2014), this left the question of whether the very mild impairments reported in the NABW group were more related to the word-retrieval aspect of the tasks or aspects of mental flexibility and cognitive control. Here, we aimed to answer that question by examining the performance of the NABW group on (a) noun and verb naming reaction times (RT) and (b) an in-house measure of executive functioning. We focus on naming RTs rather than naming accuracy, because our prior work demonstrated no group-level differences in accuracy alone. By answering this question, we hope to improve our understanding of the underlying impairments reported within the NABW group, which is necessary for treatment planning.

Methods

All participants completed noun and verb naming tests, plus an in-house executive

functioning task called Antelopes and Cantaloupes (A&C; McCall et al., 2022).

Picture Naming: The verb naming test was 30 items, and the noun naming test was 60 items (Fama et al., 2019). Both tasks used line drawings.

A&C: This is a four-alternative forced choice task, using picture stimuli, with three levels: (S1) selecting a single target repeatedly (S2) selecting two alternating targets repeatedly (S3) selecting three alternating targets repeatedly. There were five versions: semantic (stimuli: cow, pig, goat, sheep), phonological (stimuli: cone, corn, coin, can), unrelated (stimuli: duck, shoe, rope, bread), standard (stimuli: triangle, square, circle, star), and nonverbal (stimuli: four abstract shapes). The nonverbal and standard versions of the task do not require lexical retrieval. 12 measures of A&C were analyzed. These included average performance across levels for each version, phonological cost (unrelated minus phonological), semantic cost (unrelated minus semantic), and the switching cost seen between level one and levels two and three in each version.

Statistical Analysis

See Table 2 for formulae for calculating behavioral indices. Mann-Whitney U tests were utilized to determine differences in group-level task performance for each of the 14 measures. Pearson's r correlations were then utilized to determine the relationship between each measure and the letter fluency tasks that were previously found to be sensitive and specific to very mild aphasia. Univariate receiver operator characteristic (ROC) curves were then used to determine optimal cutoff points for each task, and sensitivity and specificity were calculated. We analyzed whether any measures were more sensitive and specific to very mild aphasia than the combined letter fluency tasks, which had a sensitivity of .89 and a specificity of .81.

Results

There were group-level differences ($p < .05$) in nine of the 14 measures, with six surviving Bonferroni correction (corrected $\alpha = .00357$; see Table 3). These were measures of naming RT, and mental flexibility and cognitive control, specifically when lexical retrieval was required. Correlations between letter fluency and nine of the 14 measures were significant ($p < .05$), with six surviving Bonferroni correction (corrected $\alpha = .00357$; see Table 4). A&C measures that did not require lexical retrieval were not related to the letter fluency tasks. None of the measures analyzed outperformed the letter fluency tasks in classifying individual cases of mild aphasia versus controls (see Figure 1; Table 5) with both sensitivity and specificity, although noun naming RT did have a higher sensitivity of .93.

Discussion

Our results demonstrate group-level differences in NABW individuals from healthy controls in naming RT and mental flexibility and cognitive control, specifically in tasks that require

lexical retrieval. We did not observe a group-level difference in the A&C measures that did not require lexical retrieval, and there was no relationship between these tasks and the letter fluency tasks. These results suggest that the difference in performance between the NABW and control groups on letter fluency is likely driven by impaired lexical retrieval and not nonlinguistic executive function deficits.

This finding provides helpful information for clinicians working with stroke survivors with very mild aphasia, as interventions should target the speed of word retrieval. This skill may be particularly necessary in complex communication contexts, needed for return to work, and participation in normal daily conversations. Unfortunately, item-level RTs are not readily available for clinicians. Future research should consider other timed options, such as total task completion time, which would be easily recorded by clinicians in any setting and may provide a measure for documenting impairments during evaluations and improvements in response to treatment.

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Development and Clinical Validation of an Auditory Naming Test in Persons with Post-Stroke Aphasia

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Introduction and aims

Word-finding difficulties are a common deficit in stroke survivors with aphasia (Flowers et al., 2016). However, current assessments, such as picture naming tasks, may be insufficient due to the importance of verbal context in everyday communication and the potential presence of visual impairments post-stroke (Rowe et al., 2019). This study highlights the necessity of a more comprehensive approach to assessing word-finding difficulties in clinical practice, tailored to the needs and preferences of all patients. We aim to develop an auditory naming test that is designed in parallel with the commonly used picture-based Dutch Naming Test (DNT, van Ewijk et al., 2018), using spoken descriptions to elicit target words and to identify word-finding difficulties. In addition, we intend to evaluate the reliability, validity, and clinical applicability of this test for individuals with post-stroke aphasia in both the acute and chronic phases.

Methods

Development

We developed a screening version of an auditory naming test consisting of six nouns (i.e., *Auditieve Benoem Test, ABT-6*). The nouns were matched to the six target words from the validated screening version of the Dutch Naming Test (DNT-6, Alons et al., 2022). In a first step, multiple items were selected for each target word of the DNT-6, matched for the linguistic characteristics word frequency, age of acquisition, and number of syllables. A description was given for each item. In a pilot study, these 25 items were administered to 60 neurotypical individuals aged between 30 and 90 years in order to select, the best matching item per target word.

Validation

For clinical validation, the ABT-6 was administered in two phases: (1) the chronic phase, including 48 stroke patients with aphasia and 29 neurotypical individuals, and (2) the acute phase, including 31 stroke patients with aphasia and 13 without aphasia, of whom 8 had visual impairments. Performance on auditory naming was compared with visual naming using reliability and validity measures. In addition, case studies were conducted to illustrate

the added value of a broader assessment of word-finding.

Results

The selection of six items was guided by both quantitative and qualitative analyses. Quantitatively, we aimed to minimize the influence of age and gender by excluding items that showed significant score differences between different cohorts. Qualitatively, items were excluded if their description failed to elicit the intended response. This applied to descriptions that (1) were too long or syntactically complex, (2) contained part of the intended response and thus provided a phonemic cue, (3) lacked specificity and evoked multiple responses, or (4) demanded excessive cognitive processing. In clinical validation, the selected items of the ABT-6 demonstrated an internal consistency of α = .82 in individuals with chronic aphasia and neurotypicals, and α = .65 in acute post-stroke patients. Despite different input modalities, moderate agreement was observed between auditory and visual naming scores in both the chronic (ICC = .76) and acute (ICC = .69) phases, suggesting that both tests measure the same construct.

However, auditory naming scores were descriptively lower in the chronic phase ($t(75)$ = -1.35, p = .181) and significantly lower in the acute ($t(43)$ = -2.29, p = .027) phase post-stroke, suggesting that auditory naming may be more sensitive to subtle deficits. Using the full DNT, consisting of 92 items and a more in-depth scoring system, as the ground truth in the chronic phase, the ABT-6 showed an optimal cut-off score of 5/6 with a sensitivity of 87.10% and a specificity of 75%. Visual impairment in the acute phase lowered DNT-6 scores without affecting ABT-6 scores. Case studies in individuals with and without visual impairment demonstrated additional benefits of auditory naming in clinical practice, providing clinicians with a more comprehensive understanding of patients' abilities and needs.

Discussion

This study highlights the clinical relevance of auditory naming in assessing word-finding difficulties in stroke survivors with aphasia. The ABT-6, developed and validated in this study, complements existing visual naming tests and addresses limitations associated with visual impairment. The test demonstrated good reliability and moderate agreement with visual naming scores, suggesting that both tests measure the same underlying construct. Notably, auditory naming may be more sensitive to subtle deficits, which is crucial for detecting nuanced impairments. The ABT-6 also showed high sensitivity and specificity, supporting its clinical utility. Performance on the ABT-6 was not influenced by visual impairments, which underscores its robustness across different patient profiles. Case studies further illustrated the additional benefits of auditory naming, providing a more

comprehensive understanding of patients' communicative abilities and needs. Future research should explore the integration of auditory naming tests into routine clinical assessments and further extend this modality by including alternative stimuli, such as environmental sounds (e.g., a baby crying) or written language (e.g., words or sentences).

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Discourse Analysis in French-Speaking Individuals with Aphasia and Primary Progressive Aphasia: Assessing Content Informativity Units and Developing Preliminary Normative Data in French

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Introduction and aims

Aphasia and primary progressive aphasia affect the ability to converse with others. People with aphasia (PWA) and primary progressive aphasia (PWPPA) often mention conversation as an essential outcome for language recovery (Wallace et al., 2017; Volkmer et al., 2018). However, speech and language therapists lack reliable measure of conversation outcomes. Discourse analysis is a method enabling speech and language therapists to assess connected speech, determine treatment generalization and appreciate the effect of any intervention on conversation (Leaman & Edmonds, 2019).

Discourse analysis is a crucial method for evaluating language production in PWA) and PWPPA, offering insights that go beyond single-word or sentence-level assessments. One established approach involves quantifying content informativity units (CIUs), as introduced by Brookshire and Nicholas (1993), to measure how much relevant and meaningful information is conveyed in spontaneous or semi-spontaneous speech. While normative data for CIUs are available in English, validated norms in French are lacking, limiting the clinical utility of discourse analysis in French-speaking populations.

Additionally, language assessment tools—and by extension, normative data—are primarily developed in English. Clinicians and researchers acknowledge that normative benchmarks are not directly transferable across languages, cultures, or ethnic groups. Also, the reference data from Nicholas and Brookshire (1993) is now three decades old, raising questions about its current clinical relevance.

This study aims to apply CIU analysis to French-speaking individuals with aphasia and primary progressive aphasia, and to compare their performance to that of neurotypical controls. By doing so, we will gather preliminary normative data for French speakers on connected speech.

Methods

We aim to recruit 20 French-speaking individuals with aphasia and fifty neurotypical

controls. Participants will be recruited on two different sites : Lausanne's university hospital (CHUV) and Geneva's university hospital (HUG). Additionally, we will recruit at least six individuals with PWPPA, representing each clinical variant (semantic, non-fluent/agrammatic, and logopenic). Now, data has been collected for 10 PWA and 10 neurotypical controls.

Connected speech samples will be transcribed and analysed for CIU-related measures, including total number of words, number of words per minute for the assessment of fluency, percentage of correct information unit for the assessment of informativity, and number of CIU per minute for the assessment of informative fluency.

Various picture description tasks will be administered to expand the dataset and support more comprehensive normative comparisons. These include:

Coloured picture descriptions:

- *Le Quai de Gare* (Ansermet & Genillod, 2008)
- An AI-generated image from ChatGPT

Black and white line-drawn picture descriptions:

- Two images from Nicholas & Brookshire (*The birthday party, 1987; firemen, 1992*)
- One image from the Comprehensive Aphasia Test (Swinburn et al., 2004)

Picture sequences:

- Black and white line drawings (The Broken Window by Menn et al., 1998; The Refused Umbrella by AphasiaBank)
- Coloured sequences from the Grémots battery (a standard aphasia battery in French, though without normative data) (Bézy et al., 2016)

Semi-spontaneous speech tasks:

- Talking about hobbies
- Describing weekend plans
- Summarizing the last movie watched

Video-based summary:

- A short black-and-white film featuring Charlie Chaplin, from the *Montréal Évaluation de la Communication (MEC)* (Joanette et al., 2004)

Participants are instructed to speak for at least 60 seconds per task, with a visible timer to support timing. During semi-spontaneous tasks, prompts will be provided by the speech and language therapist as needed.

All samples will be analysed by speech and language therapists from the French-speaking region of Switzerland. Interjudge reliability will be assessed by having an additional therapist review the initial analyses.

Results

Analyses will focus on:

- Differences in CIU production between individuals with aphasia and neurotypical controls
- Differences in CIU production between individuals with primary progressive aphasia and neurotypical controls
- Comparisons across different picture description tasks
- Identification of potential normative patterns for French-speaking populations

Speech and language therapists will extract the following measures: total number of words, words per minute, percentage of CIUs and number of CIU per minute.

Preliminary data for 10 PWA and 10 neurotypical controls matched with sex, age and socioeconomic status is described in tables 1 to 6. PWA and neurotypical controls were recruited between Geneva and Lausanne's university hospitals.

Discussion

Preliminary findings will contribute to the development of French-language norms for CIU analysis, supporting improved discourse assessment in clinical settings. Additional analyses will explore task-specific differences in informativeness, offering valuable insights into how discourse impairments present in French-speaking individuals with aphasia. Future research will involve larger sample sizes and expanded linguistic analyses to complement CIU-based evaluation.

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Discourse in post-stroke aphasia: exploring the behavioral and neural constructs of descriptive and responsive speech in chronic aphasic stroke patients

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Introduction and aims

Post-stroke aphasia can impact language abilities at multiple levels, ranging from difficulties with naming isolated words to impairments in natural discourse, which is everyday purposeful language use that surpasses single words or clauses. Assessing discourse allows for a more ecologically valid language analysis in post-stroke aphasia in research and in clinical practice. Therefore, it is necessary to understand the underlying behavioral and neural constructs of discourse. However, extensive research on discourse in post-stroke aphasia is lacking. Moreover, prior studies have largely focused on the lower-level microstructure of discourse (such as lexicon and grammar) neglecting its higher-level top-down macrostructure (such as topic coherence), which relies on other cognitive functions. Additionally, only non-responsive discourse is taken into account in previous research. This study aims to overcome the current research limitations by assessing the behavioral and neural constructs of micro- and macrolinguistic aspects of descriptive and responsive discourse in chronic post-stroke aphasia.

Methods

A total of 49 persons with chronic aphasia due to left-hemispheric (n=39) and bilateral (n=10) stroke were included in the study. Descriptive discourse was elicited using the picture description task from the CAT-NL (Visch-Brink et al., 2015), and responsive discourse samples were collected using the ANELT (Ruiter et al., 2016), which prompts verbal responses to everyday scenarios. After automatically transcribing the discourse samples, sixteen discourse variables covering micro- and macrostructural subdomains of language were semi-automatically extracted from each discourse task. A factor analysis was then conducted to identify the underlying behavioral constructs of discourse, and mass-univariate voxel-wise lesion-symptom mapping was used to explore the neural correlates of those behavioral discourse constructs.

Results

The factor analysis revealed four latent factors that explained 64% of the total variance in the discourse variables. The factors had high loadings on grammatical, phonological, lexical-semantic and macrostructural variables, and fluency variables were spread across all four factors. After correcting for multiple comparisons, lesion-symptom mapping showed a significant correlation between the lexical-semantic factor and a left temporoparietal cluster of voxels. No significant neural correlates were found for the other factors.

Discussion

This study found four behavioral constructs underlying descriptive and responsive discourse in chronic post-stroke aphasia, reflecting lower-level microstructural components (grammatical, phonological, lexical-semantic and fluency) and a macrostructural component. Although the phonological, grammatical, fluency, and macrostructural factor did not reveal a significant brain cluster, the lexical-semantic factor was found to be associated with a left temporoparietal cluster. The involvement of the middle temporal gyrus within this cluster aligns with the dual stream model assuming ventral specialization for lexicosemantic processing; however, we also observed involvement of dorsal regions (such as the Planum Temporale, the posterior part of the Superior Temporal Gyrus, and the Supramarginal Gyrus) which are typically assumed to be specialized for phonological processing (Hickok & Poeppel, 2007). Our cluster also extends beyond what is typically defined as the core language network (Fedorenko et al., 2024). This might reflect the interaction between language-selective regions and cognitive networks that support real-life language use, as mimicked in our discourse tasks.

In conclusion, these findings contribute to our understanding of the underlying behavioral constructs of descriptive and responsive discourse and its neural underpinnings in post-stroke aphasia. Moreover, the study highlights the richness of micro- and macrolinguistic information that can be extracted from discourse.

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Disentangling noun and verb production in aphasia: Evidence from item response theory

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Topic: Clinical and experimental work on aphasia and related disorders

Introduction and aims

Word production requires the rapid integration of multiple cognitive processes, where associative representations are generated (semantic processing) and mapped to a lemma (lexical processing) with its associated grammatical markers (morphosyntactic processing) and phonemic forms (phonological processing) (Dell et al., 1997). Deficits in word production have been extensively studied in aphasia as a means of understanding this underlying architecture; however, there is contention in the literature as to whether the cognitive processes involved in word production differ as a function of word class, with noun and verb production being of particular interest. Although noun-verb dissociations have been reported in the literature (Caramazza & Hillis, 1991), recent literature suggest that these dissociations may be the byproduct of measurement issues related to the tests used (Casilio, Fergadiotis et al., 2025). Item response theory (IRT) is a modern measurement framework that has previously been used to obtain precise scores for both noun and verb production tests in aphasia (Fergadiotis et al., 2015, 2023). Here, we extend this work to evaluate the dimensionality of two common noun and verb production tests in a large and diverse sample of individuals with aphasia. Our aims were to (1) test whether response probabilities on both tests simultaneously are best modeled as varying along one or two dimensions, and (2) explore the effect of relevant person covariates on person-level IRT scores.

Method

Binary item responses on the short form of the Boston Naming Test (BNT), a test of noun production, and Verb Naming Test (VNT), a test of verb production, were extracted from an archival dataset (MacWhinney et al., 2011) of 107 participants with chronic aphasia (Table 1; see our prior work for additional details).

Person covariates of interest were also extracted. These included overall aphasia severity, indexed as the Aphasia Quotient of the Western Aphasia Battery—Revised (WAB-R AQ); and (2) relevant behaviors from connected speech, given that language produced in naturalistic contexts is highly sensitive to a range of deficit patterns (Casilio, Kasdan et al., 2025). Connected speech behaviors included the following transcription-based metrics, as averaged across five standardized elicitation tasks (MacWhinney et al., 2011): percentage of nouns produced, percentage of verbs produced, percentage of word-level errors, and

percentage of utterance-level errors.

To address our first aim, we specified two Rasch IRT models in a generalized linear mixed effects framework: (1) a random-item unidimensional model, where verb and noun production are treated as productively requiring the same set of underlying cognitive processes; and (2) a random-item two-dimensional model, where verb and noun production are treated as productively requiring two distinct yet correlated combinations of underlying cognitive processes.

Then, using the best-fitting model, we explored the effect of first overall aphasia severity and then additionally connected speech on person-level IRT scores.

Results

All models converged to an admissible solution.

The two-dimensional IRT model demonstrated a better fit to the data (Table 2); however, the person-level IRT scores for each were correlated at .90 (Figure 1, Table 3).

The two-dimensional IRT model with the WAB-R AQ covariate was a substantially better fit to the data than the two-dimensional IRT model without any covariates (Table 2). WAB-R AQ was significantly predictive of person-level IRT scores ($p < .001$) and reduced the correlation between the two to .60 (Figure 2, Table 4).

The model that additionally included the four connected speech covariates yielded an even better fit (Table 2). Here, percentage of nouns produced ($p < .001$), word-level errors ($p < .001$), and utterance-level errors ($p = .019$) were significantly associated with person-level IRT scores (Table 5). There was no significant association with person-level IRT scores and the percentage of verbs produced ($p = .192$). In combination, the addition of the connected speech variables reduced the correlation between the two to .44 (Figure 3, Table 5).

Discussion

Noun and verb production in aphasia, as measured on the BNT and VNT, can productively be treated as two distinct yet highly correlated dimensions. Thus, obtaining scores from both likely yields minimal additional unique information for most people with aphasia, aligning with prior work (Casilio et al., 2025).

The shared covariance between person-level IRT scores on the BNT and VNT was explained by both aphasia severity and connected speech. These findings have two important implications. First, the person covariates that were significantly associated with the person-level IRT scores were reflective of noun production, as evidenced by the substantially larger reduction in random effect variance for the BNT as compared with the VNT (Tables 4, 5). This suggests that the cognitive processes overlapping with both noun and verb production

(i.e., lexical-semantic and phonological processing) (Casilio et al., 2025) were those driving the shared covariance. Thus, disentangling any unique contribution of noun and verb production is likely contingent on holding lexical-semantic and phonological processing constant.

Second, the inclusion of relevant person covariates reduced the correlation between the person-level IRT scores by more than half. Such scores may potentially be useful in future research on verb and noun production in aphasia that incorporates other forms of evidence (e.g., lesion information). More broadly, these findings speak to the utility and flexibility of IRT for addressing complex questions of cognitive processing.

In conclusion, as shown through a series of IRT models, verb and noun production in aphasia appears to rely on two distinct yet highly correlated sets of cognitive processes. However, disentangling the two, at least at the group level, is necessitated on controlling for person covariates likely reflective of processes (lexical-semantic, phonological) shared between both tests.

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Does picture naming performance differ from word retrieval in connected speech and self-report measures? Evidence from Finnish people with aphasia

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Introduction and aims

The presentation is part of a larger project in which we explore whether word retrieval differs across different speech production tasks (i.e., picture naming, story-telling, and conversation) and whether similar patterns can be observed across structurally different languages (Hebrew, Australian English, and Finnish). We also study relations between language production and self-ratings of communication, participation and emotional well-being with the Aphasia Impact Questionnaire (AIQ-21, Swinburn et al., 2018). Previous studies have revealed contradicting findings concerning retrieval at single word level compared to that in connected speech (e.g., Best et al., 2008; Conroy et al., 2009).

Biran et al.'s (2024) publication serves as a reference point for this study. They found that nouns were retrieved significantly better in conversation compared to picture naming and story-telling. In addition, moderate correlations between word retrieval in picture naming and connected speech tasks were observed, and the scores in a self-report questionnaire (AIQ-21) were correlated with success in word retrieval in conversation. The aim of this study is to explore whether the same pattern observed in Hebrew can also be observed in Finnish, a language that is structurally different.

Methods

We recruited 10 Finnish-speaking people with aphasia (PwA) using the following inclusion criteria: (1) diagnosed aphasia due to stroke, brain injury or tumour; 2) speech comprehension over 90% in the yes/no subsection of the Finnish version of the Western Aphasia Battery (WAB; Pietilä et al., 2005); 3) score of at least 10/60 in the Finnish version of the Boston Naming Test (BNT; Laine et al., 1997); 4) normal or corrected-to-normal vision and hearing. The participant group included 6 female and 4 male individuals, whose mean age was 66 years (range 44-84 years). The average post-onset time was 63 months (range 2

months - 12 years).

The data was collected by using the following tasks: (1) *Spoken picture naming* was assessed by the Finnish version of the Boston Naming Test (Laine et al., 1997) and the Finnish Action Naming Test (Laine et al., 2019); (2) *Story-telling* was tested with a picture-sequence of six pictures (Gagarina et al., 2012); (3) *Conversation on initiated topic* (structured conversation) included five questions about the place in which the participants were living; (4) Self-ratings were collected with the Finnish version of the *AIQ-21 questionnaire* (Ahtiainen & Renvall, n.d.). Word retrieval in connected speech (tasks 2+3) was assessed using two measures: (a) the %WR (Percent Word Retrieval; Mayer & Murray, 2010), calculating the percent of correctly produced nouns and verbs out of their total number; and (b) the Measure of Participation in Conversation (MPC; Kagan et al., 2018), measuring interaction and transaction on a scale of 0-4.

Results

Statistically significant differences were found in producing nouns across different word-production tasks, $F($1.19, 10.73) = 18.5, p < .001. The participants produced significantly fewer correct nouns in picture-naming compared to story-telling, p < .001, 95%Cl = [-34.78, -17.08], d = -1.04, and conversation, p = .006, 95%Cl = [-49.21, -15.06], d = -1.44. Similar results were obtained with verbs across different production tasks, F(1.34, 12.06) = 18.4, p < .001. There were significantly fewer correct verbs produced in picture-naming than in story-telling, p = .003, 95%Cl = [-62.29, -21.77], d = -2.09 and conversation, p = .006, 95%Cl = [-53.38, -16.29], d = -1.65. As for nouns, we also found significant correlations between naming and story-telling (with Pearson's correlation coefficient), r = .923, p < .001, and between story-telling and conversation, r = .703, p = .023.

When exploring the relationship between speech production and self-report measures (with Pearson correlation coefficient), statistically significant correlations were found between naming (nouns) and the AIQ-21 communication score, r = - .670, p = .034, and between story-telling (when looking at both nouns and verbs) and the communication score, r = -.726, p = .017. When testing the transaction (i.e., ability to exchange thoughts, opinions, and feelings) and interaction (i.e., social connection) of information in the story-telling context (with Spearman's correlation coefficient), a strong positive correlation was found between the MPC transaction score and %WR, r(10) = .87, p = .001, and a positive moderate correlation was found between the MPC interaction score and %WR, r(10) = .66, p = .038. In the conversation context, no statistically significant correlation was detected

between %WR and MPC interaction, $r(10) = -.027$, $p = .940$, or MPC transaction, $r(10) = .142$, $p = .695$. Finally, several significant correlations were found between measures of the AIQ-21 and participation in conversation between different speech-production tasks.

Discussion

Our findings show that word retrieval success differs across structured and less structured tasks in Finnish PwA. We also observed links between participants' self-reports of communication to their word-finding in naming (nouns) and story-telling. The findings were largely in line with patterns found in Hebrew people with aphasia (Biran et al., 2024). The results provide further evidence that word retrieval should be tested on a range of measures that differ in structure, together with the participants' self-ratings on their word retrieval.

Overall, the current study together with Biran et al.'s (2024) study highlight the need to assess word-finding not only with picture naming but also with connected speech tasks. The findings also imply that PwA's self-reports of communication and participation reveal similar issues of functioning to those more often used in speech therapy. We are currently collecting more data with both Finnish- and English-speaking participants to get further evidence of the phenomena.

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EEG-based neural assessment of post-stroke aphasia: the potential application of neural tracking of natural speech

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Structured abstract only

Max 1000 words for the abstract, max 200 words for references

Introduction and aims

Globally, approximately 13 million people suffer from a stroke each year, with about one third developing aphasia, an acquired language disorder. Despite the significant impact of aphasia on daily communication and quality of life, standard behavioral tests currently used to diagnose aphasia are time-consuming and focus on isolated language stimuli, which lack ecological validity and are often confounded by comorbid cognitive impairments. This has led to a growing interest in using ecologically valid, naturalistic speech paradigms, which better reflect everyday communication and allow for more comprehensive assessment.

In this study, we aim to investigate language perception in chronic stroke patients by applying EEG-based neural tracking of natural speech, a novel technique that links continuous speech features to brain activity, enabling the assessment of how effectively the brain follows spoken language (1). The most commonly used feature for neural tracking is the speech envelope, which encompasses key information needed for detecting and segmenting linguistic units such as phrases, words, and phonemes. Although previous neural tracking studies in neurotypical controls have found a relation with speech and language processing (2), it has not yet been applied in post-stroke aphasia patients. Additionally, the extent to which cognition and lesion presence may influence neural tracking is currently unclear.

Methods

We therefore aimed to record EEG data from 38 patients with aphasia, 25 patients without aphasia and 23 age-matched healthy controls as they listened to a 25-minute story. All patients were in the chronic stroke phase (≥ 6 months post-stroke onset). Neural envelope tracking values were quantified for multiple frequency bands using a mutual information model and group differences were analyzed via non-parametric cluster-based permutation tests. Additionally, all participants were classified on an individual level with a support vector machine (SVM).

Results

Neural envelope tracking in patients with aphasia was significantly decreased compared to healthy controls in the broad, delta, theta, and gamma frequency bands (1). The SVM classifier achieved 84% accuracy with just 7 minutes of training data, demonstrating its clinical potential for efficiently distinguishing patients with aphasia from healthy controls (1). Data collection for patients without aphasia is currently ongoing, but preliminary results (n = 18) indicate that they show increased levels of neural tracking compared to patients with aphasia but decreased levels compared to healthy controls. However, because of the current sample size, statistical analyses and SVM classification cannot yet be made on this group, but will be performed on the final sample (n = 25).

Discussion

This study highlights the potential of neural envelope tracking as a possible biomarker of aphasia, where individual classification is possible in a time-efficient and accurate manner. Our preliminary results suggest that cognition and lesion presence have some influence on neural envelope tracking, as evidenced by differences between patients without aphasia and healthy controls. However, the influence of language impairments is still more substantial, with aphasia patients showing the lowest levels of neural envelope tracking. Importantly, the current study only includes stroke patients in the chronic phase, so validation in the acute phase is still needed.

In conclusion, neural envelope tracking presents a promising, efficient technique for assessing language impairments in stroke patients.

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Electrophysiological correlates of recovery from anomia

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Introduction and aims

Following a stroke, a reorganisation of the language network is typically observed, both spontaneously (Cappa et al., 1997) and in response to speech therapy (Hartwigsen & Saur, 2019). The majority of studies exploring the brain reorganization induced by aphasia therapy are carried out with anatomical neuroimagery (PET or fMRI), but recovery also induces changes in the dynamics of language processes that may be tracked by electro- or magneto-physiological measures. Electrophysiological event-related potential (ERP) changes induced by anomia therapy have been localised between 300 and 700 milliseconds after onset in picture naming tasks (Cornelissen et al., 2003; Laganaro et al., 2008; Radman et al., 2016) and may vary according to the underlying deficits (Laganaro et al., 2008). However, the generalisability of previous studies is limited by small sample sizes (maximum four patients per study) and the limited links between the observed electrophysiological and behavioural changes. The present study therefore sought to explore the electrophysiological correlates of recovery from word production difficulties in a larger group of patients with aphasia in comparison with a control group, while assessing the links between these electrophysiological and behavioural changes.

Methods

Fifteen patients with aphasia suffering from anomia following a left hemisphere stroke underwent a two-week digitalised therapy on 56 common words in French. A pretest and a posttest were conducted, using a picture naming task, during EEG recordings before and after therapy. The electrophysiological correlates of the patients with aphasia were then compared with those of fifteen matched healthy control adults also performing a picture naming task with common words in French during an EEG recording. Waveform, TANOVA and spatio-temporal analyses were carried out to compare the two groups and the two days in the group of patients.

Results

The results (see Figure 1) obtained from this study revealed no significant differences on waveform analysis, but significant changes in the topographic patterns associated to picture naming before and after anomia therapy. In comparison with the control group, three distinctive periods of electrophysiological stability occurring between 200 and 400 ms have revealed changes. These differences demonstrate that therapy induced a qualitative change of two periods of electrophysiological stability, leading to more similar periods of stability to the control group after the therapy compared to before the therapy. According to ERP time course of word production studies (Indefrey et al., 2014), these changes appear during time periods generally related to lexical-semantic processes and more precisely, to lexical selection as well as lexical-phonological processes. Finally, a strong correlation was identified between the electrophysiological changes occurring between 200 and 400 ms and the rate of behavioural recovery, indicating that patients with better recovery demonstrate the largest changes in EEG/ERPs during this time period.

Discussion

Anomia therapy for individuals with aphasia has been shown to induce electrophysiological changes that are associated with temporal periods that are typically linked to lexical-semantic and lexical-phonological processes. These changes result in a form of normalisation of these lexico-phono-semantic processes, as the electrophysiological signal at scalp becomes more similar in terms of scalp topography and of duration of microstates to the electrophysiological correlates found in the control group. This normalisation has been shown to be related to enhanced behavioural recovery. Therefore, therapy for anomia leads to a normalisation of the electrophysiological correlates in a period of time that is generally associated with lexical-semantic and lexical-phonological processes and is associated with improved performance in naming.

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Evaluating traditional in-person vs. virtual Intensive and Comprehensive Aphasia Programs (ICAP) for Cantonese speakers

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Introduction and aims

Rose and colleagues (2013) described an Intensive and Comprehensive Aphasia Program (ICAP) as involving a minimum of 3 hours of daily treatment over a period of at least 2 weeks for a group of participants. The program includes individual and group therapy, educational components, and the use of technology to address impairment and participation functions. Recent research has shown significant improvements in impairment, participation, environment, and personal domains following ICAPs (e.g., Brady et al., 2022). Despite the reported benefits, the high initial setup costs have been identified as a major challenge (Battbit et al., 2015). As a result, exploring the possibility of delivering ICAP through telepractice, in addition to traditional in-person therapy, is an area that requires further investigation.

The objective of this study is to develop a new model that integrates evidence-based aphasia practices into ICAP within the context of Hong Kong Cantonese speakers. It then seeks to compare the treatment outcomes of in-person and virtual ICAP on individuals with aphasia, focusing on linguistic abilities and quality of life improvements. Lastly, the study will explore potential differences in participant recruitment and group formation when implementing virtual ICAP.

Methods

Participants:

A total of 26 adults with chronic aphasia resulting from a single unilateral, left hemisphere stroke were included in the study. The mean age of participants was 64 years for the in-person ICAP group and 56 years for the virtual ICAP group. The former group had a mean post-onset time of 2 years and 9 months, while the latter group had a mean post-onset time of 3 years and 7 months. Prior to their strokes, all participants were fluent Cantonese speakers and provided informed consent for the study.

Study design:

Each participant received a total of 39 treatment hours, consisting of 12 hours of

impairment-based treatment, 12 hours of functional-based treatment, 9 hours of technology-based training, and 6 hours of group therapy. The ICAP program had an intensity of 15 hours per week, with sessions held 5 times a week. This study utilized a nonrandomized, pre-post intervention design. Baseline assessments were conducted before the start of treatment, and standardized tests covering a range of language levels from word to discourse were administered.

Results

An analysis of the aphasia quotient within the Cantonese Aphasia Battery (Yiu, 1992) and the language scores from the Cantonese version of the Comprehensive Aphasia Test (Kong, 2024) revealed promising advancements in language skills, with no notable distinctions between the outcomes of in-person and virtual ICAP sessions. Both groups showed significant enhancements in naming accuracy and reduced errors immediately post-treatment. Furthermore, at the discourse level, participants in both groups exhibited considerable progress in generating relevant and coherent concepts following ICAP. Notably, despite around half of the participants not receiving direct training on discourse production, the results suggest a potential transfer of treatment effects from lower to higher language functions. Measures of quality of life, such as communication confidence and effectiveness, showed improvement after treatment, with no significant variance between the outcomes of in-person and telepractice therapy.

Discussion

Both the in-person and virtual ICAP groups demonstrated comparable therapeutic outcomes concerning language abilities and quality of life aspects for individuals with aphasia in this research, indicating that virtual ICAP may serve as a viable intervention approach. These findings have the potential to extend the benefits of ICAP to a greater number of individuals with aphasia, particularly those with limited physical mobility and access. Insights from semi-structured interviews with clinical supervisors underscored that, when considering individuals with similar aphasic profiles, the primary concern in recruiting participants and forming cohorts for virtual ICAP was the level of digital communication and support already in place for caregivers

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Exploring Approaches to Reading Comprehension Therapy in Aphasia: A Pilot Study Comparing Tablet-Based and Paper-Based Treatments

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Topic: Clinical and experimental work on aphasia and related disorders

Introduction and Aims

The use of software applications (apps) in the treatment of aphasia by speech-language pathologists (SLPs) has grown in popularity in recent years (Cuperus et al., 2022; Repetto et al., 2021; Szabo & Dittelman, 2014). Although studies on the effectiveness of such apps are increasing in the rehabilitation literature, limited research has been conducted on aphasia-specific apps designed for reading comprehension therapy. While SLPs have access to a growing number of digital tools, evidence-based recommendations regarding their efficacy remain scarce. Understanding how these tools compare to traditional paper-based methods is essential for informed clinical decision-making.

This study aimed to address two main objectives. First, a review of existing aphasia-specific apps was conducted to assess their availability and effectiveness in clinical settings. Second, a pilot study was carried out to compare the efficacy of a tablet-based app method to a traditional paper-based method in the treatment of acquired reading comprehension disorders. By integrating these two approaches, this research seeks to contribute to the growing body of literature on evidence-based digital interventions for aphasia.

Methods

Scoping Review of Aphasia-Specific Apps

A scoping review was conducted to identify aphasia-specific apps available to SLPs and assess their effectiveness. The review followed PRISMA-ScR guidelines, utilizing databases such as CINAHL, PubMed, PsycINFO, and Google Scholar. Inclusion criteria required studies to focus on language interventions for individuals with aphasia using apps in therapy sessions, published in peer-reviewed journals between 2000 and 2023.

Pilot Study: Comparing Tablet-Based and Paper-Based Methods

Two stroke survivors with aphasia and acquired reading comprehension disorders participated in this study. Both were monolingual anglophones who had been diagnosed with aphasia by a health professional and who experienced reading comprehension

difficulties at the paragraph level. A single-subject reversal design was employed, with each participant receiving both treatment methods over eight weeks (four weeks per method). Participants' reading comprehension skills were evaluated using subtests of the Psycholinguistic Assessments of Language Processing for Aphasia (PALPA; Kay et al., 1992) and the Discourse Comprehension Test (DCT; Brookshire & Nicholas, 1993). Pre- and post-treatment questionnaires assessed demographic information, reading habits, technology use, and self-perception of reading comprehension skills. The Advanced Reading app by Tactus Therapy Solutions (2022) was selected for the tablet-based intervention, as it provides structured exercises targeting paragraph-level reading comprehension. The treatment involved guided app-based reading exercises with progressive difficulty levels. The traditional approach consisted of printed text materials with structured comprehension exercises similar to those provided by the app. This method required participants to read passages and answer comprehension questions using pen-and-paper methods.

Results

Findings from the Scoping Review

Of 595 initial records, only four studies met the final inclusion criteria. The findings revealed a limited number of studies focusing on apps for clinical aphasia treatment, with most research emphasizing augmentative and alternative communication (AAC) or home-based programs rather than structured reading comprehension therapy.

Findings from the Pilot Study

Participant A demonstrated greater improvement with the paper-based method, achieving higher accuracy rates in therapy sessions and expressing frustration with technological issues. Conversely, Participant B showed no significant difference in treatment outcomes between the two methods. These findings suggest that individual characteristics, such as age, prior experience with technology, and personal preferences, may influence the effectiveness of different treatment approaches.

Discussion

The findings of this study highlight both the potential and limitations of digital tools in aphasia rehabilitation. The scoping review revealed a limited number of studies evaluating the effectiveness of aphasia-specific apps, with a lack of robust evidence supporting their clinical effectiveness. While some research suggested potential benefits for language rehabilitation, there was insufficient data on their impact on acquired reading comprehension disorders. This gap in the literature underscores the need for further research to determine the specific conditions under which these apps are most beneficial and to establish clearer guidelines for their use in clinical practice.

The results of the pilot study emphasize the importance of individualized treatment selection. While Participant A benefited more from the paper-based approach, no treatment method was determined to be more effective than the other for participant B, suggesting that factors such as familiarity with digital tools, cognitive profiles, and personal preferences may play a role in treatment outcomes. These findings align with previous research indicating that acquired reading comprehension disorders are multifaceted and require personalized intervention strategies.

Despite its limitations, this study provides preliminary insights into the effectiveness of tablet-based and paper-based methods for reading comprehension therapy in aphasia. It also highlights the need for clinicians to consider individual characteristics when selecting treatment approaches. Future research should focus on larger sample sizes, longitudinal studies, and further exploration of the interaction between cognitive abilities and treatment efficacy to develop evidence-based guidelines for optimizing reading comprehension interventions in aphasia therapy.

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Exploring the communication information needs of Turkish-speaking family members experiencing aphasia and their navigation through the healthcare system in Türkiye

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Topic: Clinical and experimental work on aphasia and related disorders

Introduction and aims

Information provision to family members (FMs) about aphasia is often lacking or delayed, prolonging their adjustment to aphasia and coping with severe consequences of aphasia (Rose & Wallace, 2018). Our study seeks to identify how FMs respond to the communication changes when a family member acquires aphasia (PwA), to explore their information needs (and provision in response to those needs) about communicating with PwA and their experiences of navigating the healthcare system in Türkiye.

Methods

We used a qualitative methodological approach, using online semi-structured one-to-one interviews. The video-conferencing tool called Zoom™ was used due to the restrictions imposed by the COVID-19 pandemic which was ongoing during the period of data collection. The interviews were conducted between September 2020 to December 2021. Included FMs were over 18 years of age with a family member that experienced aphasia within the previous 48 months. The interview topic schedule included eight questions, seven were derived and modified from the study of Paul and Sanders (2010). A phenomenological approach was used to examine how FMs attach meaning, experience, and interpret their experiences following aphasia (MacKenzie et al., 2019). The reflexive thematic analysis was used in data analysis (Braun & Clarke, 2022). The data were organized and systematically coded using MAXQDA (version 24.8.0; VERBI Software, 2025).

As part of credibility, the lead researcher (SO) took detailed notes including the key expressions of the participants during the interviews, which was in turn presented to them at the end of the interviews to confirm whether these expressions were accurately comprehended. Debriefing was conducted among the team members (SO, MB, IM) to foster appropriate interpretation of the data. The themes and codes were modified and finalized following discussions between the group members.

Results

Twelve FMs were recruited for the study (*Mean (SD)*= 45.91 (8.47) years; range: 31-65).

The participants had different kinship roles, including wife (*n*=4), husband (*n*=1), son (*n*=4), daughter (*n*=1), and niece (*n*=2). The mean age of PwA was 62.41 (*SD*=10.78; range: 45-80), and there were 8 non-fluent and 4 fluent PwA.

The findings revealed four themes with 11 codes in total (**see** Figure 1). Regarding Communication Changes (Theme 1), FMs were unable to communicate with PwA, referring this inability to "*the state of disconnection*". FMs employed a number of strategies to ensure the flow of communication, one of them was coming up with questions to clarify and comprehend what the individual with aphasia tried to say:

> *"He says "evening" and we expand it. He says "car" and we say, "Do you want to go by car?". He says "Filiz". "Are you calling Filiz?". After he says a word, we produce (the suggestions). "Do you want this or that?" We make no compromises."* (P5, wife of person with non-fluent aphasia)

As for Information and Training Needs (Theme 2), P4 stated that his family did not receive information about aphasia, emphasizing that the medical approach taken by speech and language therapists (SLTs) and medical doctors did not capture enough the multidimensional nature of aphasia. While searching for information, participants sourced information from individuals in their social circle whose FMs had aphasia:

> *"Speech therapists and neurologists are only on the medical side. There is a condition, it is called aphasia, but there is a demographic structure around that aphasic individual. There is a work life, family life, neighbourhood life. There is the individual's personal life. Therefore, since it is a process that affects these four points, we should not only think and evaluate aphasia from a medical point of view. It is also necessary to include the social aspect of the situation." … "There were recommendations given by a few friends whose relatives had aphasia before, … stating the fact that the process is not easy and it requires patience."* (P4, son of person with fluent aphasia)

In relation to Access to and Availability of Health Services (Theme 3), participants were referred to SLTs but there were times that participants did not have access to SLTs due to the pandemic, as in the case of P8:

> *"We started working with an SLT while we were in the hospital, but because of this pandemic, we cut our relationship with the SLT when we left the hospital after one month."* (P8, husband of person with fluent aphasia)

Finally, Rehabilitation Roles and Responsibilities (Theme 4), P1 stated that she was confused about the optimum timeframe which she had to consider for practicing what was carried out during the intervention sessions. She resolved this confusion in her own way:

> *"I found a middle ground for myself. I used to be a journalist, we used to ask NGOs*

> *[non-governmental organizations] how many people were at the protests. They would say five thousand, the police would say one thousand, we would write two thousand five hundred. That's exactly how I figure it out, if they say work every two hours, I work every six hours. If they say two hours of speech therapy, I work for 1.5 hours as much as he (the person with aphasia) is fine with it.*" (P1, wife of person with non-fluent aphasia)

Figure 1: Themes and Codes.

Discussion

Many FMs have to face with the sudden consequences of aphasia and challenges of communicating with the PwA. Instinctively, FMs develop strategies (e.g., Speaking loudly, non-verbal communication, asking questions to refine what is being said by PwA, being a social link, etc.) to mitigate, support or ensure the flow of communication. The FMs described receiving inadequate information about aphasia while seeking to address their information needs from other resources (e.g., an autobiography, etc.). In addition, various experiences of FMs about availability of health services as well as their new role in rehabilitation were discussed with reference to third party disability literature in aphasia (Grawburg et al., 2013). Healthcare professionals (including medical doctors and SLTs) in Türkiye should be aware of the information needs of FMs and critically revise their service delivery approach beyond a medical model and impairment-based approaches in terms of assessment and treatment.

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Extending the Scope of Working Memory Deficits in Turkish Aphasia

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Introduction and aims

Numerous studies have substantiated the association between aphasia and deficits in cognitive functions, encompassing executive functions, attentional capabilities, visuospatial processing, and reasoning skills (Potagas et al., 2010; Ivanova et al., 2017; Kasselimis et al., 2018; Fonseca et al., 2019). Several studies investigating the relationship between executive functions and language abilities suggest that the nature of this interaction remains underexplored, indicating that it cannot be conclusively stated as either present or absent. Consequently, it is asserted that further investigation into this issue is warranted (see Andreou et al., 2023). This study aimed to compare the working memory skills of individuals with and without aphasia.

Methods

The study included twelve individuals with aphasia and 96 healthy controls. All participants were native monolingual Turkish speakers and met the inclusion criteria: (i) no vision or hearing impairments, and (ii) no psychiatric history. PWA were recruited from the Centre of Speech and Language Disorders in Eskişehir, Türkiye. There were three female and nine male PWAs, with an average age of 57.4 years (SD = 13.76, range = 31-78 years). These participants were diagnosed with aphasia by an SLP. Participants with aphasia were administered the Aphasia Language Assessment Test (ADD; Maviş and Toğram, 2009) to determine the type of aphasia. The post-stroke time of PWA varied, averaging 33.66 months (SD = 16.81; range = 3-60 months). All healthy controls reported no history of neurological disorders and demonstrated normal cognitive functioning (i.e., a score of ≥ 73 for females and 70 for males, respectively, out of 100 on the Addenbrooke's Cognitive Examination-Revised [ACE-R; Yıldız, 2011]), except for five of them. The Corsi Block-Tapping Test (CBT) and Digit Span were administered in both forward and backward recall orders to individuals in both groups, aligning with the study's purpose.

Results

Data were analyzed via R and the Generalized Linear Model yielded significant differences between PWA and NBD in the CorsiBlock Tapping and DigitSpan tests. Specifically, NBD demonstrated significantly better performance in all tasks ($p<.05$) except for the CorsiBlock

Forward Span Test. In this task, the difference between the two groups is not significant (Z=-0.53, p=0.60).

Discussion

This study compared Turkish aphasia and healthy controls' verbal and non-verbal working memory performances. PWA showed relatively preserved visuospatial short-term memory despite having severe verbal short-term memory and working memory deficits. Visuospatial working memory, however, was found to be impaired, suggesting that (i) complex processing, as measured with working memory, is central to computing both verbal and non-verbal information, and (ii) verbal working memory difficulties extend to non-verbal domains in aphasia. We believe that potential verbalization strategies may influence visuospatial memory performance in aphasia.

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Focus-Driven Sentence Production in Aphasia: An Eye-Tracking Study in a Flexible Word-Order Language

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Topic: Language and cognition

Introduction and aims

We examined event apprehension — forming a mental representation of events — and grammatical encoding in persons with aphasia (PWA) using an eye-tracking sentence production paradigm. A common symptom of aphasia is the difficulty of producing grammatically correct sentences. While the linguistic characteristics of aphasic production are well documented, the cognitive mechanisms linking thought and speech remain partially understood. In neurotypical (NT) adults, sentence production depends on factors like referent accessibility (Lee, 2020), attention (Gleitman et al., 2007), and discourse (Wagner, 2015). The impact of these on PWA, particularly during event apprehension and grammatical encoding, is underexplored (but see Lee, 2020).

During grammatical encoding speakers may adopt a word-driven strategy, beginning production with a key element and with a partial representation of the entire event (Gleitman et al., 2007), or a structure-driven strategy, encoding the entire event during event apprehension and before production (Bock & Ferreira, 2014). NT speakers flexibly use both (Konopka & Meyer, 2014), whereas PWA tend to rely more on structure-driven approaches (Lee, 2020).

Discourse features like focus influence sentence structure (Wagner, 2015), especially in Hungarian, where word order encodes information structure (É. Kiss, 1995). Hence, we formulated the following research questions.

- What sentence types do NT and PWA produce when responding to questions of different focus?
- Does referent accessibility facilitate sentence production in PWA?
- How does linguistic focus guide attention during the above processes in PWA?
- What production strategies relate to different sentence types?

Methods

Participants

15 PWA (M_{age} = 65.93, SD = 12.52, 8 women), and 17 healthy older adults (HOA; M_{age} = 57.68, SD = 6.76, 9 women) participated. PWA were mild to moderate non-fluent patients in

the chronic post-stroke phase.

Procedure & materials

Participants viewed 90 images (45 experimental, 45 filler), depicting transitive events with two characters. Questions in three conditions preceded each image:

Control: *What is happening?*

Subject focus: *Who is chasing the robber?*

Object focus: *Who is the policeman chasing?*

During trials, participants first heard a question, after which they saw an image and provided their answer while their eye movements and responses were recorded.

Results

Analysis is currently ongoing. Three data types were analyzed: proportion of sentence types, speech onset latency, fixation patterns. Analyses included only correct responses (HOA: 3.8% excluded, PWA: 8.97% excluded).

Sentence types (Figure 1A): PWA used the default SVO word order more frequently than HOA in both the control and object focus-conditions, where HOA did not use SVO at all. In the object focus-condition, PWA produced fewer sentences that topicalized the discourse-given element (e.g., policeman). Instead, they more frequently produced sentences without a Topic, where the object was in focus (OVS), or the default SVO order. Interestingly, the subject focus-condition yielded similar results across groups: the proportions of Topic-Focus (OSV) and default SVO sentences were identical for PWA and HOA.

Speech onset latency (Figure 1B): An ANOVA showed significant main effects of group ($F(1,28) = 4.79$, $p = .037$) and condition ($F(2,56) = 101.46$, $p < .001$), but no significant interaction ($F(2,56) = 0.05$, $p = .955$). Post-hoc t-tests with Bonferroni correction revealed that latency was significantly faster for HOA compared to PWA ($t(92) = -3.03$, $p = .003$). For condition, paired t-tests with Bonferroni correction showed that latency was significantly faster in the control- than in the object focus-condition ($t(29) = 12.4$, $p < .001$), faster in the control- than in the subject focus-condition ($t(29) = 11.1$, $p < .001$), and faster in the object focus- than in the subject focus-condition ($t(29) = -4.36$, $p < .001$).

Fixation patterns: First, a word-level annotation was carried out. Data were grouped by sentence part (S, O, V), and the pre-sentence phase was divided into two time windows: from image onset to 400ms and from 400ms to speech onset. Analyses focused on: (i) SVO sentences in the control-condition, (ii) Topic-Focus sentences (OSV) in the subject focus-condition, and (iii) the same sentence type in the object focus-condition (SOV).

Regarding event apprehension, HOA showed a strong Agent bias during event apprehension in the control-condition. Also, the focus of questions affected the identification of characters. Focus-congruent characters were identified first, supporting the attentional role of linguistic focus. A similar pattern emerged for PWA, except in the object focus-condition, where PWA allocated gaze equally to both Agent and Patient early in event apprehension.

Regarding sentence formulation, fixation patterns in HOA in the control-condition replicate Lee (2020): the Agent was identified pre-speech and the Patient during speech onset, i.e. speech began before both characters were fully identified. PWA, however, fixated both characters more evenly before and during sentence onset. In the subject focus-condition, both groups produced Topic-Focus sentences after identifying the Agent, without further fixating the Patient. In the object focus-condition, this pattern held only for HOA; PWA's gaze gradually shifted toward the Patient and landed there during Subject production.

Discussion

Data on the proportion of sentence types showed that while PWA are capable of producing sentence types that align with the focus of the preceding question, they sometimes default to using SVO order. Although the present data cannot determine the specific causes of this pattern, future correlation analyses using paper-pencil language test scores may help reveal which linguistic deficits co-occur with limitations in using appropriate information structure.

Latency data suggest that lexical accessibility facilitates sentence production not only in HOA but also in PWA. Moreover, PWA are sensitive to whether the focus is on the object or subject, mirroring the pattern observed in HOA. Notably, analysis has not yet been broken down by sentence type; doing so will help refine our understanding of how accessibility interacts with grammatical encoding.

Fixation patterns reveal group differences. In the control condition, PWA and HOA appear to employ a word-driven strategy, while PWA activate a structure-driven approach. In the subject-focus condition, both groups exhibit a similar strategy in OSV sentences: the already accessible element, is not attended, but placed in the initial Topic position, while the agent (subject) is encoded next reflecting an efficient production strategy. In contrast, in the object-focus condition, only HOA employ this strategy in Topic-Focus sentences. PWA instead fixate both characters before and during sentence onset. This asymmetry may stem from a strong visual bias toward agents, which PWA may struggle to suppress.

As data analysis is still ongoing; remaining questions will be addressed after more detailed analysis.

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Grammatical Tense Impairment in Aphasia: A Usage-Based Assessment of Comprehension, Recognition, and Production

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Topic: Language and cognition

Introduction and aims

Grammatical tense is challenging for people with aphasia (PwA). Existing theories have considered the nature of tense impairment to be syntactic (Friedmann & Grodzinsky, 1997), morphological (Ullman et al., 2005), or morphosemantic (Faroqi-Shah & Thompson, 2007; Varlokosta et al., 2006). However, these accounts often address specific contrasts in isolation (e.g., spared agreement vs. impaired tense, regular vs. irregular) and overlook frequency effects.

Usage-based approaches offer an alternative theoretical framework which emphasise usage-frequency effects at the single- and multiword level and the role of lexical bias – i.e., the tendency of an item to occur more frequently in certain grammatical frames (Gahl et al., 2003). These biases can facilitate processing in PwA, with passive-biased verbs being easier to process whenever presented in passive constructions (Gahl et al., 2003) and plural-biased nouns being more prone to over-pluralisation errors (Hatchard & Lieven, 2019). However, the role of usage-based variables in tense processing remains underexplored.

This study introduces the concepts of *tense* and *time bias* – i.e., a verb's tendency to occur in a specific tense or generic time reference. We have previously discovered effects of these usage-based variables on verb production in PwA and controls (Onofri & Zimmerer, 2024). This study aims to replicate those findings and test their effect on tense comprehension and recognition. We will showcase a novel design for examining tense comprehension and recognition, and present pilot data.

Methods

Participants

We will recruit PwA and controls. Participants will be English native speakers. Participants' number will be determined by a pilot study.

Tasks

The study includes three experiments assessing how usage-based variables (e.g., lexeme/form frequency, tense/time bias) affect tense comprehension, recognition, and production. It also investigates verb regularity, phonological complexity, and semantic weight.

We predict that usage-based variables will affect processing, such that more frequent verb forms will be easier to recognise and produce. Additionally, processing will be more efficient when there is alignment between a verb's tense/time bias and the grammatical context in which it appears. For example, a verb with a higher past-time bias should be processed more accurately/quickly when presented or elicited in a past-tense context.

1. Sentence-Picture Matching Task

This task investigates tense comprehension. On each trial, participants will hear and read a sentence (e.g., *The man cooked dinner*) and then see three black-and-white images simultaneously. Each image depicts the same action at a different temporal stage: one before the action starts (*future*), one during (*present*), and one after completion (*past*). Participants will be asked to select the picture that matches the tense of the sentence.

The stimuli include 25 transitive, depictable verbs (10 regular, 10 irregular heavy, and 5 irregular light), each used in three tenses (*present continuous, past simple, and future simple*) for a total of 75 trials. Each sentence starts with a generic NP followed by the verb in the relevant tense and a direct object.

Accuracy and reaction times will be measured. If tense/time bias influence processing demands, participants will show quicker reaction times and higher accuracy whenever verbs are presented in their more strongly biased tense.

2. Grammaticality Judgment Task

This task investigates tense recognition. On each trial, participants will hear and read a sentence (e.g., *Yesterday she ate*) and will be asked to judge it as grammatical/ungrammatical via a *Yes/No* response.

The stimuli include 20 verbs each appearing in eight sentences for a total of 160 trials. Sentences start with a temporal adverb followed by the subject and the verb. Based on a match/mismatch between the tense and the adverb, there will be four grammatical (e.g., *Now she is eating*) and four ungrammatical sentences (e.g., **Yesterday she is eating*) per verb.

Accuracy and reaction times will be measured. If tense/time bias influence processing demands, verbs in their more biased tense will yield faster and more accurate responses.

3. Elicitation Task

This task assesses tense production. Participants will be asked to answer three open-ended questions designed to elicit a specific tense (e.g., *What do you typically do in your day? What will you do next summer?*). The final selection of questions will be validated by the pilot study. We will select questions in which pilot participants produced the relevant tense

in more than 80% of verbs produced.

The task compares verb forms produced by PwA and controls. The aim is to explore whether a verb's tense/time bias and frequency influence the likelihood of that form being produced. PwA might be more likely to produce verb forms that correspond to the tense/time for which each verb shows a higher bias – e.g., verbs with a stronger present bias may be preferentially selected in response to present-tense prompt, while verbs with a stronger past bias might be more easily produced in the past-tense prompt.

Based on our previous findings (Onofri & Zimmerer, 2024), we expect PwA to produce more irregular verbs, fewer regular verbs in the past, and phonologically shorter forms. No difference is expected regarding light verbs or overall past-tense usage.

Results

At the conference we will present preliminary findings from the pilot experiment with non-brain-damaged participants alongside a demonstration of the experimental tasks and materials. Analyses aim to reveal whether usage-based patterns systematically influence performance and how these patterns differ between PwA and controls.

We will use linear mixed-effects models to assess the contribution of usage-based variables (e.g., frequency, tense/time bias) and formal linguistic factors (e.g., verb regularity, phonological complexity, semantic weight). This study will profile PwA across all three domains of language processing to provide a comprehensive account.

Discussion

This project can advance our understanding of how usage-frequency and bias influence tense processing across multiple language domains and populations. This will offer a more comprehensive account of where these effects emerge and whether they can be generalised. Furthermore, the inclusion of morphological, phonological, and semantic variables will help understand how usage-frequency variables relate to other linguistic factors. Together, findings are expected to contribute to a more nuanced understanding of tense usage and processing in aphasia and typical language.

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Identifying the Cognitive Abilities of Turkish-speaking Individuals with and without Aphasia through Cognitive Assessment for Stroke Patients-Turkish Version

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Topic: Language and cognition

Introduction and aims

There are a bunch of cognitive screening tests available for clinical use for people with aphasia (PWA). However, these might be limited to the use of speech and language therapists (SLTs) when they are the sub-parts of comprehensive language batteries (as seen with the Turkish Version of the Comprehensive Aphasia Test (Maviş et al., 2022). There is a significant need for an accessible cognitive screening test for Turkish-speaking PWA, which would benefit SLTs and other healthcare professionals collaborating with them. The widespread use of screening tests like the Mini-Mental State Examination (MMSE; Güngen et al., 2002) and/or the Montreal Cognitive Assessment (MoCA; Selekler et al., 2010) does not allow for a thorough examination of the cognitive abilities of PWA, as these tests require verbal responses. Their psychometric properties are appropriate for the early detection of neuroprogressive diseases, including Alzheimer's dementia. The Turkish version of the Oxford Cognitive Screen (OCS; Oğuz, 2021) has recently been introduced to assess the cognitive skills of individuals with and without post-stroke aphasia. However, this assessment is lengthy and unsuitable for bedside evaluation due to its various subtests. Motivated by this, the Cognitive Assessment for Stroke Patients (CASP) was developed (Barnay et al., 2014) for use by SLTs.

This study aims to (i) compare the cognitive performances of Turkish-speaking PWA and healthy controls using the Turkish version of CASP (CASP-TR); (ii) compare scores from different sections of CASP-TR requiring verbal and non-verbal responses; (iii) examine the effect of demographic variables (including age, education, and sex) on CASP-TR performance among participants.

Methods

The study included 15 PWA ($Mean_{AGE}$=54.87; SD=4.73) and 120 controls ($Mean_{AGE}$=52.17; SD=1.54). Participants were stratified into four age groups (25-40; 41-55; 56-70; 71+) and three education groups (1-8 years, 9-12 years, 13 years and above). The Aphasia Language Assessment Test (ADD; Maviş & Toğram, 2009) and medical records were used to diagnose aphasia. All participants were assessed with CASP-TR, which included nine sections:

naming, comprehension, reproducing a cube, graphic series, inhibition/flexibility, bisection of a horizontal line, image recall, praxis, and calendar. The naming and calendar sections required verbal responses, while the remaining sections utilized non-verbal responses. As the total scores for sections requiring verbal and non-verbal responses were not equal, these scores were transformed into z-scores. Subsequently, comparisons between verbal and non-verbal performances were conducted.

Results

Results from the Two-Way Mixed ANOVA indicated a significant main effect of group ($F(1,133)=26.09$, $p<.001$, $\eta p2=.16$), with controls ($M=.13$, $SD=.08$) achieving higher overall z-scores than PWA ($M=-1.032$, $SD=.21$). A significant interaction between group and section variables was also observed ($F(1,133)=8.94$, $p=.003$, $\eta p2=.06$). Descriptive statistics revealed that while PWA outperformed in non-verbal stimuli ($M=-.73$, $SD=1.39$) compared to verbal ($M=-1.33$, $SD=2.09$), controls demonstrated the opposite pattern ($MVerbal=.17$, $SDVerbal=.60$; $MNonVerbal=.09$, $SDNonVerbal=.91$) (see Figure 1).

Discussion

This study reports a statistically significant difference in CASP-TR performances between PWA and controls, particularly highlighting the greater disparity in sections requiring verbal responses compared to those needing non-verbal responses.

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Impaired Aspect and Mood production in English post-stroke aphasia

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Introduction & Aims

Encoding of semantic and morphosyntactic information, and retrieval of corresponding verb forms both underlie target production of grammatical aspect (depicting event-internal temporal properties) and grammatical mood (depicting factuality or counter-factuality). Although these morphosyntactic categories are essential to meaningful language production, only a few studies have addressed whether they are impaired in persons with post-stroke aphasia (PWAs), who often exhibit verb-related morphosyntactic deficits. Wenzlaff and Clahsen (2004, 2005) and Clahsen and Ali (2009) found production of grammatical mood to be well preserved in German and English nonfluent agrammatic aphasia, while Fyndanis et al. (2012, 2018), Varlokosta et al. (2006) and Nanousi et al. (2006) found production of grammatical aspect to be impaired in both nonfluent and fluent Greek aphasia. The preservation of mood in English aphasia was accounted for by proposing that the opposition between *realis* and *irrealis* constitutes a fundamental distinction (Wenzlaff & Clahsen, 2004, 2005), and thus *not* prone to impairment. The impaired production of grammatical aspect in Greek aphasia was attributed to the fact that producing this category involves integration of extra-linguistic/conceptual and linguistic information (Fyndanis et al., 2012).

The current study investigates the ability of English-speaking PWAs (E-PWAs) to produce grammatical aspect and grammatical mood. It also examines the role of underlying linguistic factors, namely semantic complexity and verb form complexity, in aspect production.

Methods

Participants

Twenty-six E-PWAs and 23 age-matched healthy controls (HCs) participated in the study and were included in the final analyses. All E-PWAs had intact listening and reading

comprehension with a mix of fluent and non-fluent profiles (*Western Aphasia Battery Aphasia Quotient (out of 100)*: M=86.7; SD=9.4); all were more than six months post-stroke (*months post onset*: M=103.7 SD: M=99.5).

Tasks

A 100-item Aspect-Mood sentence completion task was devised (40 aspect – 60 mood). Aspect items included verbs encoding four aspectual values (*past perfective* – loved [n=10], *past imperfective* – was chasing [n=10], *present perfect* – have known [n=10], *past perfect* – had picked [n=10]), varying in semantic complexity (*simple* vs. *complex*) and word form complexity (*monolectic* [one-word] vs. *periphrastic* [two-word]; see Table 1). Mood items only included the verb *to be*, and encoded subjunctive mood (n=30) (was/were) and indicative mood (n=30) (is/are). The Mood items were interspersed with the Aspect items. All items were cross-modally presented to participants, who filled a gap in each sentence by producing the target verb in its appropriate form.

Results

E-PWAs were found to be impaired in both aspect and mood production, as they performed significantly worse than the control group on both categories. E-PWAs were also more impaired in aspect (M=24.1%) than in mood (M=69.0%; $p<.001$***). Additionally, our findings pointed to a predictive effect of semantic complexity and word form complexity on E-PWA target aspect production. Specifically, when controlling for word-form complexity, E-PWAs produced more target verb forms in semantically simple aspect conditions (i.e. past imperfective) compared to semantically complex aspect conditions (i.e. present perfect and past perfect) (M=16.4% vs. M=0.05%, respectively; $p<.001$***); and when controlling for semantic complexity, they fared better in monolectic (past perfective) than periphrastic (past imperfective) aspect conditions (M=78.6% vs. M=16.4%, respectively; $p<.001$***). *Past perfective*, an aspectual value with simple semantic complexity and morphologically encoded in monolectic verb forms, outperformed all other aspectual values (in all comparisons, $p<.001$***). Finally, E-PWAs produced as a group more target verb forms in the subjunctive mood condition (M=77.7%) than in the indicative mood condition (M=60.3%) ($p=.006$**).

Discussion

The present findings indicate that E-PWAs experience difficulties in producing both grammatical aspect and grammatical mood. The results concerning aspect are consistent with previous findings *from* studies on Greek aphasia (Fyndanis et al., 2012, 2018; Nanousi et al., 2006; Varlokosta et al., 2006). In contrast, the results regarding mood diverge from earlier findings *on* English aphasia (Clahsen & Ali, 2009) and, consequently, challenge the notion that mood is a resilient morphosyntactic category due to the fundamental distinction between *realis* and *irrealis* (Wenzlaff & Clahsen, 2004, 2005). The impaired production of

mood and aspect could be accounted for in terms of integration processes, as both categories carry interpretable features (see Fyndanis et al., 2012, and reference therein).

Within-aspect dissociations suggest that semantic complexity and word form complexity are two additional sources of difficulty in aspect production. Participants' difficulty producing periphrastic forms points to processing bottlenecks during verb form retrieval (e.g., Faroqi-Shah, 2023). Some E-PWAs consistently produced present participles (*–ing*) but omitted auxiliaries, suggesting that while verb lemmas and inflectional morphology were retrieved, the production of target periphrastic verb forms was hindered by processing limitations.

The finding that aspect was more impaired than mood may reflect task-related effects, as only one verb was included in the Mood condition. This limitation arose from the very restricted range of English verbs that encode the distinction between indicative and subjunctive mood. Alternatively, one could argue that the observed aspect–mood dissociation supports the idea that the category of grammatical aspect as a whole encompasses finer semantic distinctions compared to grammatical mood, rendering it conceptually more complex and thus harder to process. Surprisingly, in the Mood condition, E-PWAs performed better on the marked mood value (subjunctive), which is associated with counter-factuality, than on the unmarked mood value (indicative). This unexpected finding suggests that, for some reason, E-PWAs may have developed a strategy that led to an overproduction of the more demanding mood value.

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In which cases are prepositions difficult to judge? Disentangling impairments in word order and functional elements in agrammatic aphasia

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Introduction and aims

The term “agrammatism” implies that individuals with this condition struggle with grammar, but what exactly in grammar is impaired? Aphasiological research has focused on two primary symptoms associated with grammatical impairment, often treating them as one: errors involving functional elements, and errors involving word order, particularly in sentences with non-canonical word order.

While prepositions are often considered prototypical functional elements, past studies have yielded inconsistent findings regarding their status in agrammatism: whether prepositions are impaired at all, whether the impairment is consistent across tasks and modalities, and whether different types of prepositions are differentially affected. Specifically, whether prepositions syntactically selected by verbs, often considered more functional, are more affected than unselected prepositions (Friederici, 1982; Grodzinsky, 1988; Linebarger et al., 1983). The current study aims, first, to assess whether agrammatism necessarily involves both impaired syntactic movement and impaired use of functional elements, particularly prepositions. Second, it aims to identify the specific syntactic configurations and types of prepositions that pose difficulty for individuals with agrammatism, and to explain these patterns using a theoretically motivated account of the agrammatic impairment.

Methods

Participants were ten Hebrew-speaking patients with agrammatic aphasia (five with post-stroke aphasia, five with Primary Progressive Aphasia) and ten non-impaired controls. Syntactic impairment in the agrammatic group was confirmed through multiple independent tasks assessing comprehension and production. Participants completed a grammaticality judgment task consisting of 48 sentences, half grammatical and half ungrammatical, manipulated for whether the prepositional phrase appeared in its original position (in situ) or had undergone movement to the CP layer of the sentence (for question formation, topicalization, or relativization), and whether the preposition was syntactically selected or unselected by the verb. To minimize effects of memory and other processing limitations, participants were allowed to reread the sentences or ask the experimenter reread them as many times as they needed. Example (1) is an experimental set with a selected preposition.

(1)

a. *ha-rofe diber al ha-inyan ha-ze*

the-doctor talked about the-issue the-this

<grammatical, movement>

b. *ha-marce *diber et ha-nose ha-ze*

the-lecturer talked ACC the-subject the-this

<ungrammatical, no movement>

c. al ha-inyan ha-ze ha-marce diber

on the-issue the-this the-lecturer talked

<grammatical, movement>

*d. *et ha-nose ha-ze ha-doktor diber*

ACC the-subject the-this the-doctor talked

<ungrammatical, movement>

'The doctor/lecturer talked about this issue/subject '

Results

Controls performed at ceiling across all conditions. In contrast, individuals with agrammatism were able to identify incorrect prepositions when they were in situ (M = 94%), but showed significantly reduced accuracy (M = 67%) when the prepositional phrase was moved to the CP layer ($t(9) = 5.79$, $p < .001$). This pattern was consistent across participants individually, as all of them made more errors in ungrammatical sentences with movement compared to ungrammatical sentences without movement, except for one participant who did not make errors at all in this task. Performance in grammatical sentences was high both without movement (M = 98%) and with movement (M = 93%), with a marginally significant difference between them ($t(9) = 2.27$, $p = .049$). We found no significant difference in error rate between selected and unselected prepositions in detecting the ungrammatical sentences with movement ($t = 0.39$, $p = .7$), meaning that preposition type does not significantly affect the ability to identify the grammatical violation in the moved prepositional phrase.

Discussion

These results challenge the view that conflates two symptoms of agrammatism: impaired word order and impaired functional elements, as we have shown that difficulty with word order can occur without difficulty in prepositions. Difficulty with prepositions was observed only when the prepositional phrase moved to the CP layer, which is syntactically unavailable in agrammatism. This difficulty can be accounted for by the tree pruning hypothesis (Friedmann, 2002, 2006; Friedmann & Grodzinsky, 1997), which posits that the CP layer of the syntactic tree is inaccessible in agrammatism. Under this account, movement operations that target the CP layer—such as wh-questions, topicalization, and relative clauses—are disrupted, as the landing site of the movement is unavailable. Consequently, individuals with agrammatism fail to form a chain between the displaced prepositional phrase and its original position within the verb phrase. Since grammatical evaluation of prepositions relies on linking the moved element to its original position as a complement of the verb, failure to establish this chain prevents the detection of ungrammaticality (see Figure 1).

This evaluation of compatibility between the verb and the preposition is necessary for both selected prepositions and unselected prepositions, since, in both cases, the grammaticality of the sentence depends on whether the preposition appropriately links to the verb—either by being lexically specified (in the case of selected prepositions) or by being semantically and syntactically permissible given the verb's argument structure and meaning (in the case of unselected prepositions).

We propose that previous studies have found difficulties in prepositions in situ due to additional deficits that may co-occur with difficulties in movement and accessing the CP layer. Namely, a deficit in the lexicon that stores lexical-syntactic information may affect knowledge of argument structure, causing argument structure errors, including substitution of prepositions in production and difficulty in detecting violations in grammaticality judgement (Biran & Friedmann, 2012). In production, substitution of prepositions can also occur due to phonological output buffer impairment (Dotan & Friedmann, 2015). Such dissociations within grammatical functions call for a fine-grained classification of grammatical impairments in aphasia, based on a linguistically informed classification of functional elements that takes into account the stages of retrieving and accessing them.

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Investigating speech comprehension impairments in post-stroke and language-led dementias affecting the left-temporoparietal junction.

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Introduction and aims

Speech comprehension is a complex process requiring the integration of information over a hierarchy of perceptual-linguistic-cognitive functions. The left hemisphere temporoparietal junction (L-TPJ) contains elements of neural networks that support all these functions and is, therefore, critical for speech comprehension (Vigneau et al., 2006). The stroke-related conditions of Wernicke's aphasia (WA) and Conduction aphasia (CA) and the dementia-related condition of Logopenic variant Primary Progressive Aphasia (LvPPA) are acquired language impairments which stem from similar loci of neural damage to the L-TPJ, see Figure 1. Despite TPJ damage, impaired comprehension is only a diagnostic criterion in WA and is considered to be spared in CA and LvPPA.

However, neuropsychological testing has revealed a more nuanced pattern, in which comprehension impairments can be detected in CA and LvPPA. While previously this was thought to be restricted the sentence level (secondary to short term memory impairments), more recent evidence has also found single-word comprehension impairments using sensitive behavioural measures (Leyton et al., 2015; Louwersheimer et al., 2016). Furthermore, neuropsychological evidence exists for impairments across the comprehension hierarchy (perceptual, linguistic and cognitive processes) in all three conditions. This then raises questions about whether the conditions are more phenotypically equivalent than previously thought.

These similarities in neural and neuropsychological profiles raises questions about whether the conditions are truly phenotypically distinct. An alternative explanation is that comprehension is impaired in all three conditions and that the impairment is of the same nature but expressed at different levels of severity. Previous insufficiently sensitive testing measures may have given rise to appearances of selective impairments for sentence processing in CA and LvPPA and a more generalised comprehension impairment in WA, with an interpretation of correspondingly different cognitive, perceptual and linguistic causes. This distinction may have become cemented over time because the conditions have been investigated separately, using measures of different sensitivity levels, and because data have been interpreted through different theoretical lenses. This study will evaluate the full perceptual-linguistic-cognitive hierarchy across these conditions within a single,

comprehensive neuropsychological framework to evaluate whether the comprehension impairments are truly qualitatively, or are only quantitatively, different.

Study aims:

RQ1: Are distinct neuropsychological and comprehension profiles observable in WA, CA and lvPPA?

RQ2: What cognitive, perceptual and linguistic factors correlate with comprehension impairments in WA, CA and lvPPA?

Methods

Participants:

Fifteen participants with CA, WA and lvPPA, and fifteen age- and hearing-matched healthy controls will be recruited to the study via university participant registries.

Recruitment has started and approximately five to seven participants are expected to be recruited to the study for each group by September 2025 and a preliminary analysis will be conducted.

Neuropsychological testing:

Speech comprehension tests at the single-word, sentence and discourse levels will be used to comprehensively profile speech comprehension and will form the primary measures for RQ1 and RQ2.

A unified, comprehensive neuropsychological battery will be administered to assess acoustic, phonological, lexical, semantic, memory and executive (switching, updating, inhibition) processes. These assessments will form the predictor variables.

Additional measures

Pure tone audiometry, Mini-Mental State Examination and neuroimaging data will be collected to describe the groups and for use as covariates in statistical analyses where appropriate.

Results:

Data collection for this study is underway. Data will be analysed at both the group level and

case series level to answer the research questions. The anticipated data analysis frameworks are as follows:

RQ1:

Descriptive and inferential statistics will be used to investigate whether comprehension impairments and neuropsychological profiles are quantitatively or qualitatively different at the group level. Quantitative differences would emerge as a main effect of group on statistical testing. Qualitative differences would emerge as group x test interaction effects. The inferential statistics will be selected based on the nature of the data. Linear mixed effects modelling will be preferred because of the ability to account for variance induced by participant severity or test items and the ability to model covariates. Case series (individual-level) analysis using Crawford's methods (Crawford et al., 2006) will also be performed to establish whether group-level patterns are consistent at the individual level.

RQ2:

Association analyses will be performed to investigate the relationship between the primary outcome measures (comprehension tests) and predictor variables (neuropsychological tests) while accounting for variance associated with age, hearing, severity and lesion/atrophy using linear mixed effects modelling or partial correlations. Partial correlations or non-parametric correlations will be explored if mixed effects models are underpowered or fail to converge. Fisher z-transformation will statistically compare correlation coefficients if correlations are used.

Discussion:

The inconsistencies in existing data collection methods and interpretive lenses mean that WA, CA and lvPPA cannot, currently, be unified within the same neurolinguistic framework. This results in an incomplete understanding of the conditions. The results from this study will attempt to resolve current paradoxical findings by unifying the conditions within the same methodological frameworks, with a focus on speech comprehension. The results have clinical implications for assessment, diagnosis and the identification of unmet speech comprehension needs as well as the potential to refine the content of our current rehabilitation interventions to improve treatment specificity.

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Investing disfluency patterns in People with Aphasia; Evidence from Greek.

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Introduction and aims

The evaluation of fluency in spontaneous speech is crucial for diagnostic and clinical purposes in aphasia (Gordon & Clough, 2020). Aphasia is often associated with confrontation naming and lexical word retrieval deficits, irrespective of aphasia type (Goodglass & Wingfield, 1997; Raymer, 2005). Abnormally prolonged pauses, revisions, false starts, andincomplete utterances have been associated with word finding behaviors for agrammatic speakers (Sahraoui et al., 2015), but also for anomic speakers (Brookshire, 2007) and individuals with Wernicke's aphasia (Butterworth, 1979). However, it is unclear whether the distribution of dysfluency patterns differs between groups reflecting distinct impairments in word retrieval processes.

Recent studies have shown that microstructure features, such as *filled and unfilled pauses, word lengthening and false starts,* can be used as an index of the underlying cognitive processes supporting sentence planning and lexical selection (Ballard et al., 2014; Fraser et al., 2014; Mack et al., 2015; Yunusova et al., 2016; Sahraoui et al., 2015), as they are associated with cognitive processes and mental skills responsible for speech planning, monitoring, and successful word retrieval. For instance, fewer pauses between utterances have been attested in individuals with higher working memory (WM) skills, compared to peers with low WM resources, suggesting that pauses can be used as an index of efficiency at incremental planning (Swets et al., 2021).

The aim of the present study is to examine the distribution of such features in connected language samples of people with aphasia (PWA) and investigate the interrelation with participants' lexical, syntactic and executive control abilities, to determine biomarkers for screening and classification/diagnostic purposes. For these purposes, we will use manually annotated data. However, we will also investigate whether the same results can be generated when using automatically extracted data from the data set, using Naturalistic Language Processing (NLP), Machine Learning, and Speech-to-Text annotation, as our ultimate goal is to use automated measures for the reliable detection of disfluencies in PWA.

Methods

Participants

Data from 18 PWA (15 m/ 3 f) and a control group of 18 language- and education-matched Greek-speaking individuals without aphasia have been analyzed (age range: 57 to 70 years; mean age=63.8). They were all screened with neuropsychological tools prior testing (i.e., Mini Mental State Examination (MMSE); (Folstein et al. (1975), the 5-Objectcognitive screening test; Papageorgiou, Economou & Routsis (2014)), to ensure that their cognitive abilities were within norms.

Materials

Given that word retrieval patterns vary depending on the elicitation context (Williams & Canter, 1987; Conroy et al., 2009; Croot et al., 2014), the narrative data set included a personal narration, the production of an unknown story based on a 6-picture set, and the retelling of a familiar and an unknown story (Kakavoulia et al., 2014). All language samples were derived from the Greek Corpus of Aphasic Discourse (GREECAD; Varlokosta et al., 2016).

Scoring

A total of 144 spoken narrative samples were analyzed. Narratives were manually transcribed in an orthographic format and were annotated using the ELAN software. Transcriptions were time aligned, to allow for the automatic calculation of duration, and segmented into utterances, following the AphasiaBank guidelines for utterance segmentation; each utterance includes only one main clause along with its depended subordinate clause(s). Repetitions, reformulations, and false starts were removed from utterances for uniform word count and MLU calculation. The analysis included speech rate, filled and unfilled pause durations, and pause distribution in relation to lexical variables (i.e., word class, word frequency, word length). Any silence after the onset of speech longer than 100 ms was considered as a pause. An additional analysis was conducted between intra-utterance disfluencies (filled/unfilled pauses within an utterance) and inter-utterance disfluencies (filled/unfilled pauses between the end of an utterance and the beginning of the next one by the same speaker). The full narrative sample was then automatically transcribed and annotated with fine-grained linguistic units known as the Open Brain Ai (OBAi) (Themistocleous, 2024). Similar comparisons were conducted.

Results

A positive correlation was attested between the number of pauses and the total number of ungrammatical clauses, while a marginal correlation was observed between the number of pauses and total number of words and the total number of utterances in PWA. Within-group

comparisons revealed no significant correlations in PWA between the number of pauses and other linguistic or cognitive measures such as the Digit span, Raven scores, BDAE subcomponents, semantic verbal fluency tasks, word or sentence repetition tasks. No significant differences were attested across microstructural features across narrative types. Although PWA use pauses more frequently and for longer durations compared to controls, no differences were attested between picture-based narrations, compared to memory-based narratives (contra Pistono et al., 2018; Angelopoulou et al., 2024).

Discussion

Pauses can effectively be used as biomarkers for screening and classification/diagnostic purposes, as they can be used as a measure to portray global planning tendencies. Positive correlations between the number of pauses and total number of ungrammatical sentences in the narrative tasks suggest that longer and frequent pauses do not necessarily lead to accurate sentence formation; rather they are the by-product of the participants' planning difficulties. Differential patterns of disfluencies, as well as preliminary findings from the automated fluency outcome measures, will be discussed.

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impairments (RAPID).

It sounds like a word to me: Phonological impairment predicts response bias and rejection of pseudowords in written lexical decision

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Introduction and aims

Written lexical decision (hereafter, lexical decision) is a longstanding tool for investigating the factors affecting lexical access. These studies have revealed a great deal about how various psycholinguistic properties of words affect lexical processing. However, there is much less literature on how the integrity of the representational systems that underlie language processing impact lexical decision.

Theories of single word oral reading emphasize that letter strings are processed with differential reliance on the cognitive systems subserving orthography, phonology, and semantics[1]. Pseudowords are read primarily by a sublexical route that directly translates orthography to phonology[2]. In contrast, real words evoke a greater reliance on lexicosemantic processing[3]. Performance on word and pseudoword trials in lexical decision might then be expected to differ based on semantic and phonological processing abilities.

Evidence from semantic dementia (SD), a syndrome characterized by progressive impairment of semantic processing[4], suggests that performance in lexical decision is in part driven by semantic processing[5]. Additionally, some evidence shows that persons with SD show a response bias towards “word” for pseudowords that are well-matched to the orthographic characteristics of real words. This suggests that persons with SD rely on the visual form to make their decision, and fail to activate semantic information that would allow them to correctly reject the pseudoword[6]. These findings support a primary role for orthography and semantics in lexical decision, even on pseudoword trials.

Stroke alexia provides a comparison to SD. Whereas in SD impairment is primarily semantic, strokes that produce alexia most often lead to mainly phonological impairments. Evidence from priming in stroke alexia shows that semantic decision is sensitive to phonological deficits[7]. However, it is unclear if degraded phonological and semantic processing drive similar lexical decision impairments.

Here, we investigate the cognitive substrates of real and pseudoword processing during lexical decision. First, we ask what cognitive factors drive biases towards “word” or “pseudoword” responses in stroke alexia. Second, we ask how semantic and phonological processes affect performance. Consistent with single word oral reading models, we expected to find that semantic processes would drive performance on real words and phonological processes would drive pseudoword performance.

Methods

Participants and Behavioral Testing

Left-hemisphere stroke survivors (N=84) and age-matched controls (N=72) performed 400 trials of written lexical decision (200 words, 200 pseudowords). Efficiency (average accuracy/median RT) was calculated for each participant over (a) all trials, (b) on word trials only, and (c) on pseudoword trials only. Stroke survivors also engaged in a battery of tasks to assess semantic (Pyramids and Palm Trees, TALSA Category Judgement, word-picture matching) and phonological processing (pseudoword repetition, minimal pair pseudoword discrimination, picture and auditory rhyme judgement, picture and auditory syllable counting). Semantic and phonological composite scores were constructed as the average accuracy across the relevant set of tasks.

Behavioral Models

Significant ($p<0.05$) binomial tests against a chance probability of 0.5 on participant-wise “Word” and “Pseudoword” response counts identified “biased” participants. To determine the factors that influence response bias, a logistic regression predicted presence of response bias from semantics, phonology, age, education, gender, handedness, aphasia severity (Western Aphasia Battery Aphasia Quotient (WAB-AQ)), log-transformed lesion volume, and log-transformed stroke chronicity. Biased participants were further classified as “Real Word Biased” (RWB) or “Pseudoword Biased” (PWB), based on the overrepresented response. ANCOVAs examined differences in demographic and cognitive variables between the three (Unbiased, PWB, RWB) bias groups.

Three linear regressions assessed the relationship between lexical decision efficiency (all trials, pseudoword trials, word trials) and phonological and semantic processing, covarying for age, education, handedness, gender, log-transformed stroke chronicity, and log-transformed lesion volume.

Results

21% (N=18) of the stroke survivors were biased towards “word” responses, 16% (N=13) towards “pseudoword” responses, and 63% (N=53) were unbiased. Only 8% (N=6) of the controls showed bias (control<stroke, $^{2}(1,156)=15.9, p<0.001$). Younger age (odds ratio=0.89, 95% CI [0.83,0.95], $p=0.001$), lower WAB-AQ (odds ratio=1.07, 95% CI

[1.01,1.12], p=0.030), and worse phonological processing (odds ratio=0.86, 95% CI [0.78,0.94], p=0.003) increased the odds of being biased (Fig. 1).

The Unbiased and PWB groups both had better phonological processing compared to the RWB group (F(2,75)=21.5, Unbiased>RWB, p<0.001, PWB>RWB, p=0.001). The Unbiased group also had better semantic processing than the RWB group (F(2,75)=6.1, p=0.005) and were older than the RWB group (F(2,75)=6.5, p=0.018). Finally, the RWB group had worse aphasia by WAB-AQ than the Unbiased and PWB groups (F(2,75)=11.9, Unbiased>RWB, p<0.004, PWB>RWB, p=0.018). Handedness, chronicity, and lesion volume did not differ between the groups.

Overall lexical decision efficiency was predicted by semantic processing (t=2.3, p=0.022, overall regression:F(8,72)=5.6, p<0.001, R^2=.31), as was efficiency on word trials (semantics: t=2.9, p=0.004, overall regression: F(8,72)=4.6, p<0.001, R^2=.26). Pseudoword efficiency was predicted by phonological processing (t=2.2, p=0.030, overall regression F(8,72)=5.4, p<0.001, R^2=.30) (Table 2; Fig. 2).

Discussion

We find that semantics and phonology separately influence the ability to recognize a word versus reject a pseudoword in a written lexical decision task. First, impaired phonological processing induces a response bias. Specifically, we found that the RWB group had more severe phonological impairment group compared to the PWB and Unbiased groups. This finding provides an interesting convergence with results in semantic dementia[6]: worse impairment leads to classifying pseudowords as words. A possible explanation in stroke alexia is that severe phonological impairment may result in a failure to produce a viable phonological form, meaning that spurious semantic activation to pseudowords cannot be inhibited.

We also find that performance on the written lexical decision task was subserved by different cognitive systems, depending on the trial type. Overall efficiency, and word trial efficiency, was predicted only by semantics, whereas pseudoword efficiency was predicted only by phonology. These results reflect computational models of single word oral reading, which show that real words evoke greater involvement of semantics where pseudowords are decoded by a direct orthography-to-phonology route[3]. Furthermore, our results suggest that phonology plays a primary role on pseudoword trials in lexical decision. While lexical decision may involve a differential, task-relevant weighting of these cognitive representations relative to oral reading, we show that the integrity of semantic and phonological processing differentially underlie processing of word and pseudoword trials.

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Lexical Retrieval in Diglossic Aphasia: Naming Accuracy for Cognates and Non-Cognates in Modern Standard Arabic and Egyptian Colloquial Arabic

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Structured abstract only

Max 1000 words for the abstract, max 200 words for references

Introduction and aims

Lexical retrieval difficulties are a hallmark of aphasia, often leading to reduced fluency and impaired communication. While extensive research exists on lexical access in monolingual and bilingual individuals with aphasia, little attention has been given to diglossic contexts such as Arabic, where educated individuals juggle two language varieties: Modern Standard Arabic (MSA) and a regional colloquial dialect. In Egypt, educated speakers alternate between Egyptian Colloquial Arabic (ECA), the native spoken variety, and Modern Standard Arabic (MSA), the formal written variety. This dual-language context introduces unique challenges for aphasia research, particularly in understanding how individuals with aphasia (PWA) navigate lexical access across two related, yet distinct, linguistic systems.

Although aphasia in bilinguals can manifest in various patterns (e.g., parallel, selective, differential), the way such patterns unfold in diglossic speakers is still not well understood.

Prior studies suggest that lexical retrieval is influenced by language similarity, with cognates (word pairs that share the same meaning and similar forms across languages) being retrieved more accurately than non-cognates (Lalor & Kirsner, 2001; Roberts & Deslauriers,1999). Nonetheless, the impact of cognate status on lexical access in diglossic aphasia still needs to be investigated. This study addresses this gap by exploring the influence of language variety (ECA vs. MSA) and cognate status (cognates vs. non-cognates) on picture-naming accuracy in Egyptian Arabic-speaking PWA and healthy controls.

Methods

Five PWA and thirty neurologically healthy participants, all native speakers of ECA with exposure to MSA, completed the picture-naming task: once in ECA and once in MSA.

Participants

The PWA (three males and two females) were recruited from a rehabilitation hospital in Greater Cairo where the data collection took place. Control participants were matched for age, ranging from 16 to 82 years.

Material

The stimuli consisted of 60 high-frequency and concrete nouns. The pictures were selected from the Multilingual Picture (MultiPic) database (Duñabeitia et al., 2018), filtered through a norming process to ensure high naming agreement. The 60 pictures were named in ECA during the first session and MSA in the second session, resulting in a total of 120 naming attempts per participant.

Procedures

PWA first completed baseline tasks from the Bilingual Aphasia Test (BAT; Paradis & Libben, 1987). The picture-naming tasks were administered first in ECA, then in MSA. The BAT Bilingual History Questionnaire was also completed by both groups. Informed consent was obtained, and sessions were audio recorded. Sixty percent of control data were collected online. The study was approved by the Research Ethical Review Committee (CETO) of the University of Groningen.

Scoring

Error types and scoring followed the framework of Roberts & Deslauriers (1999). Error types included: no response, wrong variety, English intrusion, semantic, unintelligible, descriptive, or unrelated errors. Correct responses were scored as (1), and incorrect responses as (0).

Results

Overall, the performance of the control group was better than that of PWA in both MSA and ECA. Both groups demonstrated higher naming accuracy for ECA compared to MSA, suggesting that the spoken language variety remains more accessible post-injury.

Results also revealed a clear advantage for cognates for both groups with cognates being retrieved more accurately than non-cognates in both language varieties. This supports the hypothesis that lexical overlap facilitates retrieval in aphasia.

Error analysis for PWA showed a higher frequency of incorrect switching to ECA and no-responses in MSA, particularly for non-cognates, indicating increased lexical retrieval difficulty.

Discussion

These findings demonstrate that lexical retrieval in diglossic aphasia is shaped by similar factors to bilingual aphasia, such as language proficiency, frequency of use, and lexical similarity. However, the diglossic context adds unique complexity, particularly regarding the reduced accessibility of the formal language variety (MSA) following injury.

The observed cognate advantage across both groups supports the hypothesis that lexical overlap between ECA and MSA facilitates retrieval, consistent with findings from bilingual aphasia literature (e.g., Lalor & Kirsner, 2001; Roberts & Deslauriers, 1999).

The PWA's poorer performance in MSA compared to ECA reflects a differential impairment pattern, but the fact that even controls struggled more with MSA underscores the importance of spoken language familiarity in naming tasks.

This study offers insights on how diglossic speakers navigate their language varieties in ways that mirror, but are not identical to, traditional bilingualism. The evidence from PWA in this Egyptian context suggests a complex interplay between proficiency, lexical similarity, and language exposure, underscoring the need for aphasia tools that are sensitive to the unique dynamics of diglossia.

While clinical intervention in Egypt is typically conducted in ECA, these results remain clinically relevant. They highlight the limitations of MSA accessibility post-injury and underscore the need for greater awareness of these dynamics in both assessment and support planning. Furthermore, recognizing these limitations is essential for supporting broader communicative participation in a diglossic society.

Given the small sample size, these findings should be interpreted with caution; however, they provide important preliminary insights into lexical retrieval in diglossic aphasia.

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Mapping Linguistic and Nonlinguistic Cognitive Profiles to White Matter Integrity in Post-stroke Aphasia

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Max 1000 words for the abstract, max 200 words for references

Introduction and aims

White matter tracts play a central role in language recovery following stroke (Ivanova et al., 2021; Rosso et al., 2015), yet their relationship to functional outcomes remains complex. While numerous diffusion tensor imaging (DTI) studies have examined the role of white matter in language processing and recovery, fewer have systematically evaluated how tract-level integrity relates to both linguistic and domain-general cognitive performance within the same post-stroke aphasia cohort. The current study addresses this gap by examining the associations between fractional anisotropy (FA) in major bilateral white matter tracts and behavioral indices of linguistic and nonlinguistic cognitive abilities in individuals with chronic post-stroke aphasia.

Methods

Participant & Behavioral Assessments

Thirty individuals with post-stroke aphasia following left-hemisphere stroke participated in the study (mean age = 58.5 years, range = 18–81; mean Western Aphasia Battery - Revised Aphasia Quotient (WAB-R AQ) = 77.35, range = 12.4–98.6). To comprehensively characterize linguistic and non-linguistic cognitive abilities, participants completed a battery of 25 standardized tasks spanning multiple domains. These included all subtests from the WAB-R, the Reading Comprehension Battery for Aphasia (RCBA), the Boston Naming Test (BNT), the three-picture version of the Pyramids and Palm Trees Test (PAPT), selected subtests from the PALPA (Auditory/Visual Lexical Decision, Written Nonword Repetition), all subtests of the RBANS, as well as Logical Memory, Verbal Paired Associates, Visual Reproduction, and Symbol Span from the Wechsler Memory Scale, the Symbol Cancellation subtest from the CLQT, and a computerized sentence comprehension task (auditory and reading versions). Principal component analysis (PCA) was then performed using the psych package to reduce dimensionality while preserving interpretability across

behavioral measures. The Kaiser-Guttman criterion (Yeomans & Golder, 1982) was applied to retain components with eigenvalues greater than one, and a varimax rotation was used to produce orthogonal components. Significant loadings were defined as ≥ 0.60 and used to classify each component as reflecting primarily linguistic or non-linguistic cognition. The first two components (RC1 and RC2) were retained for analysis and interpreted as representing linguistic and domain-general cognitive abilities, respectively.

White Matter Tracts & DTI Metrics

DTI data were collected using Siemens 3T MRI scanners. Tractography was performed in DSI Studio using the ICBM152 atlas. FA was extracted for ten tracts of interest: bilateral arcuate fasciculus (AF), inferior fronto-occipital fasciculus (IFOF), inferior longitudinal fasciculus (ILF), superior longitudinal fasciculus I (SLF), and uncinate fasciculus (UF).

Statistical Approach

Linear regression models examined associations between tract-level FA and performance on behavioral components derived via principal component analysis (RC1: linguistic abilities; RC2: cognitive abilities). Models were run with and without lesion volume as a covariate, and FDR correction was applied to adjust for multiple comparisons.

Results

RC1 (Linguistic Abilities): FA in multiple left hemisphere tracts—including the AF, IFOF, ILF, SLF, and UF—was significantly associated with RC1. The left AF remained significant after FDR correction ($p = 0.055$). However, these associations were eliminated when lesion volume was included as a covariate, suggesting that lesion burden explains a substantial portion of the variance in language performance. No right hemisphere tracts were associated with RC1.

RC2 (Cognitive Abilities): Several right hemisphere tracts, including the SLF, ILF, AF, and UF, were significantly associated with RC2 across all models, even after controlling for lesion volume. After FDR correction, associations with the right AF and UF remained trend-level significant (FDR $p \approx 0.084–0.085$), while others approached significance (FDR $p < 0.14$), supporting the role of RH tracts in domain-general cognitive function.

Discussion

Findings reinforce the lateralization of language to left hemisphere white matter pathways and demonstrate that their microstructural integrity contributes to linguistic ability, although this relationship is largely mediated by lesion volume. In contrast, cognitive abilities in chronic aphasia appear to depend on individual differences in right hemisphere white matter integrity, which remained predictive even after lesion volume adjustment. These results underscore the need to incorporate DTI-based measures alongside lesion mapping to improve outcome prediction and guide personalized rehabilitation strategies.

Specifically, RH tract integrity may offer a window into cognitive reserve and compensatory potential post-stroke.

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MORPHOSYNTACTIC ABILITIES IN SERBIAN SPEAKERS WITH APHASIA

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Background: Empirical research has demonstrated that morphosyntactic impairments are common in individuals with various types of aphasia. While such deficits are typically linked to Broca's aphasia, they are also observed in other nonfluent aphasia types, as well as in fluent aphasias. Despite the established presence of these deficits, uncertainties remain regarding their precise nature, and studies examining them in different languages are scarce.

Purpose: This study aims to evaluate the morphosyntactic abilities of Serbian speakers with aphasia.

Method: The study included 62 participants with aphasia (PWA), divided into two groups: 35 with fluent aphasia and 27 with non-fluent aphasia, based on spontaneous speech characteristics. A control group (CG) of 68 neurologically healthy individuals was also included. All participants were aged 18-83 and had at least 8 years of formal education. The groups were matched for age and education. The Serbian Morphosyntactic Ability Test (SMAT) was used to assess the use of grammatical markers such as gender, number, person, tense, and case. Descriptive statistics, including frequency, percentage, mean, standard deviation, and range, were applied. The Mann-Whitney U-test compared performance between PWA and CG, as well as between different aphasia types. The Kruskal-Wallis test assessed differences in aphasia severity. Spearman's correlation analyzed the relationship between SMAT scores and variables such as age, education, and time post-onset.

Results: PWA performed significantly worse on the SMAT than the control group. Deficits were found in the use of gender, number, person, tense, and case markers. Neurologically healthy speakers answered almost all test items correctly. Individuals with non-fluent aphasia performed significantly worse than those with fluent aphasia. Additionally, participants with severe aphasia showed lower scores than those with milder forms of aphasia. No significant correlations were found between gender, age, or education in either group. Similarly, time post-onset did not correlate with SMAT scores in PWA.

Conclusion: The study concludes that the SMAT is a valid and reliable tool for clinical and research purposes. It also confirms that morphosyntactic deficits are present in both fluent and nonfluent aphasia.

Keywords: *nonfluent aphasia, fluent aphasia, Morphosyntactic Ability Test, morphosyntactic deficits*

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Morphosyntactic abilities in the early stage of Huntington's disease: a case study

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Introduction and aims

Huntington's disease (HD) is an inherited neurodegenerative disorder caused by an increased repeat of the CAG trinucleotide in the Huntington's gene. The disease causes motor, cognitive, and language impairments. Previous research suggests deficits in both morphological and syntactic processing. In particular, inability to inhibit the application of morphological rules has been assumed to lead to multiple suffixation, overgeneralizations of the regular tense morphology to irregular verbs or even to incorrect suffixation (Teichmann et al., 2008) with the error patterns depending on the language spoken. Regarding the syntactic level, previous studies have shown a high frequency of errors in sentence connection of both main and embedded clauses (Hinzen et al., 2018), a lower rate of embedded clauses compared to controls (Tovar et al., 2020), as well as a deficit in the comprehension of syntactically complex sentences, among which are object relative clauses (Teichmann et al., 2008). These deficits are related to damage in the striatum, which is involved in procedural memory, the language computational system, affecting aspects of both morphology and syntax, whereas language abilities associated with declarative memory, such as vocabulary, remain unaffected (Ullman, 2004). Furthermore, although a regularity effect has been attested both for past (Ullman, 2004) and future tense (Teichman et al., 2008), reference to different time levels per se has not been tested in HD, to the best of our knowledge. The present study aims to investigate morphosyntactic abilities in HD by examining the case of one Greek-speaking individual. In particular, the study addresses the following research questions: 1) Do patients with HD have difficulties in the past tense formation and if so, is there a distinct performance on regular vs. irregular forms? 2) Do HD speakers manifest problems with verb inflection depending on the time level? 3) Do HD patients show difficulties in the production and comprehension of syntactically complex sentences?

Methods

Participant

The patient (male, 62 years old and 17 years of education) was recruited at the B' Department of Neurology of the AHEPA University Hospital in Thessaloniki (Board meeting number of the Committee of Bioethics of the School of Medicine of the Aristotle University of Thessaloniki: 220/2024). He presents a marked motor chorea disorder and is diagnosed with HD on the basis of a genetic test and classified, with clinical consensus, as being in the early phase of the disease. He produced short sentences, suffered from apraxia of speech, and had low performance in repetition and comprehension of complex material. Otherwise, his scores fell in the 90th percentile in the Boston Diagnostic Aphasia Examination (BDAE)^{GR} (Messinis et al., 2013). The score in the Addenbrooke's Cognitive Examination (ACE-R^{GR}, Konstantinopoulou et al., 2011) was in the normal range.

Tests of morphosyntactic abilities

The assessment of linguistic abilities includes the following: a) The Perfective Past Tense Test (PPTT, Stavrakaki & Clahsen, 2009), b) Test for the Assessment of Reference of Time (TART, Koukoulioti & Bastiaanse, 2008) and c) Test of Production and Comprehension of Relative Clauses (henceforth PCRC, see for example, Talli & Stavrakaki, 2020). PPTT tested the production and comprehension of perfective past tense in regular and irregular verbs as well as abilities of rule application in rhyming and non-rhyming pseudoverbs. TART tested production and comprehension of verb forms in past, present and future and was administered in order to evaluate whether morphological deficits were associated with deficits in referring to different time levels. Finally, the PCRC elicited subject and object relative clauses by means of elicited questions referring to pictures with animal figures, whereas the comprehension part was a picture-sentence matching task, testing the same structures.

Results

In PPTT the patient showed ceiling performance in production of regular and irregular verbs and produced 87% forms following the regular rule for pseudoverbs. He had ceiling performance also in comprehension of verbs and preferred the application of regular morphology for pseudoverbs (83%), resembling the performance of healthy adults (as reported in Stavrakaki & Clahsen, 2009). He had very good performance in TART in all tenses and all time levels in both production and comprehension, as well. In the PCRC, however, the patient performed relatively well in the production of subject relative clauses (70% correct), whereas he had severe deficits in producing object relative clauses (20% correct) with the majority of the errors consisting of the production of coordinated sentences. By contrast, he had good performance in comprehension of both sentence types, although a dissociation between the two sentence types was observed (100% correct in subject relative clauses and 80% correct in object relative clauses).

Discussion

In sum, the performance of this speaker with HD suggests a selective deficit in sentence production, whereas syntactic comprehension and morphological abilities were preserved in the early phase of the disease. This pattern suggests: 1) intact lower-level language computational mechanisms (morphology) and 2) selective impairment of higher-level language computational mechanisms (syntax). While these results are subject to the limitations of a single case study, they indicate selective vulnerability for expressive syntax (specifically for the demanding object relative clauses) in the early phase of HD.

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Multimodal signatures in aphasia: A convergent analysis of emotion, visual attention, and language during movie-viewing

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Introduction and aims

Post-stroke aphasia disrupts language abilities and affects broader cognitive- perceptual processes crucial for daily communication [1,2]. Though standardized assessments effectively measure specific linguistic deficits, examining how persons with aphasia (PWA) process naturalistic stimuli like movies may further reveal preserved and altered communication mechanisms, given the interactions of neural systems supporting language, emotion, and sensory processing [3-6]. This study evaluated the extent to which emotional reactivity and visual attention during movie-viewing reflect underlying language processing abilities in aphasia.

We investigated (1) how PWA differ from healthy controls (HC) across indices derived from a movie-viewing paradigm, and (2) whether these differences systematically relate to aphasia severity, providing insight into real-world processing challenges.

Methods

Participants included 35 persons with chronic post-stroke aphasia (mean age=59.1 years, SD=10.5; mean WAB-AQ=74.9, SD=17.5) and 50 healthy controls (mean age=48.3 years, SD=15.9. Eye movements were recorded in all HC and 8 PWA. Participants watched 5-8 emotionally engaging movie clips (2-5 minutes each) while providing continuous valence ratings (-4 to +4) using an input device (i.e., keyboard or joystick). To evaluate linguistic processing, after each clip participants completed three comprehension questions and generated antonyms for five words derived from the clip's subtitles.

We analyzed group differences in task performance (comprehension accuracy, antonym generation) and processing measures using linear and logistic mixed-effects models, accounting for random effects of participant and clip. Emotional reactivity was assessed through multiple measures: root mean squared z-scores (RMSZ) capturing both the

magnitude and direction of moment-to-moment deviations from group-level response patterns, Euclidean distance quantifying the overall dissimilarity of each participant's complete rating pattern to the HC group, and multiscale sample entropy (MSE) evaluating rating complexity across timescales (1- 36s). Eye movements were analyzed using both static and dynamic intersubject correlation (ISC), comparing each participant's gaze coordinates to the mean HC pattern along both vertical and horizontal axes. A sliding window approach generated time-resolved dynamic ISC estimates to identify contiguous time segments where gaze synchrony differed between groups. Finally, a LASSO classifier identified the most discriminative features among all movie-based paradigm measures and their pairwise interactions.

Results

For movie-based language tasks, PWA demonstrated lower performance in both comprehension (β=0.081, SE=0.020, p<.001) and antonym generation (β=0.307, SE=0.038, p<.001), with the effect more pronounced for antonym generation.

Emotional reactivity analyses revealed consistently atypical patterns in PWA. RMSZ analysis showed significantly higher deviations for PWA (β=0.269, SE=0.088, p=.003), indicating greater and more positive moment-to-moment divergence from HC patterns. Analysis of Euclidean distances between individual rating patterns and HC reference patterns revealed significantly larger distances for PWA (β=39.13, SE=14.26, p=.008). MSE analysis revealed a significant group × timescale interaction (β=1.097e-04, SE=5.191e-06, p<.001), indicating PWA showed reduced emotional rating complexity at long time scales. The LASSO classifier achieved robust discrimination (AUC=0.925, 95% CI: 0.869–0.982; 96.0% specificity; 66.7% sensitivity; Figure 1). The interaction between movie-based comprehension and antonym generation accuracy emerged as the strongest predictor in the classification model. Features related to emotional response complexity (sample entropy, deviation from the typical emotional patterns) also contributed meaningfully to classifier performance.

Correlation analyses revealed varied relationships with aphasia severity. RMSZ demonstrated a significant negative relationship with aphasia quotient (β = -6.62, p = .0024), indicating that individuals with more severe aphasia showed greater deviation from typical emotional response patterns. Aphasia severity was also significantly correlated with the complexity of the emotional ratings (β=-3.181e-03, p<.001), with more severe impairment associated with reduced emotional complexity at long time scales. In contrast, the overall dissimilarity from HC rating patterns (Euclidean distance) showed no significant relationship with aphasia severity (p=.318).

In preliminary eye-tracking analyses, relative to HC, PWA demonstrated reduced gaze synchronization for both vertical (β=0.190, SE=0.056, p=.001) and horizontal (β=0.153,

SE=0.064, p=.019) eye movements, suggesting less consistent visual attention patterns compared to controls. Time-window analyses of horizontal gaze synchronization identified significant group differences during sustained periods in two clips ($p \geq .0295$), while remaining clips showed comparable patterns between groups. Consistency of visual attention patterns showed no significant relationship with aphasia severity (p=.209).

Discussion

These findings reveal that aphasia affects how individuals process emotional and visual information during naturalistic tasks. More severe aphasia was associated with greater deviations from typical emotional response patterns (RMSZ) and reduced emotional complexity at longer timescales. The classifier's strong performance indicates that indices derived from a movie-viewing paradigm can effectively differentiate and thus characterize deficits associated with aphasia. The results demonstrate that naturalistic measures provide insights into language impairments and may guide tailored rehabilitation strategies.

Figure 1: LASSO classification discriminating persons with aphasia from healthy controls. (A) Receiver operating characteristic curve with 95% confidence interval (shaded region) showing strong classification performance (AUC = 0.925, 95% CI: 0.869-0.982). (B) The four most influential features identified by LASSO, with bars indicating coefficient magnitude and direction of effect (red = negative association with aphasia, green = positive). The interaction between movie-based antonym generation and comprehension emerged as the strongest predictor, followed by the interactionbetween sample entropy and movie antonym performance. Individual measures of emotional reactivity (RMSZ and rating distance) contributed more modestly but still meaningfully to group discrimination.

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Narrative language in children with posterior fossa tumours: Investigating the impact of tumour surgery on language performance

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Structured abstract only

Max 1000 words for the abstract, max 200 words for references

Introduction and aims

Posterior fossa tumours (PFTs; i.e., situated in the cranial cavity containing the brainstem and the cerebellum) are the most common type of paediatric central nervous system tumours (Rickert & Paulus, 2001). Tumour treatment generally involves surgical resection, often followed by adjuvant radio- and/or chemotherapy. At different stages of treatment, children with PFTs may present with a broad spectrum of language impairments (e.g., agrammatism, word-finding difficulties; Persson et al., 2023; Svaldi et al., 2024).

Before tumour surgery, language impairments may be caused by, among others, tumour growth, intracranial pressure, and/or functional reorganization. Immediately after surgery, lesions at the resection site and/or surgical sequelae such as hydrocephalus can induce language impairments. Previous studies investigating pre- and postoperative impairments in children with PFTs as well as comparisons between these two timepoints reported, among others, lexical-semantic and morphosyntactic impairments. Nonetheless, language outcomes vary considerably across studies, which may be due to the lack of in-depth linguistic assessments conducted in this population (Di Rocco et al., 2011; Frank et al., 2007). Furthermore, few studies conducted a preoperative language assessment (Persson et al., 2023; Svaldi et al., 2024). This is important, however, to reliably interpret postoperative language outcomes.

Previous research has failed to provide a detailed evaluation of the effects of tumour presence/growth and its surgical resection on different levels of linguistic processing. This is important, however, to understand the isolated effects of tumour resection on language performance. The present study aims to fill this gap by investigating the pre- and acute postoperative language skills in children with PFTs as compared to typically developing children. Language was assessed with a narrative task because of its short assessment time and since it allows evaluation of multiple levels of language processing simultaneously. Included variables reflect four language processing levels (i.e., (lexico-)phonological, semantic, lexical, and morphosyntactic).

More specifically, the present study aims to investigate:

1. The *preoperative* language impairments in children with PFTs as compared to typically developing children;
2. The *acute postoperative* (i.e., one to four weeks after surgery) language impairments in children with PFTs as compared to typically developing children; and
3. Differences between pre- and acute postoperative language profiles within children with PFTs.

Results can increase understanding about the cerebellar role in language processing and development, and can help provide guidelines for language assessment and rehabilitation in children treated for PFTs.

Methods

Participants

The patient group consisted of 39 children operated on for a PFT, who were part of the Nordic-European Cerebellar Mutism Syndrome study. Patients were between three and 18 years of age ($M(SD)$ = 9.89(3.60) years) and were Dutch (n = 11), Italian (n = 11) or British (n = 17). Twenty-five patients were female and 14 were male. Three children presented with mutism or reduced speech after tumour surgery. The control group included 39 children without language and/or neurological impairments, matched for age, sex, and language background with the patient group.

Materials and procedure

Narrative samples were gathered using the Fish story of the Expression, Reception and Recall of Narrative Instrument (Bishop, 2004), in which children had to tell a sequenced story based on 15 scenes depicted in a wordless book. Patients were tested two times, within a few days before surgical resection of the tumour and one to four weeks after tumour resection (before the start of cranial radiotherapy). Dutch and Italian control data were collected by our research group at the University of Groningen. British control data were retrieved from the open-access database of Frizelle et al. (2017).

Data coding and analysis

Data analysis is underway, in which the narrative samples are transcribed and coded. In total, six standard narrative language measures and nine psycholinguistic variables of the nouns and verbs produced are included, reflecting lexical (e.g., word frequency), semantic (e.g., concreteness), phonological (e.g., word length), and morphosyntactic (e.g., mean length of utterance, grammatical accuracy) processing. A principal component analysis will be conducted to reduce the number of variables into overlapping components for further group comparisons using linear mixed models.

Results and discussion

Data analysis is currently underway and results will be available by September.

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Narrative skills in healthy ageing; a data-driven approach to an early identification of apathy and linguistic decline in order adults. Evidence from Greek, American English and Korean.

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Introduction and aims

Healthy Ageing has been associated not only with temporal changes in speech production, resulting from reduced strength, movement speed and flexibility of the vocal tract, but also with additional changes at both the micro- and macro-linguistic levels. At the micro-linguistic level, older adults often exhibit difficulties with lexical retrieval of semantically appropriate words in addition to a general reduction in sentence length and complexity (Kemper & Sumner, 2001). At the macro-linguistic level, discourse tends to show weaker cohesion between units, with many referential errors, inappropriate use of linking conjunctions, and abrupt topic shifts (Marini et al., 2005). Additionally, the correlation between discourse units and narrative themes appears to diminish significantly, leading to an increase in off-topic utterances.

Narrative abilities have been proven to be a very informative tool for assessing an individual's linguistic and communicative competence. Changes in language performance, particularly the progressive decline of both micro- and macro-linguistic features, can be used as early indicators of even mild cognitive impairment. However, substantial variability has been reported across different narrative measures. For instance, a significant decline in discourse production during healthy ageing has not always been confirmed, whether at the micro-structural level, e.g., syntactic complexity (Nippold et al., 2013), or the macro-structural level (Kemper et al., 1991). This inconsistency highlights the importance of using large language models, and cross linguistic data, essential to accurately identify subtle linguistic markers cross-linguistically.

Apathy has recently been identified as a common feature of neurodegenerative diseases (Lanctôt et al., 2017) and it is associated with accelerated cognitive and functional decline. Apathy is described as a syndrome marked by reduced motivation, diminished goal-directed behavior and interests, and emotional blunting. In healthy elderly people, early and accurate detection of apathy is crucial, as it may be used as an additional risk factor for the development of dementia. Previous studies (König et al., 2019) have utilized prosodic,

articulatory, and acoustic features of speech to detect apathy. However, other micro- and macro- linguistic features, such as the use of first-person singular pronouns, positive or negative emotion words, short and simple sentences, fewer prepositions, increased number of conjunctions, limited reference to plot elements, fewer complete episodes, less cohesion etc (Trifu et al., 2024), may also provide additional insights into an individuals' intrinsic motivation and interest.

The aim of the present study is to automatically extract data, using Naturalistic Language Processing (NLP), Machine Learning, Speech-to-Text annotation, and probabilistic models, on micro- and macro-linguistic changes across different age groups of healthy elderly individuals, with the goal of identifying markers that may be associated with the early detection of apathy.

Methods

Participants

40 Greek-speaking, 40 American English-speaking and 40 Korean-speaking healthy adults took part in this study, divided into two subgroups (a) 20 old adults ranging in age from 45 to 70 years; b) 20 elderly adults ranging in age from 70 to 90 years respectively. All participants had normal cognitive abilities, had suffered no previous neurological /neuropsychological disorders or head injuries, and had normal hearing and/or vision. Participants were selected across diverse regions and educational backgrounds, offering a degree of ecological validity.

Materials and procedure

Narrative sample included a personal narration, a picture description using the Cookie-theft picture, and the production of an unknown story (*the party*) based on a 6-picture set. All narrations were audio-recorded, were automatically transcribed and annotated with fine-grained linguistic units known as the Open Brain Ai (OBAi) (Themistocleous, 2024).

Discussion

Understanding age-related changes in discourse production can help determine when a small shift is unusually significant and potentially linked to other causes, like an underlying medical condition. In this study, Ai technologies will be used to automatically analyze both micro- and macro-linguistic changes across different languages and different age groups of healthy elderly individuals. The results will provide informative data about the effectiveness of such tools for theautomatic and reliable detection of linguistic biomarkers of apathy in healthy adults, relying solely on participants' narrative skills.

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Novel Aphasia Language Test in Akan

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Structured abstract only

Max 1000 words for the abstract, max 200 words for references

Introduction and aims

People with aphasia have difficulty in comprehending sentences (Law & Leung, 1998) and single word nouns and verbs (McCann & Doleman, 2011). They are also reported to demonstrate difficulty in their production of sentences (Caplan & Hanna, 1998) and their production of nouns and verbs with verbs (actions) being often more difficult to produce than nouns (objects) (Bastiaanse & Jonkers, 1998). In research and clinical practice, these language domains are evaluated by means of linguistic tests that have been normed to identify aphasia severity and patterns of impairment the individuals present with. Such tests are lacking in the Global South and in countries like Ghana. Empirical studies carried out with Akan speakers with aphasia have relied on the adaptation of aphasia batteries in conducting background language assessments which are culturally and contextually inappropriate (Lartey et al., 2020; Tsiwah et al., 2021). Thus, for this project and research purposes, a contextual and culturally appropriate background aphasia language assessment tool in Akan (a language spoken in Sub-Saharan Africa) – the first of its kind has been developed to assess the comprehension and production abilities of Akan speaking individuals with aphasia.

Akan comprises of three mutually distinct intelligible dialects: Akuapim twi, Asante twi, and Fante twi which have achieved literary status. The majority of Ghanaians speak Asante twi -

the dialect under study, which is the most widely spoken of all Ghanaian languages and the most used language in Ghanaian daily interactions (Osam, 2003). Akan's use as a lingua franca encompasses a wide range of socio-cultural domains, as well as social and economic aspects. Akan has borrowed from the English language in the fields of health, education, religion, agriculture, and other domains. The reason for borrowing is to fill semantic and lexical gaps (Apenteng, 2014). This newly developed background aphasia language test in Akan will assess the Akan speaking individual with aphasia's ability to understand single words, simple to complex sentences and their ability to name objects and actions. Thus, the study outlines the results of two pilot studies conducted with three neurotypical individuals each.

Methods

All pictures were designed using AI through an iterative process to achieve pictorial clarity. The test comprises a 16-item sentence comprehension test, single word comprehension tests for verbs and nouns (15 items each) and object and action naming tests (15 items each) in Akan. The single word comprehension test assesses the individual's ability to comprehend nouns and verbs respectively. The sentence comprehension test assesses the individual's understanding of simple to complex linguistic structures in Akan such as simple noun phrases, complex noun phrases, plurality, active sentences, postpositions, object clefts, relative clauses, and comparatives (see Figure 1a for an example). Sentence structures like object clefts in Akan are used to mark passive constructions in Akan since there are no passive constructions in Akan. To construct passive constructions, one has to cleft the object in a construction to take the initial position of the sentence to mark a passive sentence (e.g. *Maame no bam papa no* - 'The woman is hugging the man' is realised as *Papa no na Maame no bam no* – 'It is the man the woman is hugging'). The object and action naming test assesses the individual's ability to retrieve nouns and verbs as single words (see Figure 1b for an example). The aphasia language test was administered to each pilot participant via zoom. The comprehension and production main tests were preceded by three practice items to ensure participants understood each task. An initial pilot study was conducted with three neurotypical controls (female- 34years, educational level-master's degree; male-36years, educational level-bachelor's degree; female- 65years, educational level-master's degree). A second pilot study was conducted on three different neurotypical controls (female-56 years, educational level-masters; female-63 years, educational level-diploma certificate; female-65 years, educational level- diploma certificate).

[Figure 1 about here]

Results

Based on initial pilot testing, some modifications were made to the single word noun

comprehension test, single word object naming test and single word action naming test. Results showed 100% accuracy across all three participants in all subtests, however, close semantic and distant semantic distractors on two test items in the single word noun comprehension test were identified by one participant as potential correct responses to the target word. One test item (*samina -soap*) in the single word object naming test is likely to be elicited in English in a more generic name as (*key soap*). Since the focus of the study is on Akan, a deliberate effort was made to avoid the elicitation of target words in English or loanwords. Thus, the test item was replaced with an item that would be elicited in Akan. One test item for the single word action naming test *(ɔɔnoa-cooking)* was changed because of the possibility of the action item described in different action verbs in Akan which would still be accurate but will be difficult to compare and determine the pattern of errors. Subsequently, the necessary modifications were made, and the tests were piloted again with 100% accuracy and no issues with the new test items.

Discussion

The pilot study has given insight into the required modifications to the test items before administering the test items for the main study. Consistent results from the two pilot studies indicate the trustworthiness and the cultural - linguistic appropriateness of the test before administering the test in the main study. A new group of participants (fifteen Akan speaking individuals with aphasia and fifteen neurotypical controls who speak Akan) will be recruited in Ghana to conduct the study and results of the main study will be available and presented at the conference in September. Though the newly developed test will prove as a useful tool in conducting background aphasia language assessments in Akan research, it may also serve as a potential tool to be used clinically by speech therapists working with Akan speaking adults with aphasia.

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Oral picture description in glioblastoma patients before and after awake tumour resection

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Introduction and aims

Spontaneous speech analysis is a reliable and valid method to detect and characterize language problems in neurological populations. Deviations in the spontaneous speech of glioma patients before and/or after awake brain surgery are reported to consist of incomplete sentences, shorter mean length of utterance (MLU), repetitions, self-corrections and phonological paraphasias (Rofes et al., 2018; Satoer et al., 2013). So far, these studies are conducted in heterogeneous patient groups containing all tumour grades.

In patients with the most aggressive brain tumour, glioblastoma, spontaneous speech analyses are scarce. Traditionally, resection of glioblastoma is done under general anaesthesia. The SAFE-trial (Gerritsen et al., 2020) investigates the benefit of awake resection in glioblastoma including language outcome.

As spontaneous speech analysis (interview setting) is time consuming, an oral picture description (semi-spontaneous speech) is an alternative and is proven to be sensitive in stroke patients (Vandenborre et al., 2018).

We aimed to 1) investigate the pre- and postoperative semi-spontaneous speech using oral picture description in patients with a glioblastoma in the left hemisphere who underwent awake resection and 2) to compare their performance to that of a healthy population and to

stroke patients.

Methods

The SAFE-trial (Gerritsen et al., 2020) is an ongoing randomized controlled trial in which patients with a presumed glioblastoma in an eloquent area were randomized over the traditional resection under general anaesthesia and resection under awake conditions. For the current study, we analysed a cohort of patients with a glioblastoma in the left hemisphere who underwent awake surgery.

A short neurolinguistic test-protocol was administered preoperatively and three months postoperatively including the oral picture description task from the Dutch version of the Comprehensive Aphasia Test (CAT-NL,

The speech samples were recorded and transcribed. A conceptual analysis directed to informational content and causal relations between depicted events was administered according to the manual of the CAT-NL. Additionally, variables as productivity, grammatical organization and errors were analysed based on earlier research (Satoer et al., 2013; Vandenborre et al., 2018). For a detailed description of all variables, see Table 1.

Results

The cohort consisted of 28 patients with a mean age of 61 years (range 35-82 years). Tumour location was frontal (n = 11), temporal (n = 9), parietal (n = 4), occipital (n = 2), or in multiple lobes (n = 2).

In the pre- and postoperative semi-spontaneous speech, most common errors were interjections, incomplete sentences and repetitions. Compared to a healthy population, glioblastoma patients produced pre- and postoperatively significant ($p < 0.05$) fewer adequate content words, a shorter MLU, fewer compound sentences and more language errors (paraphasias and neologisms); and fewer causal relations preoperatively only. Compared to stroke patients, glioblastoma patients expressed significantly more causal relations ($p < 0.05$), but the other variables did not differ significantly ($p > 0.05$). See Table 1 for the results of all linguistic variables.

Between pre- and postoperative performance, most variables did not significantly change ($p > 0.05$) except for a higher percentage of repetitions and more initiation problems (both number and percentage) postoperatively. Although according to the TT 10 patients were diagnosed as aphasic preoperatively and 14 patients postoperatively, no significant change in TT results was found ($p = 0.543$). Preoperatively, patients with a frontal tumour expressed significantly more causal relations than patients with a temporal tumour ($p = 0.025$). Postoperatively, patients with a frontal tumour had a significant higher TT score than patients with temporal tumours ($p = 0.013$).

Significant preoperative correlations ($p < 0.05$) were found: between the TT score and the number of adequate content words and the percentages of correct sentences (positive correlation); between TT score and the percentages of incomplete sentences, interjections and repetitions (negative correlations). A negative postoperative correlation ($p < 0.05$) was found between the TT score and the number of language errors, interjections, initiation problems and repetitions. See Table 1 for more details.

Discussion

Semi-spontaneous speech using a picture description task appeared to be sensitive to detect language disturbances in glioblastoma patients, as well as the Token Test. In accordance with earlier research (Rofes et al., 2018; Satoer et al., 2013), most errors in glioblastoma patients concerned incomplete sentences. Compared to a healthy population, glioblastoma patients are both pre- and postoperatively less efficient in transferring content information, using shorter, less syntactically complex sentences and more language errors (e.g. semantic and phonological paraphasias, neologisms) are observed. It appears that the characteristics of spontaneous speech in glioblastoma patients resemble the performance of lower graded glioma patients (Satoer et al., 2013) albeit more severely impaired; i.e. problems at both the sentence and word level with the addition of the conceptual level. Moreover, oral picture description is less time-consuming than the traditional interviewing setting serving as an efficient clinical tool in a standard neurolinguistic examination. In addition, spontaneous speech in patients with a glioblastoma is comparable to that of stroke patients, although they appear to be able to bring a more conceptual message across.

As most variables did not significantly change between preoperative and postoperative analyses, it seems that spontaneous speech in this group of glioblastoma patients was spared by awake resection. However, this needs to be proven in a larger cohort and in relation to survival and quality of life by an ongoing RCT. Finally, a written picture description will be analysed as this modality was more sensitive than the spoken version in stroke patients (Vandenborre et al., 2018).

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Patterns of multimodal creativity in individuals with mild to moderate aphasia

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Structured abstract only

Max 1000 words for the abstract, max 200 words for references

Introduction and aims

Individuals with aphasia use gestures to compensate their verbal limitations (e.g. De Beer et al., 2020). This can be explained by a trade-off relationship of gesture and speech in which one modality (e.g. gestures) can compensate the breakdown of the other (e.g. during word finding difficulties) (De Ruiter, 2000). Especially, iconic gestures tend to have a potential to compensate verbal limitations (e.g. de Beer et al, 2020) as they can cover a broad spectrum of content aspects (e.g. by depicting information about objects or movements) (McNeill, 1992).

Creativity is a potentially relevant factor for the effective use of communicative resources by individuals with aphasia. Some individuals with aphasia were reported to overcome their verbal limitations by producing creative expressions to replace a non-retrievable target word leading to communicative success (Liederman et al., 1983). Communicative success and originality are seen as the two main criteria for an utterance to be rated as creative (Runco & Jaeger, 2012). However, in individuals with aphasia creative or deviant expressions are often rated as errors and therefore not considered in much detail.

Linguistic creativity is not limited to the verbal modality, but has also been observed in the use of gestures, e.g. when speakers experience communicative problems (Magno Caldognetto & Poggi, 1995, Cienki & Mittelberg, 2013). In cases of creative gesture use, speakers are reported to frequently employ iconic gestures (Magno Caldognetto & Poggi, 1995 Cienki & Mittelberg, 2013). So far, only few studies have focused on creativity in gesture production of individuals with aphasia but there is some evidence that individuals with aphasia use their preserved multimodal skills creatively and flexibly to convey meaning

(e.g. Magno Caldognetto & Poggi, 1995). As to now, patterns of multimodal creativity (*PAMUC*, that is creative patterns in gesture and speech) in individuals with aphasia have not been extensively investigated. The coding and description of creative gestures consequently lack consensus.

We aimed to investigate multimodal creativity in individuals with and without aphasia employing an interactive explanation task similar to the taboo-game. Prohibiting the use of certain taboo-words (i.e. constraining verbal explanations) was expected to cause compensatory and potentially creative use of co-speech-gestures, especially in PWA. We further aimed to develop and validate a new coding scheme to carefully analyse PAMUC.

Methods

Five participants with mild to moderate aphasia (PWA) and ten neurologically unimpaired controls (NUC) explained 28 noun-noun-compounds in two conditions (four vs. two taboo-words). Recordings were analysed regarding speech and co-speech-gesture production with gestures categorised by type (e.g. iconics) and by creativity patterns (PAMUC). Table 1 provides an overview of the newly developed PAMUC-coding scheme, its five categories with explanations and examples illustrating each of the categories.

Results

All PWA and all NUC in our sample used gestures creatively and all five PAMUC-categories of creatively used gestures were found across our sample of PWA and NUC. The most frequently used PAMUC-category was *creative combination of gesture and speech* (61 %).

Within the instances of creatively used gestures, the iconic gesture type was most frequently employed (54 %) when compared to other gesture types. Group comparisons revealed that creative use of iconic gestures was more frequent in PWA (78%) than in NUC (38 %). Odds Ratios indicated that PWA made creative use of iconic gestures about six times as often as of other gesture types in relation to NUC.

Discussion

As certain words had to be inhibited in the taboo task and PWA therefore experienced communicative pressure, we assumed the taboo-task to involve high communicative constraints. In this communicatively challenging task PWA were found to use iconic gestures in a creative manner. This finding suggests that individuals with mild to moderate aphasia are able to use gestures as a communicative resource in a creative way to express meaning, when spoken expression becomes more challenging. This is in line with the finding of De Beer et al. (2020) that a frequent use of iconic gestures by individuals with aphasias of varying severities is associated with tasks of high communicative constraints. Taken

together, creativity should be considered as a relevant factor influencing the effectiveness of multimodal communication in clinical practice and research with individuals with aphasia. Our current findings underline the relevance of a thorough inspection and consideration of deviant and creative multimodal expressions produced by individuals with aphasia as those expressions can be a relevant and valuable source of information.

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Perceptual speech markers in preoperative assessment: Their role in predicting postoperative speech impairment

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Introduction and Aims

Surgical resection of a posterior fossa tumour (PFT) in children may be followed by an array of symptoms, among which is postoperative speech impairment (POSI). It is described as either a severe reduction in speech or complete mutism (Grønbæk et al., 2021). Cerebellar mutism is often followed by dysarthria, a motor speech disorder affecting speech articulation. The most commonly reported symptoms of speech impairment post-mutism are monotonous voice, slow rate, and ataxic speech, e.g., scanning speech, irregular breakdown in articulation, and excess and equal stress (De Smet et al. 2007). Nevertheless, post-surgical dysarthria has also been reported when the patients have not experienced a phase of mutism.

Many studies have investigated postoperative speech deficits in the PFT population; however, only a few reported preoperative speech profiles. For instance, Di Rocco et al. (2011) performed comprehensive neuropsychological testing of children (aged between 2 and 16 years) before surgery and identified a group with preoperative language impairment (PLI). Within the group with PLI, 75% of the patients with an articulation deficit went on to experience cerebellar mutism after surgery. This suggests that there may be a predisposition to developing adverse postoperative speech problems in patients who already present speech and language problems before surgery. A reason for the preoperative impairment could be that the tumour itself invaded the regions that are crucial to the coordination of fine motor movements needed for successful articulation, such as the cerebellar hemispheres or the afferent and efferent fibers connecting the cerebellum to the cortical regions (Ackermann, 2008). This study had two aims: (1) to compare preoperative auditory-perceptual speech features between patients with PFTs and healthy controls, and (2) to identify features distinguishing patients who developed postoperative speech impairment (POSI) from those who did not. These predictors may help identify the risk for

POSI for clinicians and provide families with clearer expectations regarding postoperative outcomes.

Method

Participants. The study included 31 participants, catagorized into three groups: a group that developed POSI (n=9), a group that did not develop POSI (n=13), and a healthy control group (n=9). Data of the first two groups (patient groups) came from the database of the European study of Cerebellar Mutism Syndrome (CMS) (Wibroe et al., 2017). Patient data came from English and Dutch speakers, while controls were only Dutch-speaking healthy participants. *Materials and methods*. The participants were audio-recorded while they narrated the fish story from the Expression, Reception, and Recall of Narrative Instrument (ERRNI, Bishop, 2004).
Data analyses. Audio samples were rated by speech-language pathologists (SLPs). A rating form was used to rate 24 speech features on an impairment-based scale of 0-3. For the statistical analysis, we first applied reverse Helmert coding to the group factor. This way, we created two comparisons, one between the POSI and non-POSI patient groups and the second between both patient groups (POSI + non-POSI) and healthy controls. Afterwards, we conducted ordinal logistic regression analyses with speech features as the predictor variables and the factor group as the outcome variable. To control for multiple comparisons, Benjamini-Hochberg false discovery rate (FDR) correction was applied across all speech features.

Results

In the comparison between the control group and the patient group, several features showed significantly greater impairment in the patients. Regarding articulation and fluency, the patients demonstrated higher severity in consonant cluster segmentation, consonant cluster reduction, omitted syllables, and irregular articulatory breakdowns (all $p < .001$). In the prosody domain, patients demonstrated a slower speech rate ($p = .041$), and in the respiration, phonation, and resonance domain, strained voice was also more pronounced ($p = .034$). Notably, sequencing errors and stuttering were rated as more impaired in the control group.

When comparing the POSI and non-POSI patient groups, significant differences emerged across multiple domains. Within the domain of articulation and fluency, the POSI group showed significantly higher severity in distorted vowels, imprecise consonants, consonant assimilation, deviant voicing, omitted phonemes, sequencing errors, and stuttering (all $p < .05$). Consonant cluster segmentation was the only feature that was more impaired in the non-POSI group ($p < .001$). Regarding respiration, phonation, and resonance, the POSI group produced more short phrases ($p < .05$).

Discussion

The results provide novel insights into the speech profiles of patients diagnosed with a PFT.

Patients showed a greater impairment in articulation, speech rate, and voice quality compared to the control group, suggesting that the tumour alone can impair speech production before surgical intervention. Ongoing analyses incorporating additional control data from Italian- and Dutch-speaking participants may help clarify the unexpected finding that sequencing errors and stuttering were more prevalent in the control group. This finding may reflect cross-linguistic differences in phonological structure and stress patterns between predominantly English-speaking patients and exclusively Dutch-speaking controls, rather than group-related differences.

The comparison of patients who did vs. did not develop POSI revealed that preoperative speech profiles may indicate a risk of developing postoperative speech deficits. The POSI group showed widespread disruption of segmental accuracy and speech fluency, as reflected by greater severity in multiple articulatory and fluency-related features. The increased presence of short phrases in the POSI group further points to difficulties in coordinating respiration, phonation, and resonance during speech production. These findings also align with those by Di Rocco et al. (2011), which indicated that preoperative articulation deficits are associated with higher mutism incidence. The finding that consonant cluster segmentation was more prevalent in the non-POSI group than in the POSI group may reflect a compensatory articulation strategy where patients make the articulation of consonant clusters more deliberate and segmental, allowing them to prevent the breakdowns in fluency and articulation that are more severe in the POSI patients.
Overall, these results reinforce the importance of preoperative speech assessment in children undergoing PFT resection. Identifying early predictors of POSI may help inform surgical and rehabilitative planning, potentially alleviating long-term speech deficits.

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Preoperative Language Sample Analysis in Children with Posterior Fossa Tumours: an Analysis of Data from the European study of Cerebellar Mutism Syndrome

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Introduction and aims

Brain tumours are the most common solid malignancies in childhood. Among those are posterior fossa tumours, which make up 60% of childhood brain tumours. The posterior fossa comprises important brain structures such as the cerebellum, cranial nerves and the brain stem. Treatment typically includes surgery, with adjuvant chemo- and radiation therapy to optimize tumour removal and prevent relapse. While survival rates have improved, many survivors face cognitive impairments, including deficits in speech and language. These impairments can result from both the tumour itself and treatment or related complications, such as cerebellar mutism syndrome (CMS), where patients experience a temporary loss or severe reduction of speech. In the domain of language, Mabbott et al. (2008) reported impairments in word retrieval, Lewis and Murdoch (2011) found deficits in formulating sentences, and an extensive language sample analysis performed by Svaldi et al. (2023) revealed broad difficulties in expressive language. Most research on language outcomes, however, studies patients years after surgery. At this stage, it is difficult to disentangle the impact of the tumour itself from the impact of the treatment and complications related to treatment. Making this distinction is important for identifying impairments that can be prevented or even improved through better treatment techniques

and management of complications.

Research on the language profile of patients before they receive treatment is scarce, but indicates that already at the preoperative stage, language problems exist. Persson et al. (2024) found slower word finding in 37% of patients, inaccurate word finding in 24%, and both slow and inaccurate word finding in 16%. Di Rocco et al. (2011) found naming difficulties in 18% of patients, in addition to impairments in verbal fluency and mean length of utterance (MLU) in 29% and 25% of patients, respectively. However, the exact nature of these impairments remains unclear. This highlights the need for further research into pre-surgical language abilities. In the current study, we extensively analyse language samples collected before patients received surgery, and compare them to the language of typically developing children. This allows us to better understand the nature of the language impairments at the preoperative stage and expands our knowledge on the tumour's impact on language abilities, independent of surgery or follow-up treatment and complications.

Methods

Participants

This study included 55 children (ages 3-17 years) who underwent surgery for a posterior fossa tumour in treatment centres in Italy, the United Kingdom or the Netherlands. Clinical, demographic and language data were retrieved via the European Study of CMS (Wibroe et al., 2017). Each patient was matched to a typically developing control participant based on age, sex, and native language.

Materials and procedures

To collect a language sample, the Fish Story subtest from the Expression, Reception and Recall of Narrative Instrument (ERRNI) was used. In this story generation task, the child is presented with a picture story book and is asked to tell a story based on the pictures. Language assessment of the patients took place within a couple of days before surgery. Control participants performed the story generation task as well, in addition to background tests of language and cognitive ability to assess if the child could be included as a typically developing control participant.

Data analyses

Language samples of patients and control participants were transcribed and are currently being scored on 22 linguistic variables across four processing levels: semantic, lexical, morphosyntactic, and phonological. While data coding is close to completion, here we report the results of a preliminary analysis including only the data already checked for coding reliability. These preliminary results include a subgroup of 11 Dutch patients who were matched at a group level to 24 controls. Group comparisons were performed with the 22

variables, using a T-Test or Mann-Whitney U Test. For the final analysis, a Principal Component Analysis (PCA) will be used to reduce the number of comparisons, and linear mixed models will be applied to the extracted components to compare groups.

Results and discussion

The preliminary group comparisons of the subsample of patients and controls revealed a lower performance in the patient group across all four language levels. The differences with the strongest effects were found in the measures MLU (U = 58, p = .004, r = .561), age of acquisition of nouns (t = 0.34, p = .001, r = 1.175), imageability of nouns (t = 0.21, p = .036, r = -.679), and overall lexical (t = 11.04, p < .001, r = 1.717) and grammatical accuracy (U = 26, p < .001, r = .803). These preliminary results show that language impairments often observed after treatment might already be present at the preoperative stage. This highlights an independent impact of the tumour on language abilities, before surgery and post-surgical treatments. Also, these preliminary findings underscore the importance of further, more fine-grained analyses to better characterise the specific linguistic deficits found in this patient group. At the conference, therefore, the results of the PCA and built models with the total group of 110 participants will be presented.

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Preoperative Lexical Diversity as a Predictor of Postoperative Mutism and Reduced Speech in Pediatric Patients with Posterior Fossa Tumors

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Introduction

Posterior fossa tumors (PFTs) are the most common brain tumors during childhood. Both the tumor and its surgical resection, with the latter showing greater impact, may lead to language impairments that can persist many years after surgery with great interindividual variation (Svaldi et al., 2024a). Among the reported difficulties are lexical impairments (e.g., word-finding difficulties), assessed both via standardized tests (e.g., Persson et al., 2024) and spontaneous speech analysis (see Svaldi et al., 2024b).

A unique postoperative sequela to PFT resection is the postoperative cerebellar mutism syndrome (CMS), a transient condition that can arise within days from surgery with 10-40% incidence rate. Among its symptoms – including sudden and intense mood fluctuations, poor muscle control and reduced muscle tone – are temporary mutism or reduced speech, collectively labelled postoperative speech impairments (POSI; Grønbæk et al., 2021). The presence of POSI, regardless of its duration, can predict more pronounced language impairments (Svaldi et al., 2024a). Moreover, preoperative language impairments have been linked to a higher risk of POSI and long-term language difficulties (Di Rocco et al., 2011), stressing the often-overlooked importance of preoperative language assessments.

In this study, our goal was to investigate whether reduced lexical diversity in preoperative spontaneous speech can differentiate patients who will later develop POSI from those who will not. Lexical diversity (LD) refers to the speaker's vocabulary range and variety of word types they produce. It has been widely applied in studies on individuals with language

impairments, helping to differentiate language profiles in aphasia and support diagnosis of children with developmental language impairments (see Fergadiotis et al., 2013).

A common measure for LD is Type-Token Ratio (TTR), the proportion of unique words (types) to the total number of words (tokens) in a sample. However, TTR is sensitive to sample length, with larger samples typically yielding lower TTR values compared to smaller samples (Fergadiotis et al., 2013). This poses an issue, as children with PFTs, especially those who develop POSI, generally produce short speech samples. In this study, we therefore also apply additional measures of LD that are less affected by sample size, such as Moving Average Type-Token Ratio (MATTR), hypergeometric distribution of D (HD-D), and the Measure of Textual Lexical Diversity (MTLD). These measures respectively rely either on incremental calculations of TTR, the likelihood of unique word occurrences using a probabilistic model, or TTR stability through a text before reaching a given threshold. Hence, we additionally investigated the most appropriate measure of LD for distinguishing between our groups of interest.

Methods

We analyze differences in LD across preoperative narrative speech samples from children with PFTs who either developed POSI or not, and typically developing peers (age range 3-18 years). The samples include Italian, English, and Dutch-speaking children who did not have pre-existing cognitive or language delays. In this abstract, we report a pilot analysis focusing solely on English-speaking children (Table 1), as analyses of other languages are in progress.

Data

The patients' language samples were gathered within the *European Study on Cerebellar Mutism Syndrome*, a multi-center study gathering clinical and language data on children undergoing PFTs surgery across Europe. Control data were obtained from the online repository by Frizelle et al. (2018; https://osf.io/fvyqh/).

Stimuli and Procedure

All participants were asked to narrate the *Fish Story* from the *Expression, Reception, and Recall of Narrative Instrument (ERRNI*, Bishop, 2004) after looking at pictures representing the story. We included the preoperative samples of the patient groups, transcribed via the program ELAN (Version 6.7).

Preprocessing and Analysis

We excluded from the analysis elliptic, prompted, or mimicked utterances, repetitions and interjections, and we rewrote phonological paraphasias in their correct orthographic form, according to the transcriber's best guess. From the preprocessed transcribed samples, we

used the R package *koRpus* (Michalke et al., 2018) to extract the required LD measures.

For the analysis, we used linear models to examine the effect of group (Helmert contrast-coded: POSI vs. nonPOSI, POSI+nonPOSI vs. Control) and age (in years) on the different lexical measures (TTR, HD-D, MTLD, MATTR).

Results

From this preliminary analysis (Table 2), we can observe that there are significant differences between the control and patient (POSI + nonPOSI) groups and between patients with and without POSI, but only for two measures: TTR and HD-D.

Our preliminary findings show lower LD, in terms of HD-D, in the POSI group compared to the non-POSI, and lower LD in patients (POSI and non-POSI combined) than controls (see Figure 1). On the other hand, when considering TTR, the POSI group shows higher LD than the non-POSI, and patients (POSI and non-POSI combined) higher LD than controls (see Figure 2).

Discussion

These preliminary results suggest that reduced LD in preoperative spontaneous speech could be a distinguishing feature between groups. Specifically, while patients showed an overall lower LD compared to healthy peers, children with PFTs who later developed POSI showed even lower LD than children with PFTs who did not. This further supports previous findings on the associated risks of developing POSI when preoperative language impairments are present (Di Rocco et al., 2011).

Nevertheless, it is important to note that the reported reduction in LD refers specifically to the HD-D measure, while a more traditional analysis using TTR would actually suggest that LD is higher in the POSI group and, in general, in the patients group (POSI and nonPOSI combined). This would contradict existing literature reporting lexical impairments in these patients (e.g., word-finding difficulties; Persson et al., 2024). With more appropriate measures, it is then possible to gain insights into lexical diversity despite limitations related to sample length, and avoid truncating samples to match the shortest one (e.g., just 9 tokens for this pilot analysis).

These promising preliminary observations should be confirmed through further analysis using the full dataset, in which the three groups (POSI, non-POSI, controls) will be better balanced in terms of age. Importantly, this study contributes to identifying more fine-grained early language markers related to the later development of POSI, possibly supporting speech-language pathologists in providing more effective interventions.

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Public Awareness of Aphasia in Bangladesh

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Topic: Clinical and experimental work on aphasia and related disorders

Background
Despite a high prevalence of stroke (11.39 per 1,000 adults) in Bangladesh, public awareness of post-stroke aphasia remains limited, with no prior research addressing this issue. Consequently, the potential influence of factors such as age, sex, education, and socio-economic status on awareness levels has yet to be explored.

Aims
This study aims to investigate the level of awareness of aphasia among individuals in Bangladesh and examine whether demographic factors influence that awareness.

Methods
A cross-sectional survey was conducted using an adapted version of the questionnaire developed by McCann et al. (2013). The survey was distributed via social media using Google® Forms. It collected demographic information and assessed participants' awareness and knowledge of stroke and aphasia, including causes and symptoms. A total of 126 individuals aged 18–54 years (80 males, 46 females) participated. Data were analyzed to determine overall awareness levels and potential influencing factors.

Results
While 93.8% of participants were aware of stroke, only 35.7% were familiar with aphasia, and 64.3% reported no knowledge of the condition. Students comprised the majority of respondents (67.2%) and demonstrated relatively better awareness, with information sources including school (27.8%) and social media (38.9%).

Conclusion
Public awareness and knowledge of aphasia in Bangladesh remain significantly low. Current efforts appear insufficient, underscoring the urgent need for targeted public education campaigns. Enhancing awareness—particularly within the health sector and educational institutions—could improve outcomes for people with aphasia and support their families more effectively.

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Retrieval practice in spelling rehabilitation: a case series study of patients with acquired dysgraphia.

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Introduction and aims

This study addresses the contribution of retrieval practice to the efficiency of dysgraphia treatment at the word level. Retrieval practice is the retrieval of information from long-term memory. Retrieval practice is required when we are being tested for our knowledge of a given information, or when we are asked to name pictures. On the other hand, some tasks do not involve retrieval practice, meaning that the information is given and we just need to restate it, as in repetitive reading, repetition or copying.

Retrieval practice has proved beneficial across different contexts. For instance, students seem to learn better when they are tested than when they read a lesson multiple times (e.g., Karpicke & Roediger, 2007). Moreover, in individuals with aphasia (IWA) who are relearning spoken words, there appears to be an advantage of producing the word in a picture naming task, compared to repeating that same word (Middleton et al., 2015). Several theoretical accounts have been proposed to explain the benefits of retrieval practice in learning, in terms of “retrieval effort” (Bjork, 1975) or “depth of processing” (Craik & Tulving, 1975).

An alternative explanation for this benefit is that, in tasks such as picture naming, retrieval practice helps strengthen the connection between a word's semantics and its lexical form (Howard et al., 2006). In anomia, it is often (but not always) precisely this connection that is impaired. Therefore, it may not be the inclusion of retrieval practice in the task that yields better results, but rather the focus on addressing the underlying deficit.

Deficits affecting the retrieval of words in aphasia can have different origins: namely, at the lemma retrieval stage, or at the lexeme retrieval stage. These two stages can be transposed to written word production (see Figure 1). They can be selectively impaired in acquired dysgraphia.

Therefore, in the present study, treatment for spelling disorders will be administered to two IWA with different levels of impairment, to compare two alternative hypotheses. The first aligns with the retrieval effort hypothesis, and posits that a treatment involving a retrieval practice task will be more beneficial than a treatment without retrieval practice. This will be the case for all individuals with acquired dysgraphia, regardless of their level of impairment.

The second hypothesis emphasizes the importance of targeting the specific level of impairment. According to this view, a retrieval-based treatment will yield better outcomes only for the IWA with a deficit at the lemma selection level, with no advantage for the IWA with a lexeme-level deficit.

Methods

Participants

Two participants with chronic aphasia (VW and SC) participate in this study. They both had normal spelling abilities prior to aphasia. They underwent thorough background testing so that their level of written word production deficits could be determined. VW exhibits a lexical retrieval deficit, with 64% of her picture naming errors occurring at the lemma level, such as semantic errors, omissions, or circumlocutions. For instance, she might write /ARTISAN/ when attempting to name a sculptor. In contrast, SC struggles with accessing the correct spelling of words. In a written picture naming task, 82% of his errors arise at the lexeme level, often taking the form of phonologically plausible errors, such as /SCULPTER/for the image of a sculptor.

Experimental design

Two types of treatment tasks will be administered to both patients: a written picture naming task and a delayed copying task, with equivalent feedback in both conditions. Baseline testing was completed for both participants, and treatment has begun for SC.

Baseline testing consisted in written naming of a set of 360 pictures (Duñabeitia et al., 2018) on two separate occasions, using Eye and Pen (Alamargot et al., 2006) on a tablet to record the time course of response production, as well as a control task (writing numbers to dictation).

Following baseline testing, three matched sets of items were defined for each participant: set 1) retrieval practice, set 2) copying task, and set 3) untreated. The sets (30 items per set for VW, 60 for SC) were matched for baseline performance, and for a range of relevant psycholinguistic variables.

Treatment will run over eight sessions, conducted twice a week over a four-week period. Finally, written picture naming on the three sets of items will be conducted immediately after the treatment phase, as well as over the long term (one week and five weeks post-treatment).

The experimental design follows the recommendations of Howard et al. (2015).

Data analysis

The effect of treatment condition will be assessed on several dependent variables (accuracy, error types, response time, number of self-corrections) to obtain a detailed analysis of the pattern of recovery in each participant. Statistical analyses will be performed at the single participant level and will be adapted to single-case treatment studies (e.g., Wiley & Rapp, 2019)

And data analysis will be performed following the recommendations of prominent researchers in the domain and adapted to a single case study (e.g., Wiley & Rapp, 2019) .

Results

Data collection will be completed in June 2025 and results will be presented at the conference.

Discussion

This study will contribute to our knowledge of spelling rehabilitation mechanisms and their interaction with patient deficits (Nickels et al., 2015), helping refining theories of word (re)learning, and adding to the knowledge base that is relevant to clinicians.

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Screening Instrument for Apraxia of Speech (SIAS) - Development of a digital tool for the acute stage.

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Introduction & aims

Orofacial apraxia (OFA) and apraxia of speech (AoS) are common in patients in the early post-stroke period (Esmailzade Moghimi et al., 2024). As a consequence, there is a need for bedside screening in order to facilitate the early identification of these deficits. The goal is to provide the patient and their family with direct information, to inform the decision as to whether further assessment should be recommended at a later stage, and to provide a foundation for preliminary treatment. This is important because early treatment enhances spontaneous neuroplasticity, which can lead to more effective functional recovery (Basilakos, 2018).

Although a valid diagnostic tool, the DIAS (Jonkers et al., 2017) is available, it is not feasible to utilise it in a hospital setting. The DIAS is a comprehensive test instrument that helps speech and language therapists (SLTs) diagnose and measure severity, but is specifically designed for the rehabilitation and chronic stage after stroke (Bruffaerts et al., 2022). However, in the acute stage, a brief assessment is needed to establish a preliminary indication. In response to this need, Dutch hospital-based SLTs developed a first screening instrument that was then further extended into the current Screening Instrument for Apraxia of Speech (SIAS). The SIAS is a web tool with the purpose of observing the most commonly used indicative symptoms by SLTs (based on the results of the scoping review of Mollow & Jagoe, et al., 2019). These are initiation problems such as groping, sound distortion (phonetic deviations) and prosodic deficits. This selection was further reinforced by their congruence with the documented subdivisions of AoS, as previously reported (Feiken & Jonkers, 2012). However, it is important to note that not all researchers consider initiation difficulties, such as groping, to be specifically indicative of AoS (Mailend & Maas, 2021).

The primary objective of the present study is to examine the specificity and validity of the SIAS in two groups: native Dutch speakers without brain damage and stroke patients, both with and without AoS. Concurrently, the usability of the digital SIAS tool will be assessed. The results will be presented at the Science of Aphasia conference alongside a demonstration of the digital SIAS tool.

This abstract outlines the results of the pilot study that was conducted prior to the present study, with 40 healthy Dutch native participants and one individual with aphasia (IWA).

Methods

Participants

Included: 40 native healthy speakers of Dutch, with no history of fluency, articulation or language development disorders (16 males and 24 females), divided into three groups based on age: 18-44 (n = 9, M = 26.1), 45-64 (n = 20, M = 55.9) and 65+ (n = 11, M = 77.9). Within each age group, ages were distributed normally. There were no significant uncorrected vision or hearing problems that would interfere with the test administration. One IWA (left side stroke; one year post), not diagnosed with AoS was tested as well.

Materials

The SIAS is a digital assessment tool, consisting of six tasks that facilitate the observation of the deliberate control of the articulation muscles during 1. Oral facial movements, 2. Automatic speech, 3. Speech production of phonemes, 4. Speech production of words, 5. Diadochokinesis (DDK), and 6. Spontaneous speech. Using these tasks, the symptoms that SLTs clinically consider most indicative are systematically observed (Molloy & Jagoe, 2019) (see Table 1).

Table 1 – around here

Procedure

Prior to the assessment, the participants were provided with a concise explanation and a questionnaire concerning demographic factors and language development. Subsequently, the SIAS was conducted via a webtool on a laptop or tablet (iPad). For each item, the instruction was displayed on the screen, and also read out loud by the tester. The test items for tasks 3, 4 and 5 were presented visually as well as auditorily using speech synthesis (Azure, neutral voice). Repetition of the audio fragments was allowed once. The researcher monitored for the characteristics described in Table 1 and registered them when present.

Results

Orofacial skills (task 1): 12/40 non-brain-damaged controls showed problems with initiation and incorrect execution, but performed correctly according to the tester's model. An analysis revealed that specifically the two items ‘Spread the lips’ and ‘Cough’ accounted for the low specifity of the task. The IWA was in 5/7 items unable to perform. He also showed ‘visual mouth searching behaviour’ (groping).

Voluntary articulation (tasks 2 to 5): 39/40 non-brain-damaged controls exhibited no characteristics associated with AoS. 1/40 (woman; 87-year-old) demonstrated initiation

problems as well as inconsistent distortions. The IWA demonstrated characteristics for AoS in three all categories (initiation problems, inconsistent distortions and dysprosody).

Discussion

This pilot study has produced encouraging results which support the hypothesis that participants without brain damage will be able to perform the six tasks without demonstrating characteristics indicative of OFA or AoS, provided that adaptations are made in accordance with the recommendations arising from the pilot study. The 'spreading the lips' and 'coughing' items will be excluded and the manual will be expanded to provide clearer guidelines.

In addition, the results of the IWA produced a remarkable, unexpected result. Although the participant had been selected as a case of aphasia without AoS, the results indicated a strong possibility of AoS and the SLT was therefore advised to administer the DIAS. This finding reinforces the notion that the diagnosis of AoS is a significant challenge in clinical practice, even for experienced SLTs, and highlights the potential value of the SIAS in this regard.

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Script Training in Mixed Reality Aphasia Rehabilitation (The ICMR-MiRAR) Program: The Preliminary Findings

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Topic: Clinical and experimental work on aphasia and related disorders

Introduction

Aphasia hampers the affected people’s ability to engage in day-to-day activities and social participation. There are different approaches to managing people with aphasia; among them, the social approaches intend to augment the individual's functional ability in daily life (Fridriksson & Hillis, 2021). In recent times, there is a growing interest in these approaches (Cherney et al., 2008). Script training is one among these approaches that can enhance the functional communication skills of people with aphasia (PWA) by identifying their relevant contexts in the social settings and training these scenarios with relevant scripts (Youmans, Holland, Muñoz, & Bourgeois, 2005). However, it is challenging to establish such real-life-like settings in the clinical setups. As a solution, the newly developed program Mixed Reality in Aphasia Rehabilitation, supported by the Indian Council of Medical Research (the ICMR-MiRAR project: Shenoy, Intiaz, Tiwari, & Krishnan, 2024) can augment functional communication therapy in a simulated environment.

Aim

This presentation report showcases the preliminary findings from an ongoing study on the effect of the ICMR-MiRAR program and traditional script training on two groups of people with aphasia.

Method

P**articipants**

Four participants with aphasia in Group 1 underwent the script training through the ICMR-MiRAR program (Shenoy et al., 2024). In Group 2, an equal number with aphasia underwent script training in a traditional manner (face-to-face manner).

Materials

- The ICMR-MiRAR implements script training in a simulated environment deployed in Microsoft HoloLens. The ICMR-MiRAR program (Shenoy et al., 2024) is developed with

20 social scenarios, such as restaurants, banks, etc., to target functional communication for PWA. Participants in Group 1 underwent the ICMR-MiRAR training.
- For the participant in Group 2, the same scripts in the ICMR-MiRAR were provided in the traditional manner. The scripts were printed on an A4 sheet with a font size of 14.

Procedure

Pre-intervention

Both groups underwent five acclimatisation sessions individually (1/day, for five consecutive days) through traditional script training and the ICMR-MiRAR program (Shenoy et al., 2024) before the commencement of training. Subsequently, we provided a list of 20 scenarios and required them to select the two most personally relevant ones. One served as the training scenario and the other as a control scenario.

Training

Following the acclimatisation stage, the participants in each group underwent 20 sessions of training, spanning across four weeks (5 sessions/week) using the preferred scenario.

Baseline/post-assessment

The assessment was carried out in both scenarios (training and control) using a mixed reality environment (MRE) and the traditional (face-to-face) methods (FTF). We specifically counted the script-related words in both groups of participants.

Results

The results of the comparison using the Mann-Whitney U test revealed a significant difference between the Groups (the ICMR-MiRAR vs. Traditional F2F) ($z = 352$, $p = 0.032$), the time of evaluation (i.e., pre- vs. post-intervention) ($z = 240$, $p < 0.001$), and the scenarios (trained vs. control) ($z = 266$, $p < 0.001$). However, the assessment modality (Traditional vs. the ICMR-MiRAR environments) did not reveal a significant difference ($z = 465$, $p = 0.532$) between groups.

Discussion

This study presents the preliminary outcomes from an ongoing, novel technology-based approach using script training in a simulated environment. The participants who underwent the ICMR-MiRAR training program (Shenoy et al., 2024) showed better outcomes than the Group that underwent the traditional script training. Our preliminary findings indicate the benefits of the social communication approaches to aphasia using script training in general and incorporating the novel technology-based intervention approaches like the ICMR-MiRAR (Shenoy et al., 2024) in specific, to the rehabilitation of people with aphasia.

Interestingly, the absence of a difference between the two groups of participants who underwent the baseline and post-intervention measures under the MiRAR and Traditional environments indicates that the outcome measurement context did not influence the intervention.

Acknowledgments

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Self-initiated self-repairs in naming familiar and newly learned objects by subacutely aphasic speakers

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Structured abstract only

Max 1000 words for the abstract, max 200 words for references

Introduction and aims

Problems in naming and word-finding are present in virtually all people with aphasia (PWA). PWA produce different types of naming errors and omissions and can be aware of their errors to different degrees. Consequently, their abilities to actively implement repair behavior to make themselves better understood may differ largely. The present study aimed at measuring self-initiated self-repairs during the completion of a traditional naming test as well as during an extremely demanding task of naming newly learned unfamiliar object pictures with pseudoword names.

Methods

Materials
We annotated and analyzed audio files of assessment sessions including the Finnish version of the Boston Naming Test (BNT; Laine et al., 1997), and an object naming task used for measuring novel word learning (see Tuomiranta et al., 2025 for details on the learning experiment). We searched for naming errors, self-initiations of repairs and successful repairs and analyzed how problematic naming attempts and errors were solved by the speakers by counting the number of produced self-repair segments, different self-repair elements used, and errors left unrepaired. In the present study, successful self-repairs were defined as repairs that improved production closer to the target word.

Participants
Four participants (1 male) were chosen in the study. They all had suffered a left hemisphere stroke max. 3 months prior to the study. Their ages varied between 53 and 77 years. At the time of the assessment, they had different grades of aphasia symptoms, and all were able to name orally at least to some extent. We used as criteria for participant selection the widest possible variation and regular intervals of variation of the Aphasia Quotient, AQ (Finnish version of the Western Aphasia Battery, WAB; Pietilä et al., 2005) and naming (BNT). AQ varied between 43.9 (severe Wernicke’s aphasia) and 95.8 (mild anomic aphasia). The BNT

scores varied between 6 and 52 raw points out of 60.

Results

All PWA produced naming errors and omissions, and they all also initiated self-repairs of naming errors. The frequency of repair-attempts in relation to number of produced errors varied systematically between participants: the two PWA with milder symptoms (AQs 95.8 and 73.6) initiated repairs after all errors in the BNT. In contrast, the two PWA with more severe aphasia (AQs 60.3 and 43.9) only attempted repair in 83% and 47% of cases. Interestingly, the participant with the lowest AQ only initiated self-repairs in the BNT but never in the novel object naming task. The remaining three participants with higher AQ initiated some self-repairs during the novel object naming task (self-initiations after 56%, 50%, and 25% of errors).

Overall, all participants were able to repair their naming attempts closer to the target in at least one of the two naming tasks (see Fig. 1). Interestingly, for one participant (with moderate Wernicke’s aphasia) the proportion of successful self-repairs was higher in the novel object naming task than in the BNT. The participant with the highest AQ was the only one to produce entirely accurate repairs. The most frequently used self-repair element types varied between participants and naming task. Overall, the most common self-repair element was cut-off. The other common self-repair types were reformulation and repetition. Previous research supports these self-repair types as the most frequent in Finnish speaking PWA (Laakso, 1997; Laakso & Lehtola, 2003).

Discussion

All participants made self-repair attempts in naming familiar items of the BNT. Based on this, it can be concluded that despite aphasia severity, the participants' ability to monitor their own speech remained at least partially intact in subacute aphasia. Previous research supports this conclusion (Lee et al., 2000). Examining self-repair behavior can offer insights into the preservation of monitoring skills and therefore provide valuable information for planning effective aphasia rehabilitation.

In the present study, the severity of aphasia seemed to be associated with the preservation of speech monitoring ability when examining the proportion of unrepaired errors. Although due to the small number of participants (N = 4), the generalizability of the results is weak.

The lower proportion of attempted self-repairs in the novel object naming task than in the BNT may imply higher task demands of naming novel items: the participant may only have had vague memory traces of the pseudowords used as novel object names and therefore difficulty deciding if the production is incorrect and therefore repair is needed. Further research could provide a more thorough look at the changes in self-repairs in different stages of aphasia recovery and therefore offer valuable insights about the recovery of self-

monitoring functions.

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Semispontaneous speech of Kalaallisut (West Greenlandic) speakers with non-fluent aphasia

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Introduction

Kalaallisut (West Greenlandic) is an Inuit-Yupik-Unangan language spoken by approx. 60,000 people residing primarily in Greenland and Denmark. Kalaallisut has several features that are interesting from an aphasiological point of view – first and foremost its unusually rich derivational and inflectional morphology – since they have potential to inform theories on agrammatic aphasia. If there is a specific grammar-related deficit in agrammatic aphasia, one immediate hypothesis could be that a language with, for example, a rich inflectional paradigm like Kalaallisut's would be strongly impacted.

In the first study of agrammatic aphasia in any polysynthetic language, Nedergaard et al. (2020) found that the semispontaneous speech of individuals with aphasia (IWAs) in Kalaallisut was characterised by slow, short, and effortful utterances, but not by reduced length or complexity of words. Instead, linguistic aberrations appeared to be expressed through simplified syntactic constructions (lower proportions of subordinate and transitive clauses, etc.) However, Nedergaard et al. (2020) had several limitations: First, the recruitment of participants was based on non-expert clinical assessment. Second, the low sample size (5 IWAs) limited the robustness of the statistical inferences. For the present study, we analysed the semispontaneous speech of 12 Kalaallisut-speaking IWAs who had undergone thorough clinical assessment and 7 matched control participants.

Methods

Participants

The 12 IWAs (8 female and 4 male; median age = 62; age range = 45-71) and 7 control participants (4 female and 3 male; median age = 74; age range = 52-89) were selected from a larger sample of Kalaallisut speakers. The 12 IWAs had mild or moderate non-fluent aphasia, determined on the basis of the assessment of a trained speech and language pathologist, quantitative analyses of performance on a range of language measures, and neurological lesion data (see Nedergaard et al., 2025, for details on the procedure).

Materials

Semispontaneous speech was elicited using an updated, colourised version of the Cookie Theft Picture, the Broken Window, and the question 'What was it like for you during the COVID-19 pandemic?'

Data analysis

All speech samples were collected in Greenland and Denmark in 2023 in collaboration with test assistants who were native speakers of Kalaallisut. Transcriptions, translations, and morphosyntactic analyses were recorded and crosschecked by two of the authors independently.

Results

Production parameters

IWAs produced utterances that were both shorter (IWAs = 5.43 $MLU_{morphemes}$; control group = 10.23 $MLU_{morphemes}$) and slower (IWAs = 1.99 morphemes/sec; control group = 2.55 morphemes/sec) than those produced by control participants. IWAs also produced fewer morphemes per word although this difference, while statistically significant, was much less pronounced (aphasia group = 2.08 $MLW_{morphemes}$; control group = 2.21 $MLW_{morphemes}$). In addition, IWAs produced more dysfluencies (repetitions, unclear words, self-corrections, and unfinished words) than control participants. See Figure 1.

[INSERT FIGURE 1 HERE]

Derivational morphology

Affixes that appear between the noun or verb root and inflectional ending in Kalaallisut fall into four broad classes: **nominal modifiers** (e.g., ‘large’, ‘small’), **verbal modifiers** (e.g., ‘habitually’, ‘can’), **verbalisers** (e.g., ‘becomes’, ‘makes’), and **nominalisers** (e.g., ‘place of V-ing’, ‘companion in V-ing’). In the present study, the control group participants were only more likely to produce nominal modifiers (on average 2.6% of all morphemes versus 1.5% for the IWAs). There were no significant differences for the remaining three classes, and the lexical diversity (Moving Average Type Token Ratio; Covington & McFall, 2010) of the affixes produced was also similar for the two groups.

Inflectional morphology

Verbs in Kalaallisut are inflected for eight moods (four superordinate and four subordinate) as well as person and number of both subject and object (if present). IWAs produced a higher proportion of indicative mood verbs than control participants. The control participants also produced more diverse inflectional endings than IWAs did overall. Nouns in Kalaallisut are inflected for eight cases as well as for person and number of both possessor and possessum (if present). The two groups produced similar proportions of all cases and similarly diverse noun inflections.

Syntax

In line with results from Nedergaard et al. (2020), IWAs in the present study were also less likely to produce subordinate verbs. In addition, they were less likely to produce utterances that included at least one verb with superordinate mood inflection. However, in contrast to previous findings, IWAs in the present study were not less likely to produce transitive verbs or verbs that included affixes that are valence-increasing (e.g., causative, applicative) or valence-decreasing (e.g., passive, antipassive).

Discussion

Non-fluent aphasia and potentially agrammatism in Kalaallisut appear to be characterised by a reduction in syntactic complexity as well as a reduction in the lexical diversity of verb inflections. However, derivational morphology appears to be relatively spared with the exception of nominal modifiers which are, along with verbal modifiers, arguably dispensable. Our findings have several potential theoretical implications. In a language like Kalaallisut, it is for example far from straightforward to draw the dividing line between grammar and lexicon. The derivational affixes, for example, are bound and cannot appear on their own, but many of them have meanings that would be expressed as independent words in languages like English (e.g., 'want to', 'eat'). The present finding that the production of derivational morphology is relatively spared in non-fluent Kalaallisut speakers supports the idea that the derivational affixes (or at least the majority of them) belong to the lexicon and not the grammar (Boye et al., 2023). In contrast, IWAs produced inflectional verb morphology that was less diverse than that produced by control participants which could be a trade-off strategy for adapting to the increased cognitive load of producing grammatical items (Fedorenko et al., 2023). It is worth noting that our focus on semispontaneous speech limits the conclusions we can draw about grammatical abilities as many avoidance strategies are available. Future studies should employ more targeted elicitation to directly assess the limits of the grammatical abilities of Kalaallisut speakers with non-fluent aphasia.

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Setting a Research Agenda for the Assessment and Treatment of Aphasia in Minority Languages

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Introduction and aims

Global advancements in aphasia research and clinical practice have resulted in wider awareness and a growing number of assessment tools for people with aphasia (PWA). However, significant disparities remain. Many of these tools are available for major Indo-

European languages (primarily in English), yet there are comparatively fewer options in non-Indo-European languages. This uneven distribution underscores the imminent need for more inclusive approaches in both research and clinical settings.

Multilingualism and the multicultural nature of contemporary societies remain underexplored in aphasia research. These contexts present unique linguistic and socio-cultural complexities that must be considered in the assessment and rehabilitation of PWA (e.g., Centeno et al., 2020; Norvik et al., 2022; Pourquié & Munarriz-Ibarrola, 2025; Scimeca et al., 2022), as has been recently highlighted in a special issue led by members of Working Group 2 (WG2): Aphasia Assessment and Outcomes, under the Collaboration of Aphasia Trialists (CATs; Arslan & Peñaloza, 2025).

Following the group's recent publication and subsequent discussions, there is a clear need to prioritise minority languages in aphasia research and clinical practice. As a result, WG2 initiated a systematic effort to identify the critical topics requiring attention in the near future within the realm of assessment and treatment of aphasia in minority language contexts. Those themes were compiled and refined by an expert panel of aphasia researchers within CATs WG2, focusing on multilingualism and/or understudied languages, including Basque, Catalan, Chinese, Croatian, Galician, Sami and other indigenous languages.

Methods

A brief internal survey was sent to a total of 73 WG2 members between June and mid-July 2024 to identify the key research themes and objectives. The members were asked the following open-ended questions: "What should be on future research agenda on aphasia in minority languages?" and "What needs to be researched in the future? Kindly share your brief suggestions and comments below."

The answers were transferred verbatim to an Excel spreadsheet and three members independently coded the data by assigning general thematic labels to each response. They worked separately and remained blind to each other's classification systems. Subsequently, the coders convened in an online meeting to review the identified themes. Through collaborative discussion, they agreed on the final theme labels and resolved any disagreements unanimously.

Results

The collected responses were classified into seven main themes: *Basic definitions; Norms; Assessment tools; Research; Speech-language pathologists (SLP) Training; Treatment; Societal Impact.*

Basic definitions referred to the need to clearly define key concepts, such as minority and heritage languages, multilingualism in minority language contexts, language policies, cross-

language interactions, and language distance.

Norms highlighted the lack of available psycholinguistic norms for these minority languages. Respondents noted the predominance of English-centric assessments and related publications, and the difficulty in setting normative data and standards of proficiency based on minority speakers without communication disorders, who are generally bilingual and who do not always share a unified or standard language variety.

Assessment tools addressed the need to revise existing (dominant) assessment procedures, adapt and develop tests for understudied language communities, define best practices for validating and/or adapting existing protocols, design aphasia-friendly language history questionnaires, catalogue existing tools across languages, document the unique challenges of tool development for minority languages, and study ethical considerations in transnational collaborations, e.g., in test adaptations and developments, data sharing, and financial and other logistical concerns and related topics.

Research underscored the importance of investigating how different factors, such as socio-economic status, literacy, and educational level, influence aphasia prevalence, recovery and access to care in minority language groups. Further topics included promoting evidence-based practices, and providing and collecting demographic statistics on PWA users of minority languages and available SLPs from different countries.

SLP Training focused on increasing practitioners' awareness and knowledge of main concepts such as *multilingualism* or *linguistic variation*, enhancing training in adequate assessment practices, and studying the ways to advance the care for PWA.

Regarding ***Treatment***, WG2 members suggested exploring treatment methods currently used with multilingual PWA, studying how attitudes towards minority languages influence goal-setting and treatment adherence, identifying cross-linguistic transfer effects in therapy across L1, L2, and L3, and developing language-specific interventions, including technology-assisted rehabilitation tools.

Finally, under ***Societal impact,*** members mentioned the role of cultural identity in aphasia assessment and rehabilitation, the influence of cultural beliefs on aphasia rehabilitation outcomes, and the broader sociolinguistic histories of minority language communities.

Discussion

The identified themes related to the assessment and treatment of aphasia in minority language contexts reflect critical priorities for advancing equitable research and clinical care for PWA from minoritized linguistic and cultural backgrounds. By addressing these topics, the field can move toward more inclusive practices that ensure fair access to accurate assessment and diagnosis, effective treatment, and culturally responsive care, as envisaged in Goal 3 of the 2030 Agenda for Sustainable Development. These research

priorities and the corresponding recommendations for research and clinical practice will be further discussed during the conference.

Keywords

minority languages; aphasia assessment; aphasia treatment; research topics; research agenda

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Specific and intensive language rehabilitation on post-stroke aphasia using eCALAP: a single-case experimental design

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Introduction and aims

Aphasia, a language impairment occurring in approximately 30% of stroke cases (Flowers et al., 2016) hinders rehabilitation, increases the risk of depression, and reduces reintegration into active life (Burfein et al., 2024). Effective aphasia rehabilitation requires intensive and targeted linguistic tasks (Jacquemot et al., 2012; Bachoud-Lévi et al. 2022), yet clinical and practical challenges limit access to therapy. Digital therapy offers an opportunity to enhance rehabilitation accessibility and efficiency. However, existing digital therapy solutions often lack personalized intervention strategies and robust scientific validation (Vaezipour et al., 2020). This study evaluates the effectiveness of eCALAP-rehabilitation, a digital tool developed from previous findings (Bachoud-Lévi et al. 2022) and designed to provide targeted, personalized linguistic therapy for post-stroke aphasia.

Methods

A single-case experimental design (SCED) with a concurrent multiple baseline design across participants was implemented (Krasny-Pacini & Evans, 2018; Tate & Perdices, 2019). Five right-handed, French-speaking individuals with post-stroke aphasia (four chronic and one subacute) were recruited at Henri Mondor Hospital, Créteil, in July 2024. On the ASRS, aphasia severity varied from mild to severe, with all participants demonstrating sufficient comprehension to engage in the study. The study comprised two phases: baseline (A) and intervention (B). The baseline period (randomized between 4 and 6 sessions) consisted of repeated picture-naming tasks without rehabilitation. The intervention phase consisted of three therapy sessions a week for three weeks (9 sessions total) during which the therapist conducted the rehabilitation program and repeated measures. Additional self-rehabilitation sessions using a tablet with the eCALAP-rehabilitation program were performed. At the beginning of the intervention phase, participants were evaluated using the Core Assessment of Language Processing (CALAP; Jacquemot et al., 2019), a comprehensive battery informed by a psycholinguistic model to identify the most impaired linguistic components in comprehension, production, and repetition. The rehabilitation program was tailored to each participant’s specific deficits and adapted dynamically in difficulty.

Results

Post-intervention, four of five participants showed significant improvement in the picture-naming task, with Tau-U values ranging from 0.66 to 0.72 and p-values < 0.05, confirming the efficacy of the intervention. One participant (P2) showed moderate improvement (NAP = 0.75), possibly due to aphasia severity and prolonged post-stroke duration (26 months). Engagement in self-rehabilitation varied (2-12 sessions per participant), with session duration ranging from 3.38 to 14.49 minutes.

Discussion

The results of this study provide promising evidence for the effectiveness of the eCALAP-rehabilitation program in aphasia therapy. The positive effects observed in the picture naming task, particularly for four out of the five participants, demonstrate the potential of a targeted, personalized digital therapy tool in improving language production for individuals with aphasia. Unlike conventional approaches, which often adopt a one-size-fits-all model, eCALAP selects tasks based on the patient's most impaired linguistic components. The flexibility of the digital platform allows for higher therapy doses without increasing clinician workload and enables stroke survivors to manage fatigue by distributing rehabilitation efforts throughout the day. Additionally, digital tools may enhance patient engagement and self-esteem, promoting autonomy in rehabilitation (Wade et al., 2003).

The study highlights the feasibility and acceptability of digital rehabilitation, as no participants dropped out and all completed self-rehabilitation sessions. Further research could expand the present study. While picture-naming served as the outcome measure, incorporating a broader range of linguistic measures, such as word repetition and sentence comprehension would provide a more comprehensive evaluation. Additionally, future studies could include more refined tracking of variability inself-rehabilitation adherence to better account for individual differences in the efficacy of the intervention. The eCALAP-rehabilitation app presents a promising digital solution for aphasia therapy, demonstrating efficacy in targeted and personalized linguistic rehabilitation. Future research should replicate these findings in a larger cohort, including subacute patients, and expand assessment measures to encompass a broader range of linguistic abilities. With further validation, eCALAP-rehabilitation could offer an accessible, tailored, and cost-efficient approach to aphasia treatment, addressing critical barriers in traditional rehabilitation programs.

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Spoken Picture Naming in Monolingual Speakers with Aphasia: Influence of Phonological Neighbourhood Density and Phonological Neighbourhood Frequency

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Introduction and aims

The evidence for phonological neighbourhood density (PND) effects on accuracy in healthy monolingual spoken picture naming is inconclusive with facilitatory, inhibitory and no PND effects being reported (e.g., Gordon & Kurczek, 2014). The evidence looks equally inconclusive based on the smaller evidence base for monolingual speakers with aphasia. Gordon et al. (2002) found increased picture naming accuracy across 43 participants when the target word was high in PND, while Goldrick et al. (2010) confirmed the same effect in an experimental quantitative single case study. Similarly, Middleton and Schwartz (2010) found an effect of PND on picture naming accuracy in three participants with aphasia. When PND was further controlled for distant neighbours (words with the same onset) and close neighbours (homophones), higher naming accuracy was observed in words with many distant phonological neighbours, but accuracy decreased for words with a close phonological neighbour (see Mirman et al., 2010 using an experimental group design). It is of note that only Gordon et al. (2002) also looked at the addition of phonological neighbourhood frequency (PNF) on accuracy and error rate but found no effects on spoken word access. Laganaro et al. (2013) took their error analyses one step further and looked at the influence of PND on the different rates of error types. The authors found that participants produced more formal errors (phonological real word errors that overlapped in onset or rhyme with the target and shared at least 50% of the target's phonemes) for words with high PND. Interestingly, while formal errors increased, semantic and non-word errors decreased with increasing PND.

The aim of this study was to investigate the influence of phonological neighbourhood density and frequency on spoken picture naming considering accuracy and error types.

Methods

Design and Participants

Ten monolingual speakers with aphasia (five German monolinguals, and five English monolinguals) aged between 49 and 84 years (mean 66.75 years, SD 11.20 years) were included in this study. All ten individuals were between 8 months and 25 years post-onset (mean 155.7 months [13.0 years], SD 111.7 [9.3 years]) and experienced a left hemisphere stroke (except for MwA5, an individual with a left and right hemisphere stroke). See Table 1 for further details.

Experimental task

The experimental spoken picture naming task included 423 images for the German and 440 images for the English item set, with a name agreement of at least 80%. Two naming sessions were scheduled, with a break of at least one day between sessions. Responses were coded for accuracy and error types. Logistic regressions were used to investigate whether PND and PNF affected accuracy in each participant. Separate models were run including either PND or PNF measures. PND and PNF values were obtained from CLEARPOND (Marian et al., 2012).

To investigate patterns at the group level, additional analyses were conducted using Generalised linear mixed effects (GLME) analyses. The analyses were done separately on each error type for German and English data.

Results

The individual analyses showed an accuracy between 17.97% and 82.50% for the German and English participants. Effects of PND and PNF on accuracy were only observed for one participant. MwA5 showed significant PND and PNF effects (PND: odds ratio = 1.28, z = 2.35, p = .019; PNF: odds ratio = 7.42, z = 2.91, p = .004), with picture naming accuracy increasing with higher PND and PNF.

The GLM group analysis were consistent with this pattern of results. For the German data, high PNF increased the odds of a correct response rather than a phonological error (odds ratio = 1.91, z = 3.11, p = .002). No effects of PND/PNF were found on semantic errors, however high PNF increased the likelihood of a correct response versus an omission (odds ratio = 1.48, z = 2.98, p = .003). For the English data, high PND and high PNF both increased the probability of producing a correct response rather than a phonological error (PND: odds ratio = 4.46, z = 2.57, p = .010; PNF: odds ratio = 2.49, z = 3.90, p = .003), but no effects of PND/PNF were found on semantic errors and omissions.

Discussion

For the individual analyses, we only found an effect of PND *and* PNF within one German participant (MwA5), but no effects were detected for the English monolingual speakers with aphasia. Interestingly, a parallel study conducted with ten bilingual speakers with aphasia

(Moormann et al., in prep.) reported that five out of ten bilingual speakers with aphasia showed a within-language neighbourhood effect, while one participant showed an across-language neighbourhood effect. It remains to be further investigated whether a bilingual system may be more sensitive to PND and/ or PNF influences on accuracy.

For the group analyses, PND and PNF played slightly different roles on word production for both languages. While only high PNF caused a higher probability of accurate responses over phonological errors and omissions for German, *both* higher PND and PNF caused a higher rate of correct responses over phonological errors, but no other error types.

While our word production data collected across group is too small to reliably detect any other reliable influences on error types, the present study can serve as a roadmap for future research regarding the methods and analysis of PND and PNF effects on accuracy and error type data from monolingual and bilingual people with aphasia.

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Subtyping reading, lexical retrieval, and syntactic impairments in Primary Progressive Aphasia

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Structured abstract only

Introduction and Aims

Primary Progressive Aphasia (PPA) is heterogeneous in terms of its underlying neuropathology, yet it is commonly classified into three major variants: non-fluent, semantic, and logopenic (Gorno-Tempini et al., 2011). This paradigm is in stark contrast to research on aphasia caused by cerebrovascular and other brain diseases, where a broad range of impairments is attested and recognized in each language domain.

The present study aims to identify the full range of language impairments in PPA, in reading, lexical retrieval, and syntax. To this end, we employ linguistically informed tests that are sensitive to different subtypes of impairment within each domain. Sensitivity is achieved through careful stimulus design and detailed error analysis, allowing us to uncover the specific linguistic operations affected in each patient, rather than categorizing performance by overall accuracy.

Importantly, we do not classify participants into syndromes. Instead, we describe their profiles in terms of discrete deficits in specific language components. This approach enables us to model the impairments within cognitive neuropsychological frameworks of language. While our theoretical goals are not language-specific, this is, to our knowledge, the first study to systematically examine PPA in Hebrew-speaking individuals, contributing novel data.

Methods

We tested 40 Hebrew-speaking individuals diagnosed with PPA using tasks assessing reading, lexical retrieval, and syntax. All tasks had been previously used to evaluate language in individuals with post-stroke aphasia and developmental language disorders. Each response was coded by error type, and participants' performance was compared to norms for each stimulus type and error type. We describe each participant'simpairment profile in terms of specific language operations and map these impairments onto a cognitive neuropsychological model (Figure 1) by identifying the components that are selectively affected.

For **reading**, participants were screened using a Hebrew dyslexia screening test sensitive to multiple types of dyslexia (Friedmann & Gvion, 2003), which includes oral reading of 136 single Hebrew words, 40 nonwords, and 60 word pairs. One bilingual English-speaking participant was tested with an equivalent English task. Participants who screened positive for dyslexia completed additional tasks to characterize the dyslexia type(s). These included a list of 292 surface dyslexia-sensitive words, 160 morphologically complex words, 32 migratable word pairs (Friedmann & Toledano, 2017), and a 36-item written word association task.

Lexical retrieval was assessed with a picture-naming task, consisting of 100 color images of Hebrew words varying in morphological and phonological complexity, frequency, and conceptual category. To assess object knowledge, we used a 37-item picture association task. For single-word comprehension, we used a 20-item word-picture matching task. Phonological working memory was assessed using a nonword repetition task.

Syntactic abilities were evaluated through production, comprehension, and repetition tasks, focusing on constructions involving syntactic movement. For production, we used relative clause production task consisting of 24 sentences, 10 designed to elicit subject relatives and 14 designed to elicit object relatives. For comprehension, we used a paraphrasing task consisting of 24 sentences with sentence-embedded and final branching subject and object relative clauses. Participants who were not able to perform the paraphrasing task due to reading or production difficulties were tested with a sentence-picture matching task with similar syntactic constructions. For repetition, we used a 48 items sentence repetition task including simple sentences, embedded sentences, questions, topicalizations, relative clauses, and verb-movement.

Results

We identified 15 distinct dyslexia types, five distinct profiles of lexical retrieval impairment, and two primary syntactic impairment types. Co-occurrence patterns varied across individuals, with double dissociations observed even in features central to each traditional PPA variant.

In reading, 33 participants (83%) exhibited one or more types of dyslexia. The identified types included surface dyslexia (N=23), attentional dyslexia (N=11), phonological working memory dyslexia (N=6), orthographic buffer dyslexia (N=5), phonological dyslexia (N=3), vowel dyslexia (N=3), letter-position dyslexia (N=2), visual dyslexia (N=2), voicing dyslexia (N=1), morphological-conversion dyslexia (N=1), and deep dyslexia (N=1). We found a double dissociation between surface dyslexia and semantic impairment, suggesting that surface dyslexia does not stem from degraded semantic representations.

In lexical retrieval, 30 participants (75%) had one or more deficits in the retrieval or

access process. Specifically, 5 showed impairment in the conceptual system, 13 in the semantic lexicon, 18 in the phonological output lexicon or in access to it from the semantic lexicon, and 19 in the phonological output buffer.

In syntax, 34 participants (85%) exhibited syntactic impairment. Of these, 14 had difficulties with both subject and object movement in production, similar to the profile observed in post-stroke aphasia. The other 20 had a deficit only in object movement across modalities, akin to what is usually observed in developmental syntactic impairments (see Friedmann et al., 2006 for a discussion on the difference between the impairments).

Discussion

Capturing the diversity of language impairments in PPA requires a componential, theory-driven framework. Rather than grouping patients into broad categories, we identify specific impairments in the linguistic architecture. Our findings support modular models of language, in which reading, lexical retrieval, and syntax each rely on interconnected modular cognitive components.

Importantly, the classification we propose is not merely descriptive. It is grounded in cognitive theories of language processing and representation, and as such, it offers explanatory power: impairments are interpreted as breakdowns in specific components of the language system, rather than as symptoms of a broader syndrome. Characterizing each patient's profile within a cognitive model also allows us to use data from PPA to address theoretical questions about cognitive architecture. For example, the double dissociation between semantic impairment and surface dyslexia supports models in which the lexical route directly connects orthographic representations with their phonological form, without the need to access semantic representation to read aloud, including when reading irregular words (Blazely et al., 2005).

By using linguistically precise tools and detailed cognitive models, we show that PPA affects a broader and more nuanced range of language functions than previously recognized. This approach not only provides a more accurate theoretical model of language in PPA, but also has clinical implications for assessment and intervention.

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Targeting cognates during anomia treatment for bilinguals with aphasia: Preliminary evidence from two cases

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Introduction and aims

Bilingual persons with aphasia (BWA) often present with deficits in both languages including word retrieval difficulties. Previous research with neurotypical bilinguals has shown a facilitation effect for cognates (i.e., words that share meaning and form across languages), reflected in faster and more accurate naming relative to non-cognates (i.e., words that only share meaning but not form) (Costa et al., 2000). Importantly, this “cognate advantage” has also been demonstrated in picture naming in BWA (Marte et al., 2023) underscoring its potential to promote direct benefits in the treated language during rehabilitation. Moreover, anomia therapy could capitalize on the similarities between word forms across the languages spoken by BWA, to promote cross-language generalization to the untreated language. However, only little research has examined the effects of anomia treatment on cognates in BWA providing mixed evidence (Kohnert 2004; Kurland & Falcon, 2011). This suggests that cognate effects in therapy may depend on a range of factors including individual premorbid language proficiency and language impairment (Peñaloza & Kiran, 2019). This study reports on two Spanish-Catalan BWA with different bilingualism/impairment profiles who received a semantic-based intervention for word retrieval deficits. We aimed to examine (i) the overall direct effects of the intervention on the treated language (Spanish) and the cross-language generalization effects on the untreated language (Catalan) and to assess (ii) the specific effects of the intervention on cognates relative to non-cognates in both the treated and untreated languages.

Methods

Two Spanish-Catalan bilingual speakers with chronic aphasia were recruited in Barcelona, Spain. P1 (female, 67 years old, 9 years of education, 39 months post-stroke onset) showed an unbalanced Spanish-dominant profile of bilingualism prior to stroke. She presented severe non-fluent aphasia after a left-hemisphere stroke in the frontal lobe and the basal ganglia. P2 (female, 65 years old, 8 years of education, 17 months post-brain injury onset) showed a relatively balanced Spanish-Catalan bilingual profile prior to her brain injury. She presented mild fluent aphasia due to a left-hemisphere lesion involving temporal and parieto-occipital regions following a brain aneurism surgery.

P1 and P2 completed assessments to characterize their bilingual language history, aphasia profile and severity, and language processing abilities in Spanish and Catalan. The study followed a single-subject multiple-baseline design. P1 and P2 were administered an extensive bilingual picture naming task (> 200 coloured item photographs) to identify words that they failed to name consistently across languages (item naming accuracy ≤33% across three baseline naming probes, BLNP). Of these, 28 items were selected to design 4 word sets: 14 *treated items* and 14 *control items* (7 cognates and 7 non-cognates in each set) to measure direct treatment effects on the treated language and their corresponding 14 *untreated translations* and 14 *control translations* (7 cognates and 7 non-cognates in each set) to measure cross-language generalization to the untreated language. Cognate status was defined according to the Levenshtein Normalized Distance (NLD) between translation pairs (cognates = NLD ≥ 5; non-cognates = NLD < 5). Cognates versus non-cognates across sets were comparable in their word frequency and length. Computerized semantic anomia treatment was conducted in Spanish using PsychoPy (version 2024.2.4). Treatment (ongoing) is provided over 12 sessions (2 hours per session, 3 sessions per week, for 4 weeks). Six treatment naming probes (TNP) are administered every other session (in each language separately), including all 28 items (treated and control items) and their translations. Three additional post-treatment probes (PTNP) including all items will be administered after treatment.

Results

Thus far, P1 and P2 have equally completed 6 treatment sessions including 3 treatment naming probes prior to treatment session 6 (Table 1). Preliminary findings from P1 show superior naming performance for treated items (TNP3 accuracy = 21.42%) versus control items (TNP3 accuracy = 0%), and a slightly superior performance for treated cognates (TNP3 accuracy = 28.57%) relative to treated non-cognates (TNP3 accuracy = 14.28%). However, P1’s naming performance on TNPs remains within the range of performance observed on her BLNPs. Additionally, P1’s performance in the untreated language does not

show evidence for cross-language generalization (accuracy across BLNPs and TNPs = 0%).

In contrast, preliminary results for P2 already show substantial overall treatment gains for treated items (TNP3 accuracy = 92.85%) versus control items (TNP3 accuracy = 7.14%). These results are also supported by a large increase in naming accuracy for treated items relative to baseline (BLNP3 accuracy = 14.28%) and minimal variability for control items relative to baseline (BLNP3 accuracy = 0%). Treatment gains in P2 appear to be similar across cognates (TNP3 accuracy = 85.71%) and non-cognates (TNP3 accuracy = 100%) with slight differences in naming accuracy across word types by just 1 item. Hence, this contrast remains similar to that observed during baseline performance (BLNP3 accuracy = 14.28% for both word types). We also found initial evidence for cross-language generalization for untreated translations (TNP3 accuracy = 28.57%) relative to control translations (TNP3 accuracy = 0%). As for cross-language generalization, results show superior naming performance for untreated cognate translations (TNP3 accuracy = 42.85%) relative to non-cognate translations (14.28%), considering they departed from similar baselines (BLNP3 accuracy = 14.28%).

Discussion

This treatment study is currently ongoing, and therefore, the results reported here are only preliminary. Once treatment is completed, all therapy outcomes for P1 and P2 will be presented and discussed in terms of treatment effects on the treated and untreated languages, both as overall effects and specific effects for cognates versus non-cognates. Notably, the initial findings reported here, provide evidence for differential treatment gains for P1 and P2. Only P2 shows positive treatment gains for treated versus untreated items which for now appear to be similar for treated cognates and non-cognates, and cross-language generalization to the untreated language, with slightly superior gains for cognates relative to non-cognates. If our interim patterns of results hold through the end of treatment, the observed differences in treatment outcomes between P1 and P2 might be explained by patient-specific factors such as aphasia severity and pre-stroke bilingual profile (i.e., milder language impairment and higher pre-stroke proficiency across languages for P2 relative to P1).

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Targeting prepositions in aphasia treatment: an embodied approach

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Introduction and aims

Prepositions pose a challenge to individuals with non-fluent aphasia and foreign language learners alike. Difficulties with prepositions can be a tenacious symptom of chronic Broca's aphasia (e.g., Mätzig et al., 2010, Boieblan, 2022). There is common agreement that the wide variety of potential deficits following a stroke render designing effective therapies for non-fluent aphasia a highly complex matter. Unsurprisingly, current therapy approaches are reported to lack efficacy (Fridriksson, 2020). While developmental language learning is claimed to be embodied, multimodal and active (Mandler, 2012), non-fluent aphasia therapies appear to be neither. The role of embodiment thus seems to be a neglected area in the field of aphasia treatment. This may be based on both a misconception in terms of the nature of the deficit that underlies the loss of prepositional use in Broca's aphasia and of acquiring the use of prepositions in the context of aphasia. Partly this stems from a lack of informative interaction between theoretical research, current aphasia therapies, and research on therapy efficacy. The primary purpose of this paper is to suggest how an interdisciplinary approach that is grounded in embodied theories may enable individuals affected by Broca's aphasia to (re-)grasp the meaning of locative and directional prepositions. This is showcased by an exploratory pilot study conducted by the author (Diesner, 2024).

For various reasons, informative insights from other disciplines carry the potential to inspire approaches in aphasia treatment. Embodied methods have been reported to yield promising results in second language learning (Jusslin et al., 2022). However, definitions of embodiment in this respect may widely vary. For example, in applied linguistics, a bimodal approach to acquiring use of prepositions has produced encouraging outcomes despite only engaging auditory and visual modalities (Boieblan, 2022). To suggest how a multimodal embodied approach may be beneficial to persons with non-fluent aphasia, this paper has three main objectives:

1. to explore ways of synthesising theories in different disciplines and fields to suggest a practical therapy approach for persons with Broca's aphasia,
2. to demonstrate how this may be applied by reporting compelling findings of a pilot study that focuses on the preposition *in*, and finally,
3. to outline a number of potential factors that may in part explain the underlying mechanisms.

Methods and theoretical background

Due to the scope and the theoretical nature of this paper, the methodology mainly comprised an analytical literature review that was conducted with a flexible survey methodology. The interdisciplinary literature review focused on notions related to acquiring use of prepositions, in particular the preposition and particle *in* in the context of both aphasia and second language learning. Due to its impact on learning speed and capacity, embodied exploration of spatial relations is considered crucial to acquiring the use of prepositions (e.g., Mandler, 2012, Jusslin et al., 2022). The linguistic framework of the clinical pilot study is based on *image schema theory* (e.g., Johnson, 1987). Image schemas, understood as recurrent embodied patterns that are ubiquitous and emerge from interactions in everyday life, are considered the basis of *concepts* in developmental language learning (e.g., Mandler, 2012). In image schema theory, the locative preposition *in* expresses a variety of spatial relations loosely defined in terms of *containment*. In contrast, the notion of *support*, for instance, is expressed by the preposition *on*. Importantly, image schema theory is congruent with related embodied and grounded cognition theories such as *perceptual meaning analysis* in developmental research (Mandler, 2012) and the *inside-out framework* in systems neuroscience (Buzsáki, 2019) but also with dynamical systems theory in cognitive science. To shed new light on relevant mechanisms, the *embodied concept* approach taken in the pilot study, along with observations and findings, is also considered from a systems neuroscience perspective (Buzsáki, 2019).

Pilot study

The exploratory case study conducted focuses on a 59-year-old person with chronic Broca's aphasia 20 years after onset of cerebrovascular disease (Diesner, 2024). Despite long-term treatment, use of prepositions was severely impaired. Four units of language competence assessment were administered at different stages, up to five weeks after training completion. Initial assessment was followed by a total of 16 hours of training that targeted locative and directional prepositions expressing senses of the containment schema (*in*) and involved embodied elements. The training method followed a protocol yet remained flexible to adapt to the participant's requirements.

Results

The performance of the pilot study's participant improved in most tasks of the key assessment areas, i.e. testing spatial relations in the form of locative prepositions. The results corroborate findings of previous research that emphasises the role of embodied exploration for the acquisition of language (e.g., Mandler, 2012, Jusslin et al., 2022). Moreover, the promising results not only indicate a transfer effect but also sustained effects (see Diesner, 2024).

Discussion

There is considerable theoretical support from neuroscience for the embodied approach taken in the pilot study. Observations in the pilot study indicate that the underlying

impairment is semantic, i.e. meaning-based, in nature. The prepositional neglect observed is characterised by either omission or intra-category substitution rather than inter-category errors (also see Mätzig et al., 2010). This stands in opposition to the traditional view of prepositional 'agrammatism' in Broca's aphasia as a syntactic issue. This suggests that the body's role in language competence may have been neglected in current approaches. Thus, observations of its importance in acquiring the use of prepositions justifies reconsidering both current diagnostics and therapy approaches to acute and chronic Broca's aphasia. Because of the limited sample size, however, not many claims can be made. This interdisciplinary research agenda aims at laying the groundwork and providing concrete recommendations for future research on Broca's aphasia, concerning both spatial prepositions and verb-particle constructions such as phrasal verbs.

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tDCS effects on treated and untreated language of bilingual speakers with aphasia

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Introduction and aims

Numerous behavioral therapies have been suggested to reduce naming difficulties in persons with chronic aphasia; however, their effectiveness is somewhat limited. To improve the outcomes, researchers have been applying neuromodulation techniques (e.g., transcranial direct current stimulation, tDCS) as an adjunct to anomia therapy. While previous research has been conducted almost exclusively in monolinguals, the current study focused on bilingual speakers with aphasia. The following outcomes of tDCS combined with anomia therapy were assessed: (1) naming of trained items, (2) generalization to naming of untrained items, (3) generalization to connected speech production, and (4) maintenance of therapy effects on naming trained and untrained items two months post-therapy. These therapy outcomes were examined in the treated language as well as the untreated language to test for cross-language transfer of therapy benefits.

Methods

Nine participants (four women) were enrolled in the study. They were aged 68 years on average (range: 46 to 84 years) and have had chronic aphasia for at least 6 months (range: 9 to 42 months) resulting from a single vascular stroke in the left hemisphere. Participants were Russian native speakers who learned Hebrew as a second language later in life (age range: 23 to 53 years) and used the language in everyday life prior to the stroke.

Anomia therapy was delivered in Hebrew and aimed to strengthen the semantic network of the trained words. Both trained and untrained words were chosen individually, based on performance on a screening test, such that participants were unable to name the to-be-chosen words in neither Hebrew nor Russian but were able to recognize them in each language. Each word in the training set was paired with a word in the generalization set based on semantic relatedness (e.g., *cat-dog*).

Ten 1-hour therapy sessions were divided equally between two blocks, each lasting two weeks. In one of the blocks, active stimulation was delivered (20 min, 2 mA), and the other served as a control condition (sham stimulation). The anode electrode was placed over F3 (the left dorsolateral prefrontal cortex, DLPFC) according to the 10–20 international system

for EEG electrode placement and the cathode electrode – over the right supraorbital area. Left DLPFC was targeted because it supports both word retrieval (Pestalozzi et al., 2018) and discourse production (Coelho et al., 2012) as well as cognitive control, which has been previously shown to promote generalization and maintenance of naming therapy benefits (Simic et al., 2020).

Before and after each block, naming accuracy of trained and untrained items as well as connected speech (elicited by a picture sequence) in Hebrew (the treated language) and Russian (the untreated language) were assessed.

Results

Change scores were calculated as the difference between post- and pre-therapy scores. Mean difference between the change scores of the two blocks was tested, separately for each dependent variable, using one-tailed paired-samples *t*-test. Naming of the trained items in **Hebrew**, the treated language, improved comparably following the active and the sham block (48% and 39%, respectively). In contrast, naming of untrained items improved more following active compared to sham stimulation (11% and -2% change, respectively). Positive effect of active over sham tDCS was maintained two months post therapy for naming the treated items (p = .025) and the untreated items (marginally significant result, p = .059). Finally, there was a significantly greater improvement in productivity measures of connected speech (as indexed by the number of words per minute and the number of different words per minute) following active compared to sham stimulation, while the remaining connected speech measures (i.e., dysfluencies, retrieval difficulties, and content informativeness) showed no difference between the blocks.

Naming of translation equivalents in **Russian**, the untreated language, was comparable between the blocks for the trained items (12% *vs* 0.5%, respectively) but better following active stimulation for the untrained items (9% vs -5% for active and sham stimulation, respectively). These results were replicated at two-months follow-up: no difference in naming of trained items between active and sham stimulation and greater improvement in naming of untrained items following active compared to sham stimulation (9% vs -12%, respectively). None of the connected speech measures provided evidence of a tDCS effect.

Discussion

The present study suggests anodal tDCS over the left DLPFC combined with anomia therapy can have numerous benefits in bilingual speakers with aphasia. In the treated language, it promotes generalization of therapy effects to retrieval of untrained words and to connected speech as well as long-term maintenance of therapy effects on naming. These findings align with previous reports on monolingual speakers with aphasia. In the untreated language, therapy benefits are limited to immediate and long-term improvement in naming of untrained items. Interestingly, naming accuracy of the untrained items decreased on

average following sham stimulation, suggesting inhibition effects in the untreated native language (Goral et al., 2013). Thus, active tDCS may have improved naming of items in the generalization set by countering this inhibition effect. These preliminary results highlight the clinical applicability of tDCS in bilingual speakers with aphasia and pave the way to developing diagnostic and therapy protocols specifically designed for this population.

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Temporal speech patterns in normal Ageing: Data from Greek

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Introduction and aims

Aging and the accompanying physiologic changes have been associated with a reduction in strength, endurance, speed of movement and flexibility of the vocal tract (Boone, McFarlane, Von Berg & Zraick, 2014). It has been well documented that temporal aspects of speech production can be affected by normal aging (e.g. Jacewicz, Fox, O'Neill & Salmons, 2009). The most consistent finding emerging from these studies is that elderly speakers tend to speak slower compared to young adults, a pattern attributed to various factors including physiological and congitive changes (e.g. Ramig, 1983). The well-documented word-finding issues associated with older age are thought to cause more, or more frequent pauses and affect fluency (e.g. Martins and Andrade, 2011). On the other hand, research on the effects of ageing on perception of temporal speech organisation has been lacking, although age-related cognitive changes can also affect aspects of speech perception (Bilodeau-Mercure, Lortie, Sato et al., 2015).

From a clinical perspective, speaking rate constitutes a powerful, behaviorally modifiable variable for patients with neurogenic communication disorders. Cues to speak slower, employing rigid or more natural rate reduction strategies (e.g. Van Nuffelen et al., 2010), or to adjust speaking rate as part of standardized intervention protocols, such as "clear speech" or "intentional speech" (Behrman et al., 2020) have been successfully designed and implemented for patients with dysarthria. Additionally, approaches with a focus on speech rate and rhythm control have also targeted apraxic patterns that often occur in the presence of Broca's aphasia. Examples of such approaches are rhythm-only variants of melodic intonation therapy (Zumbansen et al., 2014) and metrical pacing therapy (Brendel & Ziegler, 2008). The success of these intervention programs relies on the conscious adjustment of temporal speech characteristics via tasks that require increased cognitive focus, in line with well-established priniciples of motor learning (Maas et al., 2008). Thus, cognitive and physiologic age-related changes on speech production and perception could affect patient performance on such treatment protocols.

The aim of this study is to provide normative data on temporal aspects of speech in the Greek elderly population, in terms of both speech output and input. In terms of production, our goals are to acoustically quantify the effect of ageing on speech tempo across different

speaking tasks, and on the ability to vary speech rate apropriately. In terms of speech perception, we are set to examine how the listener's ability to perceive speaking rate changes is modulated by age. The ability to change your manner of speaking with instruction is generally regarded as a positive prognostic sign in speech intervention, moveover, intact perceptual skill facilitate self-monitoring during treatment.

Methods

Speech production experiment

Two speaker groups, 30 elderly speakers (70-80 years old) and 30 young adults (20-25 years old) carried out three speaking tasks: a spontaneous narrative, a picture description task and sentence reading. The latter task involved reading 20 sentences of varying complexity in three different rate conditions: "habitual", "slow" and "fast", on request. A series of metrics were calculated based on breath group duration, articulation time, pause time and position. Speaker performance was also analyzed on an individual basis, calculating absolute and relative rate change for each individual speaker, which was then compared to the just noticeable difference (JND) for rate of speech (Quené, 2007).

Speech Perception experiment

Two listener groups, 30 young (20-23 years old) and 30 elderly (70-80 years old) naïve listeners carried out a perceptual experiment in which they listened to pairs of segmentally identical sentences produced with either a typical, slow or fast speaking rate and had to identify which sentence was produced slower. Data was randomly selected from the speech production experiment data set. Each listener judged 225 sentence pairs; sentence pairs that involved rate changes lower than 10% (JND) were excluded. Based on the speaking rate metrics, listener judgments were classified as correct or incorrect.

Results

The elderly group spoke significantly slower ($p<0.001$) than young adults, across all tasks and rate conditions. Although the young group could decrease and increase speech rate to a greater extent, older speakers, as a group, were still able to signal changes in speech tempo in a perceptually transparent manner. Speaking rate adjustments involved manipulations of both speaking time and pause time. The preferred pause position in SVO sentences was between the subject and the verb.

In terms of perfomance on the speech perception experiment, acoustic measures tended to correlate with listeners' ability to perceive the direction of speech tempo variation. However, speaking rate measures alone, could not account for all judgment patterns. Correlation trends were stronger for the young listeners. Elderly listeners experienced difficulties identifying shifts in speaking rate.

Discussion

In agreement with available literature, aging appears to have an effect on the speed and flexibility of the vocal tract movement. Possible age-related speech processing changes could be related to the observed difficulties of the elderly listeners to accurately identify acoustically transparent speech tempo variations. These findings have possible implications for the implementation of speaking rate modification protocols for elderly patients with apraxia and aphasia.

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Test–retest reliability of experimental language tasks in post-stroke aphasia: A large sample study with multiple sessions

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Introduction and aims

Knowing that an assessment or treatment task has good test–retest reliability is crucial, as it indicates that the results obtained in a single session reliably reflect a person's ability and remain stable over time. In aphasia, it has gained increasing attention, particularly in the context of standardized assessments of language and cognition (e.g., working memory; DeDe et al., 2014), spoken discourse analysis (e.g., Stark et al., 2023), and eye-tracking studies using the visual-world paradigm (e.g., Mack et al., 2016). However, test–retest reliability data are still lacking for many commonly used experimental language tasks in aphasia, underscoring the need to assess their temporal stability. The aim of this study was to assess test–retest reliability of experimental language tasks designed to measure phonological, lexical, and semantic processing, based on the cognitive neuropsychological approach (Whitworth et al., 2014). Specifically, the tasks targeted auditory phonological analysis, the phonological input lexicon, and the semantic system involved in word processing, using phoneme identification, auditory lexical decision, and auditory animacy decision tasks.

Methods

Participants

Data from 55 adults with post-stroke aphasia (29 women; mean age = 57.95 years, SD =12.25 years; post-onset = 15.54 months, SD = 36.45 months) was included. Inclusion criteria were: aphasia due to stroke (diagnosed using the Western Aphasia Battery [WAB], Hungarian adaptation: Osmánné Sági, 1991), native Hungarian speaker, adequate hearing, physical ability to complete the tasks, and ≥50% accuracy in auditory word comprehension on the WAB. Exclusion criteria included major neurological or psychiatric disorders, moderate-to-severe hearing impairment, and global aphasia.

Procedures and design

Participants were assessed on four approximately consecutive days (session 1–4; mean

interval = 6.25 days) using the same set of three auditory tasks on each day. The experimental tasks assessed phonological, lexical, and semantic processing under low and high WM demand. Participants completed three structurally identical yes/no decision tasks: phoneme identification, lexical decision, and animacy decision. In the low WM condition, participants were asked to indicate whether (1) the heard phoneme string contained the phoneme /b/ or not (phoneme identification), (2) the phoneme string was a real word or a nonword (lexical decision), or (3) the word referred to a living or non-living entity (animacy decision). In the high WM condition, two auditory stimuli were presented, and participants indicated whether only one of them (vs. both or neither) (1) contained the phoneme /b/, (2) was a real word, or (3) referred to a living entity, depending on the task. The tasks were programmed in PsychoPy, and auditorily stimuli were presented as prerecorded audio files. Stimulus presentation lasted ~1 second in the low WM and ~2 seconds in the high WM condition. Participants had up to six seconds to respond, including stimulus presentation time. To assess test–retest reliability, intraclass correlation coefficients (ICCs) were calculated using a two-way random-effects model with absolute agreement, based on single measurements across all combinations of the four time points, for both accuracy (ACC) and reaction times (RTs) in each condition (Koo & Li, 2016).

Results

ACC was highest in the lexical decision task, ranging from 91–96% in the low WM condition and 70–80% in the high WM condition across the four time points. In the animacy decision task, ACC ranged from 86–91% in the low WM condition and 60–70% in the high WM condition. Performance was lowest in the phoneme identification task, with ACC ranging from 68–75% in the low WM condition and 54–60% in the high WM condition.

Except for the low WM condition in lexical decision, ICCs primarily ranged from moderate to excellent across tasks and measures. Phoneme identification demonstrated the highest reliability, particularly for ACC in the low WM condition (ICCs mostly > 0.80), with lower reliability in the high WM condition (ICCs = 0.47–0.82). RTs were consistently reliable, especially at later time points (ICCs = 0.78–0.89). Lexical decision accuracy exhibited poor to moderate reliability, especially in the low WM condition (ICCs = 0.03–0.69), whereas the high WM condition showed moderate to good reliability (ICCs = 0.62–0.72). RTs for lexical decision were also moderately reliable, particularly at later sessions (ICCs = 0.71–0.78, excluding session 1). Animacy decision accuracy and RTs showed fair to good reliability (ICCs = 0.45–0.85), with little difference between WM conditions.

For phoneme identification, confidence intervals (CIs) for ACC were narrow, especially at later time points (e.g., 0.70–0.89), indicating stability. Lexical decision accuracy had wider CIs, often crossing zero, suggesting low reliability for many comparisons. RTs had generally wider CIs than ACC, reflecting greater variability across sessions. Among the 12 cases (3 tasks x 2 conditions x 2 measures), ICCs were highest between session 2 and 3 in five cases,

between session 3 and 4 in four cases, between session 1 and 2 in two cases, and between session 2 and 4 in one case (Table 1). ICCs were higher when excluding session 1 in all but one case.

Discussion

The highest reliability was found for phoneme identification, followed by animacy decision, with lexical decision showing poor to moderate reliability for ACC. ICCs were highest when analyses excluded the first time point, suggesting greater stability at later time points, potentially due to initial adaptation or learning effects. Based on ICC and CI patterns, ACC was more reliable than RTs. Interestingly, task complexity did not appear to affect reliability. While one might expect higher complexity to introduce more measurement error, which typically decreases reliability, this was not observed. The higher complexity conditions did not show decreased reliability, likely because the increased between-subject variance in these conditions positively contributed to reliability (Hedge et al., 2018). Overall, these tasks were generally reliable, except in conditions where near-ceiling performance limited data variance. This highlights a common challenge in reliability studies: when performance is too high, reliability can be artificially inflated, as there is little room for variability. The second time point contributed most to increased reliability, with minimal improvement thereafter, suggesting that initial learning or adaptation effects stabilized over subsequent sessions.

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The CogNeuro App: Introducing a Co-Designed Web-Based App for Neuropsychological Assessment of Impairments of Language

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Introduction and aims

Understanding cognitive neuropsychological models of language underpins clinical assessment and management of language impairments. However, teaching theoretical models and their clinical application, such as the psycholinguistic assessments of language processing in aphasia (PALPA) can be complex and might be perceived as overwhelming by speech pathology students and early career clinicians. Therefore, this project -funded by the Tavistock Trust for Aphasia (Biedermann, Coltheart, Saunders, Hersh, Hill, 2022-2024, CTR-JL-17990)- aimed to develop, co-design and test an interactive language-model app that can simulate isolated and multiple language impairments and give immediate feedback on the accuracy of assessment and diagnosis. The CogNeuroApp is based on the PALPA model as one of the most prominent language processing models (Kay, Lesser, & Coltheart, 1996) for the aphasia context and facilitates the diagnoses of multi-faceted patterns of language impairments. Two functions are of mention: the 'Random Impairment' function provides opportunity to practice systematic assessment; whereas the 'Choose an Impairment' function serves for assumption testing in case the broad area of impairment has already been established. While the first function provides students with an opportunity to practice complex case diagnoses without consequence before they go on their first clinical placement, the second function gives early career clinicians a tool to grow confidence in cognitive neuropsychological assessments and clinical educators a feedback tool for their students. In addition, the CogNeuroApp can also be used to visualize the impairment for the person with aphasia to explain why a certain task needs to be practiced in order to strengthen a specific language component. This presentation will walk the audience through the co-designed process and the resulting main features and functions of the CogNeuroApp.

Methods

We established a reference group including ten members (four final year speech pathology

students, one clinical educator, two clinicians, three clinical researchers), who were involved as partners in co-designing the CogNeuroApp. Reference group members were initially given an overview of an early draft of the App before they attended two subsequent co-design workshops to provide feedback on functionality, feasibility, and user-friendliness (for a co-design approach, see Jennie & Cosier, 1994). Feedback collated from the first co-design workshop was immediately incorporated into the second version of the App. This subsequent version was then taught to 2nd year students (~n=80) in the unit "Acquired Language and Cognitive Communication Disorders" and feedback on the App was given via a free text survey. Six of 2nd year students were interviewed at a later stage when they attended their first adult placement and used the App for their session planning. Surveys and interview data were then used to create the third version of the App which was then presented to the reference group at the second co-design workshop which led to fine-tuning of the final design.

Results

The oral and written feedback of the first and second co-design workshop improved functionality by making language throughout the App more accessible (e.g., simplification of the component definitions and linking to examples), by adding two further tabs (test tab and reference tab), by linking standardized test names to each test description as well as next assessment steps (e.g., spoken picture naming -> PALPA 54 -> next steps), and by giving direct input into the logo design of the CogNeuroApp.
The student (free text) survey responses and the six student semi-structured interviews were analysed following a qualitative thematic analysis (Braun & Clarke, 2022). The thematic analysis revealed three overarching themes 'learning with the app', 'app design' or 'suggestions' that were further subdivided into eight ordinate themes: (i) practical learning; (ii) positive app design, (iii) negative app design, (iv) improving relevance to clinical placements; (v) improvement of design, (vi) improvement of instructions, and (vii) request for different language modes. Especially the highlighted difficulties in app navigation and comprehension of instructions found in the student perspective resulted in the creation of an introductory video tutorial which will be freely available and linked directly to the App (see Figure 1 for view of the home screen).

Discussion

To date, co-design and collaboration from all stakeholder groups were key to the success of this project. The CogNeuroApp offers a technological addition to stimulate education, training and clinical services. The CogNeuroApp is an evidence-based assessment tool for clinical practice that can benefit students, clinicians, and their clients, with potential to transform the teaching and learning of cognitive neuropsychology for aphasia. The CogNeuroApp is freely available as an open access resource via this link (https://cogneuro.app/) and is also listed on the Tavistock Trust for Aphasia affiliated

Aphasia Software Finder website (https://www.aphasiasoftwarefinder.org/links-to-helpful-resources). To date (April 2025), the CogNeuroApp has been accessed over 1,700 times across six countries (Australia, Germany, Great Britain, Poland, Ukraine, United States). As this is a co-designed App, we welcome feedback for improvement at any stage. Our future aim is to incorporate a bi-/multi-lingual aspects tab and adapt the CogNeuroApp into different languages.

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The Dutch Mini-Linguistic State Examination (MLSE-NL): Preliminary Findings in Primary Progressive Aphasia (PPA)

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Introduction and aims

Changes in speech and language occur as the first symptoms of Primary Progressive Aphasia (PPA). The Mini-Linguistic State Examination (MLSE) is a short, intuitive, easy to use speech and language test first developed to detect and diagnose PPA in English speaking patients (Patel et.al., 2021). Speech and language alterations offer the possibility of early and non-invasive detection within the broader spectrum of Frontotemporal Degeneration (FTD) including PPA, however, the use of speech and language markers in FTD is limited by the fact that 75% of studies only investigate English-speaking patients (Coppieters et.al., 2024). We have adapted the MLSE into Dutch and aim to validate this new version.

Methods

We assess the MLSE-NL in 21 Dutch-speaking patients with PPA (non-fluent variant PPA n=7, primary progressive apraxia of speech n=3, logopenic variant PPA n=6, and semantic variant PPA n=5) (mean age: 69, 50% male) and 113 healthy volunteers (mean age: 65, 34% male). The MLSE is composed of sub-scores in different domains (motor speech, phonological structure, semantic knowledge, syntax, working memory) as well as a total overall score. The MLSE subscores and total score were compared between controls and patients, as well as between the PPA variants, using linear models adjusting for age, sex, and education. Post hoc pairwise comparisons of the estimated marginal means were performed, with Bonferroni correction applied to adjust for multiple comparisons within each test (total and subscores).

Results

Preliminary findings in the MLSE-NL show significantly lower scores for all PPA variants for total MLSE score with scores ranging from 33-91/100 (average = 70.1±16.1) in patients and 83-100/100 (average = 97.3±2.9) in controls (<.0001). A cutoff of <91 was calculated,

which allowed discrimination between patients and controls. Subdomain analysis showed that nfvPPA and PPAOS had more motor speech errors than controls ($p < 0.001$), svPPA exhibited more semantic errors ($p < 0.001$), while lvPPA had the most working memory deficits ($p < 0.0001$). Syntax errors were more frequent compared to controls in all PPA variants except PPAOS, while phonological deficits were observed more in lvPPA and nfvPPA compared to controls ($p < 0.001$). Figure 1 shows the scores of participants in the different domains and the total score.

Discussion

The Dutch adaptation of the MLSE shows promise for accurate detection and differentiation of the variants of PPA. Further investigation of the MLSE-NL in larger patient cohorts will further confirm its utility and is currently ongoing.

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The influence of sleep quality on anomia treatment outcomes in post-stroke aphasia

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Structured abstract only

Max 1000 words for the abstract, max 200 words for references

Introduction and aims

Behavioral language treatment is the clinical standard for managing aphasia. These interventions involve structured, repetitive therapy tasks that promote re-learning of language abilities and facilitating access to lexical-semantic representations that are inconsistently available for language use after stroke[1]. Although behavioral treatment can be effective, outcomes vary widely and the mechanisms driving treatment response remain poorly understood[2,3]. Identifying factors that contribute to this variability is essential for improving outcomes. One such factor may be sleep. A large body of research has demonstrated that sleep plays a critical role in memory consolidation and redistribution of newly-learned information across brain networks – processes that are likely central to the learning and generalization that aphasia treatment depends on[4].

Despite these well-established links between sleep and learning, the role of sleep in aphasia recovery remains largely unexplored. 20% to 50% of stroke survivors experience sleep disturbances, which are associated with poorer post-stroke outcomes[5,6]. However, previous studies have focused on physical recovery and stroke severity, typically excluding language-impaired stroke survivors. This project addresses these gaps by investigating the role of sleep in behavioral naming treatment outcomes, guided by the following research question:

How is objectively measured sleep quality associated with changes in naming accuracy for anomia treatment targets across three timepoints: (i) an initial pre-treatment timepoint, (ii) a second pre-treatment timepoint, and (iii) a post-treatment follow-up timepoint?

We hypothesize no significant association between sleep quality and changes in naming accuracy between the two pre-treatment timepoints. However, we expect that better sleep quality will be associated with greater improvements in naming accuracy from pre-

treatment to post-treatment follow-up, consistent with the role of sleep in supporting learning and consolidation of language re-learning in post-stroke aphasia[7].

Methods

This project uses data from an ongoing clinical trial at the Veterans Administration Pittsburgh Healthcare System investigating treatment dosage effects on aphasia naming-treatment outcomes. Participants (target n=7) are native English speakers with chronic aphasia following left-hemisphere stroke. All received clinician-delivered Semantic Feature Analysis (SFA) twice daily (2-hour sessions), five days a week, for three weeks. Each participant completed treatment on three 10-word lists (trained target words), selected based on predicted naming accuracy derived from a 30-item adaptive version of the Philadelphia Naming Test[8].

Sleep was assessed both objectively and subjectively. Participants wore ActiGraph GT9X Link devices continuously for 21 days during treatment, and completed twice-daily sleep diaries to assist with actigraphy processing. An existing pre-processing pipeline[9] was used to extract total sleep time (TST), sleep efficiency (SE), and wake after sleep onset (WASO). Self-reported sleep disturbance was measured before treatment using the Patient Reported Outcomes Measurement Information System (PROMIS) Sleep Disturbance (-SD), where higher T-scores indicate greater sleep disturbance.

To evaluate whether sleep predicts treatment response, we plan to use Bayesian mixed effects logistic regression models with item-level naming accuracy as the outcome variable. Fixed effects will include timepoint (Pre-treatment 1, Pre-treatment 2, Follow-up), a sleep variable (TST, SE, WASO, or PROMIS-SD), and their interaction. Models will include random intercepts for subject and item, and random slopes for timepoint per subject. Separate models will assess the influence of each sleep metric on naming outcomes.

Planned analyses will be completed after data collection for the parent trial concludes in June 2025. To demonstrate feasibility, we present initial descriptive data from two individuals with aphasia who have completed study procedures.

Results

Table 1 displays relevant demographic, stroke, and sleep variables for both Subject 1 and Subject 2. Subject 1 self-reported minimal sleep disturbance (PROMIS-SD T-score = 30.5), while Subject 2 reported elevated disturbance (T-score = 66.2). Consistent with these self-report scores, Subject 1’s average total sleep time met the minimum of 7 hours recommended for adults[10], and his sleep efficiency was almost consistent with what is expected given his age[11]. In contrast, Subject 2 slept on average 5.5 hours per night and presented with notably reduced sleep efficiency, consistent with poor sleep quality.

Regarding anomia treatment outcomes, Subject 1 was able to name 18/30 (60%) of his treatment targets before intervention. Immediately after intervention, his naming accuracy increased to 30/30 (100%). Subject 2 was able to name 1/30 (3%) of his treatment targets before intervention, and his naming accuracy remained unchanged immediately after treatment.

Discussion

Preliminary data from two individuals with chronic aphasia revealed striking differences in both sleep quality and anomia treatment response. Subject 1, who reported minimal sleep disturbance and met recommended thresholds for total sleep time and sleep efficiency, showed substantial gains in naming accuracy following treatment. In contrast, Subject 2, who reported high sleep disturbance and demonstrated reduced sleep quantity and efficiency, showed no observable treatment response

While these initial findings are consistent with the hypothesis that sleep supports treatment-related word-retrieval gains, alternative explanations must be considered. Subject 1 is younger, more educated, and presented with milder aphasia than Subject 2 – factors known to influence treatment outcomes[3,12]. Thus, it is not possible to attribute the observed difference in treatment response between these two individuals to sleep quality. Analyses of the full sample (n=7), to be completed in July 2025, will allow us to better isolate the unique contribution of sleep by modeling these predictors and accounting for individual variability in aphasia severity, demographics, and stroke characteristics.

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The organisation of the lexical-semantic network in older vs young adults on Tip of the Tongue states

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Introduction and aims

Word selection is mediated by the organisation of the lexical-semantic network, i,e, the number of associates (semantic richness) and the prototypicality of the links between the target word and its associates impact on target activation/selection (Krethlow et al., 2020). The organisation of the lexical-semantic system can affect word access, leading to a temporary access difficulty known as the Tip of the Tongue (ToT) phenomenon, which occurs at all ages. Stronger difficulties in accessing words in the lexicon are also found in impaired populations (i.e. primary progressive aphasia or post-stroke aphasia) and may be associated with a deregulation of the organisation of the lexical-semantic network (Nickels et al., 2022). Moreover, the organisation of the lexical-semantic system changes with age leading to an age-specific impact of an age-specific lexical network (Krethlow et al., 2020). However, most studies did not take into account the individual lexical-semantic network of each participant at a precise moment. In our previous study (Couvreu & Laganaro., in preparation) and in order to fill this gap, we investigated how the momentary organisation of the lexical-semantic network of each participant influences word access in young neurotypical adults. The results showed that when participants were in a ToT state, the semantic richness at this precise moment was lower and the prototypicality of the network was heterogeneous compared to when the word was directly accessible. Also, more coordinates associates were given than superordinates in ToT states. Following this line of research, our current study intend to assess whether the impact of the lexical network on ToT states is affected by age. The aim is to investigate how and if the organisation of the lexical-semantic network in terms of richness and prototypicality has an impact on both ToT and “accessible” states, by comparing older to young participants.

Methods

30 young (mean age = 22.01; 7 men) and 28 older (mean age = 60.06; 9 men) neurotypical adults French-speaking, without diagnosed language impairment, delay or neurological disease and dementia were included in the study so far. The participants performed a picture-naming task with 80 infrequent words in French, that elicited a high proportion of ToT states in a pretest, followed by a continuous free word association task for each word that elicited a ToT state or that was correctly retrieved and produced (see Fig 1). In the continuous free word association task, participants say all the words that come to mind in relation to a target word for 10 seconds. Between the two tasks, participants had to answer

3 questions about their knowledge of the word corresponding to the picture during the picture-naming task. The associates given during the continuous free word association task were categorised based on a classical taxonomic classification (superordinate-coordinate-subordinate) enriched with some features from the Semantic Features Analysis (SFA) classification (spatiotemporal – perceptive – functional – other).

Results

Overall, the task elicited ToTs in 37% of the trials for the young neurotypical adults, which is significantly more than for the older participants (28%) ($X2(1) = 17.31$, $p<0.001$). In terms of the richness of the lexical-semantic network, the results showed that both young ($X2(1) = 14.65$, $p = 0.000$) and older neurotypical adults ($X2(1) = 13.07$, $p = 0.000$) gave fewer associates when they were in a ToT state compared to when they had access to the word.

Bayesian mixed models were used to assess the distribution of the type associates in both groups. The results indicated that in both groups and across states, the most representative category was functional and the least represented was perceptive. Among young participants and categories, coordinate associates are more likely in ToT states than spatiotemporal ($\beta = 0.97$, 95% CI [0.44, 1.52]), perceptive ($\beta = 0.73$, 95% CI [0.06, 1.37]), functional ($\beta = 0.68$, 95% CI [0.17, 1.20]) and superordinate ($\beta = 1$, 95% CI [0.47, 1.55]). Regarding older participant, coordinate associates are only more likely in ToT states compared to superordinate associates ($\beta = 0.45$, 95% CI [-1.39, -0.23]).

Finally, the associates given were more heterogeneous across participants for the ToT words than for the accessible words in young neurotypical adults and older participants ($X2(1) = 9.50$, $p = 0.002$).

Discussion

The aim of the present study was to investigate the organisation of the lexical-semantic network in ToT states compared to an accessible state in young and older participants. We focused on two factors that influence word production, namely the semantic richness and the prototypicality of the lexical-semantic network, using a picture-naming task and a continuous free word association task. The richness availability results confirm that production is facilitated in both groups when the word has a rich associative network (Krethlow et al., 2020), even in a temporary state, as in a ToT (Couvreu & Laganaro., in preparation). Regarding the prototypicality, the organisation changes between states and groups. Indeed, we found that young neurotypical adults gave more coordinates in ToT states compared to the other associates and that older participants gave only more coordinates in ToT states in opposite to the superordinates. Those results may be interpreted in the vein of the theory of the lexical selection by competition (Roelofs, 1992). It also appears that older participants have fewer ToT states that can be related to the changes of the organisation of the lexical-semantic network with ages. These findings may open a new window for understanding the current debate on whether older people tend to experience more ToT and the processes underlying ToT (Brown, 1991; Juncos-Rabadán et

al., 2010).

Thus, the present findings suggest the importance of considering the organisation of the lexical-semantic network of the speaker in the understanding of the momentary access deficit across ages. A better understanding of lexical-semantic organisation and its changes across the lifespan may indeed provide a cue for the early detection of some neurodegenerative diseases

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The production of discourse particles by individuals with aphasia and neurotypically healthy speakers in different contexts

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Introduction and aim

Discourse analysis is commonly used in addition to standardized tests to evaluate linguistic skills in persons with aphasia (PWA) and allows identifying linguistic difficulties or compensatory strategies in (semi-)spontaneous language production (Stark, 2019). Discourse particles (e.g., *ja* 'yeah') are frequent in spontaneous language production and comprise a heterogeneous group of words that fulfil different functions. Discourse particles, for example, help structure the discourse or can mark the relationship between the speaker and hearer (van Bergen & Hogeweg, 2021). Studies showed that PWA use discourse particles more frequently compared to neurotypically healthy speakers (NHS) (see for example Wets et. al, 2024). Previous research in PWA also suggests that the type of discourse task matters for the analysis of specific linguistic variables (Stark, 2019). Yet it is unclear how discourse particles are used by PWA in different contexts (i.e. across different discourse tasks). More discourse particles might be produced in dialogic discourse compared to a monologic discourse given the functions that discourse particles fulfil (Fox Tree, 2010). This study aims to investigate differences in discourse particle use across various tasks (i.e. a collaborative communication task, discussing statements, and semi-spontaneous interview) in Dutch-speaking PWA and NHS. More specifically, this study focuses on the following research questions: (1) How frequently are discourse particles produced by Dutch-speaking PWA and NHS in spoken language? (2) How are discourse particles produced by PWA and NHS in different contexts of spoken communication (e.g., having a familiar versus an unfamiliar conversational partner and varying degrees of spontaneity)?

Methods

So far, we collected data from 28 Dutch-speaking PWA (age range: 27-81; etiology: CVA; time post onset: 0;5-22;11 years; different degrees of severity and educational level) and 19 NHS (age range: 47-80 year). The neuropsychological assessment consisted of the following tests: *Nederlandse Benoem Test* (i.e. Dutch naming test) (van Ewijk et al., 2020), Syntax

Complexity Test (Janssen et al. 2018), procedural task, subtests of the AfasieNet cognitive communication screening (Bon et al., 106), and Digit Span forwards and backwards (Wechsler, 2008). Furthermore, three different discourse tasks ranging from less to more spontaneous language production were administered, namely (1) a semi-spontaneous interview, (2) discussing statements and (3) a collaborative language task with pictures. For (2) and (3), a version with a familiar addressee (e.g., partner) and an unfamiliar addressee (investigator) was administered. Discourse tasks were initially automatically transcribed using Whisper model (Radford et al., 2022) and afterwards manually reviewed and corrected. Discourse samples were analysed for six Dutch discourse particles (i.e. *eigenlijk, toch, nou, wel, ja, nee*) based on previous research (Wets et al., 2024). To account for differences in sample length, the percentage of discourse particles was calculated as the number of discourse particles relative to the total amount of spoken language in words. Below we present the preliminary results of 14 participants (PWA: N = 7; NHS: N = 7).

Results

PWA produce a higher percentage of discourse particles than NHS. Based on visual inspection of Figure 1, it seems that NHS produce more discourse particles in dialogue discourse (e.g., discussing statements) compared to monologue discourse (e.g., interview). Inspection of the data at the participant level in PWA also shows a trend in which PWA typically produce fewer discourse particles in monologue discourse compared to dialogue discourse. This highlights the importance of investigating the production of discourse particles across different discourse tasks further. Further analyses are needed and currently ongoing to investigate the production of different discourse particles by Dutch-speaking PWA and NHS in different contexts. These results will be presented at the conference.

Discussion

The study aims to gain insight into the production of discourse particles by PWA and NHS in different contexts. Our preliminary results show that PWA produced more discourse particles compared to NHS, which is in line with previous studies (Wets et al., 2024). Interestingly, it seems that individuals who are more severely impaired produced the largest percentage of discourse particles. The language production of these individuals is impaired, yet these individuals use discourse particles. For example, the discourse particle *ja* 'yeah' was used by PWA to signal word-finding difficulties. Furthermore, our preliminary results seem to show that the percentage of discourse particles produced differs across discourse tasks. NHS produced fewer discourse particles in monologic discourse compared to dialogic discourse, which is in line with previous literature (e.g., Fox Tree, 2010). At the participant level, PWA tend to show a similar pattern in which fewer discourse particles are produced in a monologic discourse task compared to dialogic discourse tasks. Our results suggest that it is important to further investigate how discourse particles are used in different contexts and that these insights could be valuable not only in research but also in clinical environments.

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The SALT Labsystem: Bringing aphasia assessment into the digital age.

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Introduction and Aims

Current aphasia assessment practice suffers from several nontrivial limitations: a) administrative burden for therapists, b) logistical burden for clients, and c) inaccuracies arising from human error. Administrative burden for therapists usually arises from maintaining paper-based scoring sheets and notes taken during testing, necessitating a high organizational burden to store, maintain and regularly access these records. Logistical burden arises when clients, especially those suffering from neurological or age-related limitations have to travel to the therapist, or even vice versa. This challenge limits clients' access to quality care, particularly in remote, rural areas. Finally, inaccuracies can arise when therapists use devices such as stopwatches to measure reaction times, as this relies on human judgement. Manually turning voice recorders on and off may lead to missed portions. In this digital age, there is abundant scope to drastically improve the overall testing experience and accuracy by integrating technology into the process.

Methods

We present the SALT Labsystem, a system for digitally and remotely administering aphasia assessments using a non-transitory computer-readable medium. This system comprises a testing portal device linked to a patient device and a tester device (any touchscreen device). The portal device is configured to: (1) receive a plurality of tests presented to the patient by the patient device, and corresponding answers input by the patient; (2) collect marks for each response by the tester from the tester device; and (3) automatically generate test result reports based on the aggregated from the tests, responses and marks. The system can also be configured such that the tester device is in communication with the patient device and can output, to the tester, the answers that are in real-time being input by the patient to the patient device; and receive an input from a tester to control the test and how they are presented to the patient.

Results

The system enables real-time monitoring of patient inputs by testers and allows testers to

control test parameters and presentation. By automating scoring, timing, and recording, it minimizes human error. By storing data digitally and providing automated performance reports, it significantly reduces administrative burden.

Discussion

The system is currently undergoing 3 active clinical trials in the United Kingdom and is in constant iterative improvement based on user feedback. While it currently only houses Arabic assessment batteries, the aim is to expand the scope to multiple languages, therapy exercises and other neurological disorders.

Time reference and morphological complexity in Tagalog-speakers with non-fluent aphasia

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Introduction and aims

Several studies have investigated the production and comprehension of time reference in agrammatism. As a result, the “Past Discourse Linking Hypothesis” (PADILIH, Bastiaanse et al., 2011) was formulated. According to PADILIH, reference to the past is impaired, across languages due to problems in discourse linking. Languages expressing past time reference through verb-inflection were studied, and also languages that realize time reference differently (e.g. with aspectual adverbs in Chinese, Bastiaanse et al., 2011).

Other studies have discussed the influence of morphological complexity (Faroqi-Shah & Thompson, 2010; Koukoulioti & Bastiaanse, 2020; Kurada et al., 2022). However, for many languages, past-disadvantage and morphological complexity are difficult to tease apart. In Tagalog, an agglutinative language spoken in the Philippines, aspect is used to indicate time reference, marking initiation and completion of an action through inflection (Cena, 2014). The morphological complexity differs across time frames, with reference to the past being less complex compared to present and future.

In the current study, we aim to tease the past-disadvantage and morphological complexity apart. Results from an earlier study on spontaneous speech (Gerona et al., under review) indicate an influence of morphological complexity. If the current experimental study confirms these outcomes, past forms would be relatively preserved. PADILIH would predict an opposing pattern, with particular problems in past time reference.

Methods

Participants

Two groups of Tagalog-dominant speakers were recruited: Ten participants with non-fluent aphasia and 10 non-brain-damaged control participants. They were matched on age, gender and education level.

Materials & Procedure

Comprehension and production were tested in line with the TART-setup (cf., Bastiaanse et al., 2008). Sixteen verbs were chosen and inflected according to the [mag-] voice-paradigm. Those forms were then inflected for perfective, imperfective or contemplative aspect, referring to past, present and future time reference, respectively. For each of these resulting 48 items, a matching photograph was used. For the comprehension task, all three pictures relating to the same verb were presented next to each other in a consistent order (future – present – past, from left to right). Each picture panel was used for three targets, once for each time frame.

For the production task, all 48 items were used as a target. Each verb was paired with a different verb that served as a prompt. For this prompt, the correct sentence was provided by the researcher. The participant then had to follow the example, completing a sentence in the same time frame using the verb depicted on the target picture. The root of the target verb was also provided. The focus was thus on correctly inflecting the target verb.

Scoring

For the comprehension task, accuracy was scored with a binary system. For the production task, participants received 2 points for the correct aspect in the prompted paradigm, 1 point for the correct aspect in a different voice-paradigm and 0 points if the aspect was incorrect. For both tasks, error types were also noted.

Results

Figure 1 displays an overview of the results. For comprehension, a generalized linear mixed model (random effects for participant and item) revealed main effects for group ($X^2(1) = 60.4$, $p < .001$) and condition ($X^2(2) = 63.6$, $p < .001$). Participants without aphasia outperformed those with aphasia. A Bonferroni-corrected post-hoc analysis for condition revealed a hierarchy in which comprehension of present was more accurate than both past ($p = .003$) and future ($p < .001$). In turn, performance for past was better than that for future ($p < .001$).

[Figure 1 about here]

For the production task, a Cumulative Link Mixed Model (random effects for participant and item) revealed significant main effects for group ($X^2(1) = 32.4$, $p < .001$) and condition ($X^2(2) = 26.2$, $p < .001$), as well an interaction between those two ($X^2(1) = 6.422$, $p = .040$). Therefore, a post-hoc analysis (with Tukey-correction) was carried out only within the group of participants with aphasia. Production of past time reference was better preserved than that of present ($p < .001$) and future ($p = .009$), while the latter two did not differ significantly ($p = .218$)

An error analysis of the aphasia group's productions was conducted per target time frame. For the past, correct answers (42.8%) and bare verbs (44.6%) accounted for most of the

responses. For the present, bare verbs (33.8%), replacement with a contemplative form from a different paradigm (28.1%), correct answers (18.8%) and replacement with the perfective (16.3%) form were the most common answer types. For the future, the most common answer types were bare forms (37.5%), usage of a contemplative form of a different paradigm (24.4%), infinitive form (17.5%) and correct answers (13.8%). All other error types, such as verb omissions and replacements with forms from other time frames or infinitives, were occurring in less than 7% of the items.

Discussion

The results for comprehension are in line with PADILIH, at least regarding the contrast past-present. However, PADILIH cannot explain why future time reference is less often correctly interpreted compared to past time reference. In the future condition, most errors were selections of the present time picture. It could be the case that the very small acoustic difference between these forms (first morpheme *nag-* versus *mag-*) or the prominence of the present picture (in the middle with the actual action depicted) could play a role in the performance.

The production data on the other hand are not in line with PADILIH. Production of past time markers was most preserved. These forms are morphologically less complex compared to both contemplative and imperfective aspects, which supports the morphological complexity account. Furthermore, the error analysis that showed that most error types are simplifications, either by producing bare forms or resorting to simpler forms from the same or a different voice paradigm. While we must consider other factors, such as the influence of phonology or frequency of usage, we can cautiously conclude that the influence of morphological complexity plays a vital role in the verb production of Tagalog speakers with non-fluent aphasia.

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Topic fronting constructions: Recommended for communication, but not easier for people with aphasia or Alzheimer's disease

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Introduction and aims

In topic fronting (TF) constructions, the topic appears at the beginning of the utterance ("So, breakfast. There is some juice."). People with aphasia (PwA) have shown a tendency to overproduce TF constructions (Beeke et al., 2007). Because these constructions can be grammatically simpler and they make referents more salient, they have been proposed as a tool for facilitating communication with individuals with language impairment (Beeke et al., 2013; McGill, 2021), including by the Royal College of Speech and Language Therapists (2009) in the United Kingdom.

However, there is no published empirical evidence showing that TF constructions help with communication. We believe that, in some regards, TF constructions can be more difficult to comprehend. The removal of grammatical information may obscure the relationship between constituents. Further, overreliance on topic fronting may present an unusual way of speaking to which people with language impairment may have difficulties adjusting.

In this study, we tested comprehension of TF constructions, compared to constructions in which all information was presented in one clause (OC; "There is some juice for breakfast."). We designed a sentence-picture matching task to assess comprehension accuracy and response time to both sentence types.

In the first stage of the study, we compared people with Alzheimer's disease (AD) with non-brain damaged (NBD) controls. In the second stage, we tested PwA.

Methods

Participants

For the first stage, we tested 18 people with AD and 21 NBD controls. We tested cognitive capacity using the Montreal Cognitive Assessment (MoCA; Nasreddine et al., 2005). Individuals with AD had a mean of 14.09 (out of 30), and NBD participants a mean of 28.05. In the second stage, we recruited 21 PwA. The group displayed severe grammatical comprehension difficulties, scoring an average of 8.04 on the Test of Reception of Grammar (Bishop, 2003).

Materials

We approached speech and language therapist networks over social media to provide examples of how they use topic fronting constructions. We used these sentence frames to create language stimuli describing ten depictable situations. For each, we created a TF utterance (e.g., “Look, here is the beach. We should go swimming.”) and one utterance which contained one clause (OC, e.g., “We should go swimming at the beach.”). For each situation, we created four images of which one matched the sentence (e.g., someone swimming near the beach) and others were distractors.

Procedure

We created two trial blocks with an equal number of TF and OC construction items. In each block, each situation was presented once, and we varied the order of trials blocks between participants.

In each trial, the participant was first presented with the spoken language stimulus, followed by the four pictures on a touchscreen. Participants were asked to select the picture which best matches the language stimuli as quickly as possible. We measured accuracy and reaction times (RT).

Results

The mean number of errors for TF constructions was 4.22 (SD = 2.84) for participants with AD, and .57 (SD = .75) for NBD controls. For OC constructions, the mean number of errors was 2.9 (SD = 2.40) for participants with AD, and .14 (SD = .36) for NBD controls. We examined the relationship between cognitive capacity (as measured by the Montreal Cognitive Assessment, MoCA; Nasreddine et al., 2005) and performance. Participants with lower MoCA scores made more errors (β = -.21, SE = .02, t(74) = -5.89, p < .001). Participants made more errors in TF construction trials (β = 2.13, SE = .81, t(74) = 2.64, p = .01). Individuals with lower MoCA scores were more affected by construction type, however, this interaction effect was not significant (β = -.06 SE = .03, t(74) = -1.72, p = .09).

We analyzed RT to accurate responses. The average RT for was 2212ms (SD = 243) for NBD participants, and 5254ms (SD = 2975) for participants with AD. A model with MoCA scores and trial type as predictors, and RT as the outcome, found that people with lower MoCA scores were significantly slower (β = -157.97, SE = 26.81, t = -5.89). The effect of construction type was marginal, with responses to TF constructions being slower (β = 213.85, SE = 112.88, t = 1.90).

For PwA, the mean number of errors was 2.43 (SD = 2.80) for TF constructions and 1.62 (SD = 1.86) for OC constructions. We only inserted construction type as predictor. There

was no effect of construction type (β = .81, SE = 0.73, t(40) = 1.10, p = 0.28). There was also no significant difference in RT for PwA between construction types (β = -69.9, SE = 193.2, t = -.36).

Discussion

This first investigation of comprehension of TF constructions suggests that producing the topic in the utterance-initial position does not result in an advantage. In participants with AD and NBD controls, the disadvantage of TF constructions was significant. This may be because TF constructions are less common, or that the reduction of grammatical information makes it harder to establish the relationship between constituents. PwA also made more mistakes when presented TF constructions, however, the effect was not significant. This may be because grammatical impairment makes the type of construction less relevant as PwA may have relied more on lexical-semantic information, while especially in participants with AD and lexical-semantic impairment, comprehension is more dependent on grammatical structure.

Our results do not suggest that TF is always detrimental. It may be useful if combined with a sentence in which the topic is grammatically integrated with the rest of the information (e.g. “So, breakfast. There is some juice for breakfast.”). Further research should also investigate the effects of TF in goal-driven discourse.

Our study demonstrates the need to provide communication advice based on empirical evidence.

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Transcription-less analysis of five discourse tasks in Laurentian French persons with post-stroke aphasia: adaptation and reliability

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Introduction and aims

Discourse analysis is essential in aphasia assessment and outcome measurement, yet transcription-based methods are time-consuming and resource-intensive. Transcription-less approaches such as Main Concept Analysis (MCA; Nicholas & Brookshire, 1993), thematic Units (TUs; Brisebois et al., 2020), and coherence/reference (Ulatowska et al., 2003) offer feasible alternatives. MCA integrates lexical and propositional content, while coherence/reference and TUs assess discourse structure and informativeness.

Despite promising use, their psychometric properties remain underexplored in Laurentian French. Guided by the LUNA framework (Dipper et al., 2021) , which emphasizes multi-level discourse analysis, this study aimed to: (1) evaluate intra- and inter-rater and test-retest reliability of these transcription-less measures across five tasks and (2) assess construct validity. Secondary goals included the reliability of microstructural (i.e., linguistic) variables and linking measures across discourse levels.

Methods

As part of a larger ethics-approved study (CIUSSS NIM # 2020-1900), twenty-three French-speaking adults (age: x = 58.2, SD = 12.8 years old ; 13 females) with chronic post-stroke aphasia were assessed twice (mean interval = 11.7 days, SD = 6.2). Five monologic discourse tasks were administered: the WAB-R picture description (Kertesz, 2006), Cinderella storytelling using the administration method of AphasiaBank (MacWhinney et al., 2011) and (3) three narrative sequences from AphasiaBank (Broken Window, Refused Umbrella, and Cat Rescue).

Transcription-less measures included adapted main concepts (MCs), TUs (WAB-R only), and coherence/reference scoring. Microstructural variables (e.g., mean length of utterance (MLU), correct information units (CIUs)) were extracted from CLAN transcriptions. Raters scored 20% of samples twice (intra-rater) and cross-coded for inter-rater reliability. Reliability was evaluated using intraclass correlation coefficients (ICCs), Spearman’s rho,

and Wilcoxon tests (not reported). Construct validity was assessed through correlations between macrostructural, propositional and linguistic variables.

Results

Intra- and inter-rater reliability was between good and excellent for most measures of each discourse tasks. It was poor to moderate for some main concepts with lower occurences such as accurate incomplete.

For the transcription-less measures of the combined tasks, MCs yielded an ICC of .799 (95% CI [.582, .909]) and Spearman's ρ of .755 ($p < .001$), while the coherence/reference score demonstrated excellent reliability (ICC = .923, 95% CI [.828, .967], Spearman's ρ = .911, $p < .001$). The microstructural variables with the highest test–retest reliability were total words (ICC = .934, 95% CI [.852, .972], Spearman's ρ = .835, $p < .001$) and CIUs (ICC = .937, 95% CI [.857, .973], Spearman's ρ = .811, $p < .001$).

For the Cinderella retell task, test–retest reliability was excellent for MCs (ICC = .910, 95% CI [.787, .963], Spearman's ρ = .903, $p < .001$) and for absent MCs (ICC = .921, 95% CI [.812, .968], Spearman's ρ = .708, $p < .001$). The microstructural measures presenting the strongest test-retest reliability were: total words (ICC = .926, 95% CI [.824, .970], Spearman's ρ = .880, $p < .001$), words per minute (ICC = .908, 95% CI [.782, .962], Spearman's ρ = .890, $p< .001$), and CIUs (ICC = .919, 95% CI [.806, .967], Spearman's ρ = .889, $p < .001$).

For the WAB-R picture description, the coherence/reference scores yielded excellent reliability (ICC = .967, 95% CI [.925, .986], Spearman's ρ = .887, $p < .001$) whereas TUs showed good reliability (ICC = .791, 95% CI [.569, .906], Spearman's ρ = .733, $p < .001$). Among the microstructures variables, the highest reliability was found with MLU (ICC = .960, 95% CI [.909, .983], Spearman's ρ = .825, $p < .001$), total words (ICC = .953, 95% CI [.893, .980], Spearman's ρ = .818, $p < .001$) and CIUs (ICC = .941, 95% CI [.867, .975], Spearman's ρ = .879, $p < .001$).

Regarding construct validity, coherence/reference scores were strongly correlated with main concept scores across most tasks and time points. For example, at Time 2, the correlation between these variables reached Spearman's ρ = .907 ($p < .001$, p adjusted < .001).

Discussion

This study provides the first comprehensive psychometric evaluation of transcription-less macrostructural and propositional discourse measures in Laurentian French. MCs, TUs, and

coherence/reference demonstrated good to excellent intra- and inter-rater reliability across most tasks, supporting their feasibility for clinical and research use in chronic aphasia.

Among transcription-less variables, coherence/reference scores showed excellent reliability for the picture description of the WAB-R and the narrative sequences from AphasiaBank, and strong correlations with MCs. This relationship highlights how macrostructural discourse organization is closely tied to lexical and propositional informativeness, aligning with multilevel discourse models (e.g., Marini et al., 2011), and also support the construct validity of the measures under the LUNA framework (Dipper et al., 2021)

Microstructural variables such as CIUs and total words demonstrated excellent test–retest reliability, especially for the WAB-R and Cinderella tasks, consistent with previous findings (Stark et al., 2023). Although some variability was observed by task and aphasia severity, overall reliability levels support their use in longitudinal designs.

The use of combined narrative sequences (e.g., Broken Window, Refused Umbrella, Cat Rescue) and the Cinderella story retell yielded reliable scores for both coherence and main concept analysis. These tasks offer flexible yet psychometrically sound options for capturing discourse change over time. In contrast, while the WAB-R picture description limits the application of MCA, it provides efficient and highly reliable scores coherence/reference, Thematic Units and CIUs.

Taken together, the results validate transcription-less approaches for capturing key dimensions of discourse in aphasia. The development of culturally adapted discourse psychometric data further support their integration into clinical workflows as these three protocols are quickly administered. Overall, this work enhances the accessibility and psychometric rigor of discourse assessment tools for French-speaking PWA and enables more consistent tracking of recovery and treatment outcomes.

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Using a novel data-driven method to determine predictors of spoken lexical retrieval in aphasia

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Introduction and Aims

Lexical-semantic variables such as imageability, age of acquisition, word familiarity, visual complexity, image agreement, name agreement and frequency have been found to predict lexical naming performance in persons with aphasia. Various studies have found different variables to emerge as the strongest predictors, ranging from imageability, age of acquisition, frequency and word familiarity (Nickels & Howard, 1995; Franklin et al., 1995; Bird et al., 2001; Mirman et al., 2010, etc.). To date, the primary statistical method used to determine this relationship has been regression modelling, with methods ranging from simple linear regression to more advanced mixed models. We previously analyzed 3 PwA by fitting individual logistic regression models (Khwaileh et al., 2017). Given the variation that has been found in the results from these methods, we propose a novel, data-driven method based on machine learning and AI approaches to find more robust relationships. We use an expanded version of the same dataset.

Methods

Object and Action naming tasks were administered to 11 PwA. Each PwA named 24 objects and 20 actions. Responses were initially scored as incorrect (0), partially correct (1), or correct (2), then binarized (0: incorrect/partially correct; 1: correct) for computational modelling. Two XGBoost models—a machine learning algorithm designed to detect complex, non-linear relationships in data through ensemble decision trees—were trained to classify naming success. Patient-grouped cross-validation ensured the models generalized to unseen individuals, reducing overfitting and enhancing reliability. Feature importance was evaluated using Shapley Additive Explanations (SHAP), a model-agnostic approach that quantifies the contribution of each feature to model predictions based on cooperative game theory. Additionally, Partial Dependence Plots (PDPs) were generated to examine model decision boundaries, allowing the determination of thresholds at which each feature significantly influences naming accuracy while averaging out the effects of other features.

Results

The XGBoost classifiers prioritized distinct predictors for each task. For Object Naming, Word Familiarity and Age of Acquisition emerged as dominant. For Action Naming, Age of

Acquisition and Reaction Time were more influential. Both models achieved robust performance (F1 scores: 0.75 for Object Naming, 0.77 for Action Naming), validating the predictive power of these data-derived features. For Object Naming, Partial Dependence Plots revealed that the Age of Acquisition boundary is approximately 3.3, after which patient responses tend to become incorrect. Word Familiarity for Object Naming has a threshold of approximately 4.3, beyond which naming accuracy improves. For Action Naming, Reaction Time threshold is approximately 1277 milliseconds, beyond which patients begin to produce incorrect responses. Age of Acquisition has a decision boundary of approximately 3.2, beyond which naming accuracy declines.

Discussion

By integrating XGBoost's pattern-detection capabilities with SHAP's interpretability and PDP's insight into decision thresholds, this analysis provides an empirical, data-driven framework to determine critical factors influencing word retrieval in aphasia. To the best of the authors' knowledge, this method has not been previously utilized to investigate factors influencing word retrieval, and may provide more robust and conclusive insights than traditional regression models. This analysis underlined the reliable effect of Age of Acquisition, and did not find the commonly established factor of Imageability to be as strongly predictive of naming accuracy. In addition, Word Familiarity was found to be influential independent of Age of Acquisition, suggesting that the two variables don't correlate as strongly as has been traditionally postulated. Finally, in a novel method, we identified thresholds that predict beyond which point naming accuracy decreases. We found that an Age of Acquisition lower than 3.3 years leads to more incorrect responses in Object Naming, and 3.2 years in Action Naming. These combined findings have significant implications for the development of stimuli in aphasia assessment and therapy, as well as for psycholinguistic investigations into lexical processing in aphasia.

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Using Syntactic and Semantic features for automatic detection of Schizophrenia Spectrum Disorder and Wernicke's Aphasia

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Introduction and Aims

Schizophrenia Spectrum Disorders (SSD) and Wernicke's aphasia (WA) are psychiatric and neurological conditions, respectively, that both lead to speech impairments. When speech is impaired in SSD, it is expressed by disorganized speech patterns, including derailment, tangentiality, and neologisms. WA primarily affects language comprehension and often results in fluent yet nonsensical speech. Despite their distinct causes, the speech produced by individuals with SSD and WA can be remarkably similar. For example, previous studies have shown that even experts (i.e. neurologists and psychiatrists) struggle to differentiate between the two conditions based on speech transcripts alone [1].

Natural Language Processing (NLP) offers a systematic approach to analysing spontaneous speech, which could detect subclinical linguistic abnormalities [2], potentially producing clinically relevant linguistic markers. While NLP has been increasingly used to study SSD, its application to WA remains limited. To date, only [3] attempted to distinguish SSD and WA speech using NLP measures, with only semantic-based features.

This study aims to identify predictive linguistic markers that differentiate SSD, WA, and healthy controls using NLP techniques. Specifically, we investigate:

1. The classification accuracy of syntactic and semantic features in distinguishing WA from healthy controls.
2. The classification accuracy of syntactic and semantic features in distinguishing WA from SSD.
3. The extent to which combining multiple feature types improves classification performance.

Methods

We analyse spontaneous speech transcripts from interviews with individuals diagnosed with WA and healthy controls from AphasiaBank [4].

Spontaneous speech transcripts of individuals with SSD, with on average mild language disorders (based on scores from Scale for the Assessment of Thought, Language, and Communication (TLC) [5], and healthy controls were obtained from [2]. All speech samples are pre-processed to remove transcription artifacts.

Three types of linguistic features are extracted:

1. Syntactic Features: Dependency parsing, constituency tree-based complexity, and parts-of-speech measures.
2. Semantic Features: Cosine similarity of word and sentence embeddings within moving windows.
3. Surprisal-Based Features: Token-level surprisal scores generated using the unidirectional LLM Llama-3.2-3B to quantify unexpected word usage patterns.

Features are calculated and classification is performed at the level of spontaneous speech tasks. Random forest and naïve bayes classifiers are trained on the above-mentioned feature sets to evaluate their discriminative power. Performance is assessed using leave-one-patient-out cross-validation.

To compare the two patient groups, only open-ended speech tasks were considered. The control groups of the two datasets were compared as well on open-ended speech tasks, to investigate the validity of cross-dataset patient classification.

Additionally, direct prompting of a large language model (LLM) for classification was done using a quantized version of the instruction-tuned Mistral Small 3 model [6] and compared to the classification using more traditional NLP measures.

Results

Preliminary results show that classification models trained with syntactic features distinguish WA and healthy controls with 87% accuracy on a speech task level. Semantic features slightly outperform syntactic features, with 92% classification accuracy, with very limited performance improvement when combining the feature sets. Additionally, using surprisal alone as a feature performed on par with semantic features, with their combination achieving 94% classification accuracy. Using LLM prompting resulted in an 85% accuracy, with similar performance across the different spontaneous speech task categories.

When distinguishing between SSD and their healthy controls, syntactic features achieved 60% accuracy and semantic features 62%, with negligible improvement when combined. Using forward feature selection on the combined feature set, accuracy rose to 66%. LLM prompting managed to get 65% accuracy.

In terms of classifying WA and SSD, LLM prompting reached 79% accuracy. Moreover,

syntactic features achieved 79%, semantic features 74%, and their combination reached 80% accuracy. Surprisingly, when the classifier is tasked with distinguishing between the two control groups, using the combined features achieved 84% accuracy. Post-hoc analysis showed that syntactic features were able to predict the speech task for healthy controls.

Discussion

Our findings show that WA produces robust linguistic anomalies which can be captured both with syntactic and semantic NLP features. This underlines that WA is a disorder of language, not of thought.
SSD is not easily detected using the semantic and syntactic features, even for the more severe cases. This suggests that its speech disturbances are more heterogeneous and less reliably captured by these standard measures compared to WA. Further research could create NLP features that align more with the TLC scale [5].

Classification between the two control groups performed similar to classification between the patient groups. This suggests the need for caution when comparing between datasets, as differences in demographics and speech tasks appear to influence NLP features.

Classification using LLM prompting showed promising results. This indicates that large-scale models can detect linguistic abnormalities without explicit and disorder-specific training. However, unlike traditional NLP methods, instruction-based LLM classification lacks interpretability and does not allow discovery of linguistic markers. Fine-tuning on disorder-specific datasets may improve performance.

LLM-based surprisal features performed comparably to semantic features. This suggests that surprisals capture linguistic anomalies effectively. Notably, while surprisal scores take advantage of recent LLM breakthroughs, they can provide token-level insights and do not require prompt engineering. However, while surprisal scores can identify general language disorder, they do not easily lend themselves for differentiation between disorders, lacking disorder-specific feature creation.

Overall, NLP-based linguistic markers, particularly syntactic, semantic, and surprisal-based features, can effectively detect WA. Future work could focus on fine-tuning LLMs and exploring additional linguistic markers to improve classification of SSD and healthy controls. Additionally, the creation of a dataset applying the same interview protocol to various patient groups would enable insightful comparisons.

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Validation of the digital Diagnostic Instrument for Mild Aphasia in patients with gliomas: preliminary results

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Introduction and aims

Patients with primary brain tumors, such as gliomas, frequently show subtle language disturbances (mild aphasia) with negative effects on quality of life. However, there is a lack of sensitive language tests to detect mild language disturbances. Therefore, the digital Diagnostic Instrument for Mild Aphasia (DIMA) was developed. DIMA examines the most important linguistic levels: phonology, semantics and (morpho-)syntaxis at production and comprehension (Satoer et al., 2022). DIMA is also useful in the preparation of glioma patients undergoing awake brain craniotomy with intraoperative language monitoring, as it was developed as an addition to the Dutch Linguistic Intraoperative Protocol (DuLIP) (De Witte et al., 2015). We aim to validate DIMA in a preliminary group of glioma patients.

Methods

Patients with gliomas underwent awake surgery due to location in eloquent areas. They were tested as part of standard care on two moments: preoperatively (T0), 2-3 months (T1) postoperatively with DIMA (mean age 48.38, sd 14.64). Patients were matched according to test moment, age and education with 42 healthy Dutch-speaking participants (mean age 45.43, sd 17.38). All patients were compared to healthy participants, using an independent samples t-test. Patients' mean z-scores were computed for all DIMA subtests (z-score ≤-1.5 = clinical impairment, clinical change = difference z-score 1.5). Reaction times were computed for T0 and T1.

Results

T0: Preoperatively (N=21)

No significant differences on DIMA performance were found between patients and healthy

controls, apart from a trend on one subtest: total sentence judgment (p=.069). However, patients were slower than healthy controls on the sentence completion task (p<0.05). A clinical impairment was found on repetition of compound words (phonology) (z=-2.19).

T1: Two-three months postoperatively (N=13)

On repetition of sentences (phonology) a significant difference was found between patients and healthy controls (p<0.05). A clinical improvement on repetition of compound words was found (T0: z= -2.19 – T1: z=-0.19) compared to preoperative level.

Discussion

Digital DIMA appeared to be sensitive in a preliminary patient group with gliomas. Pre- and postoperative language impairments were found on phonological subtests of DIMA. Awake surgery seemed to have protected language functions until short-term postoperatively as no significant and clinical deterioration was found. Instead, a clinical improvement was found on repetition of compound words, underlining the value of intraoperative monitoring of word repetition (Sierpowska et al., 2017). In addition, patients deviated on reaction times on sentence completion preoperatively. Reaction time in language tests has already been found to be sensitive and important for the rate of return to work (Moritz-Gasser et al. 2012). It may also reflect earlier spontaneous speech analyses regarding the occurrence of incomplete sentences (Satoer et al., 2018). Patients did not differ in reaction times from the healthy population on all other subtests and postoperatively. It could be explained by the small sample size and skewness of the data. We will further examine the long-term language outcome at 1 year, influence of demographic and clinical variables on performance in a larger dataset of glioma patients and performance of DIMA in other neurological patient groups. We advise adding the DIMA to standard perioperative language evaluation of glioma patients, as it allows for more detailed baseline investigation before awake surgery and counseling about language recovery at the different linguistic levels with indications for rehabilitation. Digitalization of tests such as DIMA is important: a standardized tool with audio recording, (semi-)automatic scoring including reaction times and data storage is crucial for international uniform standard care and research to investigate outcome.

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Vascular Contributions to Social Cognition: Theory of Mind Impairments and Small Vessel Disease in Post-Stroke Aphasia

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Structured abstract only

Max 1000 words for the abstract, max 200 words for references

Introduction and aims

Although Theory of Mind (ToM) deficits have been frequently linked to right-hemisphere stroke, their prevalence and nature following left-hemisphere stroke—particularly in individuals with post-stroke aphasia—remain poorly understood (Surian & Siegal, 2001). Prior evidence from a small number of single-case studies suggests that ToM abilities may be preserved in people with aphasia (PWA) and relatively independent of language function (Varley et al., 2001). However, these studies are limited in scope and lack generalizability to the broader PWA population.

The present study addresses this gap by systematically investigating ToM processing in individuals with chronic left-hemisphere stroke and aphasia. Specifically, we aim to: (a) assess the prevalence of ToM impairments in PWA using nonverbal false-belief tasks; (b) examine whether ToM performance is associated with aphasia severity; and (c) explore the relationship between ToM task accuracy and overall brain health, as indexed by structural markers of cerebral small vessel disease (CSVD).

Methods

Participants & Behavioral Assessments

Forty-four individuals with post-stroke aphasia following left-hemisphere stroke participated in the study (mean age = 57 years, range = 20–81; mean Western Aphasia Battery - Revised Aphasia Quotient (WAB-R AQ) = 82, range = 31.5–100). Participants completed two nonverbal belief reasoning tasks designed to assess different components of ToM (Biervoye et al., 2018). Each task involved viewing short video clips depicting object-hiding scenarios, after which participants were asked to identify the location of a green object (“Where is the green object?”) and received feedback after each trial. The reality-unknown (RUK) task measured spontaneous perspective-taking, requiring participants to infer another person's

belief without knowing the true state of affairs. In contrast, the reality-known (RK) task assessed the ability to inhibit one's own knowledge of reality in order to judge someone else's false belief. Both tasks included false belief and true belief trials, supplemented by memory control and filler trials to control for non-ToM-related processing demands.

Structural MRI & CSVD Rating

Cerebral small vessel disease (CSVD) refers to a group of brain pathologies affecting small perforating vessels, commonly observed in aging and stroke populations. It contributes to cognitive impairment and dementia. Structural MRI markers of CSVD capture early microvascular injury and serve as a non-invasive proxy for overall brain health.

In this study, CSVD burden was assessed in a subset of 28–31 participants based on available MRI sequences. Four validated MRI biomarkers were rated following standardized criteria (Wardlaw et al., 2013). White matter hyperintensities (WMH) in periventricular and deep regions were scored on the Fazekas scale (0–3), with higher scores indicating greater lesion severity. Enlarged perivascular spaces (EPVS) in the basal ganglia and centrum semiovale were rated on a 0–4 scale, with >20 EPVS indicating elevated burden. Lacunes, defined as small subcortical cavities (3–15 mm), were rated as present/absent. Cerebral microbleeds (CMBs) were defined as small (<5 mm) hypointense lesions on susceptibility-weighted imaging. All markers were rated independently by two trained raters blinded to behavioral data; discrepancies were resolved by a third rater. A total CSVD burden score (0–4) was calculated based on Pasi et al. (2021) and served as a proxy for cerebrovascular burden in analyses.

Statistical Approach

To estimate the prevalence of ToM deficits in PWA, we applied the decision tree framework and age-based cut-off scores developed by Biervoye et al. (2018). To evaluate the association between ToM performance and aphasia severity, we conducted linear regression analyses using overall task accuracy as the dependent variable and WAB-R AQ scores as the predictor. Finally, we conducted linear regression analyses to examine whether overall percentage accuracy on each ToM task was predicted by individual CSVD markers and the total CSVD burden score.

Results

ToM deficits were common among individuals with post-stroke aphasia (PWA), with 22% showing impairment on the reality-unknown (RUK) task and 36% on the reality-known (RK) task, based on decision tree classification (Biervoye et al., 2018). Comparison to age-matched normative data confirmed these impairments, particularly in false belief (FB) trials,

which directly probe ToM abilities. Performance was more impaired on the RK task, likely due to its higher demands on inhibitory control. Figures 1A and 1B illustrate the variability in individual performance relative to normative expectations, highlighting the heterogeneity of ToM abilities in this population.

Aphasia severity, as measured by WAB-R AQ scores, was not significantly associated with ToM task performance, either in terms of overall accuracy or binary classification (spared vs. impaired) for the RUK or RK tasks. These results held after adjusting for age and lesion volume.

Enlarged perivascular spaces in the basal ganglia (EPVS-BG) were significantly associated with reduced accuracy on both the RUK ($p = 0.0038$) and RK ($p = 0.0162$) tasks. These relationships also remained significant after adjustment for covariates. Cerebral microbleed (CMB) count showed a significant negative relationship with task performance: higher CMB burden was linked to lower accuracy on the RUK ($p = 0.0021$) and RK ($p = 0.0004$) tasks.

Discussion

Our findings highlight that ToM deficits represent a significant yet often overlooked challenge in post-stroke aphasia. Given the integral role of ToM in social cognition, these impairments may contribute to difficulties in interpersonal interactions and overall quality of life. A holistic assessment approach that includes ToM evaluation could enhance clinical decision-making and inform more comprehensive rehabilitation strategies. Our findings also indicate that aphasia severity does not appear to influence ToM performance, suggesting a degree of independence between language and social cognition. ToM deficits may be present even in individuals with mild aphasia, while others with severe aphasia may show no impairment, highlighting the need to assess these domains separately. In addition, our results suggest that markers of cerebrovascular brain health may be linked to ToM outcomes, independent of language impairment. This aligns with prior research indicating that structural brain changes associated with vascular pathology can affect cognition beyond traditional language networks. A multifactorial approach that considers both linguistic and neurovascular contributions may be essential for accurately characterizing cognitive and social challenges in PWA, and for tailoring interventions accordingly.

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Verb rates in agrammatism across languages

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Topic: Clinical and experimental work on aphasia and related disorders

Introduction and aims

While agrammatism is first and foremost defined by difficulties producing grammatical elements of language, the speech of people with agrammatism is often said to contain few verbs compared to the speech of people without aphasia (cf. Miceli et al. 1984: 207; Bastiaanse et al. 2002: 142-143; Caplan 2018: 247; Faroqi-Shah 2023: 6-7; Fedorenko et al. 2023: 1988).

In this meta-study, I consider data from a variety of languages and show that low verb rates in semispontaneous speech are not a universal characteristic of agrammatism. Across languages verb rates in agrammatism may be reduced, increased or neither compared to the speech of people without aphasia. The variation in verb rates across languages is related to the specific requirements and affordances of different languages (see Discussion for examples).

Methods

Review

I review studies on semispontaneous speech of people with agrammatism (i.e. people with non-fluent aphasia who use a limited number of grammatical morphemes and sentence structures) speaking different languages, including Dutch, English, Standard Indonesian, Swahili, Tagalog, Thai and Turkish.

I regard proportions of verbs in speech and noun-to-verb ratios as measures of verb rates. Many studies also report verbs per utterance as an indication of verb mastery, but this is not suitable since few verbs per utterance could be an effect of the generally short utterances characteristic of agrammatism.

New Greenlandic data

The published data are supplemented by new semispontaneous speech data from Greenlandic, which is a radically different language than the well-studied Indo-European languages. For instance, Greenlandic has rampant argument omission, which means that Greenlandic data can serve as a testing stone to determine whether few verbs is a (potentially) universal or a language-specific characteristic of agrammatism.

Results

The results show that a paucity of verbs (measured as either proportions of verbs or noun-

to-verb ratios) only characterize the speech of people with agrammatism in some languages (English, Thai). In several languages, people with agrammatism produce as many verbs as people without aphasia (Dutch, Standard Indonesian, Swahili, Turkish), and in some languages, people with agrammatism produce more verbs than people without aphasia do (Greenlandic, Tagalog).

Results from languages for which proportions of verbs are available are summarized in Table 1. The table clearly shows that proportions of verbs differ considerably between languages, both among speakers without aphasia and speakers with agrammatism. For example, verbs make up 9% of the words of Dutch speakers without aphasia and 27% of Thai speakers without aphasia.

Discussion

The different verb rates observed across languages can be accounted for, at least partly, by the specific requirements and affordances of grammars. It must be stressed though that other linguistic aspects also influence verb production, for example, item frequency and communicative needs (see Gahl & Menn 2016; Boye et al. 2023).

Different grammars “pull” speakers toward producing verbs to different degrees. In Greenlandic, for instance, nominal arguments are never obligatory. Thus, if a speaker intends to produce a transitive clause consisting of a subject, an object and a verb, but struggles to provide all three elements, the grammar guides the speaker to omit an argument rather than the verb. In contrast, English grammar typically requires speakers to produce nominal arguments. So if an English speaker wants to produce a subject, an object and a verb but struggles to do this, they are not guided by the grammar to what they should omit, and chances of leaving out the verb are equal to chances of leaving out either of the arguments. This can explain why verb rates are reduced in English, but not in Greenlandic, Turkish, Swahili, Tagalog and Standard Indonesian, which all have frequent argument omission.

Another way that grammars can “pull” speakers toward verb production is through stable positions of the verb. In Tagalog, where we find increased verb rates in agrammatism, verbs occur clause-initially, while other constituents occur in any order. The highly regular and clause-separating position of Tagalog verbs could pull Tagalog speakers towards producing verbs. In Dutch, where we see no reduced verb rates in agrammatism despite argument realization requirements comparable to English, verbs occur in either second or last position depending on the clause type and inflection. The fixed positions of Dutch verbs could make Dutch speakers with agrammatism more likely than English speakers with agrammatism to produce verbs.

A third factor that needs to be considered is the affordances of different grammars. In Thai, where verb rates are reduced in agrammatism despite frequent argument omission, serial

verb constructions are common, which means that one clause often contains several verbs. Accordingly, verb rates are quite high among Thai speakers without aphasia, indeed the highest across the languages investigated. But Thai speakers never have to use serial verb constructions, and speakers with agrammatism are less likely to make use of this construction. The possibility of producing serial verbs constructions can explain why Thai verb rates are higher among speakers without aphasia than among speakers with agrammatism.

It is important that explanations for varying verbs rates across languages do not become ad hoc. One way to avoid this is to test whether verb rates are regularly reduced in agrammatism in languages where serial verbs are frequently used (like Thai), and whether verb rates tend not to be reduced in languages where verbs occur in fixed positions (like Tagalog and Dutch).

Considering agrammatism in the light of the specific linguistic "pulls" of different grammars also promises to explain the variation in erroneous use of grammatical elements within and across languages, e.g. that tense is associated with higher error rates than agreement (cf. Faroqi-Shah 2023: 6), and that articles are omitted more often in some languages than in others (Bates et al. 1987).

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Verbal Inflection in Aphasia: Exploring Tense and Agreement in Argentinian Spanish

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Introduction and aims

Introduction

Research conducted in a variety of languages has consistently documented difficulties with verbal inflection in people with aphasia (PWA), particularly with tense morphology when compared to subject-verb agreement (Bastiaanse, Bamyaci, Hsu et al., 2011; Benedet, Christiansen & Goodglass, 1998; Friedmann & Grodzinsky, 1997; Gavarrò & Martínez-Ferreiro, 2007; Kok et al., 2007; Wenzlaff & Clahsen, 2004).

Multiple theoretical accounts have been proposed to explain this dissociation. Among them, the Diacritical Encoding and Retrieval Hypothesis (DERH; Faroqi-Shah & Thompson, 2007) suggests that this pattern results from a selective disruption in mapping temporal semantic information onto verbal morphosyntax. This disruption, associated with processing constraints in PWA, is thought to interfere specifically with the selection of the appropriate tense morpheme based on temporal semantic cues, due to impaired encoding of temporal diacritical features.

Aims

The present study investigates the production and comprehension of tense and subject-verb agreement inflections in individuals with non-fluent aphasia who are native speakers of Argentinian Spanish. The goal is to provide empirical evidence regarding morphosyntactic processing in this population and to characterize the nature of their linguistic impairment. To that end, a set of tasks was created with potential applications in both clinical diagnostics and rehabilitation. The findings aim to contribute to the broader understanding of this linguistic deficit and to inform ongoing discussions on its underlying mechanisms.

Methods

Participants

Nine individuals with non-fluent aphasia participated in the study. All were native speakers of Spanish, with a mean age of 46.2 years (SD = 18.03) and a high level of education (mean = 16 years; SD = 2.24).

Materials

A total of four experimental tasks were developed to evaluate participants' performance in both verbal production and comprehension. Two of them targeted production: (1) a sentence completion task (SC), in which participants were asked to complete sentences with the correct verbal inflection, and (2) a sentence elicitation task (SE), where participants generated target sentences in response to visual and auditory prompts.

The other two tasks focused on comprehension: (3) a grammaticality judgment task (GJ), requiring participants to assess the syntactic well-formedness of sentences, and (4) a sentence-picture matching task (SPM), where participants selected the image that best corresponded to a given sentence.

Stimuli manipulated both temporal reference (past, present, future) and subject form (first person singular, third person singular and plural). All sentences followed an Adverb-Subject-Verb-Object (ASVO) structure, e.g.:

"Ayer Juan juntó flores" / "Yesterday Juan picked flowers"

"Ahora Juan y María escuchan un disco" / "Now Juan and María listen to a record"

"Ayer yo besé a mi hijo" / "Yesterday I kissed my son"

"Mañana Juan cosechará las uvas" / "Tomorrow Juan will harvest the grapes"

Results

In the Sentence-Picture Matching task, a significant difference in accuracy was observed between stimulus conditions ($z = 3.65$, $p < .01$). PWA performed more accurately in the Agreement condition (selecting between one or two characters) than in the Tense condition (choosing between past or present scenarios).

Grammaticality Judgments results revealed a similar pattern: participants were significantly more accurate in detecting ungrammatical sentences in the Agreement condition ($z = 2.94$, $p < .01$) than in the Tense condition.

In the Sentence Elicitation task, accuracy rates differed significantly across inflection types ($z = 2.60$, $p < .01$), with higher accuracy for Agreement than for Tense inflections.

The Sentence Completion task showed a significant interaction between inflection type and stimulus condition ($z = 2.59$, $p < .01$). Further analysis revealed significantly lower accuracy for Tense inflections ($z = 4.09$, $p < .01$) when participants had to encode tense while agreement could be copied from the model (Tense condition). However, no differences were found when participants encoded agreement and copied tense features from the model (Agreement condition; $z = 0.56$, $p = 0.57$).

Discussion

The results provide a detailed profile of morphosyntactic deficits in PWA who are native speakers of Argentinian Spanish. In line with previous findings across languages, participants showed greater impairment with tense than with agreement morphology in both comprehension and production. Notably, the data also offer insight into the source of this difficulty: tense inflection performance declined when the task required active encoding

of temporal features, supporting the predictions of the DERH (Faroqi-Shah & Thompson, 2007).

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Verbs and their arguments in the production of Czech speakers with aphasia

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Verbs and their arguments in the production of Czech speakers with aphasia

Introduction and aims

Verb production has been among the most frequently studied topics in the research of language in aphasia. Impaired verb retrieval has been reported for agrammatic aphasia and for the non-fluent aphasias in general (cf. Malyutina et al., 2016). Studies have shown that verb production can also be impacted in speakers with fluent aphasia (e.g. Bastiaanse, 2011). In particular, argument structure has been a major focus of research. It has been shown that persons with agrammatic aphasia have more difficulties with the processing of verbs with two or three arguments compared to one-place predicates and also with verb structures that, under a generative analysis, involve *movement* (e.g. unaccusative verbs) (e.g. Thompson, 2003). Such an effect has been demonstrated for agrammatic aphasia for several typologically different languages (e.g. Sung, 2016 for Korean), and Cruice et al. (2014) have reported this effect for the speech of persons with aphasia regardless of subtype. Interestingly, Flanderková (2019) has failed to replicate this effect for agrammatic aphasia in Czech. Malyutina & Zelenkova (2020) discuss contrasting results across tasks and aphasia subtypes. This speaks to the need for more research in various languages and clinical subgroups.

This paper presents an exploratory analysis of verb production in the connected speech of Czech speakers with aphasia. Czech is a morphologically complex, pro-drop language that remains generally understudied in the context of aphasia. The aims of this paper are:

1. To explore and describe verb production in relation to various syntactic, semantic, and usage factors;
2. To explore the relationship between verb fluency and these variables, since greater argument complexity has been tied to increased processing demand which in turn can be hypothesized to affect fluency;
3. To explore the patterns of realization of obligatory arguments of verbs.

Methods

Data

The verbs were sampled from a corpus of connected speech produced by eleven Czech native speakers with aphasia (four anomic, three transcortical motor, two conduction, two Broca's) and three typical speakers. The analysis was restricted to all lexical verbs produced in a subcorpus of three tasks (story (re)telling, picture description). Clusters of verbs including repetitions or reformulations were treated as single observations, resulting in a total of 1253 analyzed verbs.

Data annotation

The verbs were annotated for a number of variables:

- cumulative lemma frequency of the verb in a general corpus of Czech
- voice
- finiteness
- presence of modal verbs
- number of obligatory arguments (based on a valency dictionary of Czech)
- transitivity
- number of adjuncts
- semantic verb type (Halliday & Matthiessen, 2004)
- semantic roles of arguments.

Furthermore, the number of realized arguments and their syntactic weights were coded (zero, pronoun, bare noun, phrase, clause). The verbs were also marked as non-fluent when preceded by a disfluency (filled or silent pause, word fragment).

A descriptive exploratory analysis was performed with main focus on the number and syntactic weight of expressed arguments and on the levels of structural complexity of the verbs produced by individual participants and its relationship between structural complexity and fluency.

Results

The data shows that the mean number of arguments in the valency frames of the verbs produced by participants was comparable as was the proportion of verbs with a "complex" frame (transitive or unaccusative verbs). A conditional inference tree and random forest analysis also showed that the presence of disfluencies was predicted by the frequency of the verb and its semantic class, but not by the complexity of its argument structure. Furthermore, there was a strong correlation between the mean number of fluently produced trigrams and the mean number of adjuncts. Interestingly, this measure of fluency was also strongly correlated with the mean number of actually produced arguments (0.6, $p = 0.0317$) and their syntactic weight (0.64, $p = 0.0183$). A subsequent analysis focused on verbs with

an obligatory object and/or oblique argument that was omitted in the production. While zero obliques appear in all speakers, zero objects were almost exclusively produced by the participants with aphasia (65 vs. 5).

Discussion

The data shows that argument complexity as such does not seem to differ substantially across individual participants or aphasia subgroups nor does it seem to predict the occurrence of disfluencies before verbs. However, the sample is admittedly small. On the other hand, persons with aphasia produced more transitive verbs with zero objects. While this might be interpreted as either the participants' not being able to access the valency frame, resulting in agrammatic production, or as a compensation strategy due to limited processing resources, this seems not to be the case.

A subsequent check of spoken corpus data showed that most of the verbs in the sample produced with zero objects show a similar pattern in typical usage, being motivated contextually (cf. 1), while some differ from typical usage. Interestingly, the data suggests that rather than being unaware of a verb's valency frame, the participants were, in the majority of cases, not able to retrieve the target word for the object position (cf. 2). Similarly, there were also a few instances where the verb was not retrieved at all but all of the obligatory arguments were produced. This suggests that an appropriate argument structure is activated but not all the positions are necessarily filled due to limited processing resources. Such a pattern could be explained by the notion of argument structure constructions as posed in Construction grammar (Goldberg, 2019).

Examples:

1. *maminka <silent pause> vaří* 'mom is cooking' - 49% with zero object in spoken corpus
2. *ta nese <word fragment> <silent pause> to nevim* 'she is carrying I dunno' - 5% with zero object in spoken corpus

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Visual formats matter?: comparing lexical access using emojis, colored and black-and-white drawings

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Introduction and aims

Pictures have long been a valuable resource in cognitive psychology and neuropsychological research for exploring cognitive processes such as memory, language, and semantic access. One of the most used tools for language assessment in aphasia patients is the Boston Naming Test (BNT), which presents black-and-white line pictures. However, newer studies have indicated that color can be an important semantic attribute to distinguishing visually similar concepts, prompting the development of new color versions of the BNT (Li et al., 2022).

A new form of pictorial representation has emerged in recent years: emojis. They encompass various semantic categories that are essential for depicting different aspects of daily life, including emotions, animals, fruits, vegetables, means of transportation, clothing, and much more. Although their potential applications in scientific fields are still relatively novel, their utility has already been demonstrated in education and medicine (Chen et al., 2022; Moisset et al., 2022).

This abstract aims to present the results of a study comparing access to Living Things (LTs) and Non-Living Things (NLTs) through an oral naming task using different formats: emojis, black-and-white drawings, and colored drawings. By analyzing participants' responses, we examined how each visual format influences the accuracy and speed of naming objects across the two semantic domains. These findings will contribute to understanding how different pictorial representations affect cognitive processing and may have implications for clinical assessments and educational materials.

Methods

Participants

The sample included 90 volunteers. They were divided into three material groups: (i) colored drawings, (ii) black-and-white drawings, and (iii) emojis. The groups were matched for sex, age ($\chi^2(2) = .124$; $p = .940$) and years of education ($\chi^2(2) = .400$; $p = .819$). The participants were natives of Argentina without neurological or psychiatric histories.

Materials

Three picture naming tasks were administered: one presented emojis, one black-and-white drawings, and one colored drawings. The tasks were conducted using DMDX software. Sixty-four stimuli were presented for oral naming (32 LTs, 32 NLTs). Drawings were collected from Cycowicz et al. (1997), and emojis were taken from Emojipedia (https://emojipedia.org/).

Both semantic domains were paired on the basis of the lexical–semantic variables H Index ($U=385$, $p=.086$), lexical frequency ($U=395$, $p=.116$), and age of acquisition ($U=485$, $p=.722$) (Martínez Cuitiño et al., 2015).

Procedure

The participants were randomly assigned to each of the described testing groups. They were assessed in a single session. Each participant was asked to name aloud with a single word, as accurately and quickly as possible, each stimulus presented. The stimuli were individually presented against a white background in the center of the screen.

Each trial began with a 400-millisecond (ms) display of a fixation point followed by an 800-ms stimulus presentation. This was followed by a 4000-ms blank screen during which participants could name the stimulus that remained visible on the screen even if the participants named it before the 800-ms had elapsed.

Before the task, the participants practiced with 10 stimuli to familiarize themselves with the procedure. No feedback on their performance was provided throughout the process.

Accuracy rates and reaction times (RTs) were recorded. All oral responses were subsequently analyzed using the CheckVocal program (Protopapas, 2007).

Analyses

A generalized linear mixed effects model (GLMM) with a binomial function was used to analyze the dichotomous performance data. The accuracy variable was taken as the dependent variable, and the fixed factors included the format (black-and-white drawings vs. colored drawings vs. emojis) and the semantic domain (LTs vs. NLTs), as well as their interaction. Subjects and items were considered random effects.

To analyze RTs, a mixed linear model (MLM) was fitted with RTs as the dependent variable. Fixed factors included format and semantic domain and their interaction, whereas subjects and items were considered random effects.

Results

No differences in accuracy were found across the different formats, but results confirm that format impacts processing speed, since black-and-white drawings are processed more slowly than both colored drawings and emojis. Consequently, color decreases the recognition times. With respect to emojis, participants exhibit faster reaction times in accessing meaning within both semantic domains (LTs and NLTs), which suggests that compared with traditional colored drawings, emojis may facilitate faster cognitive processing of visual information.

Within the LTs domain, color always facilitates lexical retrieval, and participants are not only equally accurate but also faster with emojis. Within the NLTs domain, participants showed faster response times with emojis compared to black-and-white drawings. Color may not be that particularly relevant for naming NLTs, since no differences were identified between colored drawings and emojis (Figure 1 and 2).

Discussion

In light of our findings, there are several advantages of considering emojis as a potential format for implementation in neuropsychological and speech therapy clinics. With rapid technological changes, black-and-white materials (which are currently used in the clinic) are becoming outdated as our interaction with the world is not black-and-white. On the other hand, emojis are freely and globally available, and their use eliminates the need to create specific stimuli for each country or culture. Furthermore, depending on the style of the emoji selected, some include information about movement, which serves as an additional semantic attribute.

Given the growing use of digital media, integrating emojis into neuropsychological and speech therapy assessments could provide a more ecologically valid and engaging tool for lexical assessment. Future research should study their utility in clinical populations, as well

as their potential benefits for patients with different neurological conditions, such as aphasia, progressive primary aphasias, or Alzheimer's disease.

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Word retrieval among healthy older adults – single words and words in context: The effect of personal factors and quality of life

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Introduction and aims: Life expectancy constantly increased over the last decades, and it is expected to continue growing. Therefore, understanding the functional changes within the elderly population is crucial (Aburto et al., 2020). One of the most common and consistent complaint among older adults is word retrieval difficulties. Deterioration in retrieval ability is well established, generally from the age of 70 years (e.g., Biran et al., 2023; Murphy et al., 2020). However, the extent of reported deterioration varies between studies, presumably due to the heterogeneity of the older adults' population, personal factors that may affect their functioning (e.g., education, living environment, emotional state), and the heterogeneity in research tasks used in different studies.

Studies examining word retrieval among older adults have mainly focused on single word retrieval. Studies that compared word retrieval in isolation and in context usually found better performance on tasks of word retrieval in context. It was suggested that this is due to the older adults' ability to rely on semantic and syntactic redundancy (Kavé & Goral, 2017). Few studies examined the effect of personal and environmental factors on word retrieval and found significant effects of age, education and living environment (at home or in an institution).

A decrease in language functions, and specifically in word retrieval, might reduce older adults' communication and interpersonal relationships. This might consequently lead to increased feelings of loneliness and depression, and thus, adversely affect older adults' quality of life (QOL. Hummert et al., 2004; Messer, 2015).

In the current study we aimed to assess the effect of various variables (age, education), on word retrieval ability among healthy older adults, and the relation between word retrieval and self-reported QOL, comparing between different retrieval tasks – in isolation and in context.

Methods: Forty-six Hebrew-speaking older adults participated in the study (31 females), age range: 65-101 years (mean: 78), with 10-23 years of education years of education (mean: 15). Twenty-four lived in senior living houses and 22 lived at their home. They were native Hebrew speakers or spoke Hebrew as their dominant language for at least 45 years. They had normal, or corrected to normal, hearing and vision; with no neurological history; intact cognitive function as manifested in the MoCA (Montreal Cognitive Assessment)

screening test (Nasreddine et al., 2005; Hebrew version: Heinik, 2008).

The procedure was similar to that of Biran et al. (2024) and Renvall et al. (2024), including tasks of single nouns retrieval and retrieval in context:

(1) SHEMESH naming test (Biran & Friedmann, 2005) – naming 100 pictures of objects; (2) Sentence completion – 49 sentences to be completed with one word; (3) Story-telling according to a series of 6 pictures; (4) Conversation on initiated topic, by answering five questions about the place in which the participant lives; (5) QOL questionnaire (based on the WHOQOL-AGE. Caballero et al., 2013) – 13 self-report QOL questions, responding on a five-point rating scale.

Word retrieval in connected speech (tasks 3+4) was assessed using the *Percent Word Retrieval* (%WR. Mayer & Murray, 2003), calculating the percent of correctly produced nouns out of the total number of nouns.

Results: The main findings are:)a) Performance on the story-telling task (85%) was significantly lower compared to the three other tasks: picture naming (94%), sentence completion (92%) and conversation (92%). (b) Weak-to-moderate positive correlations between single word retrieval (picture naming and sentence completion) and word retrieval in context (story-telling and conversation). (3) Contribution of personal factors: negative correlation between age and retrieval in story-telling and sentence completion tasks; positive correlation between education level and picture naming task. (4) Weak-to-moderate positive correlation between the score in the QOL questionnaire and retrieval in conversation.

Discussion: The comparison between different retrieval tasks, in isolation and in context, revealed similar, and relatively high, performance in picture naming, sentence completion and conversation tasks, with significantly higher performance compared to the story-telling task. This finding is different from findings from people with aphasia (PWA) – in Hebrew, Finnish and English (Biran et al., 2024; Renvall et al., 2024), in which retrieval in conversation was significantly better than in other retrieval tasks. This may be explained by the high scores of the older adults on the three tasks (picture naming, sentence completion and conversation; 92-94%). The low performance on the story-telling task might be due to its nature as an intermediate phase between picture naming and conversation, which is also less natural and familiar for the participants.

Additionally, in line with previous studies, correlations were found between tasks of word retrieval in isolation and in context, indicating that retrieval in isolation is related, to some extent, to retrieval in context. Furthermore, personal factors – age and education level – were found to affect word retrieval, therefore indicating the importance of considering these variables in assessment.

Finally, self-reported QOL correlated only with retrieval in conversation, indicating that better retrieval in conversation is associated with higher self-reported QOL. This is compatible with findings from PWA (Biran et al., 2024) and highlights the important role of communication in QOL. That is, better word retrieval in conversation may affect the individual's social and mental state and hence may positively affect QOL.

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