Jaargang 27, Supplement 2, november 2022

Stem-, Spraak- en Taalpathologie

Abstracts of Science of Aphasia Conference 2022 University of Bordeaux, 12-15 September 2022

Programme:

Monday 12-09
The Neural Organization of Language

09h30- 10h30 : Stephanie Forkel
11h00 - 12h00 : Vitória Piai
14h00 - 15h40 : Oral presentations 1
15h45 - 17h00 : Coffee & Poster session 1

Tuesday 13-09
Language and Control Mechanisms (incl. bilingualism)

09h30 - 10h30 : Kalinka Timmer
11h00 – 12h00 : Manual Carreiras
12h15 - 13h45 : Lunch & Poster session 2
14h00 - 15h40 : Oral presentations 2

Wednesday 14-09
Language and Semantics

09h30 - 10h30 : Yosef Grodzinsky
11h00 - 12h00 : Marco Marelli
14h00 - 15h40 : Oral presentations 3
15h45 - 17h00: Poster session 3

Thursday 15-09
Language and Memory

09h30 - 10h30 : Naama Friedmann
11h00 - 12h00 : Steve Majerus
12h15 - 13h45 : Lunch & Poster session 4
14h00 - 15h40 : Oral presentations 4

INFORMATION for POSTERS & ORAL PRESENTATION:

- Size of the posters: **A0** (84.1 x 118.9cm / 33.11 x 46.81 inches) / portrait layout.
- Before the poster sessions, a brief oral presentation "3-slides-3-minutes" is required.

For the presentations (oral & posters' 3-Slide), and to avoid technical problems, **please upload the presentation during the lunch time**. A computer will be made available and somebody will help you in the amphitheater.

- Monday 12-09 for presentations of the **Monday and Tuesday**
- Wednesday 14-09 for presentations of the **Wednesday and Thursday**

Software: Microsoft Powerpoint. Please check the supported format (e.g. ppt / pptx / pdf / odp / etc.)

DETAILLED PROGRAM SOA 2022

Monday 12-09-2022

09:15 Welcome

Invited speakers: The neural organization of language *(Moderator:* ***Gabriele Miceli****)*

9:30-10:30 Stephanie Forkel

10:30-11:00 coffee

11:00-12:00 Vitória Piai

12:15-13:45 Lunch

14h-15h40 Oral presentations 1 *(Moderator:* ***Roel Jonkers****)*

- The agrammatic comprehension of indirect-object clitic left dislocations in Catalan
  Anna Gavarró | Io Salmons
- Deictic and Anaphoric Reference Production in Tagalog Fluent and Non-Fluent Aphasia
  Jonathan Gerona | Kasper Boye | Silvia Martinez-Ferreiro | Srdjan Popov

- Semi-spontaneous language production in primary progressive aphasia
  Imke Wets | Lize Jiskoot | Esther van den Berg | Nikki Janssen | Vitória Piai
- Diagnostic Instrument for Mild Aphasia (DIMA): sensitive and valuable addition to standard language assessment in glioma patients.
  Djaina Satoer | Saskia Mooijman | Bram Bulté | Elke De Witte | Evy Visch-Brink | Arnaud Vincent
- Comprehensive Aphasia Test: what do Norwegian and Croatian data reveal
  Ana Matić Škorić | Monica I. Norvik | Jelena Kuvač Kraljević | Hanne Gram Simonsen

15h45-17h Coffee & Poster Session 1

Poster session1

15h45: short (3minutes/3-slides) presentation

101. Transcranial magnetic stimulation for a right post-stroke patient with aphasia: a SCED studyArheix-
Parras Sophie | Du Puy De Goyne Mathilde | Python Grégoire | Glize Bertrand

102. Impaired production of time reference in aphasia: Disentangling encoding from retrieval deficits
Valantis Fyndanis | Marielena Soilemezidi | Theodora Kalpakidi

103. Identification of PPA by automated analysis of word frequency properties in spontaneous speech.
Roelant Ossewaarde | Roel Jonkers | Antoinette Keulen | Yolande Pijnenburg

104. Effects of healthy aging and gender on the electrophysiological correlates of semantic sentence comprehension: the development of Flemish normative data
Elissa-Marie Cocquyt | Emma Depuydt | Patrick Santens | Pieter van Mierlo | Wouter Duyck | Arnaud Szmalec | Miet De Letter

105. Comparing the effect of linguistic vs. cognitive training coupled with transcranial magnetic stimulation on sentence comprehension in early Alzheimer's disease
Christina Manouilidou | Georgia Roumpea | Michaela nerantzini | Katarina Marjanovič | Andreja Speh | Tatjana Marvin | Zvezdan Pirtošek | Jure Bon

106. Semantic distance, rather than neighbourhood density, influences error rate during object naming under nTMS in people with brain tumours
Jocelyn Lubbers | Effrosyni Ntemou | Thomas Picht | Adrià Rofes

107. On the Distribution of Bilingual Effects: A PRISMA Review
Vittoria Dentella

108. Development of an action fluency task in German to assess verb retrieval in aphasia
Sandra Hanne | Nicole Stadie

109. Processing of gender information of German possessives in aphasia
Gianna Urbanczik | Seçkin Arslan | Leonie F. Lampe | Lyndsey Nickels | Sandra Hanne

110. Who can it be now? Processing of reflexives and null object pronouns in non-fluent aphasia in Turkish.
Seckin Arslan | Semra Selvi Balo | Ilknur Maviş

111. A corpus-based study of pauses and dysfluencies in autobiographic discourse and picture description of individuals with non-fluent aphasia
Halima Sahraoui | Lorraine Baqué | Julie Mauclair | Silvia Martìnez-Ferreiro

112. Effects of lexical frequency and collocation strength of word combinations on speech pause duration of individuals with and without aphasi
Sebastian Bello-Lepe | Sabrina Mahmood | Rosemary Varley | Vitor Zimmerer

113. Negative Concord in Neglect Dyslexia: Evidence from Italian
Alessia Rossetto | Stefania Laratta | Paolo Tonin | Cecilia Poletto | Giulia Bencini | Alessio Toraldo | Carlo Semenza

Tuesday 13-09-2022

Invited speakers ***Language and control mechanisms*** *(Moderator:* ***Roelien Bastiaanse****)*

9:30-10:30 Kalinka Timmer

10:30-11:00 coffee

11:00-12:00 Manual Carreiras

12:15-13:45 Lunch & Poster session2

Poster session 2

12h15: short (3minutes/3-slides) presentation

201. Do individuals with aphasia show adaptation in online sentence processing? A self-paced listening experiment in German
Dorothea Pregla | Frank Burchert | Paula Lissón | Shravan Vasishth | Leonie F. Lampe | Nicole Stadie

202. The relationship between baseline white matter hyperintensities and longitudinal language outcomes in aphasia
Vadinova, V. | Sihvonen, A.J. | Copland, D. | de Zubicaray, G. | Garden, K. | McMahon, K. L. | Meizer, M. | O\'Brien, K. | Roxbury, T. | Ziraldo, L. | Brownsett, S.L.E.

203. Dual-task interference on word production in aphasia depends on the timing of the secondary task
Cyrielle Demierre | Grégoire Python | Bertrand Glize | Marina Laganaro

204. Language and communication assessment in aphasia: From naming tests, to connected speech and to self-report questionnaire
Michal Biran | Galit Ben-Or | Hila Yihye-Shmuel

205. Aphasic patients with phonetic impairment show phonetic flexibility
Verhaegen Clémence | Huet Kathy | Piccaluga, Myriam | Roland, Virginie | Delvaux, Véronique

206. Cognitive and linguistic intervention in children with Developmental Language Disorder
Theodora Bachourou | Stavroula Stavrakaki | Ioanna Talli

207. Development of a model-oriented assessment tool for verb processing in German (MoVe)
Nicole STADIE | Sandra HANNE

208. The efficacy of aphasia treatment based on temporal information processing
Aneta Szymaszek | Mateusz Choinski | Anna Bombinska | Wolak Tomasz | Elzbieta Szelag

209. Neuropsychological correlates of P300 latency in people with aphasia
Mateusz Choinski | Elzbieta Szelag | Anna Bombinska | Aneta Szymaszek

210. Effect of repetitive Transcranial Magnetic Stimulation on language in mild-AD: evidence from one Slovene-speaker
Georgia Roumpea | Katarina Marjanovič | Andreja Speh | Zvezdan Pirtošek | Jure Bon | Christina Manouilidou

211. Standardization and validation of the French version of the Comprehenive Aphasia Test in L1 and L2 speakers in Switzerland
Gregoire Python | Martina Danna | Elodie Pfyffer | Charlotte Jacquemot | Eva Soroli

212. Systematic review and meta-analysis of the prevalence of cognitive and language impairment post-stroke in young adults
Rosemarije Weterings | Roy Kessels | Frank-Erik de Leeuw | Vitória Piai

213. The effect of transitivity on nTMS mapping of the arcuate fasciculus: evidence from healthy adults and people with brain tumors
Effrosyni Ntemou | Klara Reisch | Frank Burchert | Roel Jonkers | Thomas Picht | Adrià Rofes

214. Exploring language interactions in French speakers with Aphasia: the AADI project
Aleksandra Nowakowska | Thyphanie Prince

14h-15h20 Oral presentations 2 *(Moderator: **Marina Laganaro**)*

- Developmental deep dyslexia in Palestinian Arabic
Manar Haddad-Hanna | Naama Friedmann
- Intraoperative speech and language errors and the relation to postoperative language outcome: A systematic review
Ellen Collée | Arnaud Vincent | Clemens Dirven | Djaina Satoer
- Syntactic and lexical mapping in awake craniotomy
Naomi Levy | Naama Friedmann | Zvi Ram | Rachel Grosmann
- The effect of musicality on language recovery after awake glioma surgery
P.R. Kappen| J. van den Brink| J. Jeekel | C.M.F. Dirven| M. Klimek| M. Donders-Kamphuis| C.S. Docter-Kerkhof | S.A. Mooijman R.D.S. Nandoe Tewarie| M.L.D. Broekman| A.J.P.E. Vincent| D. Satoer

15h30 -> Free afternoon & Social event

Wednesday 14-09-2022

Invited speakers: Language and semantics *(Moderator: **David Howard**)*

9:30-10:30 **Yosef Grodzinsky**

10:30-11:00 coffee

11:00-12:00 **Marco Marelli**

12:15-13:45 Lunch

14h-15h40 Oral presentations 3 *(Moderator: **Wendy Best**)*

- Lexical retrieval models beyond the single word: the case of morphologically complex verbs within sentences in different kinds of aphasia
Yuval Z. Katz | Naama Friedmann
- Imageability and Concreteness - Same or Different?
Dörte de Kok | Natalie Koetsoeba

- What is the origin of associative errors in aphasia?
  Bruna Tessaro | Solène Hameau | Lyndsey Nickels
- Language mixing and factors affecting cross-language activation: A bilingual aphasia case study
  Solene HAMEAU | Urszula DMOWSKI | Lyndsey NICKELS
- Cognitive control and bilingual aphasia: exploratory results in French-speaking bilinguals
  Ezzedine, Nour | de Boissezon, Xavier | Köpke, Barbara

15h45-17h Poster session 3

Poster session 3

15h45: short (3minutes/3-slides) presentation

301. Comparison of T1-weighted and T2-FLAIR MRI lesion volume and its relationship with language recovery
Kimberley Garden

302. Cerebellar tDCS in bilingual post-stroke aphasia: a case-study
Silke Coemans | Anastasia Lada | Dorien Vandenborre | Ineke Wilssens | Sebastiaan Engelborghs | Kyrana Tsapkini | Esli Struys | Stefanie Keulen

303. 'To be' or not 'to be': An analysis of copula omission in patients with Broca's aphasia.
Maria Garraffa | Charlotte Kershaw | Valentina Brunetto

304. Dissociations in novel word learning in aphasia: A case series study
Claudia Peñaloza | Nadine Martin | Matti Laine | Antoni Rodríguez Fornells

305. Nonverbal and verbal cognition in Catalan-speaking individuals with aphasia
Io Salmons | Helena Muntané-Sánchez | Anna Gavarró

306. Systematic review of generalisation effects in single-case speech production treatment studies
Kati Renvall | Auli Laankoski | Anni Suominen | Maria Bukyanagandi |The members of the Finnish Aphasia Therapy Guidelines Project (Jutta Tiensuu, Riitta-Leena Manninen, Sanna Lemmetyinen, Johanna Rantanen, Saara Taipale, & Kati Renvall)

307. Domain-general mechanisms and language recovery after stroke: a longitudinal study
Karen Arellano-Garcia | David Soto | Maria del Mar Freijo | Simona Mancini

308. A Double Dissociation between language and thought: Embedding in Agrammatism and in aTOMia
Maayan Gabso-Rajuan | Noga Balaban | Naama Friedmann

309. Short-term word learning and consolidation through immersive virtual reality
Julie Franco | Marie Couvreu De Deckersberg | Valentin Bourdon | Marina Laganaro

310. The role of cognitive functions, demographic factors, and locality in verb-related morphosyntactic production
Marielena Soilemezidi | Marina Chrisikopoulou | Valantis Fyndanis

311. Linguistic and cognitive abilities in patients with Multiple Sclerosis
Panagiotis Grigoriadis | Christos Bakirtzis | Elli Nteli | Stavroula Stavrakaki

312. Dynamic network approach to the language assessment in patients with a cerebral glioma: on Event-Related Potentials and Spontaneous Speech monitoring
Yana Criel | Edward Baert | Jean-Pierre Kalala | Giorgio Hallaert | Dirk Van Roost | Luc De Baerdemaeker | Wouter Degrève | Marijke Miatton | Patrick Santens | Pieter van Mierlo | Miet De Letter

313. The "MAP" survey: an international investigation of SLPs' training and working practices to assess and treat plurilingual people with aphasia.
Marie POURQUIÉ, Seçkin ARSLAN, Ritienne GRIMA, Valantis FYNDANIS, Maria KAMBANAROS, Silvia

MARTÍNEZ-FERREIRO, Amaia MUNARRIZ-IBARROLA, Monica I. NORVIK, Claudia PEÑALOZA, Grégoire PYTHON, Eva SOROLI, Wei Ping SZE & the Multilingual Aphasia Practice (MAP) Group (Collaboration of Aphasia Trialists Working Group 2)

Thursday 15-09-2022

Invited speakers ***Language and Memory*** *(Moderator:* ***Lindsey Nickels****)*

9:30-10:30 **Naama Friedmann**

10:30-11:00 coffee

11:00-12:00 **Steve Majerus**

12:15-13:45 Lunch & Poster session4

Poster session 4

12h15: short (3minutes/3-slides) presentation

401. Language outcomes in children who underwent surgery for a posterior fossa tumour: A systematic review of the literature
Cheyenne Svaldi | Effy Ntemou | Roel Jonkers | Saskia Kohnen | Vânia de Aguiar

402. Morpho-lexical effects in neglect dyslexia: the case of prefixation
Bianca Franzoia

403. An online investigation of syntactic prediction in aphasia in German
Leonie F. Lampe | Dorothea Pregla | Nicole Stadie | Frank Burchert

404. Strategic language control in voluntary switching in bilingual aphasia: a multiple case study
Saskia Mooijman | Marina Ruiter | Rob Schoonen | Ardi Roelofs

405. Morphosyntactic processing in agrammatic aphasia: An eye-tracking study
Talat Bulut | Volkan Yaman

406. Spatiotemporal patterns of brain activity in EEG data during naming
Anne Beuter | Vitaly Volpert | Quentin Mesnildrey | Gérard Dray | Sébastien Harispe | Andon Tchechmedjiev | Binbin Xu

407. Aphasia Cognitive Screening in Spanish (ACS.esp): a new digital test to asses language in aphasia
Xabi Ansorena | Manuel Carreiras | Mireia Hernández | Isabel Benítez | Simona Mancini

408. Dysgraphias in the sublexical route
Maya Yachini | Naama Friedmann

409. Using error analysis to distinguish between phonological output buffer deficit and apraxia of speech
Aviah Gvion | Hadar Saadya | Naama Friedmann

410. Online Group Meditation for People with Aphasia: A preliminary qualitative study
Britta Biedermann | Anne Whitworth | Deborah Hersh

411. Between-session intraindividual variability in language processing: Links to post-stroke aphasia severity
Lilla Zakariás | Ágnes Lukács

412. A systematic Review: Idiom Comprehension in Aphasia: The Effects of Stimuli and Task Type
Anastasia Lada | Philippe Paquier | Christina Manouilidou | Stefanie Keulen | Silke Coemans

413. How do language age-of-acquisition and dominance influence picture-naming errors in bilingual people with aphasia?
Mareike Moormann | Joana Cholin | Lyndsey Nickels | Solène Hameau | Gary Dell | Larissa Kuehnel | Elizabeth Ambrose | Britta Biedermann

414. Relationships between implicit and explicit auditory sentence processing tasks in aphasia therapy
Claudia Bruns | Amir-Homayoun Javadi | Fern Rodgers | Jane Warren | Rosemary Varley

13h45-14h00 Jean-Dominique Journet, Fédération Nationale des Aphasiques de France

14h-15h40 Oral presentations 4 *(Moderator: **Carlo Semenza**)*

- Investigating the influence of structural damage on the synchronization between the language and MD networks in post-stroke aphasia
  Anne Billot | Maria Varkanitsa | Isaac Falconer | Swathi Kiran
- Right hemisphere structural connectivity and post-stroke aphasia.
  Sonia L.E. Brownsett | Veronika Vadinova | Kimberly Garden | Katie L McMahon | David Copland | Aleksi J Sihvonen | Tracy Roxbury
- A ventral white matter temporal pathway for retrieving proper names in visual modality
  Eléonor Burkhardt | Ilyess Zemmoura | Anne-Laure Lemaître | Sam Ng | Sylvie Moritz-Gasser | Jérémy Deverdun | Fabrice Hirsch | Hugues Duffau | Guillaume Herbet
- The use of EEG in distinguishing a phonological encoding disorder from Apraxia of Speech in individuals with aphasia
  Jakolien den Hollander / Roel Jonkers / Peter Mariën / Roelien Bastiaanse5
- Pilot Study: Effects of rTMS in temporal processes during naming tasks in patients with chronic aphasia
  Françoise de Morsier | Bertrand Glize | Sophie Artheix-Parras / N. Sentucq / Grégoire Python

15h45-16h "Final remarks

16:00 End of the Conference"

The agrammatic comprehension of indirect-object clitic left dislocations in Catalan

by Anna Gavarró | Io Salmons | Universitat Autònoma de Barcelona | Universitat Autònoma de Barcelona

Abstract ID: 5
Submitted: 23/03/2022
Event: SoA 2022 Bordeaux
Topic: Clinical and experimental work on aphasia and related disorders

Introduction and aim

It is well-known that individuals with agrammatic aphasia present problems in comprehending noncanonical sentences (e.g. Caramazza and Zurif, 1976; Grodzinsky, 2000; Bastiaanse and van Zonneveld, 2005; Grillo, 2009). Previous studies have mainly investigated structures like passives, object relatives, clefts and wh-questions, and the aim of the present study is to test the agrammatic comprehension of clitic left dislocations (CLLD) in Catalan, which display noncanonical word orders and are very productive in Romance, with views to evaluating current hypotheses on the comprehension deficit in agrammatism. In addition, previous studies have mostly focused on sentences with verbs with only two arguments. Here we test the comprehension of sentences with three arguments –subject (S), direct (DO) and indirect objects (IO)– in order to investigate the agrammatic interpretation of other thematic structures, namely <agent, theme, goal>. In fact, the complexity of argument structure has been argued to have an effect in agrammatic aphasia, for example, in production (Thompson, 2003).

The studies on the agrammatic comprehension of CLLD are scarce. The only antecedent in Romance is the study conducted in Spanish by Beretta et al. (2001), whose findings showed that the comprehension of DO dislocations was compromised. Previous studies on the comprehension of DO clitics have reported high percentages of correct responses in Romance (Luzzatti et al. 2001 for Italian; Baauw and Cuetos 2003 for Spanish; Gavarró 2008 for Catalan; Martínez-Ferreiro 2010 for Catalan, Galician and Spanish; see Arslan et al. 2021 for a meta-analysis in different languages and aphasias). To our knowledge, the only study that tested the comprehension of IO clitics in Italian, Luzzatti et al. (2001), found that the overall performance of eleven participants with aphasia (PWA) only reached a 53% of correct responses on gender-mismatched sentences.

Methods

Participants

Eight Catalan-speaking subjects with agrammatic aphasia (age range: 41-72, etiology: CVA, TPO: 3-15 year, different degrees of severity and education levels) participated in the study. Eight age- and education-matched adults were tested as controls.

Materials

The task included five conditions with twelve items each, all of them semantically reversible: declaratives (1a), subject topicalisations (1b), IO clitic left dislocations with preverbal (1c) and postverbal (1d) subjects, and declaratives with IO clitics (1e):

(1) a. *El policia va regalar una flor a la nena.*
the policeman gave a flower to the girl
AGENT THEME GOAL
b. *El policia, va regalar una flor a la nena.*
'The policeman, he gave the girl a flower.'
c. *A la nena, el policia li va regalar una flor.*
'The girl, the policeman gave her a flower.'
d. *A la nena, li va regalar una flor el policia.*
'The girl, the policeman gave her a flower.'
e. *El policia li va regalar una flor.*
'The policeman gave her a flower.'

Procedure

The task consisted of a sentence-picture matching task: participants were asked to listen to a sentence and point to the matching picture in a printed sheet. They were shown two alternatives: the target picture and the role reversal. The sentences (#60) were presented in pseudorandom order.

Results

Control subjects performed at ceiling on all conditions. The performance of PWA (see Table 1) varied across conditions: they reached high percentages of correct responses on declaratives, subject topicalisations and sentences with IO clitics, in which they did not differ significantly from the controls. In contrast, the overall performance of the aphasic group on IO dislocations was significantly lower than the controls' performance: OR=15.67, 95% [3.36,73.15] and OR=38.21, 95% [10.45,139.73] for preverbal and postverbal CLLDs. Given that the results involved intersubject variability, specially on dislocations, a goodness of fit test was conducted to learn whether the performance of PWA was at chance. The results showed that the general pattern of response on each condition was reproduced at the individual level, with the exception of three PWA that performed above chance on CLLDs with preverbal subjects.

Discussion

PWA showed good comprehension of declaratives, subject topicalisations and IO clitics, whereas their performance significantly declined on the two IO dislocation conditions.

These findings are consistent with previous research on the comprehension of dislocations and DO clitics in Romance, though not with the data reported in Luzzatti et al. (2001) on the comprehension of IO clitics. The PWA's good performance on IO clitics in the present study was replicated individually and allows us to rule out the possibility that the clitic is the responsible for the poor comprehension of CLLDs . The fact that sentences with IO clitics (1e) were well-comprehended despite the noncanonical word order (S-IO-V-DO) rules out the hypotheses that predict that derived word orders are difficult to comprehend and that non-canonicity is at the source of miscomprehension (DOP-H; Bastiaanse and van Zonneveld, 2005). On the other hand, our findings are consistent with the hypothesis by Grillo (2009), according to which the poor performance is derived as an instance of generalized minimality effects. Under this hypothesis, the subject that stands between the displaced IO and its copy in sentences (1c) and (1d) intervenes giving rise to minimality effects, hence disrupting the comprehension. Finally, the argument structure did not seem to have any effect, as declaratives, subject topicalisations and IO clitics were well-comprehended despite the three-argument structure.

Selected references

Grillo, N. (2009). Generalized Minimality: feature impoverishment and comprehension deficits in agrammatism. *Lingua, 119(10),* 1426-1443. https://doi.org/10.1016/j.lingua.2009.04.003

Luzzatti, C., Toraldo, A., Guasti, M.T., Ghirardi, G., Lorenzi, L. and Guarnaschelli, C. (2001). Comprehension of reversible active and passive sentences in agrammatism. *Aphasiology, 15(5)*, 419-441. https://doi.org/10.1080/02687040143000005

Bastiaanse, R. and van Zonneveld, R. (2005). Sentence production with verbs of alternating transivity in agrammatic Broca's aphasia. *Journal of Neurolinguistics, 18(1)*, 57-66. https://doi.org/10.1016/j.jneuroling.2004.11.006

Table 1. Correct responses by condition

Condition	Group	Count	Mean %	P-value	Standard error mean	Lower mean	Upper mean
Declaratives	Control	93/96	97%	<.0001	0.01493	0.9179	0.9950
	Aphasic	93/96	97%	<.0001	0.01840	0.9039	0.9903
Subject topicalisations	Control	92/96	96%	<.0001	0.02136	0.8895	0.9850
	Aphasic	91/96	95%	<.0001	0.02399	0.8752	0.9793
IO-CLLD preverbal subject	Control	94/96	98%	<.0001	0.01493	0.9179	0.9950
	Aphasic	72/96	75%	.0001	0.05327	0.6321	0.8397
IO-CLLD postverbal subject	Control	92/96	96%	<.0001	0.01840	0.9039	0.9903
	Aphasic	43/96	45%	.4179	0.06415	0.3278	0.5744
IO clitics	Control	94/96	98%	<.0001	0.01493	0.9179	0.9950
	Aphasic	88/96	92%	<.0001	0.03070	0.8333	0.9603

Nonverbal and verbal cognition in Catalan-speaking individuals with aphasia

by Io Salmons | Helena Muntané-Sánchez | Anna Gavarró | Universitat Autònoma de Barcelona | Universitat Autònoma de Barcelona | Universitat Autònoma de Barcelona

Abstract ID: 6
Submitted: 23/03/2022
Event: SoA 2022 Bordeaux
Topic: Language and cognition

Introduction and aim

It is well-known that people with aphasia (PWA) can also present nonverbal cognitive impairments (see Fontseca et al. (2016) for a review). However, the relationship between these impairments and the linguistic deficits that they present is still controversial (among others, Christensen et al., 2018; Little et al., 2019; Choinski et al., 2020). The interest on this debate increased over the last years due to the relevance of nonverbal cognition in clinical practice (Helm-Estabrooks, 2002; Murray, 2012). A comprehensive assessment of individuals with brain injury is useful to design more efficient interventions, still there is a lack of neuropsychological measures to assess cognition and language disorders in aphasia.

Here we present the results from a group of Catalan-speaking PWA on the *Comprehensive Aphasia Test* (CAT; Swinburn et al., 2004; Salmons et al., 2021), which is one of the few batteries designed to evaluate linguistic and other cognitive skills of PWA comprehensively and in a relatively short administration time, which makes it suitable for clinical use. The aim of the present study is to characterize the cognitive and linguistic deficits of Catalan-speaking individuals with aphasia, and to explore whether there is an association between their deficits in language and nonverbal cognition.

Methods

Participants

Eighty-four control subjects (18-90 years old, 50 women) participated in the study, as well as twelve people with different types of aphasia due to left-hemisphere damage (44-78 years old, 7 women, all right-handed, time post-onset: from 10 months to 12 years). All the participants were native speakers of Catalan and had different educational backgrounds.

Materials

The participants were evaluated with the Catalan version of the CAT. The test includes eight tasks to evaluate verbal and nonverbal cognition including verbal and visual short-term memory, semantic memory, executive function, motor praxis, and visual and arithmetic skills. It also includes nineteen tasks to assess specific linguistic skills in comprehension,

production, repetition, naming, reading and writing.

Results

The performance of control participants was at ceiling in all tasks. PWA obtained lower scores on several tasks, especially on those that required language skills: for example, a fixed effects model revealed a main effect of group in the sentence comprehension ($F = 16$, $p < .001$) and word repetition ($F = 22.57$, $p < .001$) subtests. PWA's performance on nonverbal cognitive tasks was higher but still worse than that of controls'; for example, the mean correct responses of the aphasic group on a semantic memory task was of 9.34/10 (range: 7-10), only slightly below the control's performance: mean of 9.79/10 correct responses. However, PWA presented greater intersubject variability than the controls, and two of the PWA did not reach the cutoff point in this task.

We examined whether there was any correlation between certain nonverbal and verbal cognitive measures, which would suggest the disruption of a common underlying mechanism. The results showed that, for example, the scoring on a digit span task measuring verbal short-term memory did not correlate with the scoring on the sentence comprehension task (Spearman coefficient of .57, $p = .056$). However, it was strongly associated with the sentence span task ($r(10) = .62$, $p = .03$), which also measures verbal short-term memory.

Discussion

Our findings suggest that PWA's linguistic abilities are compromised, and that they often present deficits in cognitive tasks that require linguistic skills, whereas their performance on nonverbal cognitive tasks is mostly preserved. These results are in line with crosslinguistic studies that evaluate individuals with different types of aphasia with the same test (Abou El-Ella et al. (2013) for Arabic; Kuvac Kraljevica et al. (2020) for Croatian; Swinburn et al. (2004) for English; Tokac et al. (2019) and Mavis et al. (2021) for Turkish). Aphasic performance was not completely homogeneous in our study, as some patients did present nonverbal cognitive deficits, which is consistent with previous research on the heterogeneous presence of cognitive deficits in aphasia, as they may be dependent on other factors such as the lesion size (Lee and Pyun, 2014; Marinelli et al., 2019). The results also showed that nonverbal and verbal measures were not correlated. These results suggest that the nonverbal cognitive deficits observed in some PWA cannot explain their linguistic deficit.

Selected references

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What is the origin of associative errors in aphasia?

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Introduction: When retrieving words, people with aphasia often produce responses that are related in meaning to the target (semantic errors). Associative errors are one subtype of semantic error, such as answering “school” to the picture of a “desk”. In this study, we investigated the origin of such associative errors in naming tasks in people with aphasia. There are two accounts that posit different explanations for the occurrence of these errors: According to the Controlled Semantic Cognition (CSC) account, associative errors are indicative of a control deficit (Lambon Ralph et al., 2017). This derives from research with individuals who score more poorly on tests of semantic association (e.g., the Pyramids and Palm Trees test; Howard & Patterson, 1992). These individuals are argued to have poorer semantic control and therefore a higher proportion of their semantic errors are predicted to be associative (Jefferies & Lambon Ralph, 2006). Another account suggested that it was item-related properties that influence the type of semantic error (Nickels et al., 2009), as there was no evidence supporting a relationship between participant factors (e.g., level or type of impairment) and type of semantic error.

Aim: We aimed to investigate these two contrasting accounts regarding the occurrence of associative errors in naming in aphasia. **Analysis 1** investigated whether associative errors are a symptom of cognitive control deficits, and **Analysis 2** investigated if the occurrence of associative errors is driven by items’ properties.

Methods: Participants were 212 people with aphasia included in the Moss Aphasia Psycholinguistic Project Database (Mirman et al., 2010), who had data on the Philadelphia Naming Test (Roach et al., 1996) and the Pyramids and Palm Trees Test (Howard & Patterson, 1992). Aphasia profiles, based on scoring on the Western Aphasia Battery (Kertesz, 1982), fell across eight categories: Anomic (n=90), Broca’s (n=50), Conduction (n=39), Wernicke’s (n=21), Transcortical Sensory (n=6), Posterior Cerebral Artery Aetiology (n=3), Transcortical Motor (n=2), Global (n=1) aphasia.

Associative errors were classified manually. We used generalised linear mixed effects models (GLMM) for binomial data with associative errors vs. other semantic errors as the dependent variable. To account for the dependencies in the data, we included both by-subject and by-item random intercepts in the models (Baayen et al., 2008). Likelihood ratio tests and Akaike Information Criterion values (AICs) were used as measures of goodness of fit and therefore provided information for model selection.

The Controlled Semantic Cognition account argues that individuals who score more poorly on tests of semantic association have more severe impairments in cognitive control and these individuals tend to make more associative errors on naming. Therefore, **Analysis 1** investigated whether participants' scores on the Pyramids and Palm Trees Test (PPT) predicted the likelihood of associative errors in naming.

Analysis 2 investigated whether two item-related properties (i.e., Category Cohort Size and Strength of Associates), as well as PPT scores predicted the likelihood of associative errors. Category Cohort Size referred to the estimated number of coordinates (Hameau et al., 2019), and Strength of Associates was calculated based on the sum of the three highest cue-response associative strength values from an association corpus (English Small World of Words -SWOW-EN – de Deyne et al., 2018). We also ran additional models that included, as control variables, psycholinguistic properties of items that have been found to influence naming performance: age of acquisition, familiarity, imageability, lexical frequency, name agreement and visual complexity.

We checked for multicollinearity by examining the correlation between predictors. We used $r = .80$ and variance inflation factors (VIF) > 2.5 as indicative of multicollinearity between predictors (Hutcheson & Sofroniou, 1999; Alisson, 2012). Category Cohort Size and Strength of Associates measures were not substantially nor significantly correlated ($r = -.046$, $p = .545$; VIFs = 1). Thus, both predictors were included in the maximal fixed effect structure of the models.

Results: The output of the linear mixed effects models are shown in Table 1.

Analysis 1 found that PPT did not significantly predict the production of associative errors (Table 1 – Model 1).

In **Analysis 2**, again, there was no significant effect of PPT on the associative errors, and the model structure that best explained our data included Category Cohort Size and Strength of Associates, as well as the interaction between them (Table 1 – Model 2). The results from Model 2 showed that there was a significant main effect of Category Cohort Size on the likelihood of an associative error: the smaller the category cohort, the more likely the error was associative. The interaction between Category Cohort Size and Strength of Associates indicated that associative errors were more likely to occur in items with stronger associates and smaller category cohort size. When we added the six

psycholinguistic control variables to the model there were no differences in the significant main effect of Category Cohort Size nor the interaction between it and Strength of Associates.

Discussion & Conclusions: Overall, our results support an account where it is item characteristics that predict the occurrence of associative errors. The hypothesis that associative errors are a symptom of semantic control deficits was not confirmed, as there was no relationship between the degree of control impairment (as indexed by PPT score) and the rate of associative errors in picture naming. In contrast, there was strong evidence that associative errors were less likely to occur when naming items that have many coordinates (larger Category Cohort Size), and the significant interaction between Strength of Associates and Category Cohort Size suggested that it was when category cohorts were small, that items with strong associates were likely to result in an associative error. Supplementary analyses confirmed that items with larger category cohorts were instead more likely to result in coordinate errors, as also found by others (Bormann, 2011; Bormann et al., 2008; Hameau et al. 2019). These findings contribute to our understanding of semantic processing in aphasia, with accurate interpretation of the source of different types of semantic naming errors influencing theories of semantics and word processing, which in turn have an influence on treatment planning and rehabilitation in aphasia.

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Table 1. Summary of the generalised linear mixed-effects models estimates for the prediction of associative errors vs. other semantic errors

	Model 1					**Model 2**					
Model Equation	glmer(AssociError ~ PPT + (1|Participant) + (1|Item), data = data, family = binomial)					glmer(AssociError ~ CategoryCohortSize*StrengthofAssociates + (1|Participant) + (1|Item), data = data, family = binomial)					
Predictors	*Odds Ratios*	*std. Error*	*CI*	*Statistic*	*p*	*Odds Ratios*	*std. Error*	*CI*	*Statistic*	*p*	*VIF*
Intercept	0.30	0.05	0.22 – 0.42	-7.32	**<0.001**	0.31 ***	0.04	0.23 – 0.41	-8.17	**<0.001**	
Pyramids & Palm Trees	0.91	0.07	0.79 – 1.06	-1.20	0.231						
Category Cohort Size						0.39 ***	0.05	0.30 – 0.51	-7.17	**<0.001**	1.00
Strength of Associates						1.07	0.14	0.84 – 1.37	0.54	0.591	1.02
Category Cohort Size:Strength of Associates						0.69 **	0.09	0.53 – 0.89	-2.84	**0.005**	1.02
	Random Effects										
σ^2	3.29					3.29					
τ_{00}	0.53 $_{participant}$					0.52 $_{participant}$					
	2.98 $_{Test\_word}$					1.93 $_{Test\_word}$					
ICC	0.52					0.43					
N	212 $_{participant}$					212 $_{participant}$					
	174 $_{Test\_word}$					173 $_{Test\_word}$					
Observations	2587					2560					
Marginal R^2 / Conditional R^2	0.001 / 0.517					0.155 / 0.516					
AIC	2437.697					2355.868					

Note. AssociError = associative error, PPT = Pyramids and Palm Trees total score, CategoryCohortSize = Category Cohort Size, StrengthofAssociates = Strength of Associates, 1| Item = random intercept per item, 1|Participant = random intercept per participant. VIF = Variance Inflation Factor. Values of significant effects (p<.05) are printed in bold.

Language outcomes in children who underwent surgery for a posterior fossa tumour: A systematic review of the literature

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Structured abstract only

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

Introduction and aim

Following surgical resection, children with a posterior fossa tumour may have a wide range of spoken or written language impairments, such as word-finding and reading difficulties (Hodges et al., 2021). In approximately one out of three cases, these impairments are part of the paediatric cerebellar mutism syndrome (pCMS). This syndrome is characterised by a transient loss of speech that is often followed by speech and/or language impairments. While postoperative language impairments are not always associated with pCMS, studies have reported worse outcomes in children who experienced pCMS compared to children who did not (e.g.,Ris et al., 2013). More generally, it is unclear if certain language processing levels are more prone to impairment with other levels more likely to be preserved. Furthermore, attempts to identify possible risk factors have been complicated by the considerable variation in the presentation and severity of the observed language impairments (Lewis & Murdoch, 2013).

The present systematic review synthesised the literature regarding the expressive and receptive postoperative language outcomes in children with a posterior fossa tumour. It set out to identify which language levels are more prone to impairment, but also which language functions tend to be preserved. We also investigated if the emergence and severity of the observed language impairments differed depending on demographic characteristics (e.g., age at diagnosis), tumour characteristics (e.g., tumour size, tumour type) and treatment characteristics (e.g., extent of tumour resection). For this second aim, we were particularly interested in the influence of the emergence and duration of pCMS. Potential benefits of this work could be the identification of gaps in the literature and a starting point toward formulating guidelines for postoperative language assessment in this clinical population.

Methods

A comprehensive literature search was conducted, including both peer-reviewed and grey literature (e.g., unpublished theses). Studies with participants who (1) underwent posterior fossa surgery during childhood (< 18 years); (2) were at least two years old at the time of the postoperative language assessment; (3) did not have a premorbid history of developmental language, learning or neuropsychiatric impairment (if possible to identify based on age at assessment) and (4) did not have a preoperative language impairment caused by the presence of the tumour were included. The methodological quality of the included studies was assessed using an adapted version of the Joanna Briggs Institute checklist. Studies of a reduced quality (score < 50%) were excluded.

Narrative synthesis is currently underway. This synthesis summarises the language outcomes of children who underwent posterior fossa tumour surgery. Outcomes are organised by level of language processing (e.g., phonology, morphosyntax). Also, the influence of several mediators on the language outcomes is considered. A critical evaluation of the administered assessment tools is conducted.

Results

Seventy-five studies met the inclusion criteria of which five were excluded because of reduced methodological quality. A final 70 studies were included for the narrative synthesis. A preliminary synthesis of 20 studies showed that lexical-semantics (e.g., naming task) and phonology (e.g., verbal delayed recall task) were assessed most often across studies in contrast to, for example, pragmatics (e.g., analysis of narrative cohesion) and morphosyntax (e.g., sentence assembly task). Even though few studies looked at pragmatics, pragmatic impairments (66%) were most often reported across assessments. The proportion of studies reporting impairments was also high for phonology (64%) and literacy (62.5%). For literacy, both reading (60%) and spelling (67%) tended to be impaired. Lexical-semantics (38%) and morphosyntax (42%), on the other hand, seemed to be preserved in the majority of the included studies.

Nonetheless, a large interindividual heterogeneity in the presentation and severity of the language impairments was observed. For example, in some studies no evidence of language impairment was found (e.g., Docking et al., 2016), while others reported severe language impairments across different levels of language processing (e.g., Cámara et al., 2020).

Discussion

Our results suggest a broad spectrum of language impairments in children who underwent posterior fossa surgery, in line with previous reports by Cámara and colleagues (2020) and Lewis and Murdoch (2013). Pragmatic, phonological and literacy impairments were reported most often (e.g., Cámara et al., 2020). Also, possible strengths in the language profile were identified, such as vocabulary size. Nonetheless, the language impairments

were characterised by a large heterogeneity in their presentation and severity. These results highlight the need for an individualised and comprehensive postoperative language assessment, similarly to other child populations with language disorders (Hodges et al., 2021; Lancaster & Camarata, 2019).

Several issues were identified. A preoperative language assessment was missing in more than 90% of the included studies. This could provide us with an important baseline, allowing us to correctly diagnose the language impairments caused by posterior fossa surgery (Paquier et al., 2020). Also, several gaps in language assessment were identified. For example, pragmatics and verb processing were rarely assessed, in contrast to phonology and lexical-semantics. Finally, the variability of the testing regimes makes any estimates of the prevalence of difficulties across language levels unreliable. Further research is necessary, targeting these gaps in language assessment by focusing, among others, more deeply on morphosyntax (e.g., by evaluating sentence production). It should be noted that the current results are only based on a subset of the data and should be viewed with caution.

The present systematic review synthesised the literature on the language outcomes in children following posterior fossa tumour surgery. Our results suggest that this population may present with a broad spectrum of postoperative language impairments, which is also characterised by a large heterogeneity. This highlights the need for an individualised and comprehensive postoperative language assessment.

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Dynamic network approach to the language assessment in patients with a cerebral glioma: on Event-Related Potentials and Spontaneous Speech monitoring

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Introduction and aim

In patients with a cerebral glioma affecting areas that are involved in language processing, the most favorable outcome in terms of postoperative language function is obtained by awake surgery with intraoperative language mapping. To achieve maximum preservation of language function postoperatively, an extensive pre-, intra- and postoperative language assessment is required. The current pre- and postoperative language assessments used in this population mainly consist of the administration of existing aphasia test batteries and naming tests (De Witte and Mariën, 2013). Similarly, intraoperative language mapping is most often composed of language tasks at the word level, that are selected region-specifically (De Witte and Mariën, 2013; Martin-Monzon et al., 2020). From a hodotopical, dynamic network perspective on the neural organization of language (Duffau et al., 2014), we argue that a pre- and postoperative language assessment based on behavioral batteries provides insufficient insight in neuroplasticity and intraoperative language mapping based on tasks at the word or sentence level cannot sufficiently capture all aspects of speech and language. Therefore, considering the organization of language in dynamic networks, the current study aimed to (1) assess the added diagnostic value of phonological event-related potentials (ERPs) compared to pen-and-paper tasks in the pre- and postoperative language assessments in patients undergoing awake surgery, and (2) assess the utility of the intraoperative language mapping approach proposed by De Witte et al. (2015a, 2015b), consisting of the administration of DuLIP (Dutch Linguistic Intraoperative Protocol, De Witte et al., 2015b) tasks during direct electrical stimulation (DES) of cortical structures and the monitoring of spontaneous speech during tumor resection (De Witte et al., 2015a).

Methods

Five patients selected for awake surgery underwent pre- and postoperative language assessment consisting of behavioral assessment by means of the Comprehensive Aphasia Test/Aachner Aphasia Test and Boston Naming Test, and the administration of a pre-

attentive and attentive phonological auditory oddball paradigm, eliciting the Mismatch Negativity (MMN) and P300 ERP components respectively. ERPs were assessed on a single-case level through the comparison with normative data (Aerts et al., 2013) on the one hand, and the comparison of pre- and postoperative outcome on the other hand. The proposed approach to the intraoperative language mapping was adopted in fourteen surgeries. During DES, language mapping was performed using DuLIP tasks. During tumor resection, language monitoring was performed through the elicitation of spontaneous speech, with the aim of assessing both linguistic, motor speech and cognitive aspects of language.

Results

Regarding the use of ERPs, whereas behavioral ceiling effects were reached preoperatively in three out of five patients, phonological ERPs, specifically the P300, were found to be aberrant/absent in all patients preoperatively. Moreover, although all patients exhibited aberrant phonological ERPs preoperatively, four out of five patients reached normal behavioral and ERP results postoperatively (Figure 1). In regard to the intraoperative linguistic screening approach, in six out of fourteen surgeries it was decided to deviate from the original protocol. In these patients, an early switch was made from language mapping through the administration of DuLIP tasks to language monitoring through the elicitation of spontaneous speech due to (1) reduced arousal or fatigue, (2) the need for monitoring of cognitive functions supporting language processing and (3) time constraints.

Discussion

The use of phonological ERPs in the pre- and postoperative linguistic assessment of patients undergoing awake surgery proved to be a valuable tool. First, phonological ERPs appeared to be more sensitive for the identification of disturbed linguistic processing compared to behavioral assessment. Moreover, preoperative ERPs might provide additional information on preoperative neuroplasticity and thus contribute to the preparation of a patient-specific intraoperative approach. Thirdly, postoperative insights in neuroplasticity using a combination of ERPs and a behavioral language assessment might provide indications for rehabilitation and follow-up. As for the intraoperative protocol, we argue that an early shift to spontaneous speech monitoring might be preferential in some cases, although this should be assessed for each patient individually by an experienced speech-language pathologist. Lastly, these preliminary results indicate that the combined approach of pre- and postoperative ERPs and intraoperative language mapping by means of DuLIP tasks and spontaneous speech monitoring results in a favorable language outcome.

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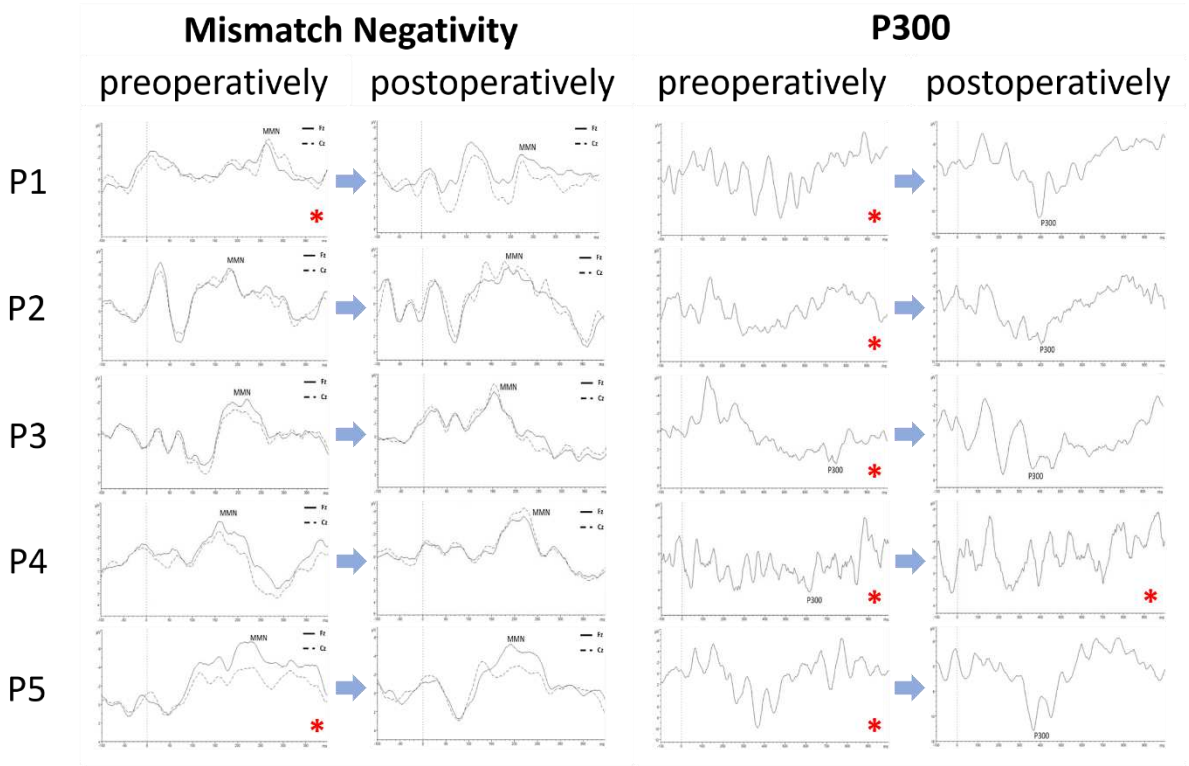
Figure 1. Pre- and postoperative Mismatch Negativity difference wave at Fz and Cz, and P300 deviant wave at Pz for each patient.



Note. *aberrant or absent ERP component in comparison with normative data (Aerts et al., 2013) by means of visual inspection and z-scores.

Negative Concord in Neglect Dyslexia: Evidence from Italian

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Negative Concord in Neglect Dyslexia: Evidence from Italian

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Introduction and aim

Neglect dyslexia (ND) leads to difficulties in processing written material on the contralesional side. Spatial processing in ND seems to be modulated by linguistic structure and content, both on single word and on sentence level. At the lexical-level neglect is modulated by word frequency, word class, concreteness, orthographic neighborhood and spelling regularity. At the sentence level, studies found semantic plausibility effects, with fewer errors on plausible sentences than on non-plausible ones (Vallar et al., 2010). Abbondanza et al. (2020) found that patients with ND made fewer neglect errors in reading sentence initial material when it structurally corresponded to the left periphery of the sentence.

We exploit the presence of a structural dependency between two linguistic elements: in negative concord (NC) two negative elements (*non* and nc-word) follow one another (De Swart & Sag, 2002), but the overall meaning is not a double negation: it is a negative one (e.g., *Non dice mai la verità*, lit. Not tells never the truth [He never tells the truth]). We

suppose that the element on the right acts as a cue to find the obligatory element on its left. We employed sentences with single negation (N), which contrasted minimally with NC sentences: they both presented the sentence-initial negative element *non*, but they differed on the presence of a structural cue in the middle of the sentence. If we assume that spatial exploration of a written sentence in ND is modulated by syntax, the prediction is that the presence of a nc-word may act as a cue in NC structures, leading to the search for the obligatory negative element *non* on the left.

Methods

Participant

ZE was a 61-year-old, Italian-speaking man. He was diagnosed with a left neglect syndrome following a tumor in the right posterior temporal lobe. Tests from the Behavioral Inattention Test (BIT, Wilson et al., 1987), including ND tests, confirmed the diagnosis. The study was approved by the ethical committee of Istituto S.Anna (Crotone, Italy).

Materials

Three sentence types were selected: Negative Concord (NC: e.g., *Non resto mai all'università* [(I) Not stay never at_the university]), Negative (N: e.g., *Non entrano nel loro ufficio* [(they) Not enter in_the their office]) and Affirmative (A: e.g., *Mangiamo solo le patate arrosto* [(we) Eat only the potatoes roasted]) sentences. Two verb types were used: transitive and unaccusative verbs. Transitive verbs were followed by obligatory direct objects (arguments of the verb), while unaccusative verbs were followed by not obligatory elements (adjuncts). In order to test our main hypothesis, i.e., that reading performance is better in NC sentences than in N sentences, we measured accuracy of overall reading and number of neglected words. Responses were counted as accurate when the patient correctly pronounced all the words in the stimulus in the correct order. Neglect severity was defined on the basis of consecutive neglected words starting from the leftmost one.

Results

The patient made 86/150 reading errors, all involving a consecutive spatial portion of the string on the left side. As expected, an effect of Condition was found (χ^2_2= 14.15, p<.001, ΔAIC=+10). NC sentences were read more accurately (60%, 30/50) than N (32%, 16/50) and A sentences (38%, 19/50). Multinomial LR proved the different distribution of neglected words in NC with respect to N (χ^2_4= 35.33, p<.001, ΔAIC=+27) and A (χ^2_3= 35.57, p<.001, ΔAIC=+29). Accuracy increased with time (χ^2_1= 10.788, p=.001, ΔAIC=+9) and decreased with length (χ^2_1= 5.721, p=.017, ΔAIC=+4). In NC sentences, the patient showed a clear bimodality. The trigger for an active search on the left for the initial *non* in NC sentences, which we expected, was found in ca. two thirds of the trials, but a different strategy dominated the majority of the other sentences, with ZE providing pseudo-exclamative responses based on the last 3 words (e.g., *neanche una lettera* [not even a letter]). It seems that in sentences with a post-verbal argument ZE actively looked for the verb, stopped his

search in position 2 when the verb was present, or continued leftward to position 1 if he could not find the verb in position 2. On the contrary, in sentences with post-verbal adjuncts, ZE stopped his search in position 2 not only when he found the verb, but even when the verb was *not* there. The argument effect was significant in A sentences only. In N sentences the missing verb was in position 2, easier to reach, so even the relatively weak cue from an adjunct might be enough to trigger the search on the left.

Discussion

The contrast between NC and N sentences offers strong evidence that the presence of linguistic cues for sentence structure modulates attention during reading in ND. We suggest that the argument status was the cue for transitives: direct object arguments are stronger cues for verbs than adjuncts. In conclusion, our study provides new data from Italian showing effects from structural cues on the reading performance of patients suffering from neglect dyslexia.

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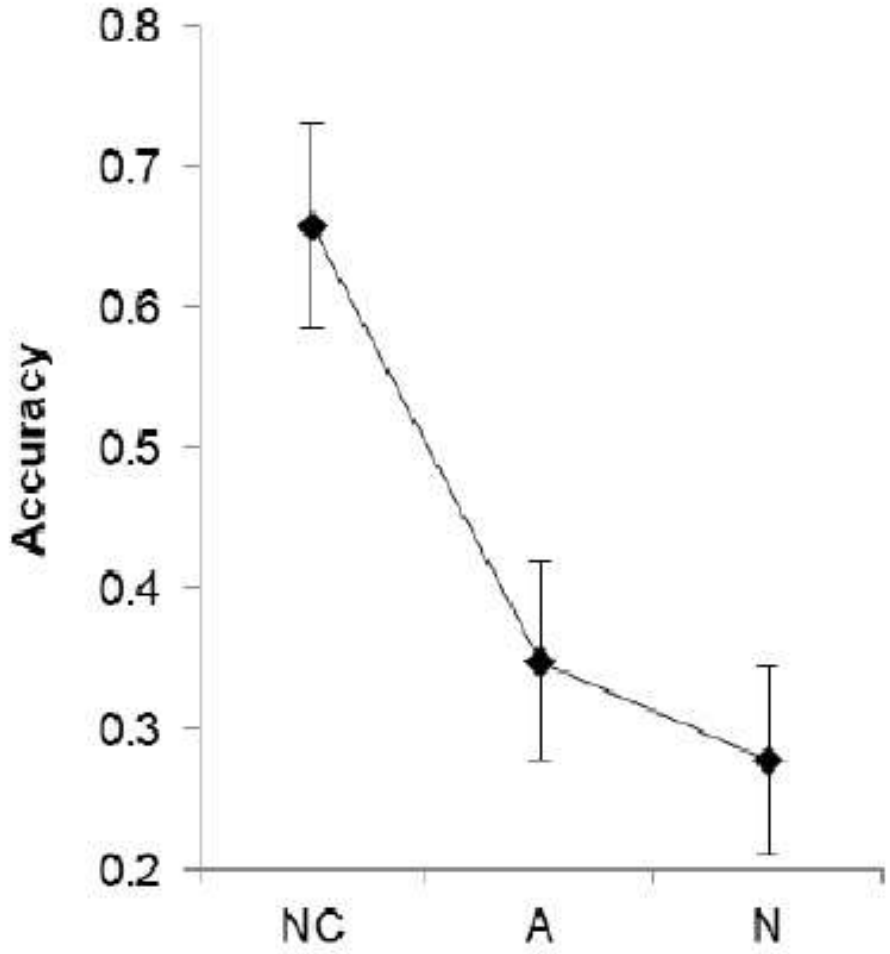

Figure 1. *Accuracy (mean ± SE), estimated by Binomial Logistic Regression Analysis, is shown as a function of Condition: NC, Negative Concord; A, Affirmative; N, Negative.*

Effects of lexical frequency and collocation strength of word combinations on speech pause duration of individuals with and without aphasi

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Introduction

Individuals with aphasia have difficulties with rarer words and weaker collocations, contributing to more and longer pauses. Pauses in speech reveal neurocognitive processes and cognitive effort underpinning language production (Butterworth, 1979). Previous studies in neurotypical speakers have found that pauses in speech were shorter before words with higher usage frequency (Beattie & Butterworth, 1979; Goral et al., 2010). However, frequency also manifests as collocation strength between words. Stronger collocations may be processed more holistically, reducing processing effort. Speakers with aphasia tend to produce more strongly collocated combinations (Bruns et al., 2019, Zimmerer et al., 2018), but so far, the relationship between collocation strength and effort has not been demonstrated. In this study, we investigated the effects of Lexical Frequency and Collocation Strength of two-word combinations (bigrams) on Pause Duration in narrations of individuals with aphasia (IWA) and neurotypical controls (NC). We predicted pauses would be shorter before words of higher frequency, or within bigrams with stronger collocations.

Methods

Participants

The NC group (n = 20) had an age mean of 67.45 years (SD = 8.02) and a mean educational level of 16.8 years (SD = 2.75). The IWA group (n = 20) had a mean age of 58.85 years (SD = 9.93), and a mean educational level of 15.55 years (SD = 3.03). The IWA group included fluent and non-fluent speakers. Mean Boston Naming Test (BNT) scores for IWA was 38.5

(SD = 16.01; Median = 42.5; Min = 2; Max = 59), indicating a wide range of severity, with many participants in the mild-to-moderate range.

Procedures

Participants narrated the “Dinner Party” comic (Fletcher & Birt, 1983), a task where participants described an 8-picture story about events at a dinner party. Transcriptions were annotated using ELAN (Max-Planck-Institute for Psycholinguistics, 2020). We set no minimum duration for pauses, and values could be zero (no pause before a word). Lexical Frequency and Collocation Strength were extracted using the Frequency in Language Analysis Tool (FLAT; Zimmerer et al., 2018). We computed Collocation Strength as t-scores, which describes whether a combination is rare or common considering the frequency of its component words (Gablasova, Brezina & McEnery, 2017). We further categorized words as content or function words using the R package "Spacyr" (Benoit & Matsuo, 2018). We used Linear Mixed Models in order to predict how lexical frequency and bigram collocation strength predicted pause duration. Methods were pre-registered in the Center for Open Science (https://archive.org/details/osf-registrations-9gbvz-v1).

Results

Table 1. Descriptive statistics for Pause Duration, Lexical frequency, Collocation Strength (bigram t-scores) and Pause Duration in neurotypical controls and individuals with aphasia.

	Lexical Frequency; mean and SD (per million)	Bigram Collocation; Strength mean and SD	Pause duration; mean and SD (ms)
NC Group	16594 (1839)	22.97 (4.5)	213.25 (88)
IWA Group	18168 (3167)*	25.35 (10.11)**	1110.5 (983.75)***

* Mann-Whitney U test showed:
- significantly higher lexical frequency (W = 135, p-value < .001) in individuals with aphasia.
- significantly higher collocation strength (W = 500, p-value < .001) in individuals with aphasia.
-significantly longer pause duration (W = 646, p-value < .001) in individuals with aphasia.

IWA produced longer pauses before function words ($p < .001$) in comparison with neurotypical controls. In linear mixed models, when word category was added as a predictor, Lexical Frequency effects were not significant ($\beta = -.03$, $p = .179$). The effect of collocation strength was significant and pauses in speech were shorter within stronger collocations for both groups but had a greater effect in the IWA group ($\beta = -.005$, $p < .001$). There was an interaction between Group and Collocation Strength, with a greater effect of Collocation Strength in IWA ($\beta = -3.54e-03$, $p = .001$). A post-hoc analysis examined the relationship between BNT scores and Lexical Frequency. There was a positive significant correlation between BNT scores and Lexical Frequency ($r_s = .54$, $p = .01$, $N = 20$).

Discussion

Results support the view that weaker collocations contribute to more and longer pauses, incrementing processing demands and affect fluency in speakers, particularly those with aphasia. It is possible that as syntactic/analytic capacities decrease, holistic processing of combinations, shaped by statistical properties in language, gain more importance in language production in aphasia. The non-significant effect of lexical frequency is at odds with previous studies, but the inclusion of both content and function words in the analysis might have influenced these results. Next steps will consider the effects on pause duration within word categories (e.g. nouns/verbs/adjectives in content words). The significant positive correlation between BNT scores and lexical frequency was in the opposite direction to expectations. Individuals with higher BNT scores might produce more fluent language, increasing the lexical frequency due to the inclusion of more function words. In conclusion, frequency-based approaches may be valuable in explaining patterns of preservation and impairment in aphasic language production.

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Analysis of Language Production in Aphasia and Right Hemisphere Damage: Frequency and Collocation Strength. Aphasiology, 32 (11) p1267-1283.

Effects of lexical frequency and collocation strength of word combinations on speech pause duration of individuals with and without aphasia

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Introduction

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Short-term word learning and consolidation through immersive virtual reality

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Structured abstract only

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

Introduction and aim

Word learning is a skill that is used daily even by adults (Hartshorne & Germine, 2015) for learning a new word in the mother tongue, a second language or recovering words after stroke. Integrating a new word to the mental lexicon is a complex process that involves several steps from short-term recall to full consolidation (Van der Ven et al., 2015). While the majority of new word learning experiments studied the consolidation phases indexed with "lexical behavior" effects through word *recognition* tasks (Dumay & Gaskell, 2007), consolidation and "lexical behavior" in word production tasks is often neglected (Clay et al., 2007). Learning method constitute a crucial factor that may influence consolidation (lexical-semantic integration) in word learning (Van der Ven et al., 2015). The development of new technologies tends to allow the creation of learning approaches that are closer to everyday-like communication. Immersive virtual reality (iVR) has the huge potential of integrating a larger number of word semantic properties relative to standard/static learning and this in a context that can be close to everyday life communication (Rodriguez-Mier et al., 2015). Effectiveness of iVR has been widely demonstrated in L2 learning (Dhimolea et al., 2021) and a certain potential has also been demonstrated in recovery in participants with aphasia (Cao et al., 2021), but no study has been interested in word learning through iVR in native language.

The aim of the present study is to investigate whether new-word learning with iVR leads to an advantage relative to more standard/static learning in one or several learning phases from short-term learning to consolidation and lexical-semantic integration in terms of "lexical behavior" tested with word production (rather than recognition) paradigms. The study is carried out with neurotypical adults learning new-words as a proxy of reeducation of anomia in aphasia, to which we will turn in a second phase.

Methods

30 young neurotypical adults learned two lists of 40 rare words matched on relevant psycholinguistic variables (frequency, number of phonemes, phonological neighborhood, and so on) belonging to four semantic categories. The study took place over a one-week period, alternating assessment (day 1, 3, and 5) and learning sessions (day 1, 2, 3, and 4). Learning was carried out tanks to iVR that consists of a market scenario in which participants have to search for objects by asking avatars or with a more standard tablet application. Performance was evaluated at baseline and after each learning period with a picture naming task and a lexical decision task, and at the end only, a picture-word interference task.

Results

In terms of short-term recall, results show that learning with iVR doesn't differ from standard learning in number of words learned, whether assessed in production or in recognition. Interestingly, on consolidation measures (performance tested three days after learning), performance tends to improve relative to short term assessment (picture naming, RT: $t(2019) = -10.88$, $p < .001$; lexical decision, accuracy: $z = -1.97$, $p < .05$, $\beta = -.83$, $SE = .42$). Learning with iVR leads to larger consolidation-related gain on accuracy in recognition (lexical decision) than learning with tablet ($z = -2.88$, $p < .01$, $\beta = -.94$, $SE = .32$) while learning with tablet leads to faster reaction times than learning with iVR ($t(1281) = 4.68$, $p < .0001$). Finally, lexical-semantic integration as measured with a production picture-word interference (PWI) task was also observed for newly learnt words (accuracy: $z = -2.23$, $p < .05$, $\beta = -0.51$, $SE = 0.23$, RT: $t(17) = -1.84$, $p = .06$), which was present only in the sub-group of participants that learned with iVR in the first phase.

Discussion

The absence of advantage of iVR in short-term learning is rather surprising and may be due to limited interactions in the present iVR. However, it should be noted that none of the previous studies has compared iVR to learning with other technologies also involving active word production (Dhimolea et al., 2020). By contrast, the surprising increase in performance in the consolidation phase when a decline has been usually found out (Walker et al., 2020) seems to be related to method-specific performance advantages. Finally, "lexical behavior" in production tested with the PWI has been observed with newly learned rare words similar to frequent words (see review in Bürki, 2020), but only for the group that started to learn with iVR, reveling a potential learning method order effect. iVR seems to have some advantages in terms of consolidation in neurotypical speakers and may be premising for treatment of aphasia, but more investigations are needed in neurotypical adults and in participants with aphasia to achieve a better understanding of word learning and recovery short term and consolidation phases.

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Dual-task interference on word production in aphasia depends on the timing of the secondary task

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Introduction and aim

Utterance production is affected under dual-task conditions (e.g., cooking or walking while speaking), and this may be all the more the case in case of impaired language. It has actually been recognized that utterance planning is not entirely automatic and that conceptualization and lexical selection are affected under dual-task paradigms (Roelofs & Piai, 2011). In people with aphasia (PWA) an increase of lexical errors has been observed in PWA performing a sentence completion task presented simultaneously with a tone discrimination task (Murray, 2000), while Laganaro et al. (2019) have shown an increase of phonological errors in picture naming when concurrent auditory stimuli appeared at SOA +300 ms, likely targeting phonological processes. Given the different effects of dual task interference in Murray (2000) and Laganaro et al. (2019), we investigate in the present study whether interference on lexical and post-lexical processes indexed by specific error types in word production depended on the timing of the secondary task.

Methods

Population

Twenty-one participants (mean age: 59.52) suffering from aphasia following a left hemispheric stroke took part to the Experiment 1 and nineteen (mean age: 59.52) to the Experiment 2. A neurotypical group composed of twenty-six participants (mean age: 38.12) with no history of neurological impairment also took part to both experiments.

Material & tasks

Participants underwent a picture naming task and an auditory syllable detection task in isolation and under dual-task condition. Under dual-task condition, the auditory stimuli (four different CV syllables) appeared at three SOAs (+150, +300 or +450 ms), corresponding to the time-window associated with lexical, phonological and phonetic encoding according to Indefrey (2011). Experiment 1 was performed under divided attention condition meaning that the participants were instructed to name the pictures as fast and accurately as possible, while pressing a key when they heard the syllable /fo/ (associated with filler

pictures, discarded from the analyses). In Experiment 2, the dual-task was performed under focused attention, participants were instructed to ignore all syllables.

Results

In both experiments, an impact of dual-task was found in both groups with an increase of naming latencies at each SOA.

In PWA, phonological errors increased at late SOAs in Experiment 1 (+300 : z=2.37, β= 0.40, SE=0.17, *p*=.02; +450: z=2.25, β= 0.38, SE=0.17, *p*=.02) and 2 (+300: z=4.46, β= 0.74, SE=0.17, *p*<.001; +450: z=2.81, β= 0.48, SE=0.17, *p*<.01). An increase of omission errors was found at SOA +150 ms (z=2.32, β= 0.68, SE=0.29, *p*=.02) under divided attention whereas it was found at each SOAs under focused attention (+150: z=2.21, β= 0.80, SE=0.36, *p*=.03 +300: z=2.99, β= 1.04, SE=0.35, *p*<.01; +450: z=3.00, β= 1.04, SE=0.35, *p*<.01)).

An increase of phonological errors was also observed in the neurotypical group at SOA +300 ms (z=2.39, β= 0.70, SE=0.29, *p*=.02) under divided attention.

Discussion

The results confirm that lexical and phonological processes are impacted under focused and divided attention at specific SOAs, giving rise to specific types of errors. The increase of omission errors at SOA +150 ms (observed only under divided attention) is consistent with a lexical-semantic origin of such errors (Chen et al., 2019). The increase of phonological errors at SOA +300 ms replicates the observations of a previous study with PWA (Laganaro et al., 2019) but it also extends the effect to SOA +450 ms and to neurotypical participants. The increase of phonological errors in both focused and divided attention and both groups, are in favour of the hypothesis that interference is due to the use of competing resources when two tasks involve the same modalities, i.e., the cross-talk hypothesis, (Navon & Miller, 1987). However, not all the results fit this interpretation. First, the increase of omission errors can hardly be attributed to the phonological overlap between the two tasks. Second, the pattern of results is not exactly the same in both experiments, suggesting that some results are specific to the kind of attention involved, which leads to a limitation of the attentional capacities. The overall results are therefore compatible with a combination of interference related to the use of competing (phonological) resources and of a limitation of attentional capacities (He et al., 2021).

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Lexical retrieval models beyond the single word: the case of morphologically complex verbs within sentences in different kinds of aphasia

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Lexical retrieval models beyond the single word: the case of morphologically complex verbs within sentences in different kinds of aphasia

Introduction and aim

Lexical retrieval is a central theme in the cognitive- and neuro-psychological study of language and language impairments. Most models describe the stages of retrieval from a single, abstract, non-linguistic concept to a single phonetic string corresponding to that concept. Accordingly, assessment in the lab is usually carried out by tasks that examine the production of single words. However, outside of the lab, words rarely appear in isolation – they are part of sentences, and are often composed of smaller meaningful units. In this study we consider the sentential context of words and their morphological structure, towards a finer description of the lexical retrieval process, and unified model of lexical retrieval, morphology, and syntax. We use Hebrew non-concatenative morphology as a case study, focusing on verbal alternations. Verbal alternants are verbs that have a different morphological realizations that correspond to the event structure of the sentence. For example, the transitive and the intransitive Hebrew verbs *sagar* and *nisgar* in (1) and (2) respectively both translate into ‘closed’ in English.

(1) dan ***sagar*** and ha-xalon (Dan closed the window).

(2) ha-xalon ***nisgar*** (the window closed).

The two alternants share root consonants (SGR), but differ in the morphological pattern (vowels and affixes). The transitive verb is in the CaCaC pattern, and the intransitive is in the niCCaC pattern. There are five verbal patterns in Hebrew, and all Hebrew verbs (alternating or not) must be in one of them. What makes alternating verbs unique is the morphological alternation in two verbs that share a root, which signifies an alternation in event structure – one of these alternants takes two arguments – an agent and a theme, the other takes only a theme. Although the alternation in pattern is the standard case in Hebrew verbal alternations, the choice of specific pattern is not rule-governed, and therefore must be listed in a lexical component.

By testing aphasic patients with impairments in various loci in the lexical retrieval and syntactic processes we aim to isolate the different stages of morphologically complex verb retrieval, to describe their lexical representation at each stage, and to clarify in what sense they are composed of smaller morphological units. Specifically for alternating verbs, we ask at which stages two alternants (e.g., *sagar* and *nisgar*) share a representation, and at which stages they are distinct entities. Since the distinction between the alternants is related to thematic structure and sentence structure, insights from impairments in alternating verbs allow us to propose a model that integrates lexical retrieval into the construction of sentence structure.

Methods

We designed seven tasks to assess the production of morphologically complex Hebrew verbs with various morphological structures within sentences. The tasks included sentence completion, sentence production to a given verb, picture description, and reading. We then tested 23 Hebrew-speaking individuals with various types of aphasia, whose functional locus of impairment we diagnosed using an extensive battery of tests that do not involve verbal alternations. Finally, we inferred the function of each cognitive component in the production of morphologically complex words based on the error pattern of patients with a selective impairment in this component.

Results

A conceptual deficit characterized by difficulty in role assignment in simple sentences (“who did what to whom”) caused morphological substitutions of verbal alternants, resulting in grammatically correct sentences with incorrect role assignment. A deficit in the syntactic lexicon, characterized by errors in verb complements, caused similar morphological substitutions of alternants, but in this case the substitution resulted in ungrammatical sentences. We found two patterns of deficit in the phonological lexicon (following Friedmann et al., 2021): difficulty accessing the root, or difficulty accessing both the root and the listed morphemes with which it can occur, resulting in morphological substitutions of derivational morphemes. When these derivational errors occurred, they were not restricted to verbal alternations, but occurred in all types of verbs (and derivationally complex nouns), and did not necessarily preserve core meaning. Finally, a deficit in the phonological output buffer caused morphological substitutions of derivational (listed) (not confined to alternating verbs) as well as inflectional (productive) morphemes. A summary of the results and the proposed model are presented in Figure 1.

Discussion

From a clinical perspective, we showed that it is not the case that there exists a single “morphological aphasia”, but rather that deficits in different stages of the retrieval process

entail different types of morphological errors. This can assist in diagnosis, as the nature of the morphological errors can point to the impaired cognitive component. From a theoretical point of view, this means that morphological processes are scattered throughout the retrieval process. Our move towards a model that accounts for units smaller and larger than words brings about a few suggested changes to the standard model of lexical retrieval: most importantly, we suggest that it is not the case that there is a 1:1 correspondence between abstract entries in the semantic lexicon and morpho-phonological representations in the phonological lexicon ("lexemes"), but rather that one abstract entry can correspond to several morpho-phonological representations, depending on the sentential environment. Additionally, we diverge from Levelt (1989) and following body of work in several ways: we claim, based on Biran & Friedmann (2012), that the notion of lemma is not well defined, and that there is a stage of semantic selection separate from both conceptual-message planning and lexical-syntactic information; we show, based on our results, that inflectional morphology is not computed during selection, but at a later stage in the phonological output buffer (informed by the syntactic structure); we claim based on our results that "functional assignment" is superfluous, and can be replaced by processes in the conceptual-message level which later correspond to hierarchical structure.

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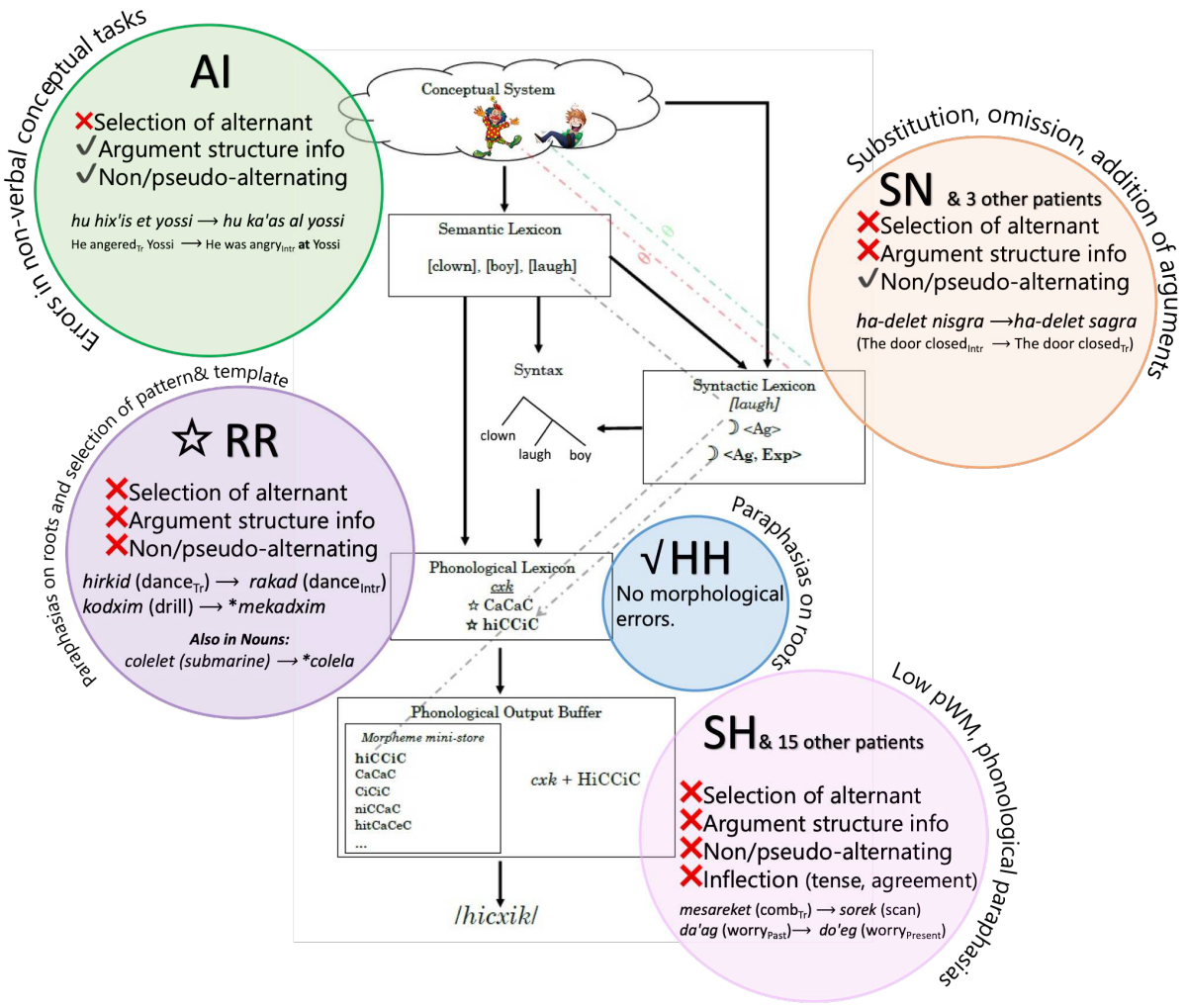

Figure 1: Our proposed model for the retrieval of morphologically complex verbs within a sentence. Each bubble represents a patient or a number of patients, and their locus of impairment.

Language mixing and factors affecting cross-language activation: A bilingual aphasia case study.

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Introduction and aim

Anomia is one of the most prevalent and challenging features of aphasia. Bilinguals with aphasia have an added constraint when producing words: retrieving them in the intended language. Indeed, some bilinguals with aphasia tend to mix languages within a single utterance. Two opposing accounts attribute unwanted language mixing in bilinguals with aphasia to different causes. “Pathological mixing” is thought by some authors to result from damage to the network responsible for language control (e.g., Green & Abutalebi, 2008). Other authors have interpreted language mixing within the context of word retrieval impairments (e.g., Ansaldo et al., 2010; Goral et al., 2019): in that case language mixing may be a (conscious or unconscious) strategy to improve communication. The present study aimed to inform this debate by systematically investigating the effect of several factors, that potentially increase cross-language activation, on the occurrence of language mixing errors in picture naming. These factors were: using the less dominant language, producing words in a bilingual rather than a monolingual context (cf “language mode”, Grosjean, 2008), processing words in two languages within a task rather than in only one, and the phonological similarity of targets to their translation equivalent in the other language. This heightened activation of the non-target language would be predicted to increase language mixing if there was a language control issue, but not if these errors stemmed from word retrieval difficulties.

Methods

The participant, CA, was a 77 year-old individual with chronic aphasia who showed language mixing. CA was a highly proficient late bilingual (L1 Spanish, L2 English) who, at the time of the study, was more Spanish-dominant, although he lived in an English-speaking country. Background testing (bilingualism questionnaires, aphasia assessments in both languages, and non-linguistic cognitive testing) suggested that CA was experiencing parallel recovery of his languages and that his word retrieval impairment was likely primarily located at the (access to the) phonological output lexicon. Finally, non-linguistic cognitive screening suggested good cognitive control abilities.

A picture naming experiment (250 target words in each language) was devised with three conditions: monolingual, bilingual, and immediate retrieval of the word in the "other" language. The target language was either English or Spanish. In monolingual testing sessions, responses were expected in only one language and a native speaker of the target language administered the task using only the target language. Bilingual and immediate retrieval of the target word trials involved switching from one language to the other and were administered, within the same session, by a bilingual examiner who gave instructions in a mix of Spanish and English.

Using logistic and multiple regressions, we investigated the influence on performance (i.e., accuracy, response latency and the occurrence of language selection errors) of four factors likely to influence activation of representations of the non-target language: language (English vs Spanish), language mode (monolingual vs bilingual), task (picture naming vs subsequent retrieval of the word in the other language), and phonological distance of the target word from its translation equivalent (a continuous measure of "cognateness", Downey et al., 2017).

Results

Accuracy was better in Spanish than in English ($X^2(1)=7.53$, $p=.006$) and on words that had higher phonological overlap with their translation equivalent ($X^2(1)=10.88$, $p<.001$).

Latencies were calculated separately for monolingual and bilingual trials, and for subsequent retrieval trials. For monolingual and bilingual trials, latencies were affected by an interaction between language mode (monolingual vs bilingual) and language (English vs Spanish) ($t=-3.02$, $p=.003$); CA was slower in bilingual trials but this was driven by his performance in Spanish and by phonological distance ($t=-2.11$, $p=.035$). Subsequent-retrieval trials were affected by phonological distance. In these trials, CA was faster on words that had high phonological overlap with their translation equivalent ($t=-3.80$, $p<.001$).

Language selection errors were the most frequent error type (29% of all errors – 30% in English and 29% in Spanish). When compared to correct responses, language selection errors were more frequent in English than in Spanish ($X^2(1)=4.89$, $p=.027$), and *less* frequent in the bilingual condition than in the monolingual condition ($X^2(2)=34.23$, $p<.0001$). When compared to omissions, language selection errors were more likely on words with higher phonological overlap with their translation equivalent ($X^2(1)=12.96$, $p<.001$), and more likely in the monolingual condition compared to the bilingual condition ($X^2(2)=118.88$, $p<.0001$).

Discussion

There was no increase in language selection errors compared to correct responses as a

result of the increased activation of the non-target language that was induced by a) the bilingual language mode, b) a task requiring both languages, or c) higher phonological overlap between the target word and its translation equivalent. This is despite the fact that these factors did affect other measures of response (i.e., accuracy and/or response latency), in the direction that is expected in unimpaired bilingual performance (e.g., Costa et al., 2005; Costa & Santesteban, 2004).

Therefore, CA's language mixing errors were most likely not related to the need to inhibit the non-target language and impairment of this ability as a result of a disruption of inhibitory control (e.g., Abutalebi & Green, 2007).

Instead, in CA, these errors were the sign of word-finding difficulties, reflecting his impairment, and in line with research that emphasises the role of word-finding difficulties on language-mixing occurrences in bilingual aphasia (e.g., Goral et al., 2019). We propose that CA most likely used language mixing as a strategy to improve communication. Given that Spanish and English share a lot of cognates, and that it is not unusual for English speakers to know some Spanish or other Romance languages, language mixing may indeed be a reasonable strategy in the present case, as there is an actual chance that the listener will be able to understand the word from the other language.

Therefore, the present study highlights that language mixing behaviours in bilingual aphasia may not be due to issues of control and instead have a potential to improve communication that should be acknowledged, rather than only focusing on their disruptive potential.

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The use of EEG in distinguishing a phonological encoding disorder from Apraxia of Speech in individuals with aphasia

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The use of EEG in distinguishing a phonological encoding disorder from Apraxia of Speech in individuals with aphasia

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Introduction

Both Apraxia of Speech (AoS) and phonological encoding problems can be accompanied by both nonfluent and fluent aphasia (Nicholas, 2005). Therefore, these disorders are difficult to differentiate in linguistic terms in individuals with aphasia (Ballard et al., 2016). Existing methods to differentiate between a phonological encoding impairment and AoS, that use speech characteristics and lesion location are not optimal.

The current study investigated how EEG can be used to differentiate a phonological

encoding disorder from Apraxia of Speech. Speech production includes several stages that take place before articulation: *lemma retrieval*, *lexeme retrieval*, *phonological encoding* and *phonetic encoding*, respectively. In aphasia, either of these stages may be affected, whereas individuals with AoS are assumed to have an impairment at the level of phonetic encoding.

In the current study, we aimed to tease these levels of speech production apart, to identify the levels at which phonological encoding errors and errors caused by AoS occur.

- Lemma retrieval was targeted using the 'cumulative semantic interference effect' (Costa et al., 2009).
- The 'Age of Acquisition effect' was used to study lexeme retrieval (Laganaro & Perret, 2011).
- Phonological encoding was investigated by interpreting the processing cost of reading aloud words with an increasing number of phonemes.
- Phonetic encoding was studied via the 'syllable frequency effect' in reading nonwords (Bürki et al., 2015). The processing cost required for phonetic encoding was expected to increase with decreasing syllable frequency.

Stimulus-locked and response-locked analyses were used to track the different stages of speech production (Laganaro, 2014).

Methods

Sixteen individuals with aphasia due to a single stroke in the left hemisphere participated in this study. Five individuals were diagnosed with a primarily phonological disorder (4 males) and had an average age of 62.4 years (range: 51-76). They were matched on gender, age and education with five non-brain-damaged individuals. Eleven individuals were diagnosed with AoS in addition to aphasia (8 males) and had an average age of 61.6 years (range: 46-70). They were matched on gender, age and education with eleven non-brain-damaged individuals.

The picture naming tests and the reading of nonwords test were administered in one session. E-Prime (E-Prime 2.0, 2012) was used to present the stimuli and to record the response times and the responses. The number of errors was calculated. A voice key was used to detect the response times. The responses were recorded using a microphone that was attached to a headset.

EEG data were recorded with 128 Ag/AgCl scalp electrodes (WaveGuard) cap using the EEGO lab system (ANT Neuro Inc., Enschede, The Netherlands). The electrode sites were distributed over the scalp according to the 10-5 system (Jasper, 1958). Vertical and horizontal ocular movements were recorded.

Results

No differences between the two groups with aphasia were found in the EEG data during the first three stages (lemma retrieval, lexeme retrieval and phonological encoding). For phonetic encoding, individuals with AoS responded faster than individuals with a phonological disorder, but they made more errors. With the EEG-analysis, it was not possible to differentiate the two groups when comparing them to the matched non-brain-damaged individuals: both groups showed a different pattern as compared to the non-brain-damaged individuals in phonetic encoding. However, the specific patterns that the two groups of aphasic speakers showed at this processing level differed. A significant difference between the two groups was found during the processing of nonwords with a moderate syllable frequency in the nonword reading task from 430 to 500 ms after stimulus presentation ($p = .013$). The effect was most pronounced over bilateral central and posterior electrodes, which is also shown in Figure 1.

Figure 1 about here

The waveforms had a comparable morphology. However, the waveform of the difference between the individuals with AoS and their matched non-brain-damaged individuals remained closer to 0 µV than the waveform of the difference between the individuals with a phonological disorder and their matched non-brain-damaged individuals, showing a negativity.

Discussion

This is the first study testing the separate processing stages of the production of words and nonwords in one session in the same two groups of aphasic speakers in comparison to a group of non-brain-damaged individuals. It was possible to differentiate both groups of individuals with aphasia analyzing the EEG patterns at the level of phonetic encoding when reading nonwords with moderate frequency. This was, however, only possible when the patterns of the two groups in relation to those of the matched non-brain-damaged individuals were compared.

Clinically, a phonological disorder and AoS are not always easy to distinguish in individuals with aphasia. The current study, however, shows that by using EEG it is possible to uncover the disordered process in these groups, making it a first step towards a clinical protocol. Further studies should be done to investigate whether it is possible to distinguish the origin of the deficit at an individual level.

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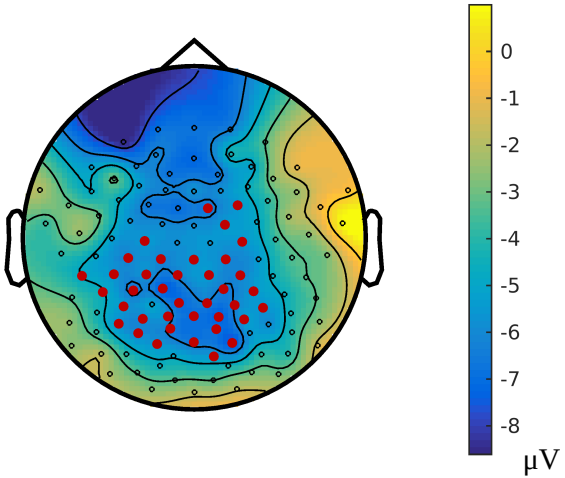
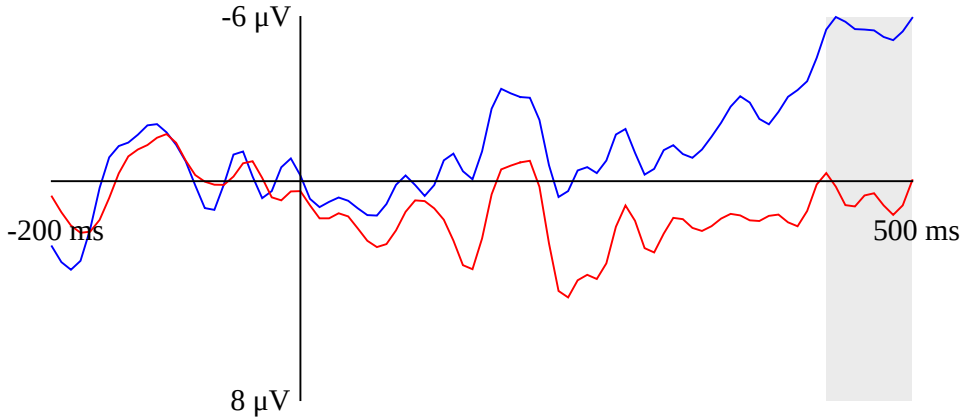
Scalp distribution and waveform of the comparison (Phonological encoding disorder vs. NBD) vs. (AoS vs. NBD)





Scalp distribution showing the cluster of electrodes related to the difference (Phonological encoding disorder vs. NBD) vs.(AoS vs. NBD) observed at 430 to 500 ms post-stimulus onset. The electrodes included in the cluster are marked red.

Waveforms of the difference Phonological encoding disorder vs. NBD (in blue) and the difference AoS vs NBD (in red) based on the grand averages over central and posterior electrodes included in the cluster. The cluster of electrodes is shown in the left panel. The time domain of the effect from 430 to 500 ms post-stimulus onset is marked in grey.

A corpus-based study of pauses and dysfluencies in autobiographic discourse and picture description of individuals with non-fluent aphasia

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Introduction and aim

Fluency disturbances such as pauses, false starts, self-corrections, abusive use of fillers, pragmatic operators and repetitions, are frequent in the speech output of individuals with non-fluent aphasia. Together with grammatical omissions and substitutions, this key feature crucially contributes to a better understanding of both impaired and strategic language use (Kolk & Heeschen, 1990; Kolk, 2006). Besides, (dys)fluency is a highly sensitive indicator susceptible to both inter- and intrasubject variability. Whereas intersubject variability may be linked to aphasia type, across-task intrasubject variability may be determined by the use of differential adaptation strategies related to the focalization on form, which may enable a better grammatical accuracy under certain conditions (Sahraoui & Nespoulous, 2012). Crucially, corrective strategies are only possible for patients with a preserved ability to detect errors and monitor their speech production (Postma, 2000; Oomen, Postma & Kolk, 2001). Under this view, we hypothesize that individuals with non-fluent aphasias, generally having minor comprehension deficits, may over-use monitoring skills in language production at a pre- or post-articulatory stage and that monitoring can vary in relation to the type of task (Sahraoui *et al.*, 2015).

Methods

To delve into this phenomenon in connected discourse, we looked at the temporal aspects and fluency disturbances in 5 French-speaking individuals with agrammatism and 6 controls across two different tasks: autobiographic discourse and picture description. Semi-automated annotation and analyses were conducted on silent and filled pauses using language and speech processing methods (Mac Whinney, 2000; Boersma & Weenink, 2015). The corpora contained a total of 47.209 words (N=23.424 from 5 PWA; N=23.785 from 6 control participants). Analyses included temporal aspects of speech (number and duration of

silent and filled pauses; N=4.298 for PWA; N=1.139 for control participants) as well as overt dysfluencies (repetitions, incomplete words, false starts, self-corrections and revisions (N=1.852 for PWA; N=500 for control participants).

Results

The analysis of pause duration, pause frequency, articulatory rate, and dysfluencies showed differences across groups in both the autobiographic discourse and the picture description tasks. Additionally, the pattern of fluency disturbances in the aphasia group was found to vary across tasks with a significant increase in the proportion of dysfluencies in picture description ($Z = -2.402$; $p = .016$) in the absence of significative differences for pause frequency between these tasks. Speech rate also showed a tendency towards significance ($Z = -1,984$; $p = .054$), with a higher speech rate in the autobiographic discourse task compared to the picture description task. Moreover, specific patterns reflecting individual variation in the aphasia group were attested, with difficulties ranging from word-finding difficulties to effortful speech and excessive reliance on repair strategies.

Figure 1: Silent and filled pause rate, speech rate and frequency of dysfluencies related in autobiographic discourse and picture description for 5 PWA and 6 control speakers

Discussion

Adaptive behavior is an essential feature of agrammatic speech. This is confirmed by the elliptical style or “preventive adaptations” (pre-articulatory), commonly observed in more flexible tasks such as the autobiographic discourse, which shows specific pausing and fluency patterns making discourse “less” non-fluent. By contrast, the description task gives rise to more overt dysfluencies and “corrective adaptations” (post-articulatory), which are imposed by complexity and accuracy requirements induced by the use of pictorial material targeting specific elements.

In line with previous work, a closer look at pauses and dysfluencies confirms that the intervention of pre-or post-articulatory speech monitoring and executive functions can account for the trade-off between fluency and linguistic accuracy across tasks in relation to different (dys-)fluency patterns. The need to better understand the role of dysfluencies in the discourse of PWA may gain from corpus-based studies in typical speech production, through the study of pauses co-occurring with other phenomena (Grosman *et al.*, 2018) or “fluencemes” (Crible *et al.*, 2017). Some of the pauses and dysfluencies could therefore be

categorized in aphasia as (dys-)fluencemes leading to a more accurate morpho-syntactic formulation (assuming a structural role) or fluencemes for speech micro-and macro-planning (assuming a discourse functional role).

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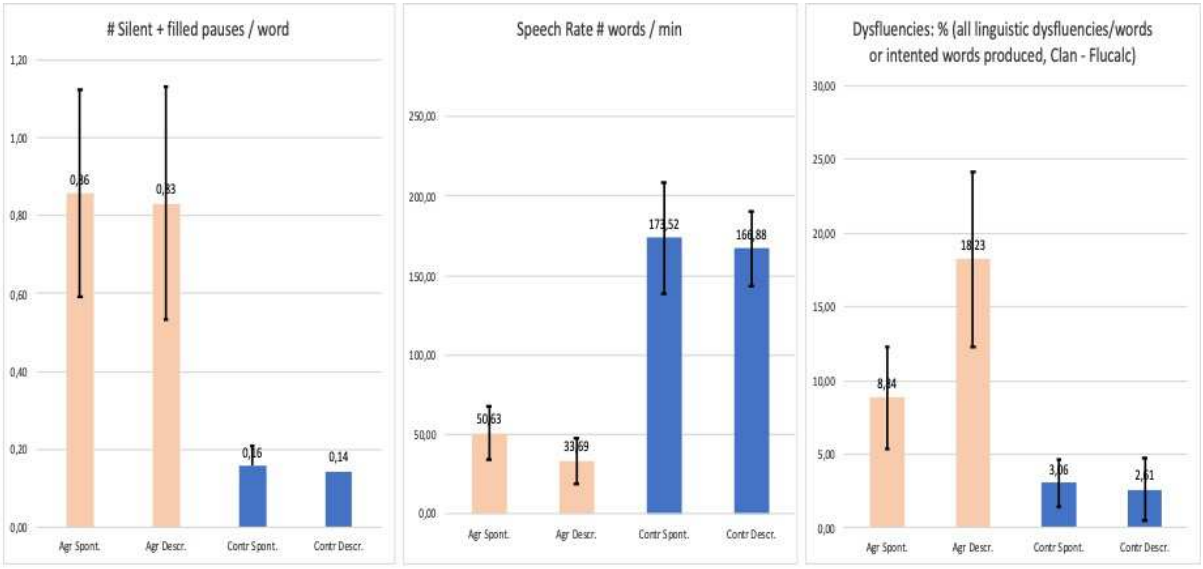

Figure 1: Silent and filled pause rate, speech rate and frequency of dysfluencies related in autobiographic discourse and picture description for 5 PWA and 6 control speakers

Language and communication assessment in aphasia: From naming tests, to connected speech and to self-report questionnaire

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Topic: Clinical and experimental work on aphasia and related disorders

Introduction and aims: Language assessment includes mainly structured tasks, which are relatively easy to score. However, everyday communication requires additional, more complicated, abilities. Therefore, the psycho-social approach to aphasia treatment emphasizes the need to include less structured tasks, and specifically conversation, in the assessment (Simmons-Mackie et al., 2005).

An important clinical question is whether the performance of an individual in structured language tasks can predict his performance and participation in everyday communication.

Lexical retrieval deficits constitute a good opportunity to compare between structured tasks, which require a single word retrieval, and less structured tasks, which require word retrieval in a context of a story telling or conversation. Previous studies revealed contradicting findings concerning the difference between single word retrieval and retrieval in connected speech (e.g., Best et al., 2008; Conroy et al, 2009; Pashek & Tompkins, 2002).

Additional information can be obtained from questionnaires, in which individuals with aphasia (or their caregivers) answer questions regarding their language, communication, participation and/or well-being.

In this study, we focused on lexical retrieval, and compared between word retrieval in structured tasks and less structured tasks. In addition, we administered the Aphasia Impact Questionnaire 21 (AIQ-21. Swinburn et al., 2018; Hebrew version: Ben-Or & Biran, 2021) – a pictorial self-report questionnaire, adjusted for individuals with aphasia, which consists of 21 questions and evaluates communication, participation and well-being.

There is a lack of assessment tools that examine participation and well-being of individuals with aphasia in Hebrew. Therefore, the adaptation of the AIQ-21 to Hebrew has a potential clinical contribution.

This study aims to examine whether the performance on structured tests, that are used in the clinic, represent the individual’s participation in everyday communication – as manifested in word retrieval in connected speech; and whether the performance on these measures is compatible with the individual’s subjective self-report on participation and well-

being, in the AIQ-21 questionnaire.

Methods: Five individuals with aphasia participated in the study (mean age: 69 years, range: 55-76 years). All were native Hebrew speakers, with 10-19 years of education (mean: 15 years). They were 19-36 months post-stroke (mean time: 28 months), and all lived in their homes at the time of testing. They had normal or corrected to normal vision and hearing; with no significant cognitive impairment.

The participants were diagnosed with different types of aphasia, with comprehension that enabled understanding of the tasks and answering the questionnaire.

Inclusion criteria: (a) Performance of at least 90% correct responses on the auditory yes/no questions subtest, and at least 75% correct responses on the reading comprehension subtest (WAB; Kertesz, 1982; Hebrew version: Soroker, 1997); (b) Good performance on a cognitive screening test – CASP (Cognitive Assessment scale for Stroke Patients; Barnay et al., 2014; Hebrew version: Rosenheck et al., 2021).

Research tests: (1) SHEMESH naming test (Biran & Friedmann, 2004, 2005) – naming 100 pictures of objects; (2) Naming to definition (Gvion & Biran, 2015) – 76 definitions of concrete and abstract words; (3) Story telling according to a series of 6 pictures (Gagarina et al, 2012); (4) Conversation about the place in which the participant lives, by answering five questions; (5) AIQ-21 questionnaire.

Word retrieval in connected speech (tasks 3+4) was assessed using two measures: (a) the %WR (Mayer & Murray, 2010) – calculating of the percent of correctly produced nouns and verbs out of the total number of nouns and verbs; and (b) the Measure of Participation in Conversation (MPC. Kagan et al., 2004, 2018) – measuring interaction and transaction, on a scale of 0-4.

Results: (a) At the group level, word retrieval in connected speech was significantly better than in the structured naming tasks. (b) At the individual level, the difference between the two types of tasks ranged from 5% to 38%. (c) In the AIQ-21 questionnaire, various responses were achieved – some participants reported difficulties despite relatively high performance on the language tasks, while the responses of other participants seemed more compatible with the level of their performance on the language tasks.

Discussion: These preliminary results indicate the importance of including tasks of connected speech in the language assessment of individuals with aphasia. In addition, it was demonstrated that additional information – which is important for treatment goals' assignment – can emerge from subjective evaluation, based on the person's report in a questionnaire concerning his communication, participation and well-being.

We are currently testing additional participants in order to establish the findings and to

examine correlations between the different tasks.

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Intraoperative speech and language errors and the relation to postoperative language outcome: A systematic review

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Introduction and aims

Awake craniotomy with direct electrical stimulation (DES) is the standard treatment for patients with eloquent area gliomas. Even though language is monitored carefully during surgery, many patients suffer from postoperative language deficits (Santini et al., 2012), with negative effects on quality of life. Different factors can influence or predict postoperative language outcome, including tumor characteristics (Satoer et al., 2012) and preoperative language status (Bello et al., 2007), such as object naming performance (Ilmberger et al., 2008). A few studies found that intraoperative factors also play a role, such as the occurrence of positive sites during DES (Bello et al., 2007; Duffau et al., 2008) and the intraoperative performance on the Pyramids and Palm Trees Test (semantic memory) (Chang et al., 2018). However, the possible influence of intraoperative speech and language error types on language outcome is not clear. Therefore, we systematically investigate the potential relation between different types of intraoperative speech and language errors and the occurrence of postoperative language deficits.

Methods

A systematic search was performed. We included 81 studies reporting specific speech and language errors during awake craniotomy with DES and the postoperative language outcome in adult glioma patients. Information was extracted from the articles: number of patients, tumor grade/location, speech and language errors, and language status (mainly based on clinical observations and in some cases on standardized tests and patient reports). Categories were formed for: intraoperative speech and language errors (anomia, phonemic errors, production errors, semantic errors, speech arrest, other errors), time points (T0) preoperatively, postoperatively: T1) acute: 1 day-10 days, T2) subacute: ≥2 weeks-3 months, T3) short term follow up: ≥3 months-8 months, T4) long term follow up: 12 months-15 months), and language outcome (modality/syndrome: comprehension, production, reading - Broca’s aphasia, conduction aphasia and/or linguistic level/other: phonology, semantics, word finding - spontaneous speech, articulation, verbal apraxia).

First, the frequency of all intraoperative errors and language status (language deficits: yes/no/unknown) was calculated. Secondly, a binary logistic regression with preoperative language status (language deficits: yes/no/unknown) and intraoperative speech/language errors as predictors and postoperative language outcome (language deficits: yes/no) as the

dependent variable was performed for T1 and T3 (reference categories: no preoperative language deficits, intraoperative speech arrest: due to high frequency in the dataset). No regression could be performed for T2 and T4 due to lack of sufficient data points.

Results

Description of intraoperative speech/language errors and language status

14 different intraoperative error types were reported, of which some frequently (>20%: speech arrest, anomia) and some infrequently (<0.5%: irrelevant paraphasia, neologisms, verbal apraxia). Language status was often reported, in >70% of the instances, at T0, T1, and T3, but only in <12% at T2 and T4. Preoperatively, language deficits were present in 34.9% of the cases. This increased to 68.9% at T1 and then decreased to 14.6% at T3.

Relation to postoperative language outcome at T1 and T3

Preoperative language deficits (OR: 3.42, $p < .001$), intraoperative anomia (OR 2.09, $p = 0.015$), and intraoperative production errors (OR: 2.06, $p = 0.016$) were significant predictors for postoperative language deficits at T1 (see Figure 1). Additionally, preoperative language deficits (OR: 1.95, $p = 0.007$) was a significant predictor for postoperative language deficits at T3 (see Figure 1).

Discussion

We found that most language deficits occurred at T1 and were resolved by T3. This pattern of postoperative transient language deficits is well-known (Duffau et al., 2002; Finch & Copland, 2014). However, 14.6% still experienced language deficits at T3, implying that a longer follow up period is necessary for this patient group, as also indicated by Satoer et al. (2016).

Additionally, results confirm that the chance of postoperative language deficits at T1 and T3 was higher when preoperative language deficits were present. This is in line with the literature (Bello et al., 2007, Ilmberger et al., 2008). The chance of postoperative language deficits at T1 was also higher when intraoperative anomia and production errors occurred, underlining the importance of an object naming test and production test (e.g. repetition, verbal diadochokinesis) during surgery.

Limitations and future research

A limitation of this study is that the articles varied in the way they reported intraoperative errors, postoperative time points and details of language status. Additionally, it is not surprising that intraoperative anomia is found as a significant predictor for language outcome, since most studies only used object naming during intraoperative mapping. This task will often elicit anomia, but may be less or not prone to elicit other errors such as syntactic or reading errors. Hence, errors may have been missed due to the lack of application of various language tasks during surgery. Further research should focus on the sensitivity of a wider range of language tasks (apart from object naming) and their relation to specific speech and language errors .

Furthermore, future prospective research may deliver more evidence regarding the prognostic value of intraoperative speech and language error types on postoperative language outcome. This may facilitate decision making during awake brain surgery in the future, which could possibly lead to less postoperative language deficits.

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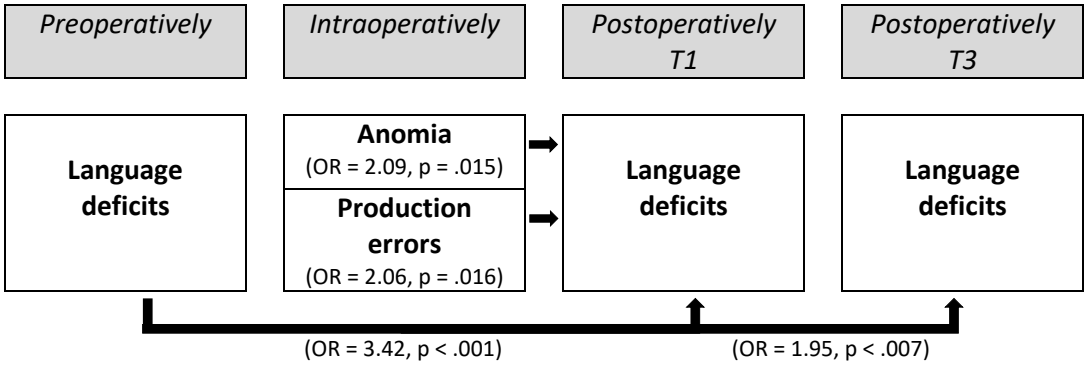
Figure 1: Significant preoperative and intraoperative predictors for the postoperative language outcome (T1, T3)



T1 = acute: 1 day-10 days, T3 = short term follow up: ≥3 months-8 months, OR = odds ratio
Reference categories = no preoperative language deficits, intraoperative speech arrest

The efficacy of aphasia treatment based on temporal information processing

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Introduction and aim

Traditional therapy of aphasia is based on speech and comprehension exercises used to improve deficient language functions directly. It was, however, evidenced that aphasia is usually accompanied by deficits of non-language cognitive functions, i.e., executive functions, attention or working memory. Deficits in these cognitive functions intensify the speech difficulties in people with aphasia (PWA) and hinder the process of rehabilitation. In aphasia treatment, therefore, training methods aimed to enhance deficient non-language cognitive functions are also implemented. Several studies have reported beneficial effects of working memory and attention trainings on language functions in PWA (Majerus, 2018; Zakarias et al., 2018).

A number of evidence has indicated that aphasia is also accompanied by deficits in temporal information processing (TIP) in millisecond time range. These deficits were evidenced in elevated thresholds for identification of order of events presented in rapid succession (e.g., Wittmann et al., 2004; Fink et al., 2006; Szelag et al., 2014). According to previous studies, TIP may be considered as a logistic function, creating a neural frame for many cognitive functions, including language, which are characterised by the specific temporal dynamics (von Steinbüchel & Pöppel, 1993). The improvement of TIP may, thus, result in amelioration of those content-related functions. Previous studies showed that the prototypical training in TIP resulted in amelioration of language functions in PWA (Szelag et al., 2014; Szymaszek et al., 2017).

In our Laboratory of Neuropsychology, Nencki Institute of Experimental Biology PAS, the innovative therapeutic tool Dr. Neuronowski® based on TIP was developed. This software includes exercises of millisecond TIP and sequencing abilities. Previous versions of this tool were effective in language therapy of children with specific language impairment and in

cognitive training of the elderly.

The aim of the present study was to compare the effects of two aphasia therapy programs: (1) the novel training method Dr. Neuronowski® and (2) a multimedial speech training.

Methods

Thirty four patients (22 male and 12 female) suffering from post-stroke, mixed aphasia after haemorrhage or ischemic stroke (lesion age M ± SD = 55.5 ± 56.47 weeks) participated in the study. They aged from 30 to 82 years (M ± SD = 58.59 ± 12.58 years), were right-handed Polish native speakers and had normal hearing level. Apart from stroke they had neither neurological nor psychiatric disorders and reported no history of head injuries.

The lesions were localized in the left hemisphere and comprised mainly structures of frontal and temporal lobes such as: frontal orbital cortex, middle and inferior frontal gyrus, superior and middle temporal gyrus.

Cognitive assessment was performed three times: before and after the training as well as in follow-up assessment conducted three months after the training completion. The assessment included several cognitive functions, i.e., language: sentence and word comprehension, comprehension of syntactic structures, phoneme discrimination, verbal fluency and naming, as well as selected non-language cognitive functions: TIP, psychomotor speed, planning, verbal and spatial short-term memory and working memory.

Patients were randomly assigned to one of the two groups trained either with Dr. Neuronowski® software (n=18; experimental group) or with the control training based on multimedia speech therapy games (n=16; control group). The protocol of each training program consisted of 24 sessions performed three times a week.

Results

Both experimental and control treatment ameliorated several cognitive functions. Patients in both groups improved in comprehension of syntactic structures and naming, as well as in planning. However, only patients in experimental group improved in non-language functions such as TIP, spatial short-term memory, verbal short-term and working memory, as well as in language functions such as sentence comprehension, phoneme discrimination and verbal fluency. The analysis of follow-up assessment confirmed the stability of these effects of both trainings after 3 months of training completion.

Discussion

The results indicated the divergent beneficial effects of both trainings. Following the control

training the near transfer was observed, i.e., the training was beneficial mainly for language functions exercised directly, extended by the amelioration of planning. On the other hand, the patients in experimental group improved trained non-language cognitive functions, including TIP, as well as untrained language functions. The enhancement of unpracticed language production and comprehension may indicate the far transfer following the treatment with the Dr. Neuronowski® software. As TIP constitutes the neural frame of other functions, the improvement of TIP resulted in amelioration of broad aspect of cognitive functions, including impaired language. These results are in line with the previous works reporting the close relationship between language and TIP (Szelag et al., 2015; Szymaszek et al., 2017). This study suggests that training in TIP may be the promising direction in aphasia treatment and may be included in therapy programs.

Funding

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Neuropsychological correlates of P300 latency in people with aphasia

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Introduction and aim

Event-related potentials (ERPs) are useful method to assess cognitive functions in various clinical groups. They are also commonly used in people with aphasia (PWA), as they enable to investigate behaviorally non-observable physiological processes underlying the cognitive functions measured with neuropsychological methods. Due to communication difficulties in PWA it is often problematic to reliably assess non-language functions with neuropsychological tests, as they require verbal communication. Using ERPs, various cognitive functions may be, however, objectively assessed.

P300 is a large positive ERP component elicited by changes in the neural representation of a stimulus's context (Polich, 2012). Its amplitude is considered as a measure of central nervous system activity which reflects the processing of incoming information when memory updating is engaged. On the other hand, the latency is viewed as an index of stimulus classification speed, as well as a sensitive temporal measure of neural activity underlying attention allocation and immediate memory. It has been reported, that P300 latency correlates with efficiency of many cognitive functions. Shorter latencies usually correspond to better cognitive performance (Polich & Martin, 1992). P300 latency gets longer with aging, in parallel to age-related cognitive declines (Fjell & Walhovd, 2001). Abnormal P300 parameters are also observed in many pathological states, like Alzheimer's disease (Lee et al., 2013) and Parkinson's disease (Nojszewska et al., 2009).

There is sparse knowledge about the nature of P300 in PWA. Few studies have examined the P300 component during the process of recovery from aphasia. Authors (Cocquyt et al., 2020) reported that those PWA who displayed auditory P300 in acute/subacute stroke phase displayed greater progress in restitution of speech comprehension over time.

The aim of this study was to explore in PWA the relationships between P300 parameters and the language and non-language cognitive functions measured neuropsychologically.

We hypothesized that P300 latency, as a neurophysiological marker of processing speed,

will be associated with cognitive functions for which temporal processing seems crucial. Furthermore, we hypothesized that P300 latency will be associated with language functions as faster processing the incoming language units indicates the effective language performance. The slower speed of processing may intensify language difficulties in PWA. Referring to previous literature studies, we also expect the relationship between P300 latency and short-term memory retention capacity in PWA.

However, in accordance with the theories (Polich, 2012), we expected that P300 latency tends not to be related to more complex cognitive functions which based on mental manipulation, updating, etc.

Method

Twenty five PWA (16 male) after their first left hemispheric stroke (haemorrhage or ischemic; lesion age M± SD = 53 ± 50 weeks) participated in the study. Participants varied in age from 40 to 78 years (M± SD = 60 ± 12 years). They were right-handed native speakers of Polish.

EEG signals were recorded during the performance of a visual Go/No-Go task. P300 was identified in time window between 300 and 600 ms on signal from nine electrodes pooled in three lines: left (F3, C3, P3), central (F4, C4, P4) and right (F4, C4, P4). Neuropsychological assessment included several non-language functions, such as: temporal resolution, psychomotor speed, verbal and spatial short-term memory, divided attention, planning, task-switching, verbal and spatial working memory, as well as language ones: word and sentence comprehension, phoneme discrimination and verbal fluency.

Results

Correlational analysis revealed that shorter P300 latencies were associated with more efficient cognitive functions. For non-language functions it was reflected both in better temporal resolution and psychomotor speed. Furthermore, shorter latencies corresponded to better spatial short-term memory and better planning. In parallel, in the language domain, shorter P300 latencies were also associated with better performance in word and sentence comprehension tests, as well as with higher numbers of correctly produced nouns in verbal fluency test. On the other hand, for the amplitude, only fragmentary significant correlations with cognitive functions were noted.

Discussion

The results are congruent with previous knowledge about associations between P300 parameters and neuropsychological measures of cognitive capacity. Similarly to other clinical groups, in PWA P300 latency appears be related to cognitive functioning, especially to measures in which speed of processing seem crucial. However, P300 tends not to be

related to more complex cognitive functions, such as divided attention and working memory. Generally, P300 latency may be used as a neurophysiological correlate of cognitive impairment in PWA and might be potentially applicable to monitor the effects of therapeutic interventions.

Funding

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Cerebellar tDCS in bilingual post-stroke aphasia: a case-study

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Introduction and aim

DCS is a promising neuromodulation tool that has been found to increase efficiency of speech-and language therapy in patients suffering from post-stroke aphasia (Biou et al., 2019). However, while an increasing number of patients speak multiple languages, past research has mainly focused on monolinguals. In addition, the search for (an) optimal stimulation site(s) is ongoing: targets of tDCS stimulation have mainly been limited to one cortical area, usually the left hemisphere language areas, and right hemisphere language homologues. The efficiency of tDCS on cortical regions differs between individuals, and speech-and language involve multiple complex neural networks. Limiting stimulation to cortical language areas might conceal the importance of other valuable network components (Sebastian et al., 2020).

This case study illustrates the potential usefulness of targeting the right cerebellum in a bilingual chronic post-stroke patient. The cerebellum is a strong candidate location for tDCS in bilingual patients, because of its anatomical connections with left hemisphere language areas, and the role it plays in language function, (bilingual) language control, executive functions, and cognition (Mariën et al., 2017). Anodal stimulation of the inhibitory Purkinje cells of the cerebellum leads to increased inhibitory effects on the basal ganglia and contralateral cortical prefrontal regions, additional regions included in the language control network, specifically important for bilinguals. This leads to disinhibition of basal ganglia output, increasing stimulation of the array of cortical regions reached by the basal ganglia and cerebellum: the prefrontal, temporal, posterior parietal, oculomotor and premotor cortex (Booth et al., 2007). In monolinguals, three studies so far have found cerebellar tDCS to lead to positive results on language improvement (Marongolo et al., 2018, Sebastian et al., 2017, Sebastian et al., 2020).

Our aim is to investigate whether cerebellar tDCS stimulation applied to the right cerebellum in right-handed *bilingual* aphasic patients, and hence contralateral to the left cerebral hemisphere, has a positive impact on language outcome in the treated language (language of therapy) and non-treated language.

Methods

Participant: The individual with aphasia was a right-handed 73-year-old male who experienced a left-hemisphere stroke 27 months before entering the study. The participant was bilingual in French (L1) and Dutch (L2), with aphasia most severe in L2. He presented with non-fluent aphasia, with weakest test performance on the naming of nouns, verbal fluency and oral and written sentence comprehension subtests of the Dutch version of the Comprenhensive Aphasia Test.

Language outcomes: The main outcome measure was change in oral naming accuracy for trained and untrained picture exemplars, tested prior to the start of the treatment, end of treatment, and 2 months post-treatment. Stimuli of both measures were matched for lexical frequency, concreteness and number of syllables. Secondary language outcomes measures were performance on subtests of the Bilingual Aphasia Test, picture description tasks and verbal fluency. Language training was provided in L2, upon request of the participant.

tDCS: We used a double-blind, within-subject crossover trial design, with two experimental conditions: “right cerebellar tDCS + L2 oral anomia treatment” and “sham tDCS + L2 oral anomia treatment”. Each condition consisted of 15 consecutive training sessions, 3 per week, separated by 2 months. tDCS was delivered at a constant current of 2mA, administered for the first 20 min of the 30-min treatment session. The anode was centered on the right cerebellum, 1 cm under, and 4 cm lateral to the inion, and the cathode was placed on the righted deltoid muscle (Sebastian et al., 2020). Sham tDCS was applied using the same electrode configuration, but current intensity was ramped down to zero after 30 s.

Results

Results will be added on language outcomes in a bilingual non-fluent aphasia patient after cerebellar tDCS. A comparison is made in changes from baseline after real and sham tDCS. For each treatment condition (sham and tDCS), we compared the performance 1) pre-treatment and immediately after treatment, (2) pre-treatment and 2 months post-treatment on each stimulus type. The patient is evaluated on oral naming accuracy of trained items (Dutch), oral naming accuracy of untrained items (Boston Naming Test, in Dutch and French), and secondary outcome measures in Dutch and French.

Discussion

tDCS is a promising tool for neuromodulation to enhance effects of speech and language therapy of post-stroke aphasia, however, an optimal stimulation site has yet to be identified. Further, tDCS research in bilingual aphasia is scarce, but necessary, as bilingualism is more and more common in today’s world. In this case-study, we expect to show whether stimulation of the right posterolateral cerebellum combined with oral anomia treatment can

improve picture naming in post-stroke aphasia, and take results in both patient's languages under investigation. Targeting the intact right cerebellum, an area involved in language and (bilingual) language control, allows for the possibility of targeting a single region that may possibly be used across different types of aphasic patients, with varying lesion sites and sizes, often occurring in the left hemisphere.

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Exploring language interactions in French speakers with Aphasia: the AADI project

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Topic: Language and cognition

Structured abstract only

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

Introduction and aim

The “Aphasia and Discourse Analysis in Interaction” (AADI) project is a FEDER project that aims to develop a French database of the oral speech of persons with aphasia (henceforth PwA). The AADI project has several objectives:

(1) Build a French language database

The main interest is to collect French language data from persons with aphasia in the form of audio-visual recordings of the control participants and those with aphasia, according to a precise protocol involving several tasks (*cf.* details in the method section). The interviews are transcribed and annotated using the coding manual and annotation system that has been adapted for the project (with CLAN). All of these new corpora (recordings, transcriptions, coding manual, etc.) will be made available to the scientific community and health professionals, in order to establish resources for furthering current knowledge on aphasia. A better understanding of this language and social interaction disorder will make it possible to optimize the rehabilitation of patients suffering from it. The main media envisaged for the provision of resources are the ORTOLANG (Huma-Num) and AphasiaBank (TalkBank) platforms.

(2) Analysis of the data collected

The aim is to carry out both quantitative and qualitative analyses, using the tools of discourse analysis in interaction, principally those based on the notions of dialogism and fluency/disfluency, in order to better characterize, in particular, the linguistic markers specific to this type of pathology:

- phonetic-phonological difficulties of speech sounds;

- morpho-syntactic deficits (in particular difficulties concerning gender, number,

morphological and syntactic categories or the structuring of a sentence);

- lexical/semantic deficits (including problems with sound association, word recognition and meaning attribution),

- discourse difficulties (including discourse structuring, discourse elements, meaning production);

- interactional difficulties and their resolution (including turn-taking, speech flow, sequencing, interruptions, disfluencies, reparative strategies).

In particular, the dialogical functioning of interactions with French PwA has never been analyzed and this presents an innovative aspect. It will contribute to broadening the knowledge on the formal and conversational functioning of the discourse of persons with aphasia.

(3) The goal is also to develop automatic speech processing tools and to help improve the therapeutic approach. Development of a computer tool for the evaluation/quantification of difficulties and anticipation strategies of aphasics in verbal interactions. We will provide models for the automatic recognition of aphasics' difficulties at all levels of verbal interaction. Automatic data processing will be carried out using CLAN and TXM software.

Methods

Participants

Fifty monolingual and bilingual native French speakers with aphasia (ages 27-75) were included in this experiment. All of the participants present with aphasia characterized by a fluent or non-fluent deficit. Several types of aphasia cases are considered regarding their lesions and deficit. At the same time, 60 healthy native French speakers were also tested.

Procedure

We collected data from 50 French speakers following an experimental protocol composed of several tasks with the aim of collecting oral productions (question-guide interview, picture description, storytelling, reading and authentic communication). Due to the SARS COVID situation, all of the interviews were recorded remotely *via* the Zoom platform. Data collected remotely offers a new perspective for the analyses.

Our contribution proposes to study the conversational dyad of the PwA and his/her helper (family member or not) collected in the project. The corpus includes 50 conversational dyads of about 20 minutes each, transcribed and annotated with CLAN. These interactions take place in a situation of authentic communication with a relational aim and give rise to varied discursive activities as well as a "collective improvisation" (Kerbrat-Orecchioni & Traverso, 2004).

Results

Based on the work of Goodwin (2007), Dubois (2014) and Bres (2021), our analysis will focus specifically on the dialogical and multimodal study of the incorporation of discourse by the interactants, with the aim of co-constructing the interaction. We will propose a typology of three forms of discourse incorporation, in order to show the complexity of the phenomenon in the conversational dyad with a PwA.

(i) sequences of incorporation and representation/reformulation in both interactants: the speaker in his/her response to the interlocutor's speech turn incorporates (takes up/represents/reproduces/reformulates) all or part of his/her interlocutor's utterances;

(ii) the PwA incorporates without representing/reformulating/appropriating the other's speech: The aphasic speaker considers the other’s speech, incorporates it into his own (in his speech turn, but does not represent it, does not appropriate it). Goodwin (2007) notes in this regard the impossibility of reporting speech in his aphasic father-in-law who only says *yes*, *no* and *and*. It is then up to the helper to speak for the aphasic speaker under the latter's control;

(iii) The PwA speaker incorporates his own speech: the aphasic speaker reacts to the reformulation and/or representation of his own speech by his interactional partner, thus developing the activity of self-reflection.

The relevance of this typology will be discussed with regard to the production of meaning in discourse in the context of language disorders. We start from the postulate that the dyad makes it possible to study the conversational profile of the aphasic speaker (establishing conversational profiles by taking into account, in particular, the non-verbal resources used to communicate) in order to complete the characterization of the deficit, which is generally done by taking into account verbal productions (agrammatism, morphosyntactic characteristics, paraphasias, *et cetera*).

Conversational behavior is not usually included in the assessment of aphasia, particularly because the health professionals who care for the person with aphasia have no or very limited access to this conversational data. Yet, it could complete the linguistic assessment of the person with aphasia. The description of the conversational dyad brings to light the relevance of the dialogical approach in describing at least some of its communicative specificities, in particular the necessary adjustments made through the incorporation of the

other discourse that make the interaction possible.

The helping speaker must constantly adjust to the person with aphasia, to help him/her to verbalize and express his/her speech, either by making proposals that will be reformulated by the PwA, or by speaking in his/her place.

Discussion

Through this research, we also wish to contribute to the research on language interaction in the context of French aphasia and to highlight the role of the helper in the co-construction of discourse.

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Exploring language interactions in French speakers with Aphasia: the AADI project

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Systematic review and meta-analysis of the prevalence of cognitive and language impairment post-stroke in young adults

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Introduction and aim

Post-stroke cognitive impairment is found as a common result of stroke in many patients (Hochstenbach et al., 2003). This literature is mainly based on individuals aged >50 years. Importantly, the incidence of individuals who had a first-ever stroke at a relatively young age (<50 years, young-stroke henceforth) has been rising over the past decade (George, 2020; Kissela et al., 2012), accounting for approximately 10% of all strokes (Ekker et al., 2019; Putaala, 2016). Studies on cognition and language in young-stroke are scarce. Given that ageing can also affect the brain and cognitive functioning (Yankner et al., 2008), it is an open question whether patterns from the general literature on stroke generalize to young-stroke.

The present study aimed at obtaining a comprehensive overview of the literature on post-stroke cognitive functioning in young adults through a systematic review and meta-analysis. One of our goals was to describe what measurement tools are used to evaluate cognitive and language functioning in the young-stroke population. Furthermore, we investigated the proportion of reported cognitive and language impairment in this population.

Methods

Four electronic databases (MEDLINE, Embase, PsycINFO, and Web of Science) were systematically searched according to the PRISMA guidelines (Page et al., 2021) on 23 December 2021. Two independent reviewers screened a total of 458 articles and assessed 154 for eligibility, of which 26 met all inclusion criteria: young to middle-aged adults (18-55 years) with a clinical diagnosis of a stroke; cognitive functioning evaluated as an outcome measure; an empirical study design. Seventeen of the 26 studies did not use aphasia as an exclusion criterion in their selection of participants.

Descriptive analyses were used to evaluate the measurement tools employed to assess cognitive and language functioning. The pooled prevalence rate for impairment, based on the eligible studies, was assessed with random-effects meta-analysis for binominal distributions. We quantified and evaluated the heterogeneity by the I-squared statistics and by visually checking the forest plots with the overlap of the confidence intervals.

Results

All 26 studies could be used to describe what measurement tools are used to evaluate cognitive and language functioning after stroke in young adults. Fourteen studies used a cognitive screening test (e.g., MMSE). Ten studies used a more extensive neuropsychological test battery (including language tests) to evaluate cognitive functioning. Seven studies used both a cognitive screening test and a more extensive neuropsychological test battery (including language tests). Four studies used a questionnaire with self-report on cognitive and/or language functioning. In five studies cognitive and/or language functioning was not based on a reported test.

Ten of the 26 studies were eligible for determining the prevalence of global cognitive impairment after stroke in young adults (total N across studies = 1495). Seven of these 10 studies quantified cognitive impairment as their outcome measure by providing a cut-off score on a test. The pooled prevalence was 44% (95% CI: 34-54%). However, heterogeneity was very high (I^2 = 92%, $p < 0.01$).

Twelve of the 26 studies were eligible for determining the prevalence of language impairment after stroke in young adults (total N across studies = 3018). Five of these 12 studies quantified language impairment as their outcome measure by providing a cut-off score on a language test. The pooled prevalence was 26% (95% CI: 17-37%). However, heterogeneity was very high (I^2 = 97%, $p < 0.01$).

Discussion

We found that cognitive functioning is evaluated in different ways with a variety of measurement tools. Studies evaluating language function in this population are scarce and the comprehensiveness of the testing is low. Additionally, a quantified definition of language impairment is often not reported. Our pooled prevalence indicated that almost half of the young adults with a stroke had a global cognitive impairment and about one fourth had a language impairment. Given that we could not analyze the data as a function of time post-onset, it is less straightforward to relate these numbers to prevalence numbers in the literature (Berthier, 2005; Tang et al., 2018). A striking finding in our study was that nine out of the 26 studies that investigated cognitive functioning excluded people with aphasia. It is easier to exclude those patients because of potential problems with understanding the tests. However, this yields a skewed picture of the young-stroke population.

We decided to take an inclusive approach for this systematic review because of the low number of eligible studies. We included studies with different stroke types (ischaemic stroke, intracranial hemorrhage, or transient ischaemic attack) and different time points post onset. We did not exclude studies of lower quality, which, for example, did not report how they measured language impairment. This is probably one of the reasons for the high heterogeneity for the prevalence of cognitive and language impairment, indicating that the estimate is not consistent across studies. Further exploratory analyses should reveal what sources of heterogeneity can explain these results.

This literature review reveals a lack of studies investigating cognitive and language functioning in the young-stroke population. The main reason to exclude articles during full-text screening was because of the age range of the patients. Studies included patients from all ages, but did not report the results separately per age range. A step forward would be to report the results on cognitive and language functioning in the stroke population by different age groups, together with improving the quality of studies by using a more quantifiable definition of impairment across studies.

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Effect of repetitive Transcranial Magnetic Stimulation on language in mild-AD: evidence from one Slovene-speaker

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Introduction and aims

Alzheimer's disease (AD) is a neurodegenerative disease characterized by progressive cognitive decline including memory loss and language impairment (e.g., Kim & Thompson, 2004), such as action and noun naming difficulties, and lexical judgment limitations. In the last few years rTMS has emerged as an alternative and non-invasive treatment method in AD due to its ability to alternate neuronal activity and cortical excitability. Cotelli et al. (2008, 2011) reported language improvement after applying high-frequency (20Hz) rTMS bilaterally over the dorsolateral prefrontal cortex (DLPFC). Both mild and moderate individuals with AD achieved significantly increased action naming performance after stimulation compared to the sham-group, while the same effect on nouns was observed only in the moderate-AD (Cotelli et al., 2008). Another study of Cotelli et al. (2011) revealed significant improvement in auditory sentence-comprehension in AD up to 8-weeks post-intervention. A positive long-lasting effect, 3-months post-treatment, was reported after active-rTMS on general cognition in AD (Ahmed et al., 2012)

While the beneficial effect of rTMS in the general cognition in AD is well establish in the literature (review: Wang et al., 2020), to our knowledge, there is a gap regarding its effect on language. Improved action and noun naming have been reported (Cotelli et al., 2008), yet other more complex word categories, such as agent-nominalizations (e.g., *reader*) and process-nominalizations (e.g., *reading*) have not been examined. Moreover, the effect of rTMS on lexical judgment in AD has been neglected in previous studies. The current study aims to further investigate the effect of rTMS on language production and lexical judgment in mild-AD by manipulating simple (e.g., *read*) and derived (e.g., *reader*) words. Also, the study targets to determine potential long-lasting benefits post-intervention.

Methods

Participant

One female (aged 75, 12 years of education, Slovene native-speaker) with mild-AD was recruited and completed two phases of treatment (active, sham). Neuropsychological evaluations were conducted at the beginning of each treatment phase (first-phase MMSE:25, MoCA:20; second-phase MMSE:26).

Stimulation Protocol and evaluations

A placebo-controlled, blind rTMS study was conducted. During the first-phase the participant underwent high-frequency (10Hz) active-rTMS over the left and right DLPFC for a total of 15 sessions (5days/week). DLPFC is engaged to language processing and important in implementing connectivity between language-networks and other functional-networks (review: Hertrich et al., 2021). The sham-rTMS was conducted during the second-phase (5-months after the end of first-phase).

The objective of the study was participant's performance in language tasks. The baseline evaluation was conducted two weeks before the beginning of the treatment and was compared to participant's performance at immediately-post-treatment, 2-weeks post-treatment and long-term follow-up 2-months post-treatment.

Experimental tasks

1. *Picture-naming task*: production of simple (verbs e.g., *to read*, nouns e.g., *chocolate*) and derived words (agent-nominalizations e.g., *reader*, process-nominalizations e.g., reading). Twenty pictures depicted verbs, agent, and process nominalizations, while 30 depicted nouns.
2. An *offline* and 3. *online* lexical decision task (*LDT*): lexical judgment of Slovene words (n= 234) and non-words (n= 234).

Results

Up to now, 2-months post-treatment data have been collected only from the active-rTMS, while from the sham-rTMS data up to 2-weeks post-treatment are available. Figure 1 presents participant's overall scores at the tasks from the active-rTMS (A) and the sham-rTMS (B).

Active-rTMS

In the *naming-task*, a significant effect of therapy was observed ($\chi2= 14.72$, $p< .01$). A significantly increased overall accuracy was demonstrated at immediately (92%; $z= 2.71$, $p< .01$), 2-weeks (97,5%; $z= 3.46$, $p< .01$) and 2-months post-treatment (94%; $z= 3.20$, $p< .01$) compared to baseline (80%). Regarding the different naming conditions, the agent-nominalizations (75%) and process-nominalizations (60%) demonstrated lowest scores at baseline, while participant's performance in these categories was highly increased at all post-intervention evaluations [agents (immediately-post-treatment 95%, 2-weeks: 95%, 2-months: 100%; process: immediately-post-treatment 90%, 2-weeks: 100%, 2-months: 90%). Participant's performance on verbs (baseline: 95%; immediately: 90%; 2-weeks: 95%;2-months: 90%) and nouns (baseline: 90%; immediately: 93%; 2-weels: 100%; 2-months: 97%) was already high at the active-rTMS baseline and remained similar at all evaluations.

At the *offline-LDT* participant's performance was high during all evaluations (93% vs. 97% vs. 93% vs. 93%) and no effect of treatment was found ($\chi2= 3.03$, $p= .38$).

Regarding the *online-LDT,* a significant effect of treatment was found ($\chi2= 36.48$, $p< .01$). Participant's accuracy was significantly improved compared to baseline (73%) at immediately-post-treatment (95%, $z= 4.91$, $p< .01$). Two-weeks (90%, $z= 3.85$, $p< .01$) and 2-months (91%, $z= 4.28$, $p< .01$) post-treatment the accuracy slightly decreased, yet it remained significantly increased. The average RT was significantly improved (2281ms vs. 1445ms vs. 1624ms vs. 1646ms) at all post-intervention evaluations ($p< .01$, always).

Sham-rTMS

In the *picture-naming*, analysis revealed no effect of treatment ($\chi2= 2.13$, $p= .34$). Thus, no significant improvement was observed on participant's overall naming accuracy neither at immediately (61%, $z= 0.17$, $p= .86$) nor at 2-weeks post-treatment (53%, $z= -1.17$, $p= .24$) compared to baseline (60%).

Effect of treatment was found at the *offline-LDT* ($\chi2= 12.49$, $p< .01$). Significantly increased accuracy at both immediately post-treatment (95.6%) and 2-weeks post-treatment, compared to baseline (87.6%).

In the online-LDT no effect of treatment was observed ($\chi2= 4.60$, $p= .09$). Participant's performance was high (94%) at the baseline and remained similar post-intervention (immediately-post-treatment 98%; 2-weeks post-treatment 91%). Regarding RT, the LDT latency was short at the baseline (1406ms) and remained similar post-intervention (immediately-post-treatment 1399ms, 2-weeks post-treatment 1386ms; $p> .05$, always).

Discussion

Active-rTMS treatment seems to be effective at improving naming and lexical-judgement in mild-AD. Regarding naming, besides actions and nouns, active-rTMS appears to benefit naming accuracy for derived words (e.g., *reader*) that seem to be more impaired compared to the simple ones (e.g., *read*). The beneficial effects might persist up to 2-months post-treatment. However, at the sham-rTMS (5-months after the end of first-phase) participant's performance had dropped and no improvement was observed. Active-rTMS seems to improve accuracy on online-LDT and positively influence LDT latency by speeding RTs. Participant's high performance and short latency at the sham-rTMS might be an indication of a long-lasting effect of the active r-TMS. Due to sample limitation, further research should be conducted for more accurate conclusions.

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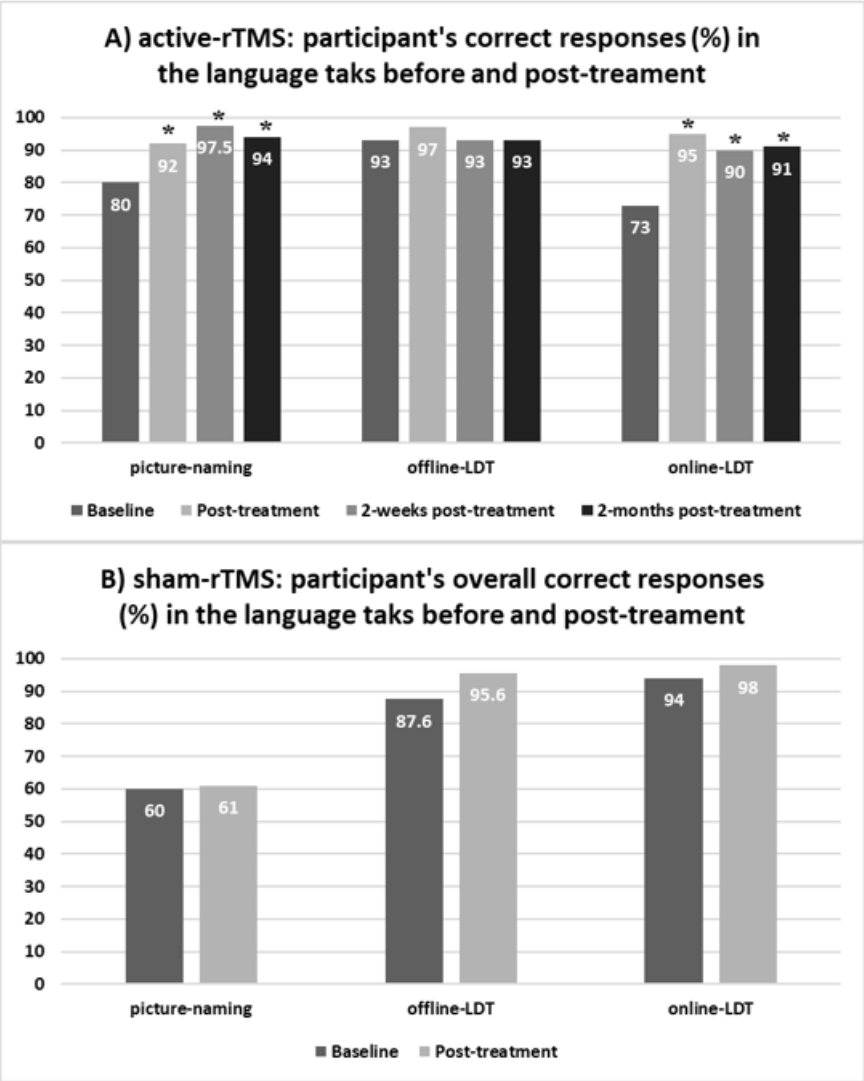
Figure 1 :


A) active-rTMS: participant's correct responses (%) in the language taks before and post-treament
100
90
80
70
60
50
40
30
20
10
0
80
92
97.5
94
93
97
93
93
73
95
90
91
*
picture-naming
offline-LDT
online-LDT
Baseline
Post-treatment
2-weeks post-treatment
2-months post-treatment
B) sham-rTMS: participant's overall correct responses (%) in the language taks before and post-treament
60
61
87.6
95.6
94
98
picture-naming
offline-LDT
online-LDT
Baseline
Post-treatment

The “MAP” survey: an international investigation of SLPs’ training and working practices to assess and treat plurilingual people with aphasia.

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Introduction and aim

Multilingualism in Speech-Language Pathology deserves particular attention as the number of plurilingual individuals requiring professional services for aphasia is growing (Goral & Conner, 2013; Ansaldo & Saidi, 2014; Centeno, 2020; Goral & Hejazi, 2021). A survey conducted by Centeno (2015) with 125 Speech-Language Pathologists (SLPs) in the US showed that there is a need for improvement of both professional training and clinical resources so that SLPs are better equipped to provide clinical services for plurilingual persons with aphasia (PPWA). Based on a survey study in Norway, Norvik et al. (2022) showed that Centeno’s conclusions can be extended to the European context. Our current understanding of worldwide clinical practices adapted for PPWA is limited since to date no comprehensive and international evaluation has been conducted to assess SLPs’ needs and the current state of affairs regarding aphasia assessment and treatment in plurilingual individuals. Given that many SLPs are providing clinical services to PPWA despite the lack of specific training and appropriate clinical tools to assess and treat aphasia in more than one language, the current study aims:

- to assess the degree of awareness of professional SLPs about multilingualism in their clinical practice;
- to determine the frequency of their clinical practice with PPWA and their perceptions of readiness for the assessment and treatment of this population;
- to identify their common clinical practices and perceived challenges when providing clinical services to PPWA.

The “Multilingual Aphasia Practices” (MAP) survey is an international and comprehensive survey available in multiple languages spoken across the globe that was designed with the aim of reaching a representative sample of SLPs and providing a comprehensive picture of the current state of affairs in multilingual aphasia management worldwide.

Methods

A consensus group of experts on “Multilingual Aphasia Practices” (henceforth the MAP group) has been assembled within the Aphasia Assessment and Outcomes working group of the international Collaboration of Aphasia Trialists network (https://www.aphasiatrials.org/). The MAP group, comprising 18 experts representing 13 countries, aims to address issues regarding multilingual aphasia management following a committee approach and survey methods. The MAP survey was thus designed. It contains a total of 31 questions organized in four sections that include: (1) SLPs’ demographic information, (2) Education background and training related to multilingualism and PPWA, (3) Clinical services provided to PPWA, and (4) Assessment tools used with PPWA. All questions were extensively discussed and reviewed between February 2021 and April 2022, with agreement reached based on group consensus and taking into account the different multilingualism situations across continents for inclusivity. The survey was initially designed in English, and there are plans to translate it into Arabic, Basque, French, Galician, Greek, Mandarin Chinese, Norwegian, Spanish, and Turkish. Survey respondents can choose to respond in the language that they feel most comfortable in. The project has been approved by the ethics committee of the University of Groningen.

Results

Online data collection is currently underway using Qualtrics. The estimated target population is 377 SLPs.

Discussion

In line with previous country-specific survey studies, it is expected that SLPs will highlight the lack of available training opportunities and clinical resources for clinical practice with PPWA. However, we anticipate important differences depending on respondents’ demographic profile (years of professional experience, country of training/profession) and language background (i.e. whether SLPs are themselves plurilingual or not). The data will constitute an unprecedented international dataset on training and clinical practices adapted for PPWA assessment and treatment.

The information obtained has several important potential applications. By identifying the lack of specific guidelines targeting clinical assessment and interventions for PPWA from linguistically diverse backgrounds, the results will inform training plans for clinicians working with PPWA and may encourage the development of standardized tools designed for assessing and treating PPWA. The responses should stimulate discussion on a potential set of international best practice guidelines for multilingual aphasia assessment and rehabilitation. The outcomes of this survey are expected to have a direct impact on clinical practice and advance the current state of multilingual aphasia management.

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Semi-spontaneous language production in primary progressive aphasia

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Introduction and aim

Primary progressive aphasia (PPA) is a neurodegenerative disorder with progressive language deficits (Mesulam, 2001). PPA includes three main accepted variants: the nonfluent (nfvPPA), the semantic (svPPA) and the logopenic (lvPPA) variant (Gorno-Tempini et al., 2011). Despite the current diagnostic criteria, diagnosing PPA and its clinical subtypes remains challenging for clinicians, especially as to nfvPPA and lvPPA (Marshall et al., 2018). Confrontation naming tests are commonly used in the diagnostic process of PPA. However, the relationship between the performance on a standardized confrontation naming test on the one hand and (semi-)spontaneous language production, on the other hand, is still unclear. Although the research field is expanding remarkably, research on (semi-)spontaneous language production in PPA variants has mainly focused on English-speaking individuals (Boschi et al., 2017). This bias in the literature is detrimental to the understanding of PPA given that English, for example, is characterized by relatively simple morphosyntax. Moreover, some symptoms can vary depending on the individual language (Canu et al., 2020). Therefore, in this preregistered study we focused on the semi-spontaneous language production in Dutch-speaking individuals. The first aim of the study is to compare linguistic variables from semi-spontaneous language production between PPA variants, especially between the nfvPPA and lvPPA. The second aim is to examine the relationship between semi-spontaneous language production of PPA individuals and their score on a standardized confrontation naming test.

Methods

Our study comprised 49 individuals with a clinical diagnosis of PPA based on the Gorno-Tempini et al. (2011) criteria (nfvPPA n = 17, lvPPA n = 17, svPPA n = 15) and 21

cognitively healthy individuals. Semi-spontaneous language production obtained from the picture description task of the Dutch version of the Comprehensive Aphasia Test (Visch-Brink et al., 2014) was analyzed for lexical and grammatical variables. The language samples were transcribed and analyzed by the first author blinded for diagnosis according to a standardized Dutch protocol, the Analysis of Spontaneous Speech in Aphasia (ASTA; Boxum et al., 2019), with some deviations. Measures of grammatical complexity (mean length of utterance and proportion of relative clauses) and other linguistic variables (lexical verbs per 100 words, copula per 100 words, proportions of correct, incorrect and missing finite verbs, nouns per 100 words) were contrasted across PPA variants (with a focus on nfvPPA vs lvPPA) using Wilcoxon rank-sum tests. If needed, the patterns were compared with the svPPA and a control group of cognitively healthy individuals to aid the interpretation of the results. Scores obtained from a Dutch version of the 60-item Boston Naming Test (Van Loon-Vervoorn & Van der Velden, 2006) were compared with the number of nouns per 100 words and the type-token ratio of nouns extracted from the semi-spontaneous samples.

Results

Patients with lvPPA produced significantly fewer nouns per 100 words compared to patients with nfvPPA, p = .001 (Figure 1). Furthermore, no significant differences were found between the patients with nfvPPA and the patients with lvPPA for lexical and grammatical variables from semi-spontaneous language production. There was a significant correlation between the number of lexical verbs per 100 words and the number of copula per 100 words for all PPA variants, r_s = - .45, p = .001.

There was no significant correlation between the score on a standardized naming test and the type-token ratio of nouns for each PPA variant separately, nfvPPA: r_s = .53, p = .361; lvPPA: r_s = .26, p = .418; svPPA: r_s = - .32, p = .287. There was no significant correlation between the score on a standardized naming test and the number of nouns per 100 words for each PPA variant separately, nfvPPA: r_s = .17, p = .521; lvPPA: r_s = .20, p = .438; svPPA: r_s = .52, p = .056.

Discussion

The main aims of this pre-registered study were, first, to compare lexical and grammatical variables from the semi-spontaneous language production between nfvPPA en lvPPA, and second, to investigate a relationship between the performance on a confrontation naming task and the semi-spontaneous language production of Dutch speakers with PPA. Our results showed that nfvPPA and lvPPA differed from each other only in the number of nouns

per 100 words in semi-spontaneous language production. This is in line with the literature and underlines the fact that both variants are not easily distinguishable from each other, also in a Germanic language other than English. This may be due to variation within one variant and overlap between variants for the linguistic variables from semi-spontaneous language production. Furthermore, there was insufficient evidence for a relationship between the performance on a confrontation naming task and semi-spontaneous language production. This highlights the additional value of looking at spontaneous language in addition to word-level confrontations tasks, as suggested by previous studies. Analysis of semi-spontaneous language can be a valuable addition to the diagnosis of Dutch-speaking patients with PPA. Given the variation within and the overlap between patients with lvPPA and nfvPPA on linguistic measures from semi-spontaneous language production, analysis of semi-spontaneous language might also guide clinicians in selecting the most suitable management (e.g., speech therapy approach) per patient depending on the linguistic difficulties as measured in the semi-spontaneous language.

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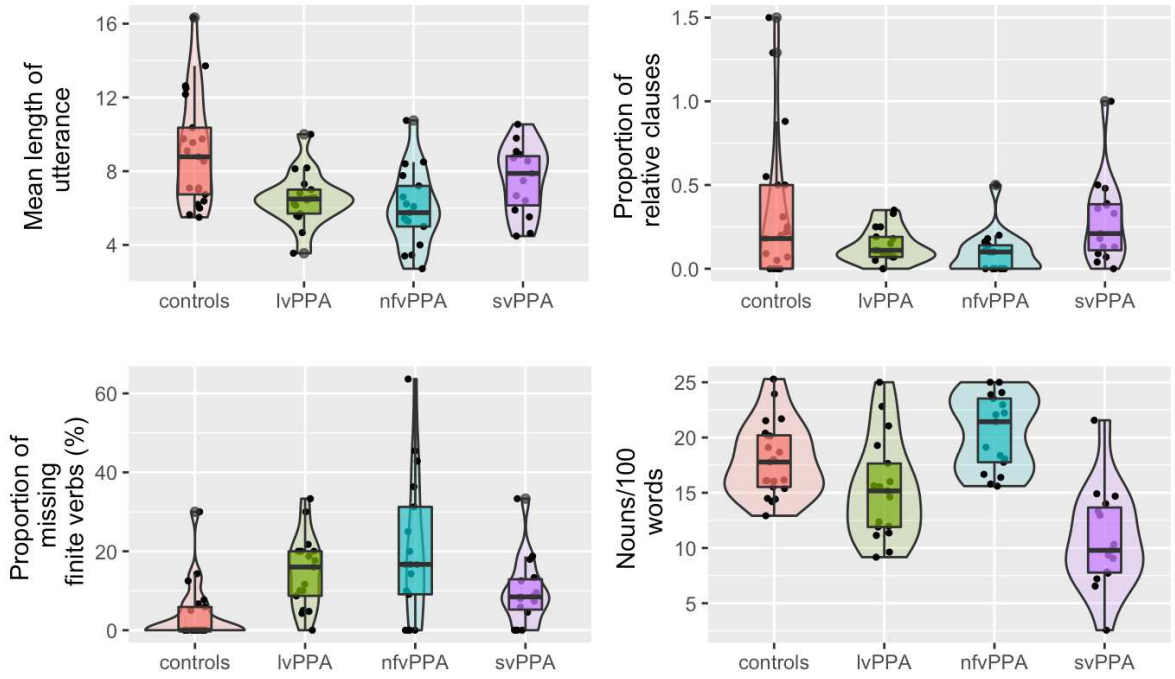

Figure 1. Mean length of utterance, proportion of relative clauses, proportion of missing finite verbs and number of nouns per 100 words from semi-spontaneous language production. Each point represents one participant.

Semantic distance, rather than neighbourhood density, influences error rate during object naming under nTMS in people with brain tumours

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Introduction and aim

Lexical selection is a competitive process, whereby lexical entries that share semantic features with the target word (i.e. semantic neighbours) – are activated in parallel and compete for selection (e.g., Levelt et al., 1999; Roelofs, 1992). Many studies used object naming and investigated the influence of the number of semantic neighbours (semantic neighbourhood density) on error rate, finding contradictory results (e.g. Bormann, 2011; Blanken et al., 2002). Another variable that can be studied is semantic distance, measured by the number of semantic features that two words share (e.g. *dog* and *cat* share the features 'animal', 'four legs', 'tail' etc.). Interestingly, semantic distance shows a more consistent influence on the number of naming errors than semantic neighbourhood density in healthy participants (Fieder et al., 2019) and individuals with aphasia (Mirmann, 2011).

We aim to assess whether semantic neighbourhood density and semantic distance influence object naming performance in people with brain tumours during navigated transcranial magnetic stimulation (nTMS). nTMS is used to create a map of cortical areas involved in language processing prior to the removal of a brain tumour. Unlike other methods, nTMS gives us the unique opportunity to deliberately induce naming errors whilst monitoring their exact cortical location, demonstrating which areas support language functions (Pascual-Leone, 2000). We assessed how semantic neighbourhood density and semantic distance influence (1) the total amount of naming errors; (2) the types of naming errors (e.g. semantic errors, anomias etc.) and (3) the distribution of errors on the cortex. In this abstract, the results for (1) are presented. The analysis of the results for (2) and (3) is in progress and will be completed before September 2022. For (1) we predict a higher error rate for words with more near neighbours, in line with previous studies.

Methods

Participants

Thirteen participants were recruited at the Charité University Hospital in Berlin. These were all native speakers of German with a tumour in the left hemisphere. See Table 1 for participant information. Handedness was measured using the Edinburgh Handedness Inventory (Oldfield, 1971). Pre-operative language abilities were tested using the Aachener Aphasia Test (AAT: Huber et al., 1983).

Materials

The object naming task of the German version of the verb and noun test for peri-operative testing was used (VAN-POP: Ohlert et al., 2020). This test includes black-and-white drawings of 75 objects and animals. A lead-in phrase is displayed above each drawing ("*Das ist…*", "This is…").

For the current study, the semantic neighbourhood density of each of the items was based on Buchanan and colleagues (2019). All words with more than one overlapping feature were taken as neighbours of the target item (cosine > 0.0). With regard to semantic distance, near and distant neighbours were defined based on cosine similarity between the feature vectors (Buchanan et al., 2019). Near neighbours were defined as having a cosine greater than 0.4 and distant neighbours were defined as having a cosine between 0.0 and 0.25, in line with Mirman (2011).

Procedure

On the basis of structural T1-weighted MRI images, DTI fiber tracking of the left Arcuate Fasciculus (AF) was performed using the Brainlab Elements software (Brainlab AG, Munich, Germany). The AF was then co-registered to the original T1 images and uploaded to the navigated brain stimulation (NBS) system (Nexstim eXimia NBS system version 4.3). Six stimulation points were placed at cortical terminations of the AF: two frontal, two parietal and two temporal points. An additional 10 stimulation points were placed on and around the tumour.

After two rounds of baseline naming without nTMS stimulation, all incorrectly or inconsistently named items were removed. The remaining items were used for naming under nTMS stimulation. The six stimulation points located at the cortical terminations of the AF were each stimulated 6 consecutive times. The 10 (peri)tumoral points were each stimulated 10 consecutive times.

Statistical analysis

Three linear regressions were used to determine the influence of raw neighbourhood density (total number of neighbours), and semantic distance (the number of near and the number of distant neighbours) on the number of naming errors during nTMS.

Results

Neighbourhood density did not significantly influence the number of naming errors during nTMS (R^2 = .000, $F(1,68)$ = 0.014, p = 0.906). Nevertheless, a significant influence of semantic distance was found: the number of near neighbours significantly predicted the number of errors (R^2 = .057, $F(1,68)$ = 4.092, p = 0.047). Items with a higher number of near neighbours displayed a higher error rate during object naming. The number of distant neighbours, on the other hand, did not show an influence on the number of errors (R^2 = .000, $F(1,68)$ = 0.036, p = 0.851).

Discussion

The results indicate that semantic distance, rather than neighbourhood density influences error rate during object naming under nTMS. These findings are in accordance with our predictions and in line with previous studies on semantic distance in both healthy participants and people with different neurological impairments (Fieder et al., 2019; Rabovsky et al., 2016).

We interpret these findings within the framework of Mirman's (2011) attractor dynamics account of semantic processing. During lexical retrieval, the target and its near neighbours attract the selection mechanism. These near neighbours are at risk of being falsely selected, which in turn results in naming errors. Distant neighbours, on the other hand, are too far away from the target to cause competition for lexical selection. Therefore, distant neighbours have no influence on error rate – as is the case in the present study.

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Table 1: Participant information

Variable				
Age	*24 – 75 (M* = 51.4, *SD* = 17.7)			
Gender	Male: 9		Female: 4	
Handedness	Right: 12		Left: 1	
AAT	Slight aphasia: 4		no aphasia: 9	
Tumour type	Glioma: 12		cavernoma: 1	
Tumour location	Frontal: 3	Temporal: 5	Parietal: 3	Insular: 2

The relationship between baseline white matter hyperintensities and longitudinal language outcomes in aphasia

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Introduction and aim

White matter hyperintensities (WMH) are a common vascular pathology identified in ageing individuals that has been linked to deficits across an array of cognitive skills (Biesbroek et al., 2017). In stroke, WMH are considered to diminish 'brain reserve' (Brickman et al., 2011), a set of brain properties that mitigate the effects of brain diseases, by compromising the compensatory efficacy of non-lesioned neural regions, leading to suboptimal language recovery in aphasia (Stefaniak et al., 2020). Evidence on the association of WMH and language outcomes after stroke is limited to the discrete skills of naming and fluency (Varkanitsa et al., 2020; Wright et al., 2018). Interpretation of findings is further confounded by inconsistencies between the time of scan acquisition and behavioural assessment (Varkanitsa et al., 2020; Wright et al., 2018). The impact of baseline WMH on impairment of complex language comprehension and production skills after stroke has not been investigated. We aimed to examine the relationship between baseline WMH burden, a proxy measure of brain reserve, and measures of spoken comprehension (*SpoComp*) and spoken production (*SpoProd*) after stroke at two different phases of recovery. We hypothesized that more severe WMH burden would predict additional variance in language outcomes after regressing out the effects of stroke pathology.

Methods

Participants: 37 individuals with aphasia (IWA) were included at baseline (early subacute), 28 IWA completed the chronic assessment.

Language measures: SpoComp measure was calculated as the raw score of Word, Sentence, Paragraph comprehension subtests from the Comprehensive Aphasia Test (CAT) (Swinburn et al., 2004). *SpoProd* score was derived by combining the Fluency and Naming CAT subtests and a Picture description task assessment.

Neuroimaging: Stroke lesions were manually delineated on T1 images in native space and their volume was calculated. Lesion masks were normalized and % lesion load within each of the 4 left-hemisphere regions of interest (ROIs) was calculated: Broca's area, the insula, the angular gyrus + supramarginal gyrus (AG+SMG), and the superior temporal gyrus (STG).

WMH assessment: The severity of WMH, assessed on FLAIR sequences, was scored using the Fazekas scale (Fazekas et al., 1987) which categorizes WMH burden into mild, moderate and severe (see Figure 1).

Statistical analyses: Firstly, stepwise multivariate linear regressions were used to test if stroke *lesion volume* and lesion load within the language *ROIs* predicted variance in longitudinal *SpoComp* and *SpoProd* scores. Secondly, stepwise multivariate linear regressions were used to test if WMH burden predicted additional variance in longitudinal *SpoComp*and *SpoProd*, after accounting for significant stroke pathology variables.

Results

Stepwise multiple linear regression revealed a collective significant effect between stroke *lesion volume* and *severe WMH* on baseline *SpoComp* (R^2 = .34, F(2, 34) = 8.76, p < .001). After accounting for the contribution of stroke *lesion volume*, *severe WMH* negatively predicted baseline *SpoComp* (t = -3.00, p = .004) and IWA with severe WMH scored on average 2.87 lower than IWA without severe WMH.

Chronically, stepwise multiple linear regression indicated that there was a collective significant effect between *insula, Brocas area ROIs* and the *severe WMH* (R^2 = .54, F(3, 24) = 9.48, p < .001). IWA with severe WMH scored on average 2.65 points lower on chronic *SpoComp*, after controlling for lesion load within the *insula* and *Brocas area ROIs,* than patients without severe WMH (t = -3.60, p = .001). Stepwise multiple linear regressions indicated that WMH measures did not explain variance in baseline and chronic *SpoProd* outcome above the ones explained by stroke pathology variables.

Discussion

This study demonstrates, for the first time, a relationship between severe baseline WMH burden (Figure 1, III.) and longitudinal recovery of language after stroke. We show that language comprehension skills in the subacute and chronic recovery periods after stroke are negatively associated with severe baseline WMH. Secondly, we provide seminal evidence that WMH may impact comprehension and production skills differentially, highlighting the need to consider both aspects of language in future studies. Finally, our findings not only suggest that brain reserve may contribute to the recovery of post stroke cognitive impairments, but that markers of this reserve may be used to improve the accuracy of

prognoses after stroke (Umarova, 2017).

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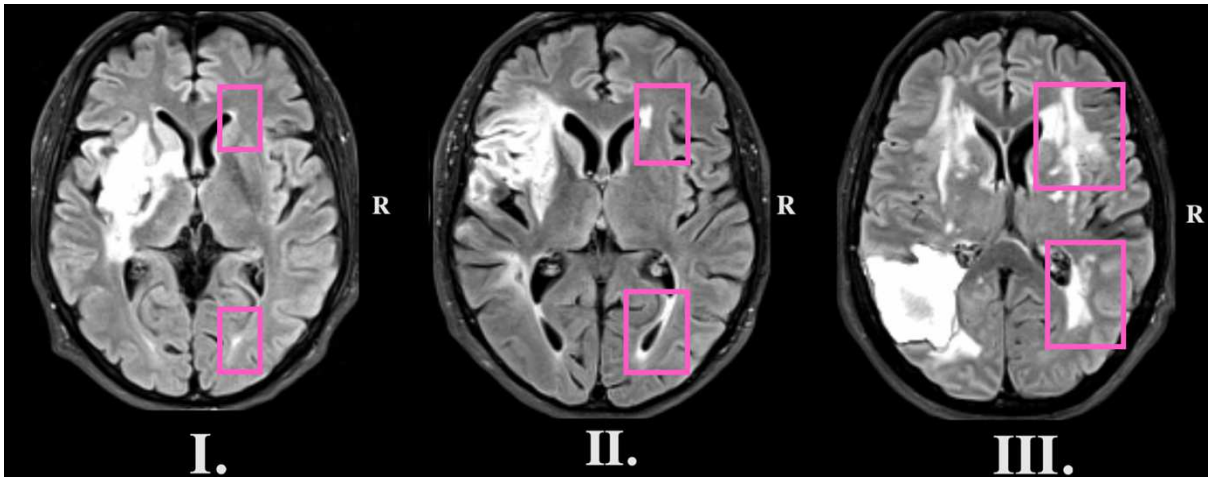

Figure 1 Fazekas score severity categories mild (I.), moderate (II.), severe (III.).

Aphasic patients with phonetic impairment show phonetic flexibility

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Aphasic patients with phonetic impairment show phonetic flexibility

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Introduction and aims

Phonetic flexibility is the ability of the speaker to adapt his/her speech behavior to the internal or external constraints of the communication situation by adjusting his/her motor programs in real time. This ability has been demonstrated in neurotypical individuals in both experimental and ecological situations (Delvaux et al., 2015). In contrast, the study of these abilities in patients with neurological disorders affecting speech motor control is less frequent.

Non-fluent aphasias, such as Broca's aphasia, frequently co-occur with speech motor control deficits in the context of apraxia of speech (AOS) or dysarthria (Laganaro, 2012). The aim of the present study is to examine whether these patients remain able to modify their articulatory patterns "on demand" within a focused experimental paradigm.

Such a protocol allows us to explore the patients' abilities to adapt their articulatory patterns to compensate for their speech difficulties or to relearn new speech patterns in speech therapy. Moreover, in addition to the clinical perspectives, this research aims at better understanding the cognitive mechanisms that support the production of speech, conceived as a strategic behavior. In this study, we focused on two supra-segmental aspects of speech: pitch register and speech rate.

Methods

Three French-speaking aphasic female patients, BD (aged 72), SV (aged 76) and CC (aged 81) participated in the study. The patients were diagnosed by speech-therapists as presenting a non-fluent aphasia and AOS or dysarthria. A first language evaluation (picture description, picture naming, word and non-word repetitions) revealed that the 3 patients presented a phonetic deficit: phoneme distortions, substitutions, cluster reductions and effortful speech were observed. Patients' performances were compared to those of 7 healthy speakers matched for age (Mean age=71.23, *SD*=4.53) and sex.

The experimental corpus was designed in order to induce variations in speech rate and pitch in the participants' speech productions. It consisted of 25 sentences, i.e. 5 versions of 5 initial sentences. Each initial sentence (produced by a "model" female French speaker) underwent 4 types of modifications affecting either its total duration (75% or 125% of the initial duration), or its average pitch (75% or 125% of the initial pitch). The sentences in the corpus (e.g. "Lalie vend du Lila"/Lalie sells Lilacs) varied in length (6-11 syllables), syllabic complexity, phonological content (e.g., some sentences are fully voiced) and prosodic pattern. The paradigm consisted of four tasks, completed in a single session: (i) reading (in order to measure the baseline pitch and speech rate); (ii) and (iii) first and second repetitions of the sentences pronounced by the model speaker; (iv) repetition with explicit instruction to imitate the oral model. In each task, the participant produced the 25 sentences. The participants' productions were recorded and acoustic measures were performed with Praat (Boersma & Weenink, 2018). The measures were: the total duration of the sentence, converted into speech rate (number of syllables/second), as well as the fundamental frequency (Hz) calculated every 5 ms, from which we extracted the median value.

Results

Figure 1 displays the variations of pitch and speech rate in participants as a function of the

task. We performed two series of Mann-Whitney *U*-tests on speech rates and z-score transformed pitch values (one in the control group and one in the aphasic participants), in order to compare the differences between the pitch/speech rate values measured in the reading task (baseline levels for each participant), and the values measured in the other tasks as a function of the presented stimulus (75%, 100%, 125% of the initial value).

In the control group, speakers tend to "follow" the model in all experimental conditions, producing sentences with a higher/lower pitch or speech rate values in response to a higher/lower pitch or speech rate (significant differences: Pitch: reading and repetition 1, 75% : U=801.00, p<.001; 100%: U=4856.00, p<.001; and repetition 2: 75% : U=1097.00, p<.001; 100%: U=5182.00, p<.001; and imitation, 75% : U=1005.00, p<.001; 125%: U=1714.00, p=.003; Speech rate : reading and repetition 1, 75% : U=1550.50, p=.001; 100%: U=5811.00, p=.001; and repetition 2: 75% : U=1414.50, p<.001; 100%: U=5591.00, p<.001; and imitation: 75% : U=1182.00, p<.001).

In aphasic patients, we also note tendencies to follow the presented model, but the differences are less marked than in controls, and are often restricted to the “imitation” condition. With regards to pitch variations, we mainly note significant differences between the reading and the imitation tasks. In this task, patients show an increase of their pitch values as the pitch of the stimuli increased. These differences from baseline as a function of stimulus characteristics are exacerbated in BD (Pitch: significant differences between reading and imitation, BD: 75%: U=00.00, p<.001; 100%: U=9996.00, p<.001; SV*:* 75%: U=15.50, p=.05; 100%: U=88.00, p=.005; 125%: U=00.00, p<.001; CC: 125%: U=15.00, p=.05).

Regarding speech rates variations, SV shows less ability to modulate her speech rate according to the stimulus than the other patients. BD and CC show mainly gradual increases/decreases of speech rate as a function of stimulus in the imitation task. However, the differences are only significant between the reading task and the 75% and 100% stimuli in CC (U=12.00, p=.005 and U=78.50, p=.002, respectively, no significant difference for BD). It should be noted that the patients made a large number of errors and self-corrections in the requested repetitions, which may have interfered with the speech rate values in some cases. These latter results should therefore be taken with caution.

Discussion

The outcomes of this study indicate that, despite their speech motor control difficulties, our patients remain able to modify their articulatory patterns as a function of stimuli and/or requisites of the task. They therefore exhibit phonetic flexibility, at least for supra-segmental aspects of speech such as pitch and speech rate. Indeed, when asked to produce sentences in response to an oral model, aphasic patients tend to imitate the pitch register (and to a lesser extent, the speech rate, notwithstanding aphasia-typical errors) of the target voice, the more so when they are explicitly prompted to imitation.

Differences between patients with regards to their different profiles will be discussed as well as language rehabilitation possibilities.

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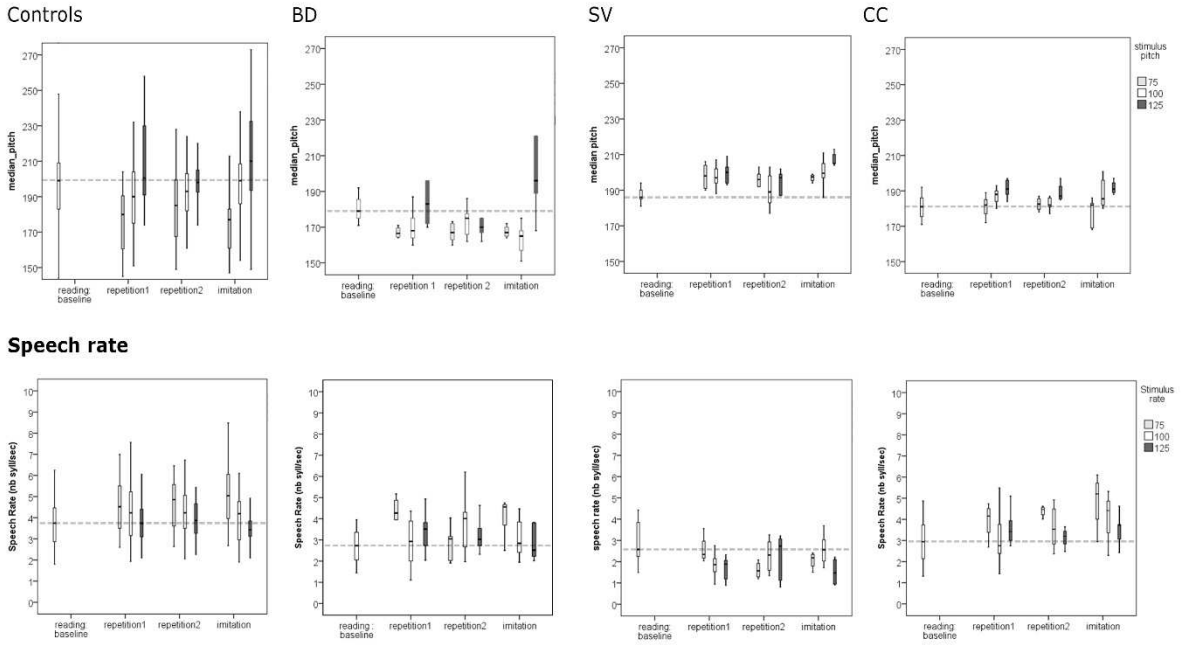
Pitch



Speech rate

Figure 1: Top : Right: pitch as a function of task and stimulus pitch (P75: lowered pitch, P100: median pitch, P125: raised pitch).
Bottom : speech rate (syll/s) as a function of task and stimulus rate (D75: reduced duration = accelerated rate, D100: median duration/rate, D125: extended duration = slowed rate).

Morpho-lexical effects in neglect dyslexia: the case of prefixation

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INTRODUCTION AND AIMS

Left Neglect dyslexia (ND) is an acquired reading disorder that impairs the apperception of the left side of words and sentences (Vallar et al., 2010). Importantly, in this syndrome, orthographic and lexical factors have been shown to modulate the exploration of written material (Arduino et al., 2002; Reznick & Friedmann, 2015; Semenza et al., 2011). The present study exploited ND to investigate how prefixation is attended to in the process of reading. Two main issues were addressed: if the orthographic morphological structure of words modulates attention, and, in particular, if lexical information may further modulate this susceptibility at higher levels of processing. To a perceptual analysis, Italian prefixed words are characterized by discrete orthographic regularities positioned on the left side of stems (i.e., prefixes). Furthermore, *semantic transparency* and *stem boundedness* are lexical factors that may influence higher-level processing of prefixed words in the mental lexicon (Marslen-Wilson et al., 1994; Pastizzo & Feldman, 2004). A set of prefixed and pseudo-prefixed stimuli was thus administered to patient ZE, 61 y.o., who, following a tumour lesion in the right posterior temporal lobe, showed left hemispatial neglect (BIT conventional: 40/146) and ND (BIT behavioural: 52/81).

METHODS

Stimuli consisted into 210 nouns and 115 past participles. *Stem boundedness* (bound vs. free) and *semantic transparency* (transparent vs. opaque) were considered in the selection of prefixed words. Nouns were: Bound Opaque (BO: *antipatia*-antipathy) and Free Transparent (FT: *antivirus*-antivirus). Participles were: Bound Transparent (BT: *condensato*-condensed) and Free Opaque (FO: *concentrato*-concentrated). Two classes of prefixed-word like types were further included in both subsets: Pseudo-prefixed words (PP: *e.g., antilope*-antelope) and Prefixed Non-Words (NW: *e.g., antimento*-antichin) (Table 1). Left sided errors were classified as either *morphological*, when respecting prefix-stem boundary (*e.g.,* omission of prefix), or as *other* when they did not respect it (*e.g.,* partial prefix omission). Chi-square analyses were run on occurrences of error type (*morph vs other*) and on occurrences of error type across categories of words. Fisher's exact test was used to determine if significant differences of errors were present across paired categories of stimuli.

RESULTS

Patient ZE correctly read 166 on 315 stimuli. Confirming his ND diagnosis, ZE made, overall, a much higher number of errors on the left (96%) as compared to the right side (9%). An overwhelming ($\chi^2 = 18.189$, $p < 0.001$) prevalence of *morphological* over *other* errors was observed. Importantly, while *morphological* errors distributed differently across categories of stimuli ($\chi^2 = 31.399$, $p<0.001$), *other* errors did not ($\chi^2 = 4.068$, $p=0.771$, $p > 0.05$). Considering Nouns, lower rates of morphological errors emerged in PP, similarly to BO ($p=0.027$, $p > 0.5$) and differently from FT ($p< 0.001$) and NW ($p< 0.001$) categories. Highest rates of morphological errors emerged in NW, similarly to FT ($p=0.55$, $p>0.5$) and differently from BO ($p= 0.003$; $p<0.05$). Additionally, differences in morphological errors were found across BO and FT prefixed nouns ($p= 0.031$, $p<0.05$). Considering past participles, Fisher's exact tests revealed absence of any statistically significant difference of morphological errors across paired categories of stimuli. Nevertheless, to a qualitative observation, lower rates of morphological errors were observed in PP (7/24), similarly to BT (7/28) and FO (7/22) categories of prefixed past participles. On the contrary, highest rates of errors were again observed in NW (14/31) (Figure 1)

DISCUSSION

Complex words are thought to engage two different stages in reading (Rastle & Davis, 2008). A pre-lexical *morpho-orthographic* segmentation, based solely on the analysis of orthography, would characterize the earliest stages of visual word perception. A *morpho-semantic decomposition* would characterize later linguistic processing, reflecting the way complex words are lexically processed and represented. If attention to written material is modulated at a merely perceptual level, the effects of ND would have equally affected the prefixes across all stimuli. On the contrary, left-sided errors distributed unequally across word categories. These results confirm that attention to written material is modulated by morpho-lexical information and not just by morpho-orthographic information. Depending on factors like *semantic transparency* and *stem boundedness* prefixed words may be differently processed by the human cognitive system.

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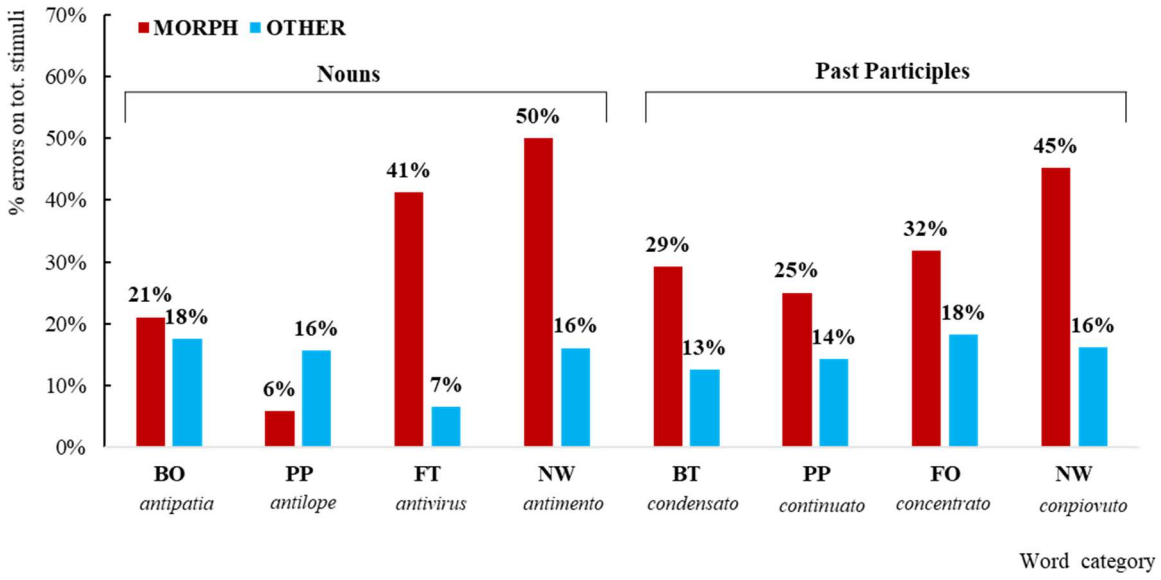
Table 1. Categories of stimuli

Category	*Syntactic class*	*N. items*	*Example.*
BO	N	57	antipatia- *antipathy*
PP	N	51	antilope- *antelope*
FT	N	46	antivirus- *antivirus*
NW	N	56	antimento - *antichin*
BT	P	24	condensato - *condensed*
PP	P	28	continuato- *continued*
FO	P	22	concentrato- concentrated
NW	P	31	conpiovuto- conrained

Figure 1. Distribution of morphological and other errors across categories of stimuli



Diagnostic Instrument for Mild Aphasia (DIMA): sensitive and valuable addition to standard language assessment in glioma patients.

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Introduction and aims

Awake surgery is the gold standard in treatment of low- and (a subgroup of) high-grade glioma (De Witt Hamer et al., 2012; Gerritsen et al., 2022). Previous research has shown that despite intensive intraoperative monitoring, language functions deteriorate short-term after surgery, but mostly return to baseline at one-year after surgery (Satoer et al., 2014). However, capturing declines or improvements in language abilities of these patients is not a trivial matter, as glioma patients generally suffer from milder aphasia as compared to the stroke population. Consequently, their language impairments are often not detected with standard aphasia tests (Satoer et al., 2012). Assessing parameters in spontaneous speech has been shown to be a sensitive way of measuring differences in postoperative language function (Satoer et al., 2018), but this is a time-consuming endeavor that is not always feasible in clinical practice. The Diagnostic Instrument for Mild Aphasia (DIMA) is the first standardized test battery to assess mild language disorders on different linguistic levels (Satoer et al., in press). In this study, we investigate the short- and long-term effects of awake surgery by evaluating the scores on standard languages tests and the DIMA at three time points.

Methods

We included patients who underwent awake glioma surgery at the Erasmus MC University Medical Centre Rotterdam, the Netherlands. Patients were assessed preoperatively (*T1*, N = 105), three-months (*T2*, N = 83), and one-year (*T3*, N = 33) postoperatively. We administered standard tests (Boston Naming Test, Category and Letter Fluency and the shortened Token Test) and DIMA as part of the standard clinical protocol. The DIMA consists of subtests that tap *phonology* (word, compound, non-word, sentence repetition),

semantics (odd-picture-out), and *syntax* (sentence completion). Test scores were compared to normative data, and linear regression analyses were performed to evaluate postoperative recovery.

Results

Standard tests

The percentages of patients showing mild impairments on standard tests (>1.5 SD from norm group) and DIMA (<7th percentile from norm group) at each test moment are visualized in Figure 1. There were no significant postoperative declines on the BNT and the Token Test, but patients deteriorated at T2 compared to T1 on Category (professions) and Letter fluency ($p < 0.01$). Between T2 and T3, patients improved on both fluency tests ($p < 0.01$). There were no significant long-term differences between T1 and T3. Overall, patients with high-grade glioma scored significantly lower on the BNT and Token Test compared to low-grade glioma ($p < 0.05$). Hemispheric tumor localization did not significantly influence standard test performance.

DIMA

There were short-term postoperative declines at T2 compared to T1 preoperative baseline on word, compound, and non-word repetition tests ($p < 0.05$). Between T2 and T3, there were no significant improvements on DIMA subtests, but patients showed a delayed decline at T3 on sentence completion compared to T2 ($p = 0.03$). DIMA test scores did not differ significantly between T1 and T3. Across time points, high-grade glioma patients performed worse than low-grade glioma patients on all repetition tests ($p < 0.05$). There was no significant effect of hemispheric tumor localization.

Discussion

Pre- and postoperative language impairments were found on standard tests as well as on DIMA subtests. Awake surgery seemed to have protected most linguistic functions until long-term postoperatively. However, patients showed short-term postoperative declines compared to baseline levels on verbal fluency tasks. In addition, patients deteriorated on three out of four DIMA repetition tests, which is in line with earlier evidence for the value of (non-)word repetition (Sierpowska et al., 2017). Patients showed longer-term postoperative declines only on DIMA sentence completion, reflecting earlier spontaneous speech analyses regarding the occurrence of incomplete sentences (Satoer et al., 2018). We did not find evidence for a significant influence of hemispheric tumor localization on test performance. High-grade glioma patients had more severe impairments than low-grade glioma patients on standard tests (BNT and Token Test) and DIMA repetition. 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.

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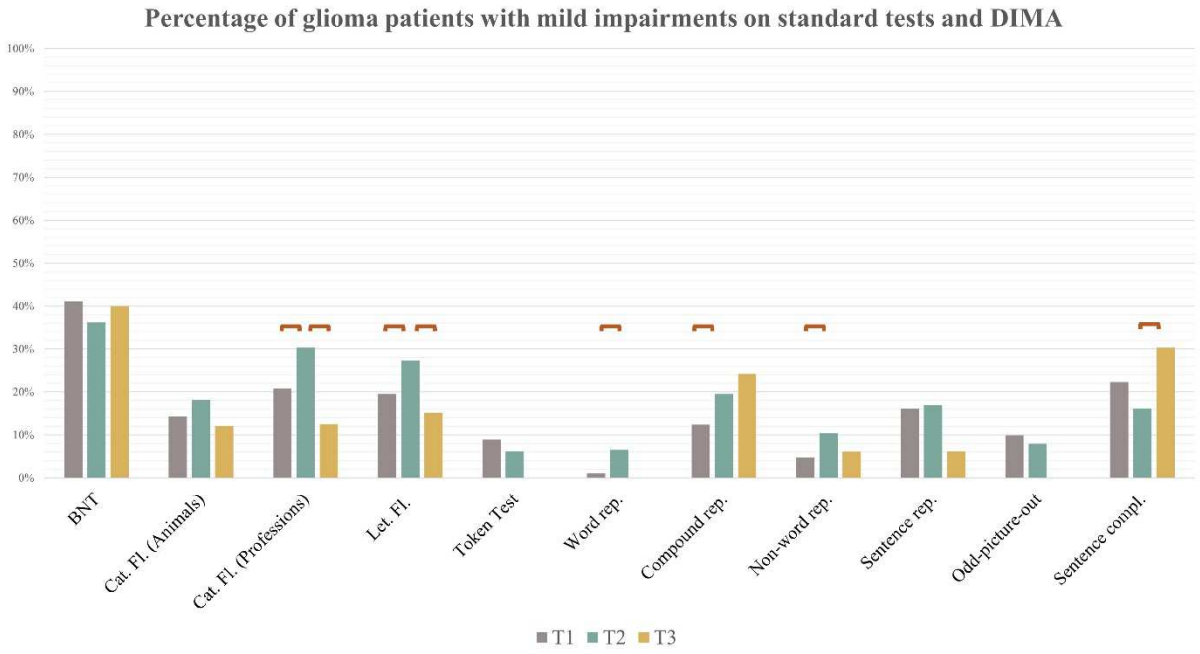
Percentage of glioma patients with mild impairments on standard tests and DIMA
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
BNT
Cat. Fl. (Animals)
Cat. Fl. (Professions)
Lct. Fl.
Token Test
Word rep.
Compound rep.
Non-word rep.
Sentence rep.
Odd-picture-out
Sentence compl.
T1
T2
T3

A systematic Review: Idiom Comprehension in Aphasia: The Effects of Stimuli and Task Type

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Introduction and Aims

Idioms differ in their semantic dimensions of familiarity (frequency of encounter), ambiguity (possibility of a literal interpretation), decomposability (possibility of the idiom's words to assist in its figurative interpretation) and transparency (possibility to deduce the original metaphorical motivation of an idiomatic phrase). Studying clinical populations such as subjects suffering from aphasia, often caused by Left Hemisphere (LH) brain lesions, can help elucidate idiom processing in the brain (e.g., 1, 2, 3, 5). Patients with aphasia sometimes show less impaired comprehension for specific semantic dimensions, suggesting that some idiom semantic dimensions may not depend solely on the LH. However, recent literature (e.g., 1, 3,4) examines whether the types of idioms and tasks employed affect how different brain areas are involved.

This study investigates idiom comprehension in aphasia and explores the potential effect of 1. the idiom semantic dimensions, and 2. the tasks employed, on the patients' idiom comprehension.

Methods

A systematic review was done following the PRISMA approach. Starting from an initial find of n =451, screening and assessment for inclusion and exclusion criteria, 15 articles were retained for further analysis. Extracted information included patient characteristics, types of idiomatic stimuli, types of tasks employed and patients' performance in idiom comprehension. For the idiomatic stimuli, we extracted information about the combinations of their semantic dimensions, and how these dimensions were defined. For the task employed, we extracted information about the type of the task, the modality of presentation and response, context manipulation as a variable of interest, and whether accuracy and/or reaction times were measured. For the patients' performance, we extracted information about the errors arising 1. considering different combinations of idiom semantic dimensions, and/or 2. considering the task design.

Results

Results indicated that studies in idiom comprehension in aphasia are characterized by heterogeneity regarding the patient characteristics, the idiomatic stimuli and the experimental task employed. Patient ages ranged between 35-82 years old. Out of a total of 15 studies, 4 were case studies including Wernicke's, Broca's, Global, Anomic or Transcortical Sensory aphasia. The rest considered all types of aphasia as one group.

For the **idiomatic stimuli**, 10 studies used only familiar idioms, 4 studies did not control ambiguity and 6 studies did not measure transparency. Only 1 study mentioned measurements for both transparency and decomposability. Last, only 2 studies included combinations of idiom semantic dimensions. In addition, 4 studies used the term "transparency" but they measured decomposability.

For the **experimental task**, 4 studies conducted only a string-to-word matching task (where participants were presented with an idiomatic string and were provided with different target words), 4 studies conducted only a string-to-picture matching task (where participants were presented with an idiomatic string and were provided with different pictures) and 1 study used only an oral definition task. 4 studies used a combination of the tasks mentioned. 1 study used a reading task, where they asked participants to simply read the idiomatic string they saw and 1 study employed a lexical decision task, where participants were asked to judge whether a target word is related to the idiomatic string that they have been previously presented with. For the matching tasks, 7 studies included options (either pictures or words) representing (1) the figurative meaning of the idiom, (2) a literally related meaning of the idiom and (3) an unrelated situation, while 4 studies used other options with either excluding the literal meaning or replacing it with a semantic associate. 2 studies included context manipulation. In terms of modality, most studies provided participants with both an oral and a written presentation of the stimuli. Considering participant response, 6 studies required their response by pointing, 1 study by using the keypad, 1 study orally and 6 studies did not specify this. Last, 13 studies focus on accuracy, only 1 measured both reaction times and accuracy as well as reading times and 1 reported only on reaction times.

Discussion

Considering the **idiomatic stimuli** employed, patients with aphasia show more deteriorated comprehension when presented with unambiguous/opaque and ambiguous/decomposable idioms. In the former case, transparency, i.e., the illustrative motivation of an idiom, may be facilitating comprehension, while in the latter case, decomposability, i.e., the existing link between the idiom's content words and its figurative meaning, may be hindering comprehension. In addition, idiom types were linked to the involvement of specific brain areas. Current literature can't unanimously account for what types of idioms involve the left and/or right temporal gyrus, but there are indications that the left Middle Temporal Gyrus (MTG) is predominantly involved in idiom comprehension irrespective of the idioms'

semantic dimensions, while the role of the right MTG is still controversial. Also, patients with frontal lesions show impaired comprehension in ambiguous idioms, but it is uncertain how an intact right temporal lobe would affect (perhaps facilitate) comprehension patterns.

Considering the **experimental task** employed, the string-to-word matching task appears more appropriate for testing patients with aphasia since it does not obfuscate their abilities. However, difficulties arise specifically relating to ambiguous idioms, irrespective of the language. The choice words or pictures for the string-to-word and string-to-picture matching tasks respectively is also crucial. Specifically, more literal errors are observed in most of the studies, irrespective of the type of task employed. More literal errors compared to unrelated errors are observed for ambiguous and decomposable idioms. Next, context displayed facilitatory outcomes. Patients were more accurate when the context was preceding the idiomatic stimulus rather than when it was following it. Last, modality may be a factor co-influencing the outcomes. Considering the case studies, only the one including the anomic aphasics referred to the error patterns, showing more literal errors with ambiguous/transparent idioms

Finally, this review underlines some limitations. First, the idiom semantic dimensions were insufficiently described and often accompanied by terminological inconsistencies. Second, patient profiles were incomplete, and results were not stratified according to type of aphasia. Future studies should give more information on patient profiles and consider giving information per type of aphasia.

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The effect of transitivity on nTMS mapping of the arcuate fasciculus: evidence from healthy adults and people with brain tumors

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Introduction

Navigated Transcranial Magnetic Stimulation (nTMS) is a non-invasive method that causally identifies cortical areas involved in language processing (Ohlerth et al., 2021; Ntemou, et al., 2021). The combination of nTMS and diffusion Magnetic Resonance Imaging (dMRI) increases language identification accuracy by allowing researchers to stimulate cortical terminations of white matter tracts (Reisch et al., under review). The arcuate fasciculus (AF) is an associative tract with cortical terminations in the frontal, parietal and temporal lobes (Catani et al., 2005). Cortical regions connected by the AF have been shown to be differentially involved in the processing of transitive and unergative verbs, with transitive verbs eliciting higher activation bilaterally (Thompson et al., 2010). These findings have led authors to suggest that bilateral parietal and left temporal areas are involved in argument structure information retrieval and verb/argument integration, respectively (Thompson & Meltzer-Asscher, 2014). In addition, performance on verbs with more arguments correlates with measures of sentence production of people aphasia (den Ouden et al., 2019). The aim of the present study is to examine whether transitivity affects the nTMS mapping outcome of people with brain tumors and healthy adults, as well as determine whether nTMS error rates for transitive and unergative verbs correlate with preoperative measures of language abilities.

Based on previous findings, we predicted that if verb production is influenced by the number of arguments, nTMS will induce more errors during naming of transitive compared to unergative verbs during language mapping of healthy individuals as well as people with brain tumors. To assess whether nTMS-induced error rates for unergative and transitive verbs correlated with measures of aphasia severity, language production and

comprehension abilities, each individual with brain tumor completed a preoperative assessment of the German version of the Aachener Aphasia Test (AAT; Huber, 1984). Based on reports from individuals with post-stroke aphasia, we hypothesized that transitive error rates would correlate with sentence production and comprehension abilities.

Methods

Participants

We performed nTMS language mapping in a group of neurologically healthy, right-handed German speakers (N = 15, mean age = 30.15), and a group of German-speaking individuals with brain tumors (N = 14, mean age = 50.28).

Materials & Procedure

We combined dMRI and nTMS during an action naming task with finite verbs (Ohlerth et al., 2020) to investigate the neural underpinnings of transitive and unergative verbs. After performing fiber tracking of the left AF (Fekonja et al., 2019), we stimulated two points over its frontal, parietal, and temporal cortical terminations six times each in both participant groups. For the group of individuals with brain tumors, an additional ten peritumoral points received ten stimulations each. As data collection is still ongoing, preliminary results are presented in the current submission.

Results

Induced errors were analyzed according to cortical terminations (frontal, temporal, parietal) and verb type (transitive/unergative). NTMS induced more errors with transitive verbs compared to unergative verbs in healthy speakers ($F = 8.7$, $p = 0.007$) as well as people with brain tumors (Exp (B) = 1.58, $p = 0.006$). Only in healthy speakers, error rates differed significantly, when stimulating temporal terminations of the left AF ($t = -3.9$, $p = 0.001$; see Figure 1a). Error rates between the two verb types did not differ during stimulation of left frontal or parietal terminations in either of the two groups.

Regarding nTMS-induced error rates and correlations with different subsections of the AAT, error rates for unergative items did not correlate with any of the AAT preoperative scores. Error rates of transitive verbs negatively correlated with ability to produce compound nouns (Rho = -0.66, $p = 0.01$, see Figure 1b), whereas they did not correlate with either sentence production or comprehension measures.

Discussion

Preliminary data suggest that nTMS induces more errors during transitive compared to unergative finite verb naming. Also, suppression of posterior temporal regions leads to increased number of errors during the production of transitive verbs in a sentence context

only when stimulating the brain of healthy individuals. Given the inhibitory nature of our nTMS protocol and in line with previous work, we suggest that during action naming posterior temporal regions are necessary for argument structure information retrieval in healthy adults (Malyutina & den Ouden, 2017). The findings regarding left AF terminations in people with brain tumors may be due to neuroplastic changes, for example, language-related activity being performed by the right hemisphere (Piai et al., 2020). Tumor (e.g., volume/location) and item characteristics (e.g., word properties), as well as a stimulation protocols of the right AF terminations, may shed further light onto this issue.

In line with our predictions, we show that unergative error rates under nTMS do not correlate with any preoperative aphasia measures. Contrary to our predictions, we did not observe correlations between nTMS-induced transitive error rates and sentence production or comprehension abilities. The only correlation we observed was between compound object naming and nTMS-induced transitive error rate, indicating that the higher the error rate under stimulation with transitive verbs, the lower the compound naming abilities of people with brain tumors. These findings indicate that unlike evidence from post-stroke aphasia (den Ouden et al., 2019; Rofes et al., 2015), action naming in a repeated sentence context of 3rd person singular present tense might not be complex enough to predict abilities in sentence production or comprehension of people with brain tumors.

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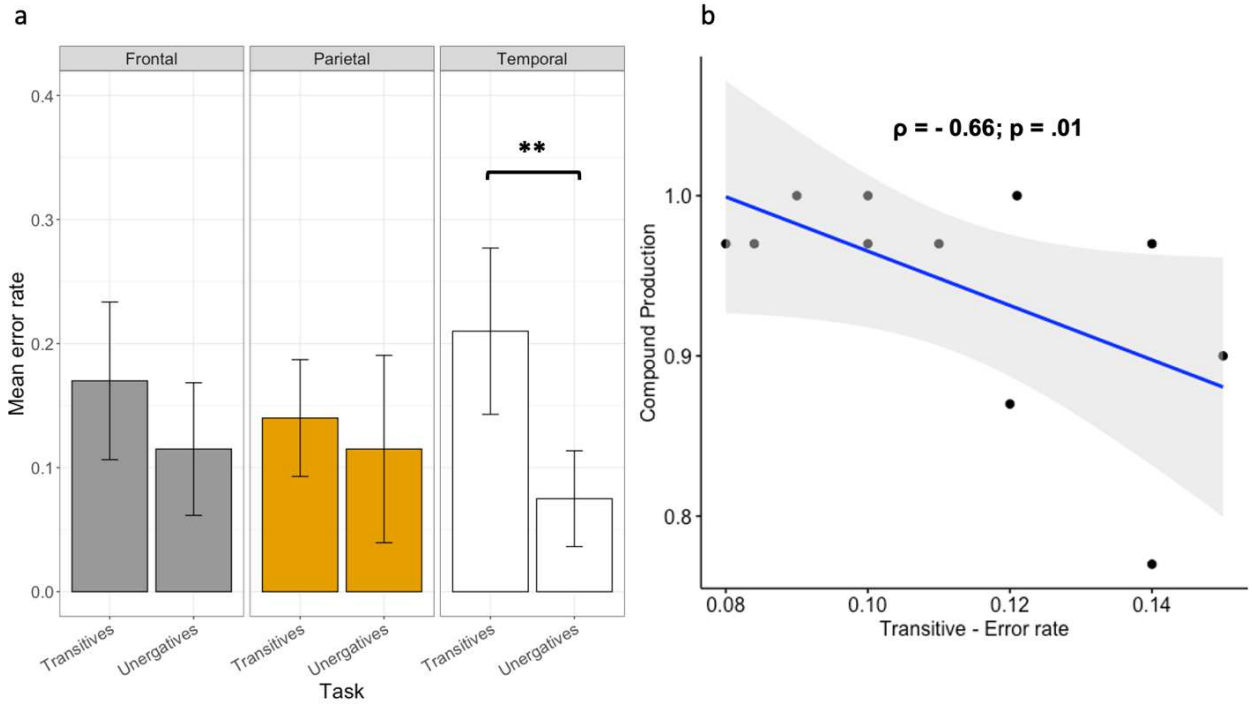

Figure 1: Error rates for transitive and unergative verbs under nTMS of healthy individuals (a) and correlation of transitive error rate with compound naming performance of individuals with brain tumors (b).

The effect of musicality on language recovery after awake glioma surgery

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Topic: Clinical and experimental work on aphasia and related disorders

Introduction and aim

Awake craniotomy is a gold standard method to resect brain tumor (glioma) while preserving language. However, differences between patients in post-operative language outcome are observed despite careful intra-operative monitoring, which might be explained by differences in neuroplastic properties and functional reorganization.(1)Musical training during younger age might affect the degree of post-operative language recovery, as a large body of evidence exists on music-induced neuroplasticity.(2) Indeed, longitudinal studies showed enhanced reading and pitch discrimination abilities in speech after musical training with children.(3) Moreover, music-induced functional reorganization is already successfully applied in patients with aphasia after stroke (Melodic Intonation Therapy / MIT).(4) Last, increased white matter connectivity properties in the corpus callosum are described in musicians compared to non-musicians, which might substantiate the enhanced functional reorganization properties in musicians. (5, 6) Hence, we hypothesize better recovery of language in musical patients after awake glioma surgery, possibly caused by enhanced connectivity properties from the corpus callosum.

Methods

Population

Adult patients undergoing resection for glioma with an awake resection procedure at two neurosurgical centers were retro- and prospectively included. Patients without language assessments at pre- and post-operative level, with a glioblastoma multiforme (WHO grade 4) or undergoing re-resection were excluded.

Data extraction

Language was assessed preoperatively (T1) and post-operatively at three months (T2) and one year (T3) with the Diagnostic Instrument for Mild Aphasia (DIMA). The DIMA is a valid tool, developed in Dutch for use in patients with gliomas, to evaluate suspected mild

aphasia. It consists of six subtests and assesses language at production and perception levels in the most important linguistic levels: phonology, semantics and (morpho-) syntax. The raw scores were extracted and corrected for age and education years based on norms from a healthy population and computed to z-scores.

The patients' musical skill was assessed through questionnaires, and divided in three groups based on the Musical Expertise Criterion (MEC) which defines musicality based on the duration (i.e. years of playing) and intensity (i.e. average hours per week) of musical training.

Volumetric measures of the corpus callosum, automated with Brainlab software, were measured after manual segmentation by two independent researchers. Moreover, inter-rater agreement was calculated with the interclass correlation coefficient (ICC) and corpus callosum volumes were corrected for total brain volume.

Statistical analysis

Language performance and corpus callosum volumes were compared between the three musicality groups. Univariate comparison was conducted with the Kruskal-Wallis (non-parametric) test or two-sided ANOVA (parametric) test. For language assessment, linear mixed models were applied with repeated measures ANOVA and two-sided ANCOVA, corrected for time between craniotomy and language assessment (days) and hemispheric side of operation, as a within and between subject variability was suspected. Corpus callosum analysis was analyzed with a two-sided ANCOVA after correcting for gender. All analysis were conducted with R (version 1.4.1717).

Results

Forty-six patients, enrolled between June 2015 and September 2021, were followed-up (mean/SD; 240/174 days after craniotomy) and divided in: non-musician (41.3%, n = 19), amateur-musician (34.8%, n=16) and trained-musician (23.9%, n = 11). An overall decrease (mean/SD) in all linguistic levels was observed in T1/T2 (-0.255/0.966) and T2/T3 (-0.246/0.947). Within the first three months (T1 vs T2), musicality correlated with improved course of language performance in the overall score (-0.411/0.865 vs. -, figure 1) and the phonological domain with subtests 'Non-word repetition' (-0.425/0.951 vs. -0.00106/1.18 vs. 0.0260/0.534, p-value = 0.19) and 'Sentence repetition' (-0.202/0.683 vs. -0.145/1.83 vs. 0.405/1.53, p-value = 0.48). Between three months and one year (T2 vs T3) musicality only correlated with improved language recovery on the phonological level with subtest 'Non-word repetition' (0.279/1.63 vs. 0.0830/0.608 vs. 0.166/0.406, p = 0.75). This trend was

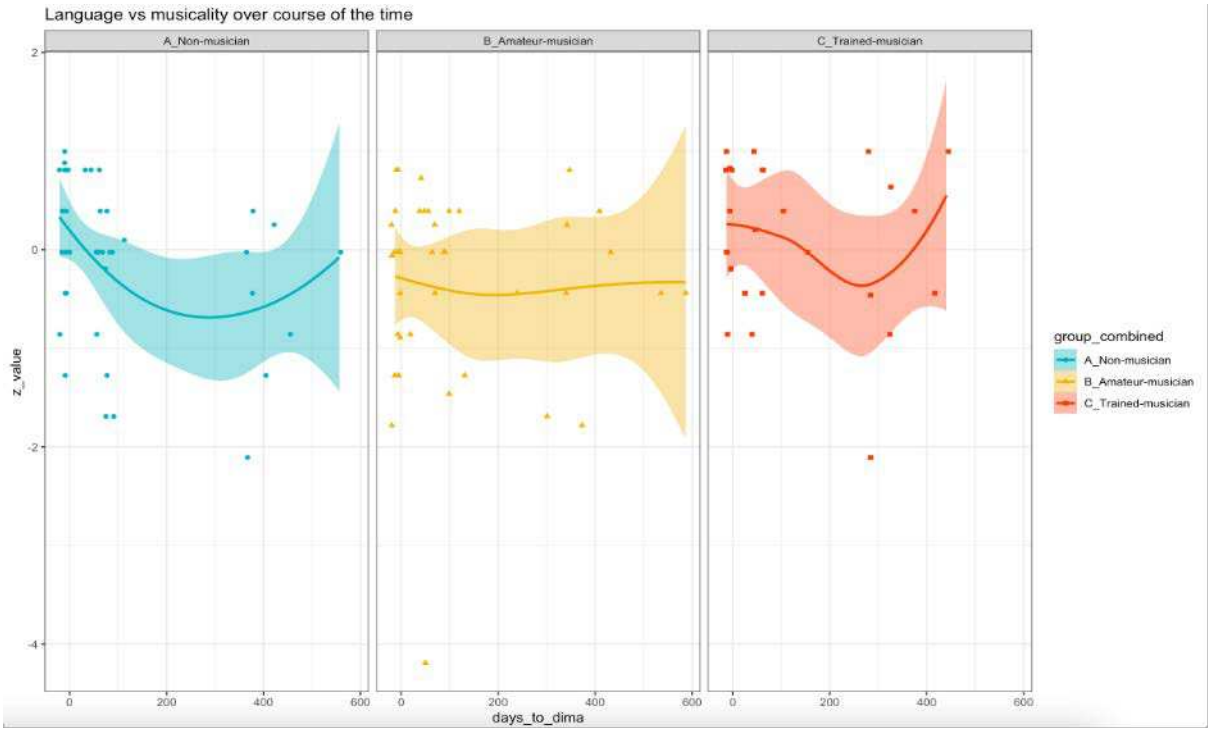
confirmed in the linear mixed model but did not reach significance for the 'Overall' (Non-musician vs. Amateur musician; p = 0.312, Non-musician vs. Trained musician; p = 0.627), the 'Non-word Repetition' (Non-musician vs. Amateur musician; p = 0.097, Non-musician vs. Trained musician; p = 0.621) and 'Sentence Repetition' tasks (Non-musician vs. Amateur musician; p = 0.1209, Non-musician vs. Trained musician; p = 0.0935).

Volumetric corpus callosum measurements showed excellent inter-rater agreement (ICC = 0.992). An increased but non-significant trend (p=0.28) between musicality and corpus callosum volume / total brain volume ratio (mean/SD) was observed in non-musicians (0.755/0.152), amateur musicians (0.789/0.119) and trained musicians (0.830/0.202, p-value = 0.6253).

Discussion

Musicality seemed to have contributed to improvement of language outcome after awake glioma surgery, especially within the first three months and mostly in the phonological level. This is plausible as phonology and music share a common hierarchical structure (e.g. syllabic and grouping structure, prosody and melody). The relevance of phonology and its prognostic relation to the quality of verbal communication at the long run were already demonstrated in aphasic patients after stroke (7). Therefore, it is important to monitor subtle changes in phonological production (e.g. word repetition, see also (8) as an indicator for the overall quality of language processing). Moreover, melodic intonation and rhythm have been demonstrated to be beneficial in improved functional language use after MIT in stroke patients with severe aphasia. (9) This may be partly attributed due to a higher white matter connectivity in the corpus callosum developed during musical training, which might have contributed to functional reorganization towards the contralateral side. The beneficial effect of musicality on language is mostly observed within the three months, as language seemed to recover in all patients after this period.

However, none of our trends were statistically significant, due to our small sample sizes. Hence, our conclusion should be handled with caution and interpreted hypothesis generating only. Future studies with larger sample sizes are needed to confirm our findings.


Language vs musicality over course of the time
A_Non-musician
B_Amateur-musician
C_Trained-musician
z_value
days_to_dima
group_combined
A_Non-musician
B_Amateur-musician
C_Trained-musician

On the Distribution of Bilingual Effects: A PRISMA Review

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Topic: Language and cognition

Introduction and aim

Research on the effects of bilingualism on development has been ongoing for decades. The focus of bilingual research has gone from comparing monolingual and bilinguals' fluid intelligence, to metalinguistic awareness and academic performance, to the contemporary shift to bilingual effects on executive functions. While the attitude towards bilingualism has evolved from concerns that adduced to it possible causes of "mental confusion", to the more positive standpoint that bilingualism is always an advantage, effects of bilingualism on development have mostly been described in biased terms. This has led to the contemporary emergence of the *bilingual advantage debate*, a scholarly search of bilingual positive effects on cognition which, in line with today's positive bias, sees negative and null bilingual effects juxtaposed to the advantage-confirming data in an ever ending duel. While equally compelling bodies of evidence make it hard to take a stance in the debate, the robustness of the bilingual advantage as a phenomenon has raised doubts, and the field continues to abound with open questions (Blanco-Elorrieta & Caramazza 2021). We argue that the best way to reconcile the opposing fronts of the debate is by theoretically accommodating both: with bilingual research having thus far failed to provide indisputably robust evidence *either* in favour *or* against a cognitive bilingual advantage, a question that has remained unanswered –and largely unasked– concerns the distribution of bilingual effects across populations.

Methods

A systematic review of the literature on the *bilingual disadvantage* was performed according to the PRISMA Statement (Liberati et al. 2009). Given that evidence for a publication bias against negative results has been reported in the literature, the chosen starting point was the least plentiful category of studies, to be checked against the most plentiful category in order to determine the degree to which the two effects co-exist within and across different populations. The search strategy thus consisted of the following keywords: "bilingual" & "disadvantage". The literature search was conducted in the following databases: PsycInfo, PsycExtra, PsycBooks, APA Journals, and PubMed. A total of 150 articles were obtained from this search procedure. Subsequently, duplicates were removed, and the remaining abstracts were screened for content. Figure 1 presents the screening and selection process.

Results

Search results (n=37 studies) are presented split in the following categories:

(i) studies that report both an advantage and a disadvantage (Advantage & Disadvantage = 21.62%);

(ii) studies that report neither an advantage nor disadvantage (Neither Advantage, Nor Disadvantage = 29.73%);

(iii) studies that report only an advantage (Advantage = 8.11%);

(iv) studies that report a disadvantage for a population/language group for which an advantage has been also reported in the literature, identified through a second complementary search (Disadvantage & External Advantage = 40.54%);

(v) studies that report a disadvantage for a population/language group for which no advantage has been found in the literature (Disadvantage = 0.00%).

Discussion

Excluding studies reporting null effects, the remaining studies either reported both effects, only an advantage or only a disadvantage. To obtain the overall picture, a second search of the literature was performed outside the first sample. This search targeted the populations mentioned in the studies reporting only a disadvantage, and revealed that the populations featured in such studies reporting bilingual disadvantages only, have all been linked to bilingual advantages in other studies.

Such balanced distribution of effects arguably calls for a reframing of the debate, starting from the making of theoretically informed predictions that can be subject to empirical (in)validation – something which has been recognized as a shortcoming of the field both on the behavioral and neural fronts (de Bruin et al. 2021). Inferring from their complementary distribution, we argue that bilingual advantages and disadvantages could benefit from terminological labelling that allows headspace for their mutually-nonexclusive nature, i.e. bilingual cognitive *enhancements* or *costs*, which could in turn aid recasting their role as connatural components of cognitive adaptations to bilingualism forming part of a trade-off. With its founding intuition traceable back to the Darwinian (1859) observation that modifications in one part of an organism inevitably cause modifications in other parts, a recent integrative framework has provided a characterization of basic functional trade-offs in cognition (Del Giudice & Crespi 2018). What these entail is that, when performing a goal-directed function, enhanced computation in one property of the system cannot occur without conferring a cost on another property. Set in these terms, bilingual advantages are *direct* evidence of a cognitive enhancement and, crucially, *indirect* evidence for the cognitive costs such enhancement(s) rest on, and viceversa; this way, null evidence can no

longer be grouped together with negative findings.

The cognitive front here outlined seems to correlate with the neuroanatomical picture: while evidence for brain adaptations to bilingualism has been found, there is no single locus for these adaptations (García-Pentón et al. 2016). The variation observed at the behavioral and neuroanatomical fronts offers support to bilingualism as a spectrum experience permitting modulations based on individual variables (DeLuca et al. 2019).

To conclude, bilingualism as an environmental trigger may confer an array of (dis)advantages that must be compensated in the opposite direction, such that it might be meaningful to talk about *cascade effects*, consisting of multiple (dis)advantages, and not about a single 'advantage-disadvantage' pair. While reasoning in such fixed terms may be practically convenient, not recognizing the composite nature of both bilingualism and its effects would pose an unnecessary limit to our understanding of bilingual cognition. As a result, we encourage the exploration of bilingual cognitive adaptations conferring *both* cognitive enhancements *and* costs, as connatural components of a dynamic trade-off relation.

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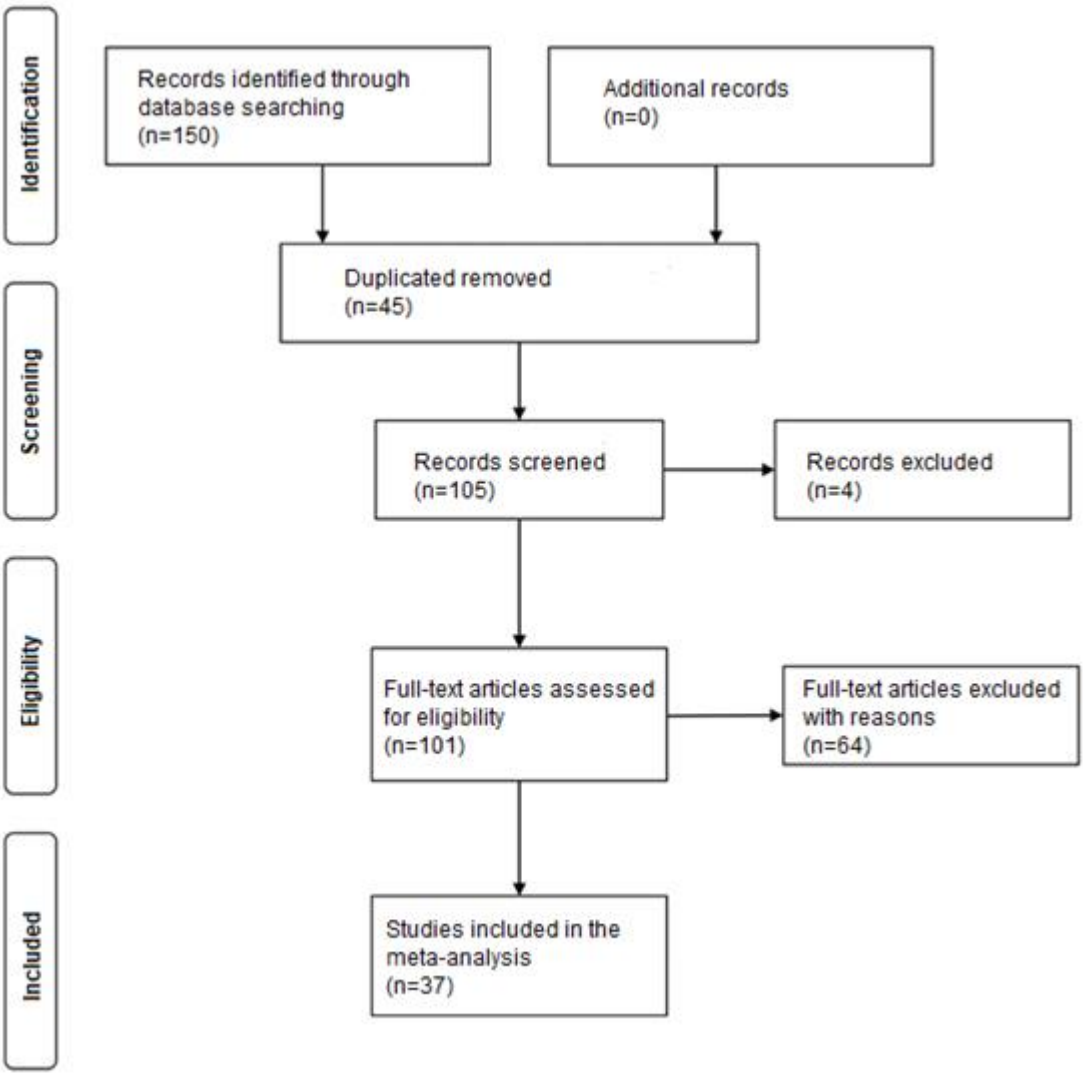

Figure 1. PRISMA Flow Chart

Effects of healthy aging and gender on the electrophysiological correlates of semantic sentence comprehension: the development of Flemish normative data

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Introduction and aims

The application of event-related potentials (ERPs) in patients with aphasia is increasingly acknowledged (Silkes & Anjum, 2021). For clinical purposes, the availability of normative electrophysiological data is an added value. Following previous research on phoneme perception (Aerts et al., 2013), semantic word comprehension (Cocquyt et al., 2022) and grammatical (word order) processing (Dorme, Van Oudenhove et al., submitted) in the Flemish population, this study aimed to investigate the effects of increasing age and gender on the electrophysiological correlates of semantic sentence comprehension.

Methods

One hundred and ten healthy, right-handed individuals (55 men and 55 women) participated in this experiment. The subjects were clustered in three age groups, namely the young (20-39 years, n=40), middle-aged (40-59 years, n=40) and elderly (≥60 years, n=30). Each age group consisted of an equal amount of men and women. During electrophysiological recording, a semantic sentence verification task was presented in the visual modality (adapted from Swaab, Brown and Hagoort, 1997). The mean amplitudes and fractional area latencies of the elicited ERPs were extracted by means of the MNE-Python toolbox. Aging and gender effects were statistically investigated through repeated measures ANOVA.

Results

The electrophysiological correlates of semantic sentence comprehension were mainly affected by increasing age. Although an N400-effect was observed in both men and women independent of their age, elderly subjects did show a reduced and delayed N400-effect in

comparison to the young subjects. Moreover, the elderly showed an increased late positive component at frontal electrode sites.

Discussion

This study provides an examination of healthy aging and gender effects on the amplitudes and latencies of ERPs elicited during a semantic sentence comprehension task. The results are discussed in the context of neuroscientific theories on cognitive aging, and gender differences in cognitive strategies. Finally, the added value of normative electrophysiological data in the follow-up of patients with aphasia is emphasized.

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Development of an action fluency task in German to assess verb retrieval in aphasia

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Introduction and aims

Tasks testing verbal fluency usually involve time-limited (e.g., 1 minute) generating of nouns, either according to certain semantic restrictions (e.g. animals, things to buy in a supermarket) or with formal constraints (e.g. generating words that start with /b/), in the absence of other prompting stimuli like pictures. Action fluency, however, tests the ability to generate verbs, i.e. things a person can do (Piatt et al., 1999). Action fluency tasks may be particularly useful for assessing retrieval of verbs in individuals with aphasia (IWA), because (i) many studies have revealed that in aphasia verbs are often more affected than nouns (i.e. noun-verb dissociations, Mätzig et al., 2009), (ii) most aphasia assessments focus on nouns and only rarely involve verb production (Alyahya et al., 2018; Papagno et al., 2020), (iii) reduced action fluency may be a particularly sensitive task to reveal residual symptoms in mildly affected IWA (Faroqi-Shah & Milman, 2017) and for the early identification of primary progressive aphasia (Beber & Chaves, 2014). For English, norming data from healthy control participants are available for action fluency, however, so far no action fluency task has been developed for German- speaking IWA.

We, therefore, aim to develop an action fluency task in German, including the collection of norming data for two age groups. In addition, our objective is to explore whether the action fluency task can also be extended to involve generating actions which belong to specific semantic fields or topics.

Methods

Data were collected either face-to-face or in (video-)calls via skype or Zoom. For action fluency without semantic restrictions, the wording of the instruction was based on previous studies, prompting participants to say, within 1 minute, as many different things they can think of that people can do (Piatt et al., 1999). For semantically constrained action fluency, we selected four topics of actions out of a wider range of ‘semantic fields’ of actions which are included in an item-set used for the development of a model-based assessment tool for verb processing in German (this will be presented at the conference in another submission by Stadie & Hanne). The topics included gardening, do-it-yourself & handcrafting, body care, and sports. Criteria for evaluating responses as correct or incorrect adhered to the

criteria used in previous studies; for semantically constrained action fluency the thematic fit of responses was validated in a post-hoc rating study conducted with 86 participants who were naïve to the goal of the study. In addition to single verbs, we also counted as correct combinations of nouns or noun phrases and verbs, as long as the verb included in the noun-verb-combination had not been produced previously.

Overall, 106 neurotypical adults participated in the different versions of the fluency task, of which 64 took part in the action fluency task without restriction, covering two age groups. Age group 1 (18-49 yrs) comprised 33 adults (21 female, age range: 18-49, M=33.39, SD=9.42) and group 2 (50 yrs and older) included 31 adults (17 female, age range: 50-84, M=68.16, SD=9.75). For semantically constrained action fluency, both age groups comprised 21 participants, respectively, of whom no one had participated in the other task (age group 1: 14 female, age range: 18-49, M=33.29, SD=10.02; age group 2: 13 female, age range: 50-83; M=61.05, SD=9.67). Both age groups were matched for education, respectively. In addition, we have piloted the task with currently 2 IWA, one of which took part in all five versions of the task. Data collection from IWA is still ongoing.

Results

Table 1 shows the results for the different versions of the task separated by age groups of the normative sample. It also includes results of testing with IWA.

For control participants, overall, the number of verbs produced in the unconstrained verbal fluency task was significantly higher than in the versions with semantic restriction (t=6.84, p<.05). Furthermore, there was an effect of group for the version prompting participants to produce actions related to the topic of sports, with group 2 producing significantly less verbs than group 1 (t=2.71; p<.05).

For determining whether IWAs' performance was significantly lower than the performance of the normative sample, we used the methods described by Crawford and colleagues and implemented in the program *SinglimsES* (Crawford & Howell,1998), since these are particularly suited to determine cut-off values for impaired performance when sample size of the control group is rather low. Because of the high inter-individual variability observed in the data from controls (see the rather high SDs in Table 1), we used a criterion of p<.099 instead of p<.05 to identify the lower bound of the normal range and thus the cut-off scores for impaired performance (Crawford & Howell,1998). This results in a higher sensitivity of the test because mild impairments or residual aphasic symptoms can also be identified in individuals who performed rather in the upper part of the normal range post-onset.

Applying this criterion, both IWA performed significantly below the age-specific normative sample in the version without semantic restriction. IWA 2 performed within the normal range in the versions with semantic restriction except for the version prompting actions related to do-it-yourself & handcrafting.

Discussion

For the semantically unconstrained verbal fluency task, our study provides normative data for two distinct age groups. In the mean, the number of produced verbs is comparable to norming data for action fluency in other languages, however, in both age groups, we found evidence for high inter-individual variability. Furthermore, we have devised a new version of the action fluency task in which participants are prompted to generate actions from specific semantic fields or topics. To our knowledge, so far no study has used this new version of the task, which can be particularly useful for assessing verb retrieval in IWA.

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Table 1: Means, standard deviations (SD) and range (MIN, MAX) of verbs produced by control participants in two age groups in the different versions of the verbal fluency task as well as performance of two individuals with aphasia (IWA)

Control group	Version	Mean	SD	MIN	MAX	IWA 1 (75 yrs)	IWA 2 (50 yrs)
Group 1 (18-49 yrs)	without semantic restriction	20.94	6.03	10	32		5 (I)
	gardening	10.65	2.91	4	16		8 (N)
	do-it-yourself & handcrafting	14.75	3.08	10	22		8 (I)
	body care	12.52	3.27	8	20		7 (N)
	sports	13.10	4.46	7	24		6 (N)
Group 2 (50 yrs and older)	without semantic restriction	19.74	5.79	8	30	8 (I)	
	gardening	10.14	2.61	6	16	n/a	
	do-it-yourself & handcrafting	13.29	4.05	6	20	n/a	
	body care	11.10	4.05	7	26	n/a	
	sports	9.95	3.35	6	18	n/a	

Note: IWA 2 took part in the version of the action fluency task without semantic restriction only. I = impaired performance, N = performance within the normal range.

Development of a model-oriented assessment tool for verb processing in German (MoVe)

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Introduction and aims

Several studies suggest that verb processing can be particularly impaired in aphasia and, in naming, verb production frequently is significantly more impaired than retrieval of nouns. There is an ongoing debate regarding the functional localization of such noun-verb-dissociations with respect to models of single-word processing. While some studies suggest a rather semantic as opposed to lexical origin of the impairment (Bird et al., 2000), others have revealed modality-specific impairments in verb processing and double-dissociations across individuals and modalities, which speak in favor of a deficit at the level of the modality-specific lexical word forms (Caramazza & Hillis, 1991). Furthermore, performance in verb processing in aphasia can be modulated by lexical-semantic parameters, like frequency, age-of-acquisition, and familiarity.

Despite the high prevalence of verb deficits in aphasia, most aphasia assessments focus exclusively on nouns and verb processing is only rarely assessed in clinical settings (Papagno et al., 2020). Moreover, the few existing tests which include verbs focus either solely on verb production (e.g. the Object and Action Naming Battery, OANB, for English, Druks & Masterson, 2009) or on comprehension (e.g. the Kissing and Dancing Test, KDT, for English, Bak & Hodges, 2003), or they rather constitute a screening only (e.g. action for German, Bastiaanse et al., 2004). For German, there is no assessment that allows for a detailed evaluation of verb processing at the single-word level including testing for modality-specific impairments and the possible effects of relevant lexical-semantic parameters (e.g. verb frequency, age-of-acquisition) on performance.

We therefore aim to construct an assessment tool including comprehension as well as production tasks for spoken as well as for written verb processing, allowing to also investigate the influence of relevant parameters and treatment effects by developing two parallel item-sets that are systematically controlled for frequency, age of acquisition and familiarity of the verbs. Moreover, we aim to collect control data for different age groups.

Methods

Development of the item set

For item construction, we first collected naming agreement for a set of 95 black-and-white pictures displaying concrete actions in a study involving 69 participants (Völsch et al., 2021). Only items for which naming agreement was at least 81% were used. For each verb, the normalized frequency of the lemma was extracted from a lexical database for German (dlexDB). Age-of-acquisition and familiarity for the verbs were compiled in two rating studies each including 20 participants (Völsch et al., 2021). Furthermore, verbs were grouped into 10 different semantic fields, each of which encompasses a circumscribed topic which, cross-individually, are associated with specific actions and combinations of actions. The items were then assembled into two distinct sets of n=40 items, in order to obtain parallel versions which are systematically controlled for the relevant parameters and each of which allows to detect unambiguous effects of frequency, age-of-acquisition and familiarity. The classification into high/low frequent, early/late acquired and highly/low familiar of the verbs in both sets was validated using statistical comparisons.

Tasks

In order to allow for the identification of modality-specific deficits, we constructed four different tasks, each focusing on a different modality in verb-processing at the single-word level: T1 spoken word-picture matching, T2 written word-picture matching, T3 spoking (picture) naming, T4 written (picture) naming. With respect to spoken verb production, the assessment includes a further task testing free retrieval of verbs, i.e. action verbal fluency, which will be presented at the conference in another submission by Hanne & Stadie. For the comprehension tests, the target pictures were presented together with a semantically related distractor from the same semantic field and a picture showing a semantically unrelated action. For each task, target verbs were presented in a pseudo-randomized task-specific order in which verbs of the same semantic field were always separated by at least 2 verbs from other fields, and maximally 3 high- or low-frequency verbs succeeded each other. Within high- or low-frequent verbs, a maximum of 3 items with the same classification regarding age-of-acquisition and familiarity were in consecutive order.

Collection of control data

Overall, n=80 German-speaking neurotypical adults participated in the norming study, which was run via an online platform (T1, T2, T4) and (video-)calls. Participants were split into two age groups. For T1, T2 and T4, group 1 (18-49 yrs) comprised n=20 adults (10 female, age range: 18-49, M=27.5, SD=8.51). For T4, group 1 (18-49 yrs) consisted of n=60 participants (51 female) with a mean age of 21.42 M=65.6, SD=11.35), who took part in testing for each of the four tests. The different age groups were matched for years of education (t(38)=0.83; p>.05) and participants in age groups were significantly older than participants in the group of n=20 younger adults (t(38)=12.01; p<.05).

Results

Table 1 shows mean performance of control participants per test and group as well as the test-specific critical cut-off score for impaired performance, which we calculated using the procedures developed by Crawford and colleagues, implemented in the program *SinglimsES* (Crawford et al., 2010). The *Singlims* method is particularly useful for comparing performance of individuals with aphasia against norms derived from rather small samples of control groups. For tests of verb comprehension (T1, T2), cut-off scores are identical for both age groups, for tests of verb production (T3, T4) the cut-off score for age group 2 falls 1 point lower than for age group 1.

Discussion

Our study is the first to provide normative data for an assessment of verb comprehension and production impairments in German-speaking individuals with aphasia using a systematically controlled set of verbs, thus allowing to detect effects of verb frequency, age-of-acquisition and familiarity on performance in aphasia. In addition, the tasks we have designed have the potential to identify modality-specific impairments in verb processing and to disentangle semantic deficits and impairments in lexical-level processes.

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Table 1: Performance of control participants, per age group and test, and results of calculations of cut-off scores for impaired performance using the *Singlims* method.

Age group	MoVe-Test	M	SD	MIN	MAX	n=	Critical cut-off score (Set 1, Set 2)	t (Set 1, Set 2)	p (Set 1, Set 2)	ES (Set 1, Set 2)
Group 1 18-49 yrs	T1	79.75	0.55	78	80	20	38	-3.69	.0008	-3.783
							39	-2.85	.0051	-2.922
	T2	79.95	0.22	79	80	20	39	-4.14	.0003	-4.241
							39	-97.59	.0000	-100.0
	T3	76.85	2.28	73	80	20	36	-2.16	.0215	-2.173
							36	-2.37	.0145	-2.429
	T4	76.77	1.93	73	80	60	36	-1.91	.0360	-1.954
							36	-1.91	.0360	-1.955
Group 2 (50 yrs and older)	T1	79.75	0.55	78	80	20	39	-97.59	.0000	-100.0
							38	-3.11	.0030	-3.182
	T2	79.90	0.31	79	80	20	39	-97.59	.0000	-100.0
							39	-2.85	.0051	-2.922
	T3	76.90	2.86	71	80	20	35	-1.95	.0330	-2.002
							35	-2.27	.0175	-2.327
	T4	76.80	2.88	72	80	20	35	-1.82	.0425	-1.864
							35	-1.79	.0450	-1.833

Note: The critical cut-off score is the first testing score, which is significantly different (at $p<.05$, one-sided) from the mean of control participants (M, given across both sets), taking into account the standard deviation (SD, given across both sets) and sample size (n). Cut-off scores were calculated separately for the two parallel sets of verbs (set 1, set 2, each comprising n=40 verbs). ES=effect size.

Comprehensive Aphasia Test: what do Norwegian and Croatian data reveal

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Introduction

Aphasia has numerous manifestations and a variable clinical picture, and it is very important to obtain a valid representation of a person's language profile for diagnosis and treatment planning. Furthermore, since more than half of the world's population speaks more than one language, there is an urgent need to understand the characteristics of aphasia symptoms in multilingual populations and to ensure appropriate assessment and treatment plans for these individuals (Goral & Hejazi, 2021). The combinations of languages a person can speak are infinite, so adapting and standardising such tests for individual countries or languages would be difficult and unprofitable. Recently, the Comprehensive Aphasia Test (CAT; Swinburn, Porter & Howard, 2004) has been adapted and normed in Norwegian (CAT-N; Swinburn, Porter, Howard, Høeg et al., 2021) and Croatian (CAT-HR; Swinburn, Porter, Howard, Kuvač Kraljević et al., 2020) as part of the Aphasia Assessment and Outcomes working group of the international Collaboration of Aphasia Trialists network (https://www.aphasiatrials.org/). Since analogous (psycho)linguistic and psychometric decisions were made during test development (see Fyndanis et al., 2017), the two tests are expected to be comparable.

Aim

The aim of this study was to compare the performance of Norwegian and Croatian speakers with aphasia on the Language Battery of the CAT, as well as to investigate the influence of different linguistic, demographic and aphasia-related variables on their performance.

Methods

Two samples of persons with aphasia, one Norwegian and one Croatian, were matched in terms of gender, age, educational level, and aphasia severity (*N* both groups = 71). We compared the performance on 10 subtests across three language modalities from the Language Battery (auditory comprehension, repetition and naming) in the two language versions. The subtests assess phonological, lexical and syntactic processing levels.

For the purpose of this study two analyses of variance (ANOVAs) with Post hoc Scheffe were performed. The first analysis focused on individual subtests, with a 3x2x3x2 factorial design: age, educational level, aphasia severity, and language were the main multiple-level factors, and each of the subtests were the dependent variables. The second analysis focused on language modalities, where the four factors remained, but the dependent variables were auditory comprehension (three subtests computed), repetition (five subtests computed) and naming (two subtests computed).

Results

The results point to several differences in performance, with the Norwegian sample achieving slightly higher overall results. The first analysis revealed a main effect of *language* only in Comprehension of spoken words [$F(1, 141) = 19.331$; $p = .000$; $\eta 2 = .148$], and Repetition of complex words [$F(1, 141) = 8.973$; $p = .003$; $\eta 2 = .075$]. Importantly, an effect of a*phasia severity* was obtained in all 10 examined subtests, with significant differences found between all three aphasia severity levels, and the same pattern of results (M severe < M moderate < M mild; all $p < .05$). Of other demographic variables, *educational level* influenced performance on three subtests: Comprehension of spoken words [$F(1, 141) = 5.048$; $p = .03$; $\eta 2 = .043$], Repetition of complex words [$F(1, 141) = 5.633$; $p = .02$; $\eta 2 = .048$] and Repetition of sentences $F(1, 141) = 4.049$; $p = .047$; $\eta 2 = .035$]. In all analyses individuals with higher levels of education achieved higher overall results (mean values differed depending on the subtests; all $p < .05$). *Age* only affected performance on the Repetition of nonwords [$F(2, 140) = 3.187$; $p = .045$; $\eta 2 = .054$].

The second analysis revealed a main effect of *language* only in Auditory comprehension [$F(2, 140) = 5.672$; $p = .019$; $\eta 2 = .049$]. Again, *aphasia severity* influenced all language modalities; Auditory comprehension [$F(2, 140) = 19.909$; $p = .000$; $\eta 2 = .264$], Repetition [$F(2, 140) = 72.840$; $p = .000$; $\eta 2 = .570$] and Naming [$F(2, 140) = 46.588$; $p = .000$; $\eta 2 = .459$]. As for other demographic variables, only *educational level* [$F(1, 141) = 4.696$; $p = .032$; $\eta 2 = .041$] was found to significantly affect Repetition. Evidently, certain language abilities are better preserved in individuals with higher levels of education.

Discussion

Of all factors, aphasia severity influences outcomes the most, with severe aphasia affecting the person’s performance on all examined language tasks, and all processing levels (phonological, lexical and syntactic). The effect of language was found mostly in subtests that assess processing at the lexical level, so presumably these differences can be attributed to language structure (i.e., specific phonological and lexical features of Norwegian and Croatian).

The obtained results are reassuring, as they indicate a high degree of comparability between CAT-N and CAT-HR. Findings of the current study therefore have direct scientific

and clinical implications for the assessment of aphasia in different languages, which will be specifically outlined and discussed during the talk.

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Comparing the effect of linguistic vs. cognitive training coupled with transcranial magnetic stimulation on sentence comprehension in early Alzheimer's disease

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Introduction and aims

Alzheimer's disease (AD) is accompanied by cognitive deterioration and language deficits. Previous studies have reported impaired comprehension at sentence level, with syntactic complexity (e.g., wh-questions, relative clauses) being a key factor in AD participants' performance (Marková et al., 2017). Repetitive transcranial magnetic stimulation (rTMS), a non-invasive neuromodulation technique, has been suggested as an effective tool to improve language (naming, sentence comprehension) and general cognition in AD (Cotelli et al., 2008; 2011). rTMS coupled with cognitive training has also been found to improve cognition in AD (Bagattini et al., 2020). On the other hand, behavioral language intervention in the form of Treatment of Underlying Forms (TUF; Thompson, 2007), has been beneficial for brain-damaged populations, i.e. people with aphasia. TUF focuses on complex sentence structures and operates on the premise that training underlying properties of language allows for effective generalization to untrained structures that share similar linguistic properties. Combined with rTMS, the beneficial effect of TUF is substantially amplified (Martin et al., 2014). Finally, cognitive training (n-back and Stroop tasks) enhanced executive functions (EFs) and working memory (WM) in people with aphasia leading to improved language performance (Zakarias et al., 2018).

The current study aims at investigating the effect of these two routes, behavioral language intervention (TUF) vs. cognitive training coupled with rTMS on sentence comprehension in AD. The comparison between these two treatment methods will highlight any common underlying processes and indicate their effectiveness on language treatment in AD. Preliminary results will be presented.

Methods

Stimulation Protocol and evaluations

We are conducting a placebo-controlled, blind study with participants being randomly assigned to the following groups: behavioral language training + active-rTMS, cognitive training + active-rTMS, behavioral language training + sham-rTMS, cognitive training +

sham-rTMS. Up to now, two participants underwent active high-frequency (10Hz) rTMS treatment over the left and right DLPFC(5 sessions/week, 4-weeks), followed by a 60min session of either TUF or cognitive training.

TUF treatment was focused on training the comprehension of center-embedded relative clauses (CE) of the type “The girl, who the mom kissed, holds the mirror”. The cognitive training targeted the enhancement of EFs and WM by using the Stroop and n-back tasks. The n-back task was adaptive, meaning that the level of difficulty was continuously adjusted according to the participant’s performance.

The primary measurement outcome of the study was participants’ performance in a sentence-picture matching task. Performance was assessed at baseline in comparison to immediately-post-intervention, 2-weeks and 2-months post-intervention. A trained linguist conducted both behavioral and cognitive therapies.

Participants

Two female mild-AD native Slovene-speakers were recruited; ZM aged 75, with 12yrs of education (MMSE:25), TB aged 78, with 18yrs of education (MMSE:22). All neuropsychological evaluations were performed by a trained psychologist and all linguistic evaluation by a trained linguist. ZM followed the TUF protocol while TB followed the cognitive training protocol.

Experimental tasks

We designed a sentence-picture matching task consisting of 5 different complex sentence structures, such as CE (The girlacc., who holds the mirror, the momnom. combed), Right-branching (RB-sentences) (The mom combed the girlacc who holds the mirror) Object Verb Subject (OVS sentences) (The girlacc combed the momnom), adverbial sentences (KO-sentences) (The father was holding a racket when he kissed the boy), and questions (Q-sentences) (The girlacc combed the momnom - Whonom combed the girlacc?). All sentences were in Slovene (CE: Deklicoacc, ki drži rožo, je objela mamanom).

Results

Due to sample limitations (1 participant per treatment group), we only conducted individual comparisons and no comparisons between the two treatment methods. Results are displayed at Table 1.

TUF + active-rTMS

Analysis revealed a significant effect of therapy on participant’s overall performance in both trained and untrained CE-structures ($\chi 2 = 8.75$, $p = .03$). A significant improvement was present at all post-treatment evaluations (immediately $z = 2.60$, $p < .01$, 2-weeks $z = 2.60$, $p < .01$, and 2-months post-intervention $z = 2.14$, $p = .03$) compared to baseline.

A main effect of treatment was attested in Q-sentences, ($\chi 2 = 5.41$, $p = .06$). Participant’s

performance significantly improved at all post-treatment evaluations (immediately 100%, z=2.19, p=.02, 2-weeks 85%, z=1.90, p=.05, and 2-months post-treatment 100%, z=2.19, p=.02) compared to baseline (45%). However, no significant effect of treatment was observed in KO-sentences ($\chi2$= 3.41, p= .33), OVS-sentences ($\chi2$= 4.22, p= .23) and RB-sentences ($\chi2$= 2.46, p= .48). These findings indicate that generalization occurred selectively to untrained constructions with similar linguistic complexity.

Cognitive training + active-rTMS

No significant effect of treatment was observed to trained CE-sentences ($\chi2$= 1.81, p= .40), or to any of the trained linguistic structures under investigation [KO-sentences $\chi2$= 1.03, p= .59; OVS-sentences $\chi2$= 3.25 p= .19, RB-sentences $\chi2$= 2.26, p= .32]. These findings indicate that cognitive training as such was not successful at improving performance at the language structures under investigation.

Discussion

The current findings are promising for the beneficial effects of behavioral linguistic therapy combined with active-rTMS in complex sentence comprehension, at initial stages of AD, something that is demonstrated for the first time in the literature. There is an indication of an overall improvement on participant's performance in both trained and untrained sentences of the CE-sentences, as well as an effective generalization to untrained structures with similar properties, like Q-sentences. The beneficial effect of the TUF + active-rTMS therapy appears to persist up to 2-months post-intervention. On the other hand, the current preliminary results do not suggest a beneficial effect of cognitive training coupled with active-rTMS, on sentence comprehension. Additional data, which is currently being collected by our team will allow for more accurate conclusions.

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Table 1

A. Participant_ZM: overall accuracy (%)				
Task	**Baseline**	**Immediately post-treatment**	**2weeks post-treatment**	**2months post-treatment**
CE-sentences	27%	58%	58%	53%
KO sentences	50%	50%	55%	65%
OVS-sentences	53%	60%	80%	70%
RB-sentences	40%	60%	40%	50%
Q-sentences	40%	100%	85%	100%

B. Participant_TB: overall accuracy (%)			
Task	**Baseline**	**Immediately post-treatment**	**2weeks post-treatment**
CE-sentences	37%	32%	44%
KO sentences	40%	58%	60%
OVS-sentences	50%	35%	55%
RB-sentences	40%	60%	40%
Q-sentences	47%	30%	30%

View Abstract

Abstract Information

Title Domain-general mechanisms and language recovery after stroke: a longitudinal study

Description

Introduction and aims

There is evidence that deficits in domain-general cognitive functions, such as attention, memory, executive functions, intelligence and visuospatial skills, co-occur with post-stroke aphasia (Fucetola et al. 2009; Gonzalez et al. 2020). However, the extent to which impairments in non-linguistic and linguistic functions are associated is still controversial. Importantly, investigating the relationship between language and domain-general abilities requires understanding not only to what extent such a link exists, but also whether it changes dynamically over the time of recovery. Current neuroimaging research (Saur et al. 2006; Stockert et al. 2020) suggests three phases in language recovery after stroke, during which domain-general functions may be differentially involved to compensate for language disruptions.

The purpose of this study is to analyze the recovery of linguistic and domain-general abilities after stroke, to assess whether the latter are part of the regular machinery supporting linguistic functions and their recovery, or if their implication changes over time. To this end, linguistic and non-linguistic functions are assessed longitudinally in a group of left-hemisphere stroke (LHS) patients and compared to the performance of a right-hemisphere stroke (RHS) patients as well as a group of non brain-damaged (NBD) participants.

We hypothesize that if domain-general mechanisms are a fundamental part contributing to proper language production and comprehension, non-linguistic recovery should predict linguistic recovery at all time points. That is, behavioral scores from linguistic and non-linguistic tasks should correlate along the follow-up.

In contrast, if domain-general mechanisms only have a temporary compensatory function during language recovery, their association with linguistic improvement should progressively decrease as recovery of linguistic functions and networks occurs, i.e. domain-general functions should significantly predict linguistic recovery at initial stages of recovery, but not at more chronic ones.

Here we report preliminary results from the analysis of a small sample of LHS, RHS and NBD participants.

Methods

Participants. Stroke patients who were admitted to the Neurology Department at Cruces University Hospital in the Basque Country (Spain) were screened for eligibility. Inclusion criteria were: having suffered from a first ischemic stroke either in the left or right hemisphere no more than one week prior and being a native speaker of Spanish. Exclusion criteria: any cognitive impairment before the event, severe aphasia or severe motor, hearing or visual deficits. 23 patients met the criteria and were approached at their bedside by their neurologist and invited to participate in the study. Of these, twelve (2 female, age: 52 to 84 years (*M*= 68.41, *sd* = 8.09) accepted to participate in the first session and continue with the follow-up. They all provided written informed consent (LHS: n=3; RHS: n=9). Three participants for the NBD group, matched in age, sex, education and linguistic profile with the clinical groups, were recruited from the BCBL database. They also provided written informed consent prior to participating in the study. Data collection to obtain a bigger sample is currently ongoing.

Design and Material. Two batteries are administered: one to assess language processing and the other to assess domain-general mechanisms. In the latter, attention, short-term memory, working memory, and reasoning abilities are tested using a non-verbal range of tasks: 1) the Attention Network Test (ANT); 2) the Digit Memory Span and Visual Span (backward and forward) subtests from the Wechsler Memory Scale Revised (WMS-R), and 3) Raven's Colored Progressive Matrices. The linguistic battery contains six tasks testing production and comprehension of phonology, syntax, and semantics, respectively. In both screening batteries, the delivery of instructions is carefully planned avoiding complex syntactic constructions that could interfere in their comprehension by participants.

Procedure. Domain-general and linguistic abilities in brain-damaged participants are assessed at four time points (TP): within the first week after stroke (TP1), three to four weeks post-stroke (TP2), three months after stroke (TP3), and six months after stroke (TP4). A minimum of two sessions of 20-30 minutes maximum has been planned for TP1 to avoid stress and fatigue at all costs. Participants in the NBD group are tested in only one session.

Results

We report mean percentages of the three group's performance on linguistic and non-linguistic tasks in TP1 and TP2 (Figure 1). Overall, the LHS group showed a similar performance in linguistic tasks compared to both the RHS and the NBD groups and across TPs (LHS: TP1 *M*= 92.66, *sd*= 12.10 / TP2 *M*= 93.47, *sd*= 10.31; RHS: TP1 *M*= 98.09, *sd*= 4.25 / TP2 *M*=96.36, *sd*= 6.28, NBD: *M*= 96.10, *sd*= 8.36). A different pattern emerges from domain-general tasks, where LHS patients performed more poorly compared to the RHS and NBD groups (LHS: TP1 *M*= 49.18, *sd*= 13.38 / TP2 *M*= 49.55, *sd*= 22.03; RHS: TP1 *M*= 57.17, *sd*= 20.34 / TP2 *M*=62.10, *sd*= 20.66, NBD: *M*= 70.08, *sd*= 22.45), with no sizable improvement across TPs.

Discussion

Preliminary data from the small sample of LHS patients presented here show a dissociation between linguistic and domain-general functions. While this group's performance in the linguistic domain is comparable to the one showed by the RHS and NBD group, a greater difference is seen in their performance in domain-general tasks. Not only LHS participants performed lower than RHS and NBD subjects in non-linguistic abilities in both TPs, but also they did not improve from TP1 to TP2 as the RHS group. Interestingly, however, the improvement pattern in domain-general functions of RHS is not observed in their performance in linguistic abilities.

As data collection is currently ongoing, the analysis of a bigger sample including patients with more evident language deficits will allow us to determine whether and how the relation between linguistic and non-linguistic functions changes over time during recovery from stroke.

Ongoing work also involves the analysis of group's performance in three different linguistic domains - syntax, semantics and phonology- and abilities, namely comprehension and production.

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Event Information

Event SoA 2022 Bordeaux

Topic Clinical and experimental work on aphasia and related disorders

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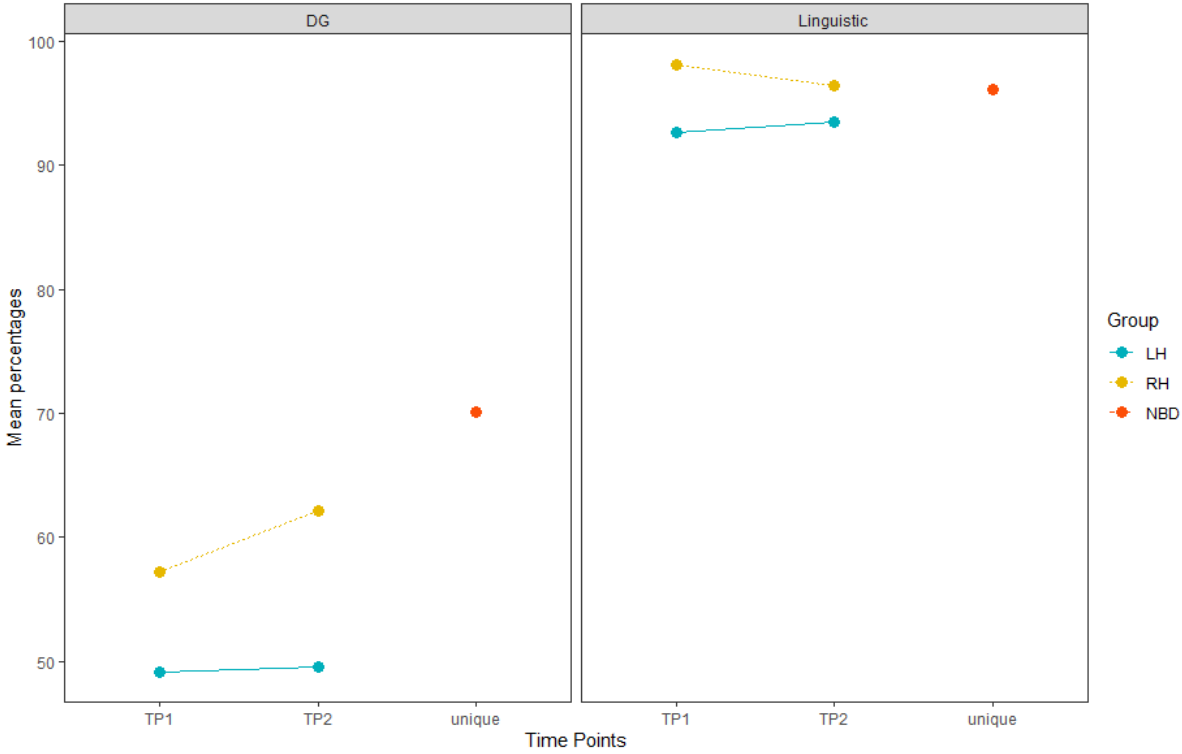

Figure 1. Means of performance of left-hemisphere (LH) and righ-hemisphere (RH) stroke patients compared to non brain-damaged participants (NBD).

A ventral white matter temporal pathway for retrieving proper names in visual modality

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Introduction and aims

Proper names (PN), especially person names, refer to unique entities that allow humans to structure their surrounding social world. Unsuccessful lexico-phonological retrieval of PN is a debilitating impairment that commonly occurs in patients suffering from various neurological conditions such as stroke, epilepsy or dementia. Anomic disorders occur even more frequently for PN than for common names (CN). This increased difficulty is generally explained by the fact that accessing PN *versus* CN is more cognitively demanding (*e.g.*, Semenza, 2006).

While a wide range of functional MRI, positron emission tomography and lesion studies has suggested that PN retrieval rely on a large cortical network centered on the anterior temporal lobe (ATL) and including distributed frontal and temporal regions (*e.g.*, Damasio et al., 2004) much less is known about the temporal white matter connections that may allow cortical functional integration in the PN network.

A few handle of studies has provided preliminary evidence for a possible role of the uncinate fasciculus (UF) (Papagno et al., 2011; Papagno et al., 2016; Mehta et al., 2016), but the inferior longitudinal fasciculus (ILF) might also contribute substantially, since this tract mainly projects into the ATL, interconnects it with the posterior lexico-semantic interface and is engaged in CN retrieval (*e.g.*, Herbet et al., 2016).

Methods

To ascertain this hypothesis, 58 patients having undergone a neurosurgery for a left lower-grade glioma were recruited. They were assessed more than 3 months since the surgery in a period wherein neuropsychological impairments are relatively stable. The evaluation consisted in a famous faces naming (FFN) task composed of 60 items. After having delineated resections cavities on the normalized MRIs, the behavioral data were processed following a multilevel lesion approach, including location-based analyses, voxel-based lesion-symptom mapping (VLSM) and disconnection-symptom mapping. Importantly, unwanted variance associated with (i) sociodemographic data, (ii) familiarity and biographical knowledge and (iii) control cognitive performances (*i.e.,* semantic and episodic memory, CN retrieval) - was regressed out in insolation or taken together in different models. Additionally, we examined the behavioral and anatomical data of two patients showing a right-lateralized temporal surgical resection massively damaging the ILF, one of them being left-hander.

Results

First, the results showed that the patient group performed worse than a group of 72 matched healthy participants. Second, patients with a surgical resection centered either on the ATL extending to the neighboring temporal structures (both UF and ILF damaged) or on the mid-to-posterior inferior temporal gyrus (ILF exclusively damaged) had FFN scores significantly lower than patients with a resection located either in the frontal (ILF and UF fully spared) or in the fronto-temporal-insular areas (UF massively damaged, ILF sparsely). Third, the VLSM analyses revealed that damage to the mid-to-anterior part of the ventro-basal temporal cortex was especially predictive of impaired PN retrieval performances. Fourth, tract-by-tract correlation analyses performed between disconnection severity and FFN performances showed the ILF was the most strongly associated pathway after correction for multiple comparisons, followed by the para-hippocampal cingulum and the posterior corpus callosum. Fifth, spatial correlations conducted with disconnection maps revealed that only voxels in a spatial location compatible with the ILF positioning correlated with FFN performances (Figure 1). Sixth, our double-case study highlighted that a disruption of the right ILF in the left-hander (and not in the right-hander) caused the long-lasting impairment of FFN also found in patients with a damage of the left ILF.

Discussion

At variance with the few previous findings (Papagno et al., 2011; Papagno et al., 2016; Mehta et al., 2016), our results clearly established the central role of the left ILF in PN processing, as its damage caused PN anomia unlike other ventral tracts including the UF. Indeed, the disconnection severity of the left ILF was the white matter tract the most robustly correlated with PN retrieval performances. Spatial correlation analyses with

disconnectome maps supported this pattern of results, albeit with a higher specificity since only white matter fibres in a location compatible with the left ILF were found to be associated with FFN scores across all models tested. We also found a causal relationship between the antero-ventral temporal structures, but not with the frontal ones, and PN retrieval. These results partially support the literature that usually reported the implication of fronto-temporal regions (*e.g.,* Damasio et al., 2004).

We cannot rule out the possibility that the previously evidenced contribution of the frontal structures in the naming of unique entities might have been mitigated here because there are potentially less central in the PN network than the temporal ones, and thus easier to be compensated for by other neural systems – lower grade glioma being established to promote neuroplastic compensations. Furthermore, the lack of evidence for a role of the UF in PN retrieval contradicts the results from Papagno et al. (2011) and Mehta et al. (2016). This discrepancy may be due to methodological differences: (i) in both studies, the results were not statistically controlled for interrelated cognitive processes; (ii) the disconnection effect of the ILF was not directly tested by Papagno et al. (2011) while, in the study of Mehta et al., the ILF was mainly damaged in its anterior part, preventing to draw definitive conclusions about its role in PN retrieval.

Taken as a whole, our results provide causal evidence for the pivotal role of the ILF in the visually-guided PN retrieval network. Beyond the fundamental implications, this novel finding paves the way for a better understanding of the pathophysiological bases underlying PN anomia in various neurological conditions in which white matter is disrupted.

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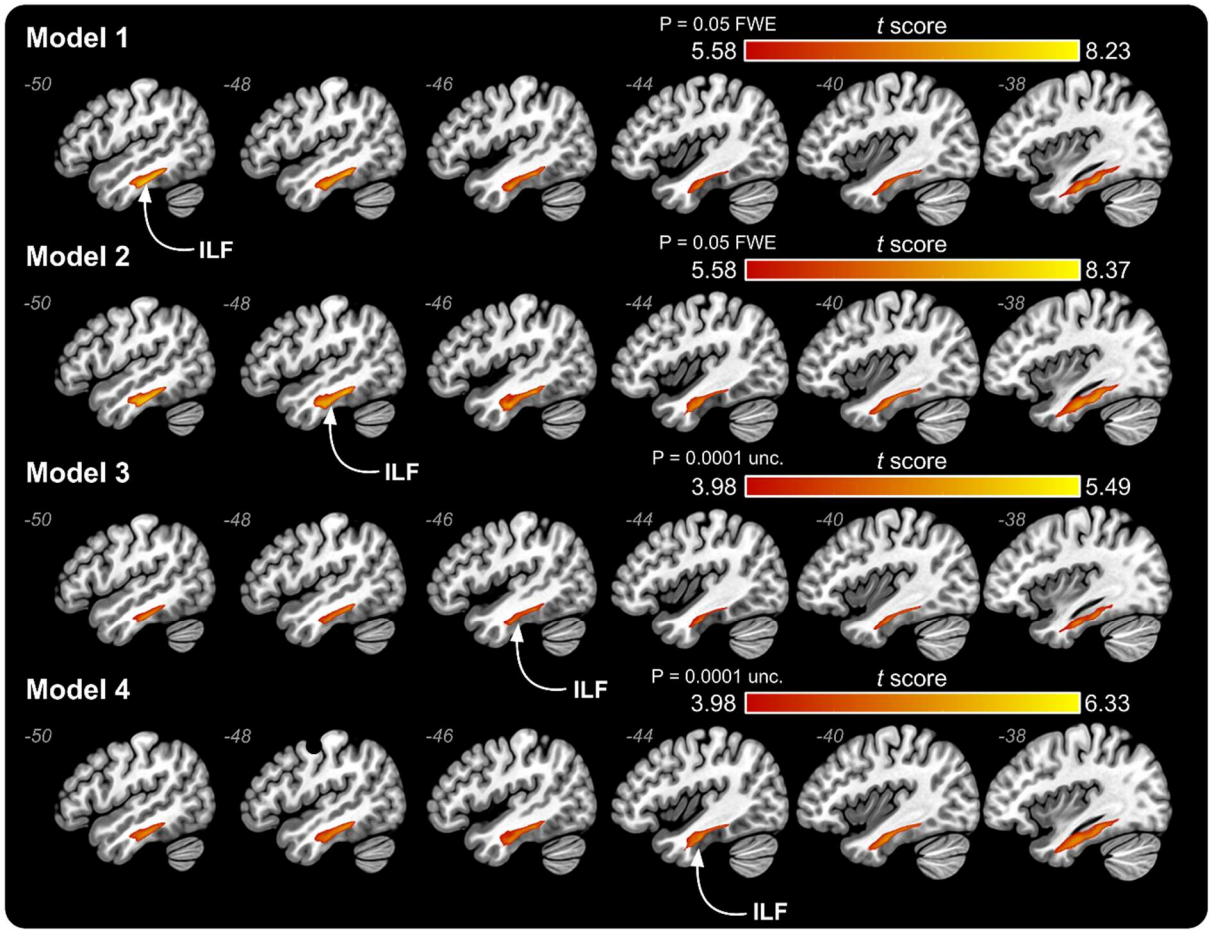

Figure 1: Spatial correlation results for each model. Bars indicate the *t*-scores. For model 1 (accounting for sociodemographic data) and model 2 (accounting for (i) sociodemographic and (ii) familiarity and biographical knowledge), only suprathresholded voxels after FWE correction are displayed. For models 3 (accounting for (i) sociodemographic data and (ii) control cognitive performances) and model 4 (accounting for (i) sociodemographic data, (ii) familiarity and biographical knowledge and (iii) control cognitive performances), a lenient threshold of $p < 0.0001$ uncorrected is used. In each model, significant voxels overlap with the known spatial positioning of the left ILF.

Systematic review of generalisation effects in single-case speech production treatment studies

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Structured abstract only

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

Introduction and aim

In the majority of aphasia treatment studies, item-specific treatment effects are reported, but signs of generalisation are scarce (e.g., Wisenburn & Mahoney, 2009) or variable across studies (e.g., Efstratiadou et al., 2018). Studying generalisation of aphasia therapy is complicated by several factors. For example, there is no full consensus on the methods how to best study treatment effects (e.g., Howard et al., 2015) or what type of effects could be considered generalisation (e.g., Webster et al., 2015). Reporting treatment effects is also highly variable. In our opinion, authors conclude that generalisation is present more often than should be the case (due to limitations of design and statistics).

In this presentation, by using the linguistic framework suggested by Webster et al. (2015), we aim to clarify the extent of statistically significant generalisation in single-case speech production studies. Our specific research questions were: 1) How many studies have investigated generalisation of treatment effects; 2) What type of generalisation has been studied; 3) What is the number of studies, individuals and analyses showing statistically significant generalisation across different types of generalisation?

Methods

The literature search was originally conducted for the purpose of creating the first national (Finnish) guidelines for aphasia therapy in Finland. The search was completed by the project members (speech therapists, including the first author) appointed by the Finnish Association of Speech Therapists. They conducted two systematic literature searches of peer-reviewed studies published between 2000 and 2019 (March). Four databases (Ovid Medline, PsycInfo, Scopus, and the Finnish Medic database) were searched using the following keywords: aphasia, stroke, ischem*, rehab*, Intervent*, therap*, speech language,

treatmen*, speech ther*, outcome. The main inclusion criterion was that a study investigated language-focused rehabilitation in individuals over 16 years of age with stroke and diagnosed aphasia. The main exclusion criteria included that the participants did not exhibit any other neurogenic, developmental or psychiatric conditions. After several phases of systematic inclusion and exclusion of relevant studies, the original data of both single-case and group-studies resulted in 122 studies that were then rated for methodological quality.

For this study, we narrowed down the focus to those single-case studies describing speech production treatment which had scored at least 5 points in the SCED scale (Tate et al., 2008). This resulted in 48 single-case studies including a total of 165 participants: 78 male, 79 female, 8 unreported. Of these participants, 159 individuals with aphasia completed treatment. The mean age of the participants was 60 (range 17–89) years, with a mean time post-onset of stroke of 51 months (range 2 months–54 years). The types and severity of aphasia across participants were highly variable. The type of treatment varied from word-level to combined word-, sentence- and discourse-level treatment methods. The duration of treatment varied between 2 and 18 weeks, and the intensity varied between 1 and 5 sessions a week.

First, the data was categorised and scored into several different categories, for example whether generalisation was reported in a study, whether it was studied statistically, and whether statistical evidence was evidenced in a study. Then, we organised the data using the linguistic generalisation types suggested by Webster et al. (2015) as far as possible. Due to the high variability in methodology for studying generalisation and different reporting styles, several methods were used to categorise and score the data. These included content analysis, cross-checking data and making decisions on challenging issues in consensus meetings Finally, all categories and scores were re-checked by a research assistant (master’s level speech-pathology student), and final decisions were made in consensus meetings between her and the first author. It is to be noted that in order to study statistical evidence for generalisation, we only considered data obtained with experimental assessment tasks and excluded results obtained with standardised assessment batteries. This was due to the challenges of studying generalisation with standardised assessment batteries, as discussed by Webster et al. (2015).

Results

Figure 1 presents the core numbers for different comparisons in the study. As can be seen, most single-case treatment studies (39/48, 81%) explored some type of generalisation and of these, 85% (33/39) included statistical analyses. Moreover, 70% of the studies using statistical methods reported some kind of positive generalisation effects at least in one participant, in any of the studied functions or in at least one of the analyses. A closer look, however, reveals that the percentages of participants (41%) and number of statistical

comparisons (25%) showing statistically significant generalisation effects were lower. Regarding the linguistic types of generalisation, the great majority of studies targeted within-level generalisation from treated words to untreated words. Within this type of generalisation, 21% of participants and 15% of statistical analyses showed statistically significant effects.

Figure 1 about here

Discussion

Generalisation is an important factor when evaluating effectiveness of aphasia therapy. Our study confirms that generalisation has often been reported and statistically explored in single-case studies. However, most studies have limited their scope to within-level generalisation from treated words to untreated words. Based on this type of generalisation, only about one fifth of the participants and one sixth of the analyses show generalisation. This could be taken as additional evidence of the importance of targeting treatment on individually meaningful items, as discussed in earlier papers (e.g., Renvall et al., 2013).

Categorising and scoring the existing data was challenging due to different methodologies and reporting styles across studies. Hopefully, methodological ratings will unify the practices in the future, so that it will become easier to compare different treatment studies including also group-studies. Currently, the heterogeneity of methods and reporting styles, complicate forming a full picture of generalisation.

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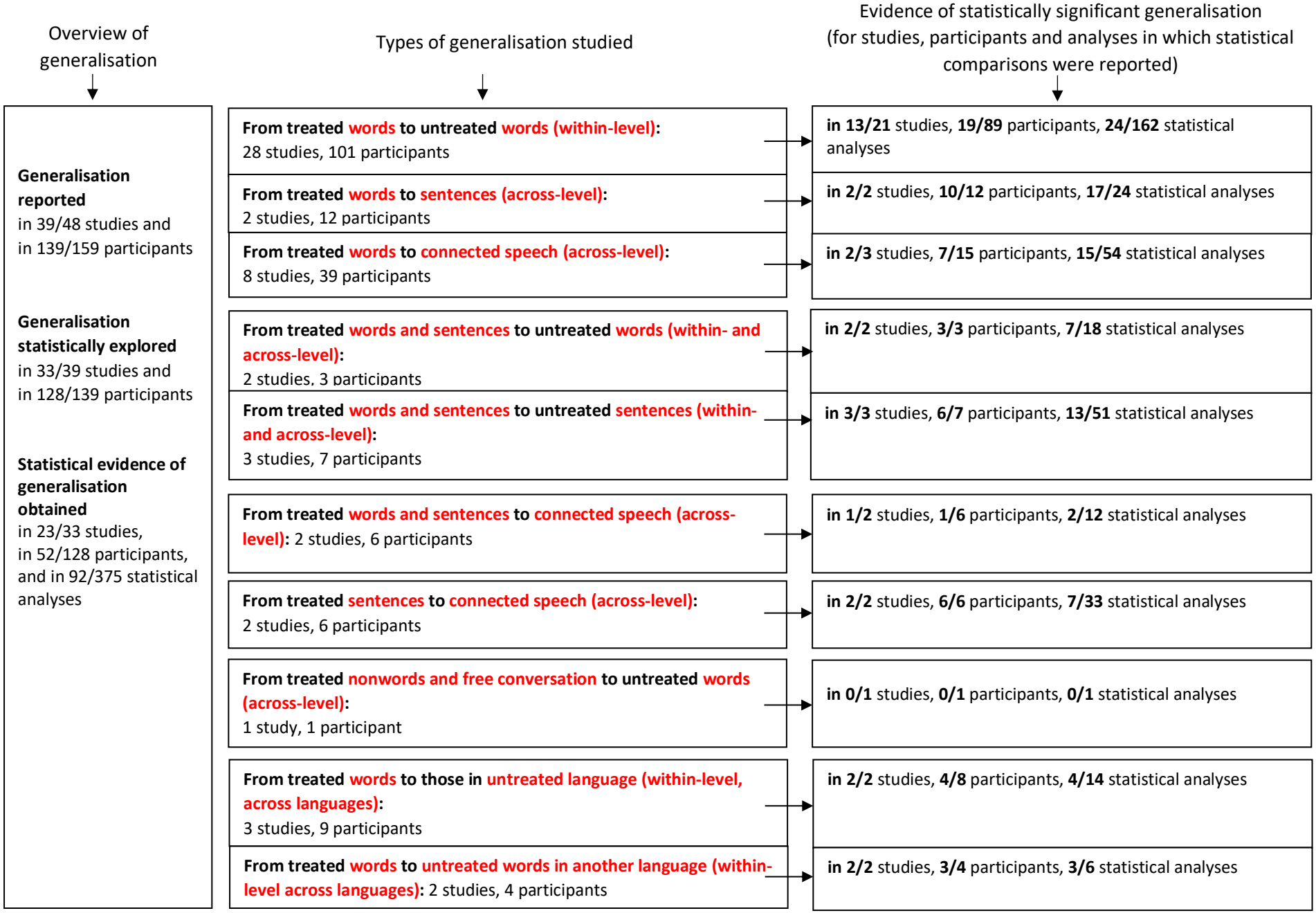
Figure 1. *Results of the study*



Deictic and Anaphoric Reference Production in Tagalog Fluent and Non-Fluent Aphasia

by Jonathan Gerona | Kasper Boye | Silvia Martinez-Ferreiro | Srdjan Popov | University of Groningen | University of Copenhagen | University of Toulouse | University of Groningen

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Background and Aims

Dating back to the ancient Greek times, one of the earliest distinctions between pronouns is the deictic-anaphoric contrast (Schneider, 1965, pp 10). Among other known pronoun contrasts such as lexical-grammatical divide (Boye & Harder, 2012; Ishkhanyan et al., 2017; Martinez- Ferreiro et al., 2019; Brink, 2014) and clause-internal versus clause-external reference resolution (Avrutin 2000; 2006; Bos et al., 2014), the deictic and anaphoric reference is not given sufficient attention in aphasiological research. While Westergaard and colleagues (2019) spearheaded this investigation in a Danish-speaking participant diagnosed with agrammatism, their conclusion must be interpreted with caution due to the limited sample size.

In relation to the principles of discourse-linking theory based on Avrutin's weak syntax model (1999; 2006) and Caplan's resource reduction model (2012; 2015), we hypothesize that individuals with non-fluent aphasias will experience more problems with anaphoric pronouns, given that this type of pronoun reference will not only be cognitively costly as it is heavily dependent on working memory for reference resolution (Westergaard et al., 2019), but also requires a more intricate grammatical computation during its production (Schmitt et al., 1999). This difficulty then leads the affected individuals to rely more on contextual information available in the environment (Avrutin, 2006). Meanwhile, data are very limited with regards to pronoun production in fluent aphasia. Regardless of this scarcity, we predict that the fluent group will show lesser impairment in deictic pronoun production as they tend to overuse deictic reference through personal pronouns (Martinez-Ferreiro et al., 2019; Arslan et al., 2021) as an adaptive strategy to their lexical deficit (Arslan et al., 2021). Again, by principle of the discourse-linking theory based on the weak syntax model (Avrutin, 2000; 2006), a certain degree of deficit in the use of anaphoric pronouns is also expected in the fluent aphasia group as they were observed to be more severely impaired during the resolution of references done clause-externally compared to individuals with Broca's aphasia (Bos et al., 2014).

With this in mind, we aim to follow up on the study of Westergaard and colleagues (2019) by investigating the performance of individuals with aphasia in terms of their use of deictic and anaphoric pronouns during connected speech with not only a bigger sample size, but also

including another class of aphasia — the fluent type. Moreover, to further our understanding of pronoun reference in a cross-linguistic view, we are doing this investigation in Tagalog, a genetically and typologically distinct language majorly spoken in the Philippine archipelago.

Methods

The first-ever aphasia corpus from the Philippines was established for this study: the Tagalog Aphasia Corpus or TAC (Gerona et al., 2021). The speech samples were collected by certified Filipino speech-language pathologists from individuals diagnosed with fluent or non-fluent aphasia secondary to cerebrovascular accident who are residing at Metro Manila, Philippines. At the end of the data collection, TAC is comprised of 7 non-fluent, 5 fluent, and 6 healthy participants. Each sample includes a personal narrative, three picture description tasks, and a story-retelling task. Once transcribed, pronouns alongside with Tagalog pronouns used as proforms (e.g. pro-verb or pro-sentence), were manually counted. Comparison in terms anaphoric-deictic ratio and the proportions of each pronoun reference type for each patient group against the healthy controls (fluent vs healthy; non-fluent vs healthy) were done through the use of Fisher's exact test.

Results

A total of 1,596 pronouns out of 12,463 words were included in the analysis. Both fluent and non-fluent aphasia groups, when compared against the healthy controls, manifested an inverse relationship in their use of deictic and anaphoric pronoun references compared to the non-brain damaged participants. While the healthy group used more anaphoric pronouns than deictic pronouns, both fluent and non-fluent groups showed patterns of overusing deictic pronouns. Meanwhile, although it is not a surprise that the non-fluent group underused anaphoric pronoun, the fluent group, however, used a comparable amount of anaphoric pronoun like their healthy counterparts.

Discussion

Results suggest that only the production of anaphoric pronouns is affected in non-fluent aphasia, while the use of deictic pronouns is apparently preserved. These patterns of impairment and preservation may be suggestive of the reorganization of the linguistic systems of individuals with non-fluent aphasia as a response to both weakened syntax and reduced cognitive resources. As per the case of fluent aphasia, opposite to our predictions, both deictic and anaphoric pronouns are deemed preserved and at par with their healthy counterparts. However, the fluent aphasia's at par performance must be treated with caution as this may be reflective of adaptive strategies brought about by complexities of this group's deficits (Arslan et al., 2021). Overall, findings from this study opens multiple doors for research in the future such as in-depth differentiation of other known pronoun contrasts within each of the pronoun references in aphasic speech.

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DEICTIC AND ANAPHORIC REFERENCE PRODUCTION IN TAGALOG FLUENT AND NON-FLUENT APHASIA

Jonathan Gerona, MSc, Kasper Boye, PhD, Silvia Martinez-Ferreiro, PhD, & Srdjan Popov, PhD

Table A: Anaphoric-Deictic Pronoun Ratio: NF vs HC & FL vs HC

Task	*Group*	*Anaphoric/Deictic Ratio*	*Proportions*	
			Deictic Pronouns	*Anaphoric Pronouns*
Overall	Non-Fluent Aphasia	0.253	5.82%	1.67%
	Healthy Controls	1.383	6.62%	8.05%
	Fisher's Exact	*p = < 0.00001**	*p = 0.3074*	*p = < 0.00001**
Personal Interviews	Non-Fluent Aphasia	0.387	6.31%	2.44%
	Healthy Controls	0.481	11.83%	5.69%
	Fisher's Exact	*p = 0.4514*	*p = 0.0008**	*p = 0.0034**
Picture Descriptions	Non-Fluent Aphasia	0.159	6.02%	1.08%
	Healthy Controls	5.0	1.86%	9.32%
	Fisher's Exact	*p = < 0.00001**	*p = < 0.0001**	*p = < 0.00001**
Story Retelling	Non-Fluent Aphasia	0.2	6.25%	1.25%
	Healthy Controls	26.2	0.41%	10.76%
	Fisher's Exact	*p = < 0.0001**	*p = < 0.00001**	*p = < 0.00001**
Overall	Fluent Aphasia	0.81	10.43%	8.45%
	Healthy Controls	1.383	5.82%	8.05%
	Fisher's Exact	*p = < 0.00001**	*p = < 0.00001**	*p = 0.5557*
Personal Interviews	Fluent Aphasia	0.297	19.36%	5.76%
	Healthy Controls	0.481	11.83%	5.69%
	Fisher's Exact	*p = 0.0025**	*p = < 0.00001**	*p = 0.9441*
Picture Descriptions	Fluent Aphasia	2.75	3.90%	10.72%
	Healthy Controls	5.0	1.86%	9.32%
	Fisher's Exact	*p = 0.0143**	*p = 0.0008**	*p = 0.2519*

Story Retelling	Fluent Aphasia	4.929	2.20%	10.87%
	Healthy Controls	26.2	0.41%	10.76%
	Fisher's Exact	*p = 0.0011**	*p = 0.0009**	*p = 0.9377*

Linguistic and cognitive abilities in patients with Multiple Sclerosis

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Introduction and aim

Multiple Sclerosis (MS) is an autoimmune disease of the central nervous system, leading to physical disabilities and sensorimotor disorders. People with MS (PwMS) are reported to have difficulties in cognition, particularly in information processing speed, working memory and attention (Brochet & Ruet, 2019). While language difficulties are not very common in PwMS, they are still possible, as proposed by Renaulda, Mohamed-Saïda, and Macoir (2016) in their systematic review. Recent studies addressed the nature of the language deficits in MS and their co-existence with cognitive impairment. For instance, morphological deficits in the production of subject–verb agreement, time reference/tense and grammatical aspect have been reported (Fyndanis et al., 2020) while co-occurrence of morphosyntactic and pragmatic difficulties with cognitive impairments and executive dysfunction has also been found (Sonkaya & Bayazit, 2018). The present study aims to provide in depth investigation of morphological and syntactic abilities of patients with MS. In addition, it explores the effect of cognitive factors, in particular, of verbal and non-verbal working memory as well as of the cognitive processing speed on the patients' linguistic performance. Finally, it assesses the overall effect of clinical factors (disease duration) on the linguistic and cognitive performance of patients.

Methods

Participants

Forty Greek speaking patients with definite MS according to the 2017 revised McDonald criteria (Thompson et al. 2018) (5 males) were recruited from the Multiple Sclerosis Center of the Second Dept. of Neurology of the AHEPA University Hospital in Thessaloniki. Their mean chronological age (CA) was 38.15 years (SD: 10.95) while their mean education (in years) was 14.9 (SD: 2.56). Their disease duration was ranged from 1-38 years (Mean:10.95; SD: 8.12). Regarding disease type, 31 were diagnosed with relapsing remitting MS (RRMS), 7 with secondary progressive MS (SPMS) and 2 with primary progressive MS (PPMS). In addition, a control group of 40 healthy participants matched to age, sex and years of

education to the experimental group was included in the study. Up to now, data from 17 controls have been analyzed and included in the present paper.

Material

We employed the following cognitive and linguistic measures:

Cognitive measures

Cognitive assessment was performed with the Greek version of the Brief International Cognitive Assessment for MS (BICAMS) battery (Polychroniadou et al., 2016). This battery consists of three tests: (i) the Symbol Digit Modalities Test (SDMT) for the assessment of information processing speed, (ii) the Greek verbal learning Test (GVLT) for the assessment of verbal working memory, and (iii) the Brief Visuospatial Memory Test -Revised (BVMT-R) for the assessment of visuospatial memory.

Linguistic measures

Morphological abilities

The existing regular and irregular verb subpart of the Perfective Paste Tense Test (PPTT) (20 verbs, in total) (Stavrakaki & Clahsen, 2009) was employed. This is an elicited production task supported by pictures.

Syntactic abilities

The receptive syntactic abilities were assessed by the means of a syntax test. The reception of subject and object relatives (24 relatives, in total) and passive sentences (N=8) were evaluated by the means of a picture pointing task. The examiner presented each sentence orally and the participant was shown a page with four pictured choices and had to select the picture that matched the spoken sentence.

Results

The PwMS performance on cognitive and linguistic tasks is presented in Table 1.

First, we performed between group analysis, using non parametric statistics, to investigate the groups' performance on linguistic measures shown in Table 1. When compared to typical controls, PwMS showed a significant impairment in the production of regular past tense (Z=2,39, p=.017). When we compared patients with RRMS to patients with SPMS and PPMS (collapsed in one group), we noticed significant differences in the reception of object relatives (Z=2.51, p=.012).

Second, we performed linear regression analysis to investigate the overall effect of disease duration on the cognitive and linguistic tasks. We found that disease duration was a significant predictor for performance on the Brief Visuospatial Memory Test -Revised (BVMT-R) (B=.334, p=.006, R^2=.183). In addition, we performed linear regression analysis (step-wise method) with scores on the BICAMS measures (SDMT, GVLT, BVMT-R) as independent variables and the linguistic variable *regular past tense* as the dependent one to investigate whether the attested PwMS vulnerability in regular past tense can be predicted by cognitive measures. Only SDMT was found to be a significant predictor for PwMS performance on the regular past tense (B=.121, p=.004, R^2=.442).

Discussion

These results indicate a linguistic impairment in patients with MS in regular tense production. In addition, they show increased impairment in the reception of object relatives for PwMS with the progressive forms of the disease (SPMS and PPMS, treated as one group) compared to patients with RRMS. Despite the linguistic impairment in these patients, the disease duration impacted only on a cognitive measure **(**BVMT-R). Remarkably, the only cognitive measure that significantly predicted impaired performance on the regular past tense was the Symbol Digit Modalities Test, which assesses the cognitive processing speed. This measure, widely employed in clinical practice for PwMS, was found to appropriately capture the cognitive dysfunction in MS (Parmenter et al. 2007). Crucially, it predicts performance in the rule-based domain of morphology (deficient production of regular past tense). We suggest that deficits in cognitive processing speed can co-occur with linguistic decay in PwMS.

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Table 1. The performance of people with Multiple Sclerosis on cognitive and linguistic measures

<table>
<tr><th colspan="5">COGNITIVE MEASURES</th></tr>
<tr><td colspan="5">BICAMS battery</td></tr>
<tr><td colspan="2">Symbol Digit Modalities Test (SDMT)</td><td>Greek verbal learning Test (GVLT)</td><td colspan="2">Brief Visuospatial Memory Test -Revised (BVMT-R)</td></tr>
<tr><td colspan="2">50.63
(11.31)</td><td>60.07
(11.55</td><td colspan="2">28.20
(6.33)</td></tr>
<tr><td colspan="5">LINGUISTIC MEASURES</td></tr>
<tr><td colspan="3">Syntax</td><td colspan="2">Morphology</td></tr>
<tr><td>Subject relatives
Maximum score:8</td><td>Object relatives
Maximum score:16</td><td>Passive voice
Maximum score:8</td><td>Regular past tense
Maximum score:10</td><td>Irregular past tense
Maximum score:10</td></tr>
<tr><td>7.1 (1.08)</td><td>14.25 (1.67)</td><td>6.70 (1.2)</td><td>7.67 (3.10)</td><td>6.73 (3.10)</td></tr>
</table>

An online investigation of syntactic prediction in aphasia in German

by Leonie F. Lampe | Dorothea Pregla | Nicole Stadie | Frank Burchert | Cognitive Sciences, Department of Linguistics, University of Potsdam, SFB1287, Potsdam, Germany | Cognitive Sciences, Department of Linguistics, University of Potsdam, SFB1287, Potsdam, Germany | Cognitive Sciences, Department of Linguistics, University of Potsdam, SFB1287, Potsdam, Germany | Cognitive Sciences, Department of Linguistics, University of Potsdam, SFB1287, Potsdam, Germany

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An online investigation of syntactic prediction in aphasia in German

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Introduction and aims

Previous research on sentence processing suggests that neurotypical individuals can use linguistic information to make predictions about upcoming linguistic representations before they are encountered in the input (e.g., Altmann & Kamide, 1999; Kamide et al., 2003; Knoeferle et al., 2005). These predictions can occur at all levels of linguistic processing (e.g., Pickering & Gambi, 2018) and are often measured with visual world eye-tracking while participants hear sentences.

Here, we focus on prediction of the syntactic structure of German declarative sentences. Previous eye-tracking studies (e.g., Hanne et al., 2015; Knoeferle et al., 2005) demonstrated that neurotypical individuals predict canonical agent-first structures when presented with initially structurally ambiguous declarative sentences. However, when unambiguous morphosyntactic cues become available in the input, these are integrated rapidly and, in non-canonical sentences, the previously predicted sentence structure gets revised.

German-speaking individuals with aphasia (IWA) often show impaired sentence comprehension, particularly of non-canonical structures (e.g., Burchert et al., 2003; Pregla et al., 2022). However, it has not yet been explored systematically if and how impaired syntactic prediction or prediction revision may contribute to impairments of sentence comprehension.

There is little evidence on syntactic prediction in IWA in German. Hanne et al. (2015)

reported that IWA only engaged in predictions after unambiguous case cues became available and even made agent-first predictions when case marking of NP1 unambiguously signalled a non-canonical sentence structure. Moreover, revision towards the non-canonical structure was delayed. Syntactic predictions by IWA in Pregla et al. (2022) were also delayed, but, in contrast to Hanne et al., IWA were unable to revise their predictions. Finally, Pregla et al. suggested that if processing of an unambiguous case cue was faster than the generation of a syntactic prediction, sentence processing was based on case information alone without engagement in syntactic predictions. While both previous studies suggested impairments in predictive processes in IWA, current evidence is not clear with respect to the exact nature of the impairment.

In the current study, we systematically investigate syntactic prediction in individuals with and without aphasia. Specifically, we study whether participants can predict a canonical sentence structure when presented with initially ambiguous sentences and if they are able to revise their prediction when presented with unambiguous morphosyntactic cues disconfirming their prediction.

Methods

Participants

Data collection is currently ongoing. A minimum of 20 neurotypical control participants and one individual with stroke-induced aphasia in the chronic phase with no severe single word processing deficit will participate in this study.

Design and Material

We use visual world eye-tracking in sentence-picture-matching to measure syntactic prediction in German declarative sentences. Predictions of canonical vs. non-canonical sentence structures are explored in present and future tense.

In all sentences, the first noun is either feminine or neuter and thus case marking of the determiner is ambiguous between nominative and accusative, making NP1 a potential subject or object of the sentence. Only an unambiguously case-marked masculine NP2 disambiguates the sentence as canonical (1a and 2a) or non-canonical (1b and 2b). There are 72 declarative sentences in each condition (i.e., 144 experimental sentences per tense).

1. **Present tense**
   a) Canonical trial (Target: Fig 1 on the left)
   Die$_{NOM/ACC}$ Ente wäscht gerade den$_{ACC}$ Hasen.
   The$_{NOM/ACC}$ duck currently washes the$_{ACC}$ hare.*b) Non-canonical trial (Target: Fig 1 on the right)*
   Die$_{NOM/ACC}$ Ente wäscht gerade der$_{NOM}$ Hase.

The$_{NOM/ACC}$ duck currently washes the$_{NOM}$ hare.

2. **Future tense**
   a) Canonical trial (Target: Fig 1 on the left)
   Die$_{NOM/ACC}$ Ente wird gleich den$_{ACC}$ Hasen waschen.
   The$_{NOM/ACC}$ duck will shortly wash the$_{ACC}$ hare.*b) Non-canonical trial (Target: Fig 1 on the right)*
   Die$_{NOM/ACC}$ Ente wird gleich vom$_{NOM}$ Hasen gewaschen.
   The$_{NOM/ACC}$ duck will shortly be washed by the$_{NOM}$ hare.

Sentences are presented auditorily while participants see pairs of black-and-white drawings on the screen. Both pictures display two animals engaged in an action, however, thematic roles are reversed between the two pictures (Fig 1). While participants listen to the sentence, their proportions of fixations on the two pictures are recorded. After sentence offset, participants select the picture that matches the sentence they heard. The same pictures are used in all four conditions.

Analysis

The eye-tracking data will be analysed with a growth curve analysis on 50ms time bins (Mirman, 2014). Anticipatory looks will be measured *before* and revision *after* the presentation of the disambiguating case information at NP2. Speed and accuracy of picture selection will be analysed as measures of sentence comprehension.

Expected results

We expect control participants to first look at the picture displaying the canonical sentence interpretation. In the non-canonical conditions, we expect a correction of looks towards the picture displaying the non-canonical sentence interpretation upon hearing the nominative case of NP2. Moreover, control participants will perform the sentence-picture matching task with accuracy at ceiling and with slower end-of-sentence responses in the non-canonical conditions.

For the IWA we expect to find differences in fixation paths for trials with correct or incorrect behavioural responses. In correct trials, the IWA will inspect the picture showing the canonical sentence interpretation, however, the increase of looks will be delayed compared to controls. After hearing the unambiguously case-marked NP2, the IWA will fixate on the respective target picture (canonical or non-canonical). In the non-canonical condition, there will again be a delay compared to controls. In trials with incorrect responses, the IWA will either not engage in preferential looks to either picture or, in the non-canonical condition, will continue to look at the canonical sentence interpretation even after the presentation of the nominative case cue at NP2. Behaviourally, the IWA will be slower and less accurate than controls, particularly in the non-canonical conditions.

Discussion

The results will speak towards the participants' abilities to engage in agent-first prediction when presented with an initially ambiguous sentence and to revise this prediction in the case of a non-canonical sentence continuation as well as towards the time-course of these processes.

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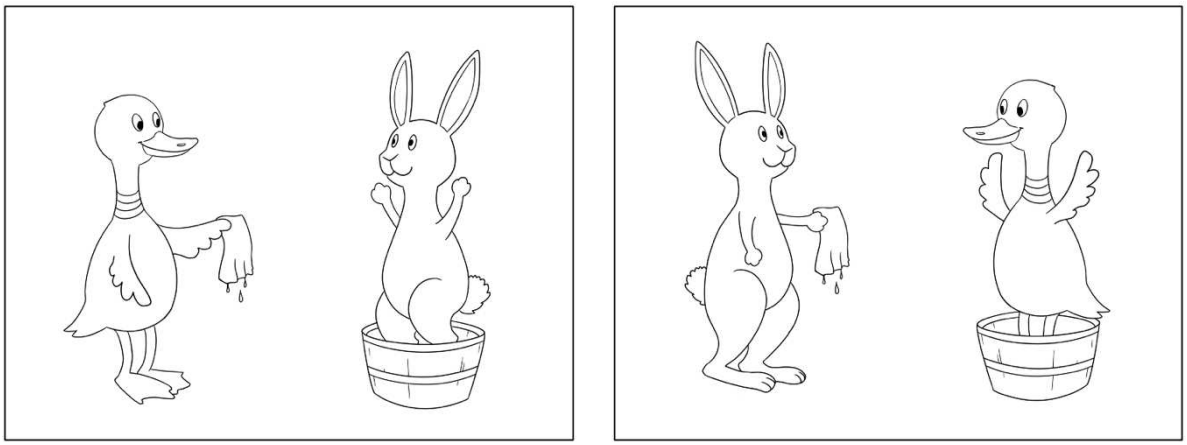
Figure 1

Example of visual display



Note. The picture on the left is the target picture for the canonical conditions, while the picture on the right is the target picture for the non-canonical conditions.

Imageability and Concreteness - Same or Different?

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Introduction and Aims

The influence of psycholinguistic variables on word processing can be seen in reaction times in non-brain-damaged individuals and accuracy scores in people with aphasia in various language tasks. Two of these variables, *imageability* and *concreteness,* both modulate semantic processing. Imageability and concreteness are highly correlated with each other (Paivio, 2013). However, they are not the same. In general, it is the case that words with a low concreteness have a low imageability (e.g., “fact”) and words with a high concreteness have a high imageability (e.g., “apple”). However, Paivio et al. (1968) also found words that are higher in imageability than concreteness (e.g., “affection”) and the other way around (e.g., “antitoxin”).

Values for both variables are typically collected through ratings. For imageability, it is stressed how easy a word gives rise to a mental image (Paivio et al., 1968). Concreteness resembles the degree to which a word refers to a perceptible entity. A concrete word refers to something that can be experienced with one’s senses or by taking an action. An abstract word refers to something that cannot be directly experienced (Bysbaert et al., 2014).

The literature is divided on whether imageability or concreteness is a better predictor for language tasks. Despite the apparent differences between the two variables, many researchers have used the two terms imageability and concreteness interchangeably.

With the current study, we aim to investigate the role of imageability and concreteness in word retrieval, answering the question whether concreteness or imageability has a higher predictive value for reaction times and accuracy.

Methods

Part 1: Naming-to-description

A naming-to-description task was conducted with 50 written descriptions eliciting nouns with a varying imageability and concreteness, e.g. “a silhouette on the ground of someone standing in the sun” eliciting “shadow”. Participants were 51 non-brain-damaged speakers of Dutch (19 to 65 years old, M=30.12,SD=13.2). The experiment was designed in PsychoPy (Peirce et al., 2019) and administered online on pavlovia.org. Reaction times were measured once participants started typing. Concreteness ratings were taken from Brysbaert et al. (2014). Imageability ratings were obtained in a separate online questionnaire (78 participants). For concreteness, the rating scale ranged from 1 (“very abstract”) to 5 (“very concrete”). For imageability the scale ranged from 1 (“very high imageability”) to 5 (“very low imageability”).

Part 2: Action & Object Naming

In this study, we used the data of people with aphasia described in Bastiaanse et al. (2016). We included only people who indicated Dutch as first language and finished both tasks (n=37). They were between 19 and 77 years old (M=56.2, SD=13.3). All participants were diagnosed with aphasia, with varying types and severities.

Black-and-white line drawings were presented in object and action naming tasks (50 items each). Frequency, age of acquisition (AoA), and imageability measures were as reported in Bastiaanse et al. (2016). In addition, we included concreteness ratings from Brysbaert et al. (2014).

Results

Part 1: Naming on description

From the 50 items, eight items were named correctly by less than 75% of the participants and were therefore removed. The remaining 42 items had a mean concreteness of 4.09 (SD=0.933) and a mean imageability of 2.5 (SD=0.982). We removed all incorrectly answered items (n=153) and strong outliers (RT>1010ms, n=78) before further analyses. The mean reaction time (n=1920) was 3387ms (SD=1667ms).

A linear mixed model analysis was performed to identify the influence of concreteness and imageability on the reaction time (dependent variable). Both parameters were entered (centralized) as fixed effects. “Item” and “participant” were included as random effects. Lower imageability lead to higher reaction times (b =0.498, SE=0.199, p=.017) while no significant effect was found for concreteness (b =0.340, SE=0.199, p=.095).

Part 2

The mean concreteness of the nouns (n=49) was 4.8 (*SD*=0.25) and the mean imageability was 1.15 (*SD*=0.138). The verbs had a mean concreteness of 4.11 (*SD*=0.353) and a mean imageability of 1.57 (*SD*=0.334). The mean accuracy for the nouns was 83.2% and for the verbs 71.4%.

Separate generalized mixed model analyses were performed for the noun and the verb tasks with accuracy as dependent variable and frequency, AoA, imageability and concreteness (centralized) as fixed effects. Item and participant were added as random effects. For the verb task, random slopes AoA/item and imageability/participant were included. For the nouns, frequency (*b* =-0.785, *SE*=0.174, *p*<.001), AoA (*b*=1.028, *SE*=0.247, *p*<.001) and concreteness (*b* =-0.710, *SE*=0.323, *p*=.028) influenced the accuracy significantly, while imageability did not (*b* =-0.631, *SE*=0.917, *p*=.491).

For verbs, imageability significantly influenced the accuracy (*b* =1.0462, *SE*=0.402, *p*=.009). Frequency (*b*=-0.170, *SE*=0.194, *p*=.381), AoA (*b* =0.024, *SE*=0.232, *p*<.916) and concreteness (*b* =-0.032, *SE*=0.368,*p*=.931) did not.

Correlations

We calculated Spearman-rank correlations between concreteness and imageability for each set. For the naming-to-description set, there was a strong correlation ($r(40)=-.768$, $p< .001$) . For the noun set, there was no significant correlation ($r(47)=-.201$, $p=.167$). For the verb set, there was a very weak correlation ($r(48)=-.294$, $p=.038$). As can be seen in Figure 1, the object and action naming task show little variance in concreteness and imageability. The naming-to-description task includes items with more varying ratings.

[Figure 1 here]

Discussion

Our study shows that concreteness and imageability are indeed not interchangeable (cf. Paivio, 2013). Depending on the task and the item distribution, either of them can be the better predictor. Varied datasets that also include items with low imageability/concreteness seem to favor imageability, as in our first study. The higher the values and the smaller the variance within the set, the more preferred concreteness becomes. For object naming, we saw highly imageable/concrete items with little variance and a better prediction with concreteness. In the action naming task, the average imageability/concreteness was slightly lower and variance higher, and imageability was the better predictor. Therefore, there is no clear advantage for either variable. Task and material properties are important to take into

account. Where possible, this difference between imageability and concreteness should be considered when designing diagnostic materials and research studies.

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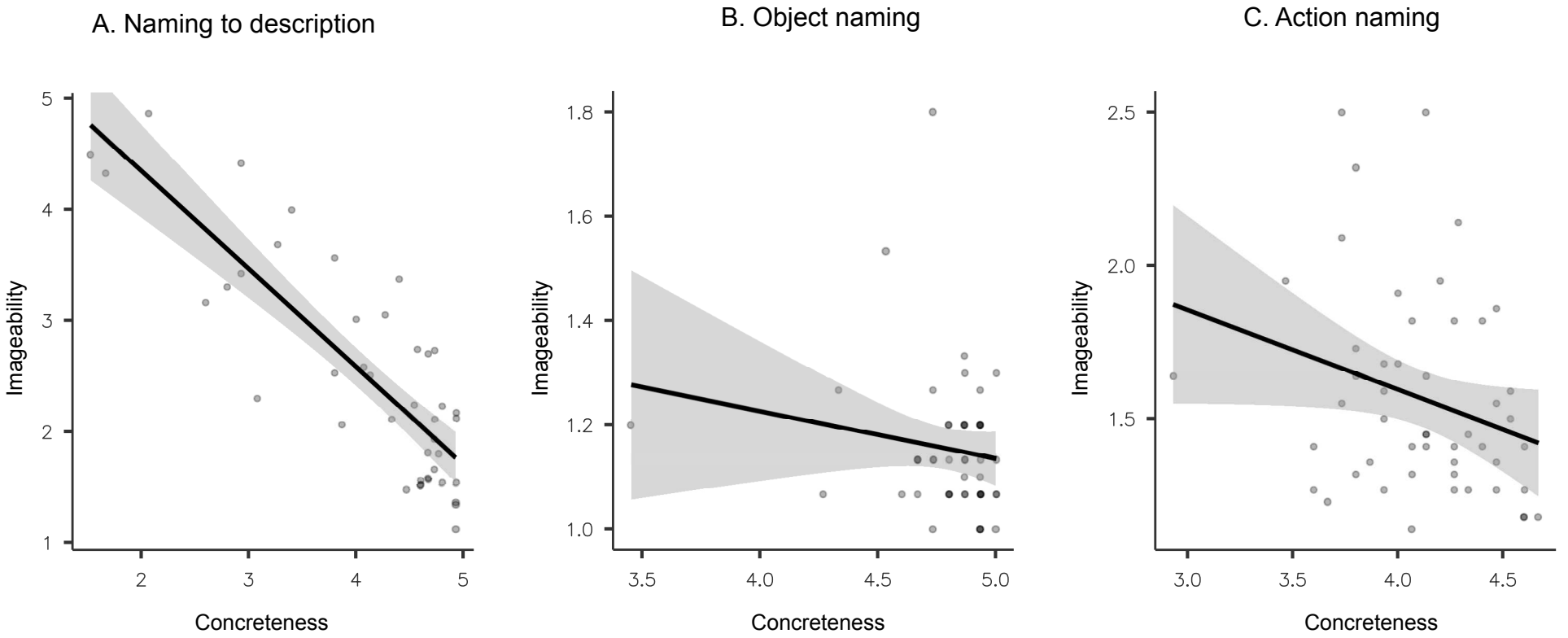
Figure 1

Correlations between concreteness and imageability for the different item sets



Processing of gender information of German possessives in aphasia

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Introduction and aim

Previous research has shown that people with aphasia often exhibit impairments in pronoun processing (e.g., Choy & Thompson, 2010; Grodzinsky et al., 1993). As pronouns are an essential part of languages and, therefore, of daily communication, identifying the underlying nature of processing impairments of pronominal forms is essential.

A recent meta-analysis (Arslan et al., 2021) has demonstrated that the majority of studies on pronoun processing in aphasia investigate only some of the many different pronoun types (i.e., personal pronouns, interrogatives and reflexives) while studies on other pronoun types such as demonstratives or possessives are mostly lacking. To tackle this research gap, this study focuses on processing of possessives, an understudied pronoun type, in German speakers with aphasia. Studies on English have shown that, in people with aphasia, the ability to comprehend possessives tends to be preserved, while the production of possessives can be impaired (Caplan et al., 2007; Goodglass et al., 1993). However, this may not hold for comprehension of German possessives, which are morphologically more complex than English possessives.

Possessives can be used both as determiners (PossDet; e.g., 'That is *her* car') and as pronouns (PossPro; e.g., 'That is *hers*'). In German, both possessive forms are morphologically complex: They are marked for features of the possessor (i.e., the person possessing something) as well as features of the possessee (i.e., the object being possessed). For third person singular forms, possessor marking requires marking of number and gender on the stem (*sein-* 'his' and *ihr-* 'her'). Number, case, and gender (masculine, feminine and neuter) are marked on the suffix for possessee agreement.

There are currently no studies exploring the processing of German PossPro, neither in people with aphasia nor in unimpaired individuals, and only a few studies have investigated processing of German PossDet in unimpaired individuals (e.g., Stone et al. 2021), and none

with people with aphasia.

In the current study, we aim to explore on-line and off-line comprehension of gender marking of German third person singular possessive determiners and pronouns in people with aphasia and unimpaired individuals. Specifically, we plan to investigate comprehension of both possessor (i.e., gender on the stem) and possessee (i.e., gender on the suffix) marking.

Methods

Participants

We plan to collect data from thirty unimpaired participants and undertake a single case study with one participant with aphasia.

Materials and procedure

We use a visual world eye-tracking paradigm and an accompanying behavioural judgement task to measure on-line and off-line processing of possessives in two experiments: one targeting PossDet and one targeting PossPro. Both tasks follow a 2x2 design.

Both experiments use the same basic task. At the beginning of each task, the participant is introduced to the two protagonists of the tasks: A man representing the male possessor and a woman representing the female possessor. The investigator then explains that the man possesses only blue objects and that the woman's objects are always yellow. For each trial, the participants first see the man with two objects of different genders coloured in blue and the woman with the same objects coloured in yellow (e.g., *Schlüssel*$_{\text{MASC}}$ 'key' and *Feder*$_{\text{FEM}}$ 'feather'; see Fig. 1a). This visual presentation will be accompanied by a prerecorded sentence with the object names in plural (e.g., *Hier sind Schlüssel und Federn*. 'Here are keys and feathers.'). Subsequently, only the four objects are displayed on the screen (see Fig. 1b) and an auditory instruction is presented. In the PossPro task, participants hear sentences such as in (1) and in the PossDet task, participants hear similar sentences such as in (2) but where target objects yet not their colours are mentioned.

(1) PossPro trial target: Yellow feather / blue feather / blue key / yellow key (see Fig. 1b)
Drücken Sie auf: Das ist ihr-e / sein-e / sein-er / ihr-er.
Press: This is hers-fem / his-fem / his-masc / hers-masc.

(2) PossDet trial target: Yellow feather / blue feather / blue key / yellow key (see Fig. 1b)
Drücken Sie auf: Das ist ihr-e Lieblingsfeder / sein-e Lieblingsfeder / sein-Ø Lieblingsschlüssel / ihr-Ø Lieblingsschlüssel.
Press: This is her-fem favourite feather / his-fem favourite feather / his-masc favourite key / her-masc favourite key.

Only one of the four pictures, the target (e.g., the yellow feather: *ihre* 'hers' in the PossPro task), matches the gender as marked on the stem and the gender as marked on the suffix of

the possessive used in the instruction. The other three pictures are distractors. One picture is a same colour possessor competitor (e.g., the yellow key: *ihrer* 'hers'), which matches the gender of the stem but not the suffix. A second distractor is a possessee competitor (e.g., the blue feather: *seine* 'his), which matches the gender of the suffix, but not the stem. The fourth object is a distractor matching neither the stem nor the suffix (e.g., the blue key: *seiner* 'his').

Analysis
We plan to look at effects of possessor and possessee marking. Therefore, we will analyse accuracy of answers as well as reaction times in the behavioural task and the fixation data from eye-tracking.

Results
This experiment is currently in preparation and data collection will start soon, with results presented at the conference.

Discussion
We expect unimpaired individuals to perform at ceiling in accuracy, while people with aphasia may display possessive processing difficulties, reflected in delayed fixation of the target and lower accuracy scores. The task is designed to enable detection of impairments of both gender comprehension on the stem and gender comprehension on the suffix. Overall, we expect people with aphasia to present with lower accuracy scores in the PossPro task than in the PossDet task since target identification relies on decoding the stem and the suffix in the PossPro task whereas decoding the suffix is not required in the PossDet task due to the presence of the possessee noun.

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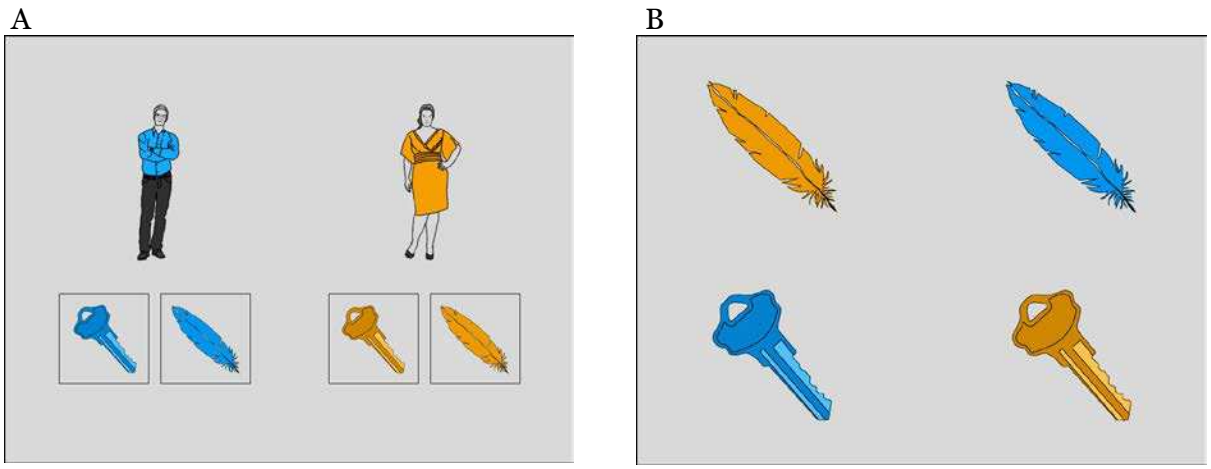
Figure 1

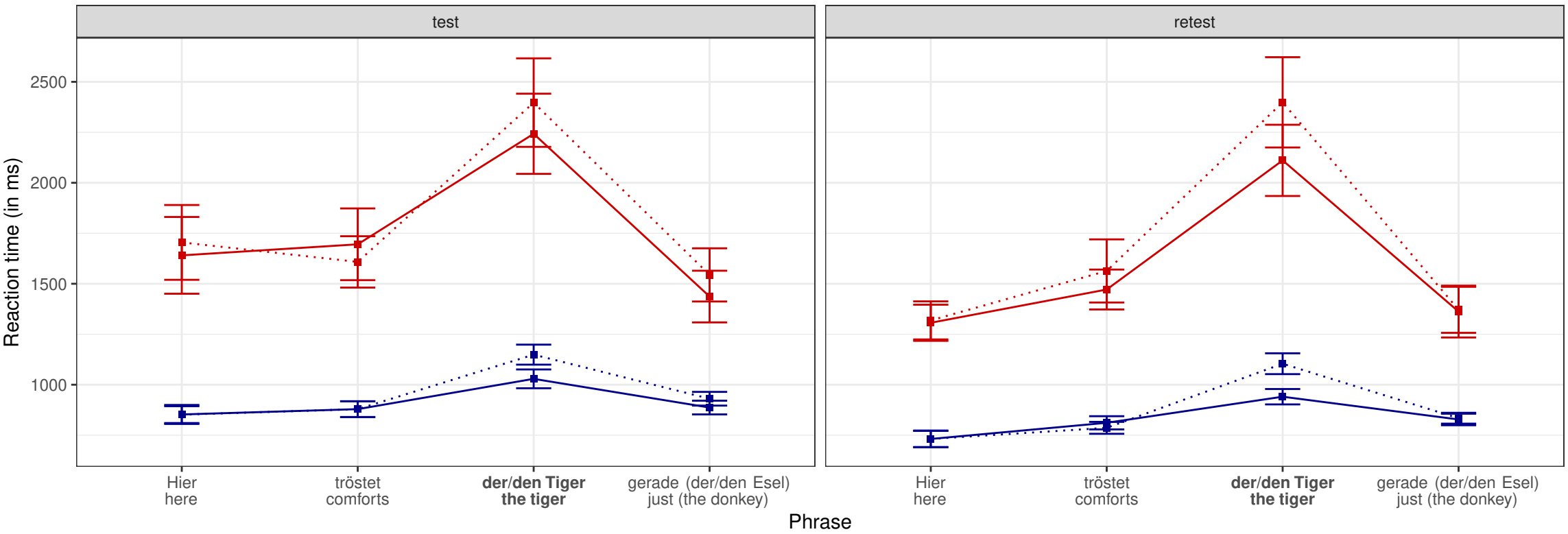
Sample experimental trial



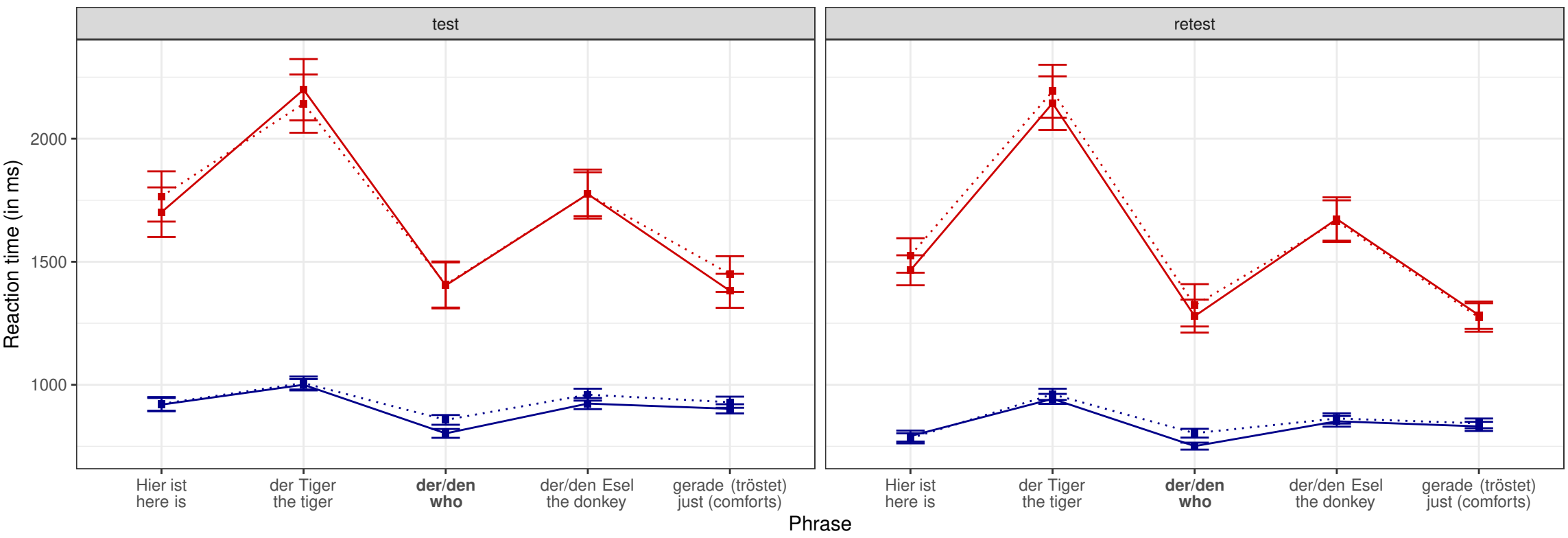
Note. The visuals for the POSSPRO and the POSSDET task are identical. All images are taken from MultiPic (Duñabeitia et al., 2018). Panel A: Introduction of the possessions of the trial together with their owners: blue objects belong to the man; yellow objects belong to the woman. Panel B: On-screen display during the comprehension tasks. Task instruction differs for the POSSPRO (see examples in (1)) and the POSSDET task (see examples in (2)).

Listening times in the self–paced–listening task

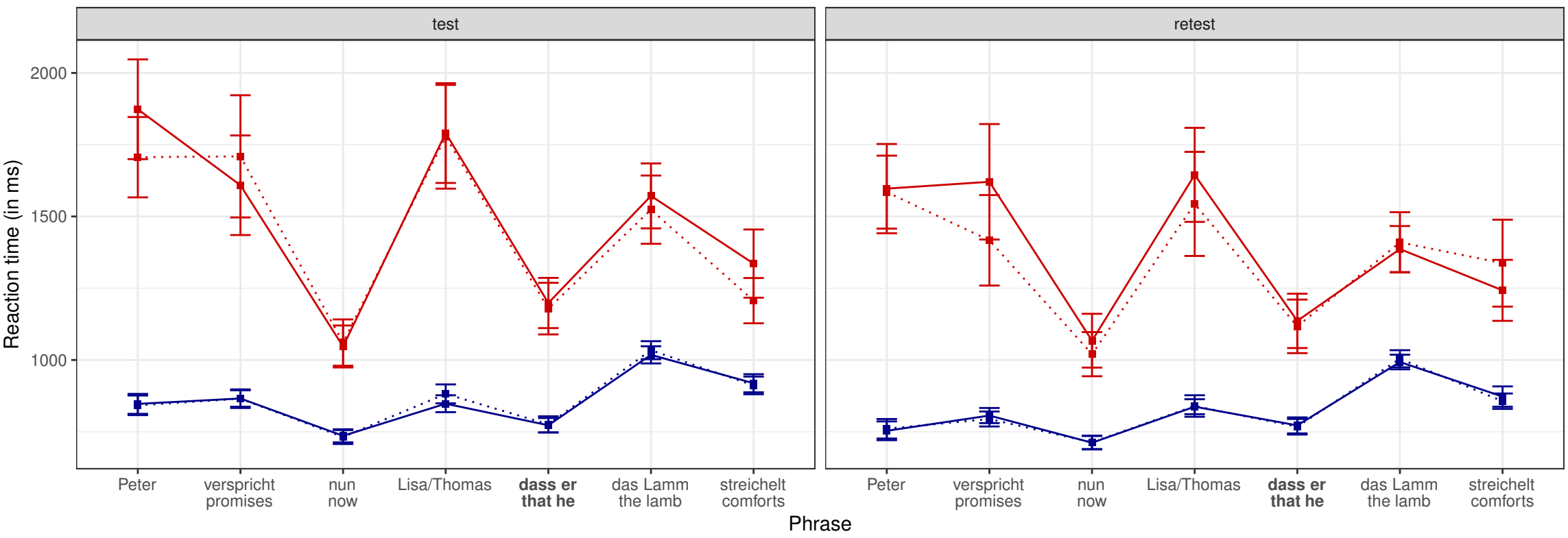
Declarative sentences



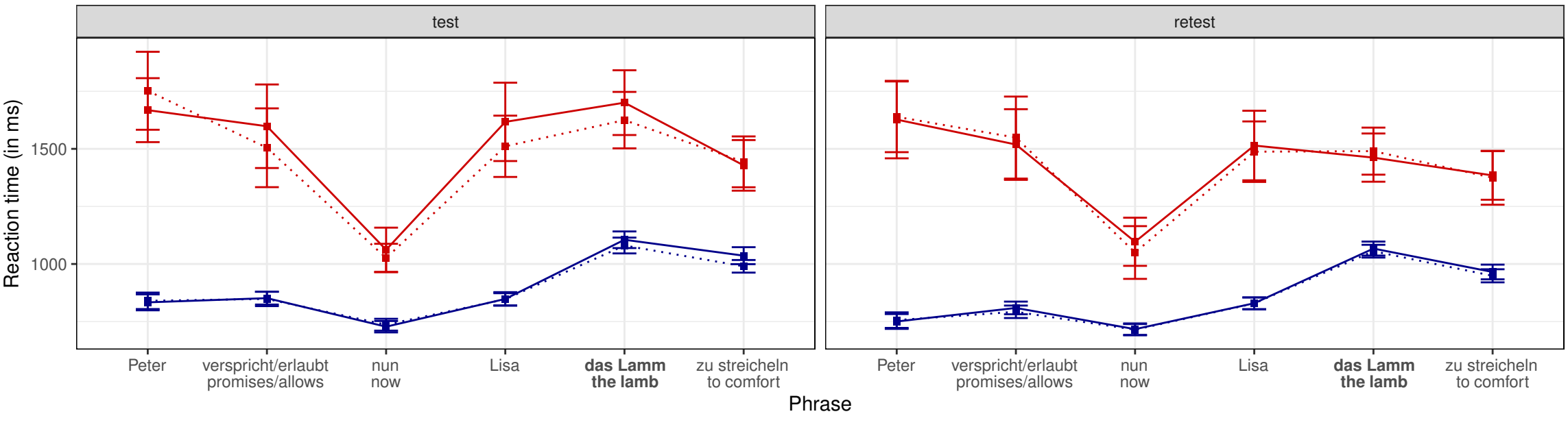
Relative clauses



Control structures with a pronoun



Control structures with PRO



Control group syntactically complex
Control group syntactically simple
Individuals with aphasia syntactically complex
Individuals with aphasia syntactically simple

Error bars represent 95% confidence intervals.
Critical sentence region is bold.

Do individuals with aphasia show adaptation in online sentence processing? A self-paced listening experiment in German

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Introduction and Aims

Syntactic adaptation refers to an implicit improvement in sentence comprehension following repeated exposure to sentences even if no explicit feedback and cues about sentence structure are given (Fine et al., 2013). Understanding processes underlying syntactic adaptation is important and will provide insights into whether repetition alone can improve sentence comprehension performance in individuals with aphasia (IWA). Such improvements are, for example, higher response accuracies or faster responses in sentence-picture-matching tasks after repeated exposure. Adaptation should be most prominently observed in syntactically complex sentences, such as object relative clauses since they are difficult to process for IWA thus having a high potential for improvement. Therefore, it is predicted that adaptation in syntactic processing leads to a larger decrease in sentence comprehension difficulty for complex sentences in comparison to syntactically simpler sentences such as subject relative clauses (Wells et al., 2009).

Adaptation in syntactic processing has been reported for language-unimpaired adults (e.g., Fine et al., 2013; Wells et al., 2009; but see Harrington Stack et al., 2018 for a replication failure). For example, Wells et al. (2009) claimed that difficulties in understanding object vs. subject relative clauses diminished after repeated exposure (4 sessions total) to relative clauses. For IWA, there are only a few findings on syntactic adaptation. In a study by Mack et al. (2016), IWA showed no changes in sentence-picture-matching accuracy for active and passive sentences between two test sessions. Additionally, Mack et al. (2016) collected eye-tracking measures for the IWA and found stable performance patterns between the two sessions. In a study by Schuchard et al. (2016), four IWA showed slight improvements in accuracy for passive sentence comprehension after repeated exposure (5 sessions total) to passive sentences, while the remaining five IWA showed a slight decline in accuracy. The findings of Schuchard et al. and Mack et al. might suggest that effects of adaptation are

smaller in IWA than in language-unimpaired adults. However, it is largely unknown whether repeated exposure has an impact on online sentence processing of IWA. To further investigate adaptation during sentence processing, we analyzed data collected in a self-paced-listening paradigm.

Methods

The study included 21 IWA (mean age = 60.2, range = 38–78 years, 1–26 years post onset) and 50 control participants (mean age = 48, range = 19–83 years), all native speakers of German. None of the IWA exhibited severe auditory comprehension deficits at the single word level. Sentence comprehension was assessed with an auditory sentence-picture matching task with two pictures (target and foil). The stimuli consisted of 120 sentences, 60 of which were syntactically simple or complex, respectively. Sentence structures included declarative sentences, relative clauses, and control structures with an overt pronoun or a covert pronoun (PRO). Sentences were presented phrase-by-phrase in a self-paced-listening paradigm, in which participants controlled the presentation of the next phrase with button presses. Adaptation to sentence structures was investigated by comparing performance across two test phases spaced approximately two months apart. Across test phases, participants were exposed to all 120 sentences in total six times. Data were analyzed using Bayesian hierarchical generalized linear models. We report the estimated mean and 95% credible intervals (CrI) of the listening times in the self-paced-listening task.

Results

Listening times of the IWA and the control group for the four sentence structures are shown in Figure 1. The statistical report focuses on the region of the sentences, in which processing should be more difficult in complex vs. simple sentences (bold in Figure 1, selection criteria for the critical region will be explained in the poster). The control group exhibited faster listening times than IWA (507ms, CrI [347, 677]). Both participant groups had faster listening times in the retest versus test phase (54ms, CrI [2, 106]), with no interaction between participant group and test phase. Moreover, both participant groups had longer listening times in complex vs. simple declarative sentences (control group: 116ms, CrI [73, 162], IWA: 263, CrI [-37, 588]) and in complex vs. simple relative clauses (control group: 42ms, CrI [27, 60], IWA: 64, CrI [-12, 143]). There were no differences in listening times for either group between the syntactically complex versus simple control structures with a pronoun or PRO. Finally, there was an interaction between syntactic complexity and test phase for IWA in relative clauses, namely the difference in listening times between subject and object relative clauses increased by 50ms in the retest phase (52ms, CrI [11, 94]). No further interactions were present for any sentence structure or participant group.

Discussion

The speedup in listening times between the test and retest phase points to an adaptation effect in both controls and IWA. However, this effect may be caused by adaptation to syntactic structures or the task itself. We think that the latter option is more likely and that participants responded faster in the retest phase because they were more familiar with the setting and more efficient in the procedure of requesting new phrases. The reason for assuming task adaptation is that there was no decrease in listening time differences between syntactically complex and simple sentences, as reported by Wells et al. (2009). Instead, IWA in our study showed an increased difference in listening time between syntactically complex and simple sentences in the retest compared to the test phase for relative clauses. This speaks against an implicit improvement of syntactic processing in IWA since no reduction in listening times was observed for the syntactically complex vs. simple sentences. The absence of syntactic adaptation in IWA is consistent with Mack et al. (2016) and Schuchard et al. (2016). These findings suggest that the sole repetition of sentences in intervention is unlikely to lead to improved sentence processing in IWA. However, a number of repetitions higher than that used in our study may potentially lead to syntactic adaptation in IWA. This may be investigated in future research. Finally, the increased listening-time differences between subject and object relative clauses may be a sign of changing syntactic processing in IWA requiring further investigation.

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Online Group Meditation for People with Aphasia: A preliminary qualitative study

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Introduction and aim

Meditation practices have been increasingly shown to be beneficial for psychological functions, in particular, to well-being in both healthy people (Sedlmeier et al., 2018; Goyal et al., 2014; Luberto et al. 2018) and those with chronic health conditions, including aphasia (e.g., Dickinson et al., 2018). Considering the range of psychosocial consequences in people with post-stroke aphasia, meditation potentially offers a useful complementary rehabilitative tool. However, improvement in methodological designs and aphasia-friendly delivery of meditation to ensure inclusion and engagement are key and need further exploration (see Pieri et al, 2022 for an overview and recommendations). While more quantitative evidence is needed to understand the effectiveness of meditation in the aphasia population (e.g., Marshall et al., 2018), the impact of meditation from the perspective of the lived qualitative experience of people with aphasia has hardly been investigated. Our recent study by Panda, Whitworth, Hersh, and Biedermann (2021) has captured such lived experience of people with aphasia, who learned to meditate in a community meditation group for people with stroke. This qualitative study served as a proof of concept that people with aphasia can learn how to meditate in a face-to-face group meditation setting. Since the onset of COVID-19 in 2020, the community meditation group (as reported in Panda et al., 2021) had to change its face-to-face format to an online format. To date, this group has settled into a hybrid format with new members being able to join, who live out of town or are less mobile. Hence, we are currently conducting a replication of the Panda et al. (2021) study by interviewing individuals with aphasia about the lived experience when receiving meditation instructions in an online group setting.
This study aims to gain insight into how individuals with aphasia experience the delivery of online meditation by identifying themes around the impact on communication, and well-being in every-day life.

Methods

Procedure

As in Panda et al. (2021), we use a qualitative design, following the principles of Interpretative Phenomenological Analysis (IPA) (Smith et al., 2009). The primary purpose of IPA is to capture the "insider perspective" (Smith et al., 2009, p. 36), in order to document individual experiences as closely as possible. We were guided by Dalemans et al. (2010) in our qualitative explorations of the lived experiences of individuals with aphasia accounting for vulnerability of the population and their communication difficulties.

We follow the interview and member check guide outlined by Panda et al. (2021), with the only difference that the questions relate in this replication study to an online meditation group context. For example, topics include first impression of online meditation, ease or difficulty of engaging with online meditation, social experience, and impact and use of online meditation.

Participants

Three individuals with aphasia, and one carer/ spouse, who frequently joined the online meditation group, have been recruited for four individual semi-structured interviews, and with one member-check group being carried out at the end of the interviews. All interviewees have been regular attendees of the online meditation group since 2020, with two of the individuals with aphasia already attending the face-to-face group meditation prior to the pandemic. All individuals with aphasia are at least five years post-onset and have two years of online meditation experience. According to the WAB-R Aphasia Quotient (Kertesz, 2006), two individuals present with mild/fluent aphasia, and one individual with moderate/non-fluent aphasia, with only mildly impaired comprehension for all participants.

Meditation program & techniques

Bi-weekly to weekly one-hour online meditation sessions are offered throughout the year via the community meditation group. Meditation techniques offered are body scan, breath counting and listening to sounds (e.g., Kabbat-Zinn, 2003).

Data analysis plan

Following the six steps suggested by Smith et al. (2009 (multiple readings; free textual analysis; collation and sorting of comments to codes; grouping of finalised emerging themes; present analysis to an independent expert in IPA analysis, validation of themes by participants)) at least three coders/ interrater will be involved in the IPA analysis.

Results

Online Group Meditation: The outcome of this thematic analysis is currently in progress. It remains an open question whether the four super-ordinate themes identified for the face-to-face group meditation (e.g., learning to meditate is gradual; meditation experience differs across individuals; the importance of meditating in a group; and meditation helps to focus away from the impairment) will be same, partly the same or different for the online meditation group context.

Discussion

While Panda et al. (2021) reported that delivery of meditation in a group context impacted positively on the face-to-face meditation experience due to social opportunities and shared understanding of aphasia, it remains unclear how this social experience might translate into an online group meditation setting. Further, the face-to-face experience of participants to experience meditation as a focussing away from the language impairment is an interesting aspect that warrants further exploration in an online meditation group setting. Further, whether online meditation can contribute to a post-stroke acceptance process as observed in the lived experience of the face-to-face meditation setting, remains still an open question for the online meditation.

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Dissociations in novel word learning in aphasia: A case series study

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Introduction and aim

In cognitive neuropsychology, the identification of dissociations is crucial for the development of theories of human cognition. Dissociations in aphasia are not limited to those observed between language comprehension and production. There is evidence for dissociations in verbal short-term memory (STM) suggesting separable STM components for phonological and lexical-semantic representations (Martin, 2005). Likewise, dissociations in phonological and semantic learning have been reported on paired-associate learning paradigms (Freedman & Martin, 2001). Here we statistically assessed the presence of dissociations in novel word learning in 3 PWA using Bayesian methods for the examination of dissociations in single-case studies. We separately examined phonological and lexical-semantic word acquisition in two statistical learning tasks. Statistical learning is a cognitive mechanism that supports the ability to parse unknown words from running speech and acquire novel word-referent mappings in referentially ambiguous contexts by computing statistical patterns in the learning context (Peñaloza et al., 2015; 2017).

Methods

Participants

Participants were 24 healthy older adults (10 male, age: 60±11.63 years) and 3 participants with chronic aphasia (PWA) resulting from a left hemisphere stroke: P1 (male, 78 years, global aphasia), P2 (male, 42 years, mixed non-fluent aphasia), and P3 (male, 73 years, fluent aphasia).

Language and verbal short-term memory assessments

The 3 PWA underwent the following language assessments: (i) BDAE III (Goodglass, Kaplan, & Barresi, 2005) to determine the presence of aphasia and aphasia severity, (ii) the phonological discrimination and rhyming judgments subtests of the TALSA battery (Martin et al., 2018) to evaluate phonological processing (composite phonological processing score), (iii) the BDAE III Word Comprehension subtest to evaluate receptive lexical-semantic processing, and (iv) the Boston Naming Test (Kaplan, Goodglass, & Weintraub, 2005) to

assess expressive lexical-semantic processing. Their verbal STM was evaluated with tasks from the TALSA battery including (i) nonword repetition, (ii) word and digit repetition span tasks and (iii) word and digit pointing span tasks.

Word learning tasks

All participants completed two word learning tasks previously validated in healthy participants and PWA, namely a speech segmentation (SS) task (Peñaloza et al. 2015) tapping phonological learning, and a cross-situational learning (CSL) task (Peñaloza et al., 2017) examining lexical-semantic learning. In the SS task, participants were exposed to a spoken artificial language composed of four trisyllabic pseudowords and needed to learn the words by identifying word boundaries (i.e., computing transitional probabilities between adjacent syllables, which were higher between syllables within words and lower between syllables spanning word boundaries). The participants then completed a test that required discriminating words from nonwords (made of syllables never concatenated together in the artificial language). The CSL task required learning 9 pseudoword-novel referent pairs across 4 training blocks. In each trial, two objects of the training set were presented together with two spoken pseudowords, and the participants needed to figure out the correct associations between words and objects. While each learning trial was referentially ambiguous (i.e., 4 possible word-referent associations), the participants could resolve this ambiguity and identify the correct word-meaning mappings by computing the co-occurrence between words and objects across the learning trials. Each training block was followed by a recognition test. Each test trial presented a spoken pseudoword and four objects of the training set, and required pointing to the object that best matched the spoken word.

Statistical analyses

To test whether each PWA individually met criteria for a dissociation in word learning, we used the Bayesian Standardized Difference Test (BSDT) implemented on the DissocsBayes_ES.exe software (Crawford & Garthwhite, 2007) by comparing the difference between each PWA's performance on each task X and task Y relative to the differences of the control group performance on these tasks.

Results

The control group showed an average performance of .66 (SD= .14) on the SS task (task X) and .81 (SD= .20) on the CSL task (task Y). These values served as reference for the identification of dissociations in the 3 PWA. As shown in Table 1, all PWA presented with a putative classical dissociation between phonological and semantic word learning, presenting deficits in CSL but not in SS relative to the healthy controls.

Discussion

All 3 PWA met criteria for a putative classical dissociation in novel word learning in aphasia suggesting that phonological and semantic word learning may be differentially affected in this population. These findings support previous research reporting dissociations in word learning in aphasia using a different experimental paradigm (Freedman & Martin, 2001). These results further suggest that relatively more automatic, phonologically based statistical word learning appears to be better preserved in PWA than the ability to discover word-referent associations in complex contexts mechanisms.

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Table 1. Dissociations in novel word learning in three participants with aphasia

	Effect Size for Task X: SS (Z_{CC})			Effect Size for Task Y: CSL (Z_{CC})			Effect Size (Z_{DCC}) for the Dissociation		Dissociation	
PWA	**Score**	**Point**	**95% CI**	**Score**	**Point**	**95% CI**	**Point**	**95% CI**	**p value**	**Type**
P1	0.63	-0.225	-0.627 to 0.183	0.33	-2.451	-3.253 to -1.634	2.065	1.191 to 2.909	0.03196	Putatively classical
P2	0.56	-0.674	-1.112 to -0.223	0.25	-2.876	-3.787 to -1.952	2.043	1.090 to 2.981	0.03566	Putatively classical
P3	0.75	0.674	0.223 to 1.112	0.25	-2.876	-3.787 to -1.952	3.293	2.151 to 4.369	0.00238	Putatively classical

Dissociations evaluated with the Bayesian Standardized Difference Test (Crawford & Garthwhite, 2007). For each PWA, the individual proportion of correct responses (score) and the estimated effect size (Z_{CC}; the subscript CC representing case–control) with point and 95 % confidence interval estimates for each learning task are reported (Task X: SS tapping phonological learning, Task Y: CSL tapping semantic learning). The effect size for the dissociation (Z_{DCC}) with point and 95 % confidence interval estimates for the difference between case and controls and statistical significance (p value, one-tailed) are also provided.

How do language age-of-acquisition and dominance influence picture-naming errors in bilingual people with aphasia?

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Introduction and Aim

Lexical access difficulties are a common feature of aphasia. Although these difficulties have been systematically studied in monolinguals (Dell & Schwartz, 2007), they have been investigated to a lesser extent in the context of bilinguals with aphasia. Studies on bilinguals with aphasia suggest that spoken picture naming errors are similar to those experienced by monolingual speakers (e.g., semantic errors, phonological errors), with additional cross-language naming errors occurring (e.g., target is ‘cat’ but bilingual response is ‘Katze’ [German for cat]) (Cargnelutti et al., 2019). However, Khachatryan et al. (2016) point out that it is too early to assume that error rates are similarly distributed between the bilingual speaker's existing languages since evidence about the influence of factors such as language history, age-of-acquisition, and language use on each respective language of a bilingual speaker is still only scarcely understood (Khachatryan et al., 2016). This study examines therefore the influence of language dominance and age-of-acquisition on picture-naming accuracy and error types.

Methods

Spoken picture naming was carried out with seven late bilinguals with aphasia (second language-acquisition after age 12, e.g., Akbari, 2014) with different language combinations (age: M=66, SD=7.54, languages: Dutch-German [^P1+P3], Polish-German [P2] English-German [P4], English-French [P5], French-English [P6+P7]). All individuals showed word finding difficulties across all languages spoken. Background assessments including questionnaires around their bilingual language use, and aphasia batteries were carried out in each language for each participant. In light of these background assessments, language dominance could be defined for each participant. The experimental picture-naming task included ~350 object images with at least 80% name agreement (Duñabeitia et al., 2017). Participants named these items in each of their languages, counterbalanced over at least

four sessions. Responses were coded for accuracy and error type and analysed within and between languages for each participant. Distribution of error types between languages for each participant was calculated by comparing the proportion of a specific error type to the overall error types between languages.

Results

Accuracy: Five participants (P1, P2, P4, P5, P7) showed a significantly different accuracy between the first and the second language (higher accuracy in the first language: P2, P4, P5; higher accuracy in the second language: P1, P7). Four of these five participants (P1, P4, P5, P7) showed a greater naming accuracy in their dominant language (see Table 1).

Error types/pattern: One participant (P6) displayed the same error rates between languages for all error types, while all others (P1, P2, P3, P4, P5, P7) showed significantly different patterns of error rates between languages for one or more error types (see Table 1 for which error types were different between languages).

To further understand error distributions between languages within participants, we will run additional linear regression and correlation analyses.

Discussion

Accuracy: Four participants (P1, P4, P5, P7) showed a significant greater naming accuracy in their dominant language regardless of whether this language was their first or second language. Whereas for age-of-acquisition only one participant (P2) showed higher accuracy in their first language that was not their dominant language. This suggests that the influence of language dominance on accuracy was greater than that of age-of-acquisition in the majority for our participants, which was also reported by Kiran and Tuchtenhagen (2005).

Error types/patterns: P6 showed the same error pattern for all error types between languages. All other participants (P1, P2, P3, P4, P5, P7) showed varying error rates for one or more error types between languages. P6 was the only participant with the same level and severity of language breakdown between languages assessed and could be classified as a balanced bilingual speaker pre-stroke. Additionally, all latter six participants (P1, P2, P3, P4, P5, P7) showed a higher rate of cross-language naming errors in their non-dominant language, displayed by a higher rate of items that were named correctly in their non-target language. This suggests that it might be easier to access the dominant language, which is in accordance with the claim of non-selective activation of lexical forms in bilingual speakers (e.g., Moon & Jiang, 2012). The model of inhibitory control proposed by Green (1998) illustrates non-selective access and explains the non-target language errors by an impaired inhibition mechanism. However, this error pattern could also be a strategy to produce a response rather than no response.

^P=participant

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Table 1

Naming Accuracy and Error Types/Pattern

Participant		Naming Accuracy (n=~350)		Error Types/Pattern							
		% correct	L1 vs L2	Cross-language naming errors		Phonological error		Semantic error		No response	
			p[b]	Raw scores (%)	p[c]	Raw scores (%)	p[c]	Raw scores (%)	p[c]	Raw scores (%)	p[c]
P1	L1	40.6	**p=.001**	48/206 (23)	**p=.003**	6/206 (2.9)	**p=.002**	35/206 (17)	p=.111	43/206 (20.9)	**p=.007**
	L2	57.6[a]		15/147 (10.2)		17/147 (11.6)		36/147 (24.5)		14/147 (9.5)	
P2	L1	80.5	**p<.001**	9/125 (7.2)	p=.397	4/125 (3.2)	**p<.001**	58/125 (46.4)	**p<.001**	13/125 (10.4)	p=.117
	L2	46.0[a]		11/245 (4.5)		32/245 (13.1)		61/245 (24.9)		42/245 (17)	
P3	L1	57.9	p=.434	24/146 (16.4)	**p<.001**	4/146 (2.7)	**p<.001**	33/146 (22.6)	p=.973	20/146 (13.7)	p=.246
	L2	62.8[a]		2/129 (1.6)		35/129 (27.1)		28/129 (21.7)		11/129 (8.5)	
P4	L1	79.8[a]	**p=.001**	2/67 (3)	p=.052	2/67 (3)	**p=.016**	22/67 (32.8)	**p=.013**	14/67 (20.9)	p=.239
	L2	59.8		17/135 (12.6)		21/135 (15.6)		22/135 (16.3)		18/135 (13.3)	
P5	L1	86.6[a]	**p<.001**	4/49 (8.2)	p=.161	1/49 (2)	p=.073	9/49 (18.4)	p=1	3/49 (6.1)	**p=.023**
	L2	52.1		31/175 (17.7)		21/175 (12)		31/175 (17.7)		38/175 (21.7)	
P6	L1	69.3	p=.660	2/112 (1.8)	p=1	3/112 (2.7)	p=1	24/112 (21.4)	p=.563	35/112 (31.3)	p=.369
	L2	72.3[a]		2/101 (2)		2/101 (2)		26/101 (25.7)		25/101 (24.8)	
P7	L1	66.3	**p=.019**	9/119 (7.6)	p=.407	19/119 (16)	p=.743	10/119 (8.4)	**p=.030**	46/119 (38.7)	**p=.003**
	L2	83.0[a]		2/62 (3.2)		8/62 (13)		13/62 (21)		10/62 (16.1)	

Note. P = participant; L1 = first language; L2 = second language.

[a] Dominant language. [b]McNemar's test exact p, 2-tailed. [c] Fisher's exact p, 2-tailed.

Cognitive control and bilingual aphasia: exploratory results in French-speaking bilinguals

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Introduction

Cognitive control processes are suggested to be involved in bilingual language production to resolve interference from non-target language. These processes are subject to alteration in brain damage cases. Bilinguals with aphasia can experience different patterns of language impairment, language recovery, as well as language switching and mixing, symptoms that have been explained by factors related to bilingualism (Kuzmina et al., 2019) and cognitive control processes (Green & Abutalebi, 2008).

The Inhibitory Control Model proposed by Green (Green, 1986, 1998) is widely referred to in healthy and pathological bilingual production studies. This model suggests that inhibition, a component of executive control, is required to ensure appropriate language selection and interference suppression in language production. This ability is attributed to domain-general control i.e., the control mechanisms involved in linguistic and nonlinguistic tasks. However, some evidence points toward a dissociation between impairments in linguistic and nonlinguistic control suggesting the involvement of domain-general and domain-specific language control mechanisms (Gray & Kiran, 2016, 2019).

The acquired knowledge from this field is drawn from small sample studies, using different methodologies and focusing on a variety of tasks (lexical decision, semantic judgment, linguistic flanker task, Stroop task, etc.). Despite the indication of cognitive control implication in bilingual aphasia deficits, this relationship still needs further investigation (Mooijman et al., 2021; Nair et al., 2021) by measuring different executive function skills (e.g., Murray, 2017) and assessing different aphasia profiles (e.g., Kuzmina & Weekes (2016)).

Aims and Methods

This study aims at exploring the relationship between language control and executive control in French-speaking BwA. More precisely, the study will address the question of domain-general *vs*. domain-specific deficit using linguistic and nonlinguistic executive control tasks.

Participants

Twenty-two bilingual participants enrolled in this study: 11 bilinguals with aphasia (BwA) (age 64.9 [6.27]) and 11 matched healthy controls ([HC] age 60.27 [8.47], matched on age, education level, and bilingualism). All participants spoke French as a second language (early and late bilinguals) whereas their first language was different: Arabic (Lebanese and Egyptian), Persian, Dutch, Basque, and English. BwA suffered a stroke in the left hemisphere. They were all included 3 months after the stroke.

Tasks

All participants filled in a questionnaire on the history of their bilingualism, language use, and language switching habits. The screening version of the Bilingual Aphasia Test ([BAT-B], Guilhem et al., 2013) was used to assess spoken language. The part C of the BAT ([BAT-C], Paradis et Libben, 1987) was used to evaluate translation skills and interaction between languages. We also assessed discourse using a sample of spontaneous speech and a picture description task (‘the cookie theft’ of the BDAE, Goodglass et al., 2001, 2007 and ‘the bank robbery’ of the MT86, Lecours et al., 1992). Cognitive control tasks comprised a Stroop task (Stroop, 1935) and a nonverbal Flanker task (Eriksen & Eriksen, 1974) to measure inhibitory control and a Trail Making Test ([TMT] Reitan, 1958) and a Shape Trail Test ([STT] Zhao et al., 2013) to measure verbal and nonverbal flexibility.

Results

Between language comparisons show significantly different performances for all participants, with better performances in L1 for BAT-B (W=254.5, p<.05) and better translation from L1 to L2 (W=241, p<.05).

Between group comparisons show significant differences for BwA and HC on language tasks (BAT-B: W=113, p<.01; BAT-C: W=103.5, p<.01) and cognitive control tasks (Stroop: W=69, p<.01; Flanker: W=64, p<.05; TMT: W=94.5, p<.001; STT: W=63, p<.05).

Performances on language tasks and cognitive control tasks are summarized in Table 1.

Moreover, performances on language tasks (BAT-B and BAT-C) are correlated to nonverbal cognitive control measures for all participants:

- BAT-B
  - Flanker task: τ_b= .513, p<.01
  - STT: τ_b= -.542, p<.05
- BAT-C
  - Flanker task: τ_b= .439, p<.05
  - STT: τ_b= -.393, p<.05

<insert here table 1>

Discussion and Conclusion

To explore the relationship between cognitive control and linguistic control in bilingual aphasia, we compared healthy participants to bilingual participants with aphasia in language and executive function tasks. The current findings show a general impairment in language and cognitive control skills in bilinguals with aphasia compared to healthy bilinguals. The impairment in all cognitive control tasks supported by the correlation to nonverbal tasks specifically suggests a domain-general deficit rather than a language-specific impairment, implying thus that mechanisms responsible for language selection and production are also involved in other cognitive functions. Additional analysis of languages by groups (e.g., translation from L1 to L2 and *vice versa* in BwA and HC) and responses (e.g., proportion of codeswitching in the part B of the BAT and in the discourse tasks) could help in further understanding of this cognitive control-language control relationship.

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Cognitive control and bilingual aphasia: exploratory results in French-speaking bilinguals

Table 1 : Performances on language and cognitive control tasks for HC and BwA

		BAT-B[1]	BAT-C[1]	Stroop[2]	Flanker[2]	TMT[2]	STT[2]
BwA		76.72 [18.02]	63.17 [25.26]	218.14 [58.65]	1.59 [0.96]	216 [121.1]	189.25 [135.4]
	L1	77.93 [19.24]	61.97 [26.6]				
	L2	75.51 [17.57]	64.49 [25.07]				
HC		90.32 [7.819]	85.06 [14]	130.27 [36.57]	0.91 [0.23]	59.73 [31.93]	86.9 [32.48]
	L1	92.3 [5.985]	85.53 [11.63]				
	L2	88.34 [9.162]	84.6 [16.61]				
Total		**83.52 [15.36]**	**74.37 [22.91]**	**164.44 [62.8]**	**1.21 [0.73]**	**130.05 [114.3]**	**132.39 [104.1]**

Notes:[1] Scores are given in percentage of correct responses. [2] Time is given in seconds. for interference conditions.

Relationships between implicit and explicit auditory sentence processing tasks in aphasia therapy

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Introduction and aim

While many aphasia assessments and therapies targeting sentences employ off-line tasks, such as reflecting on grammatical rules or mappings from semantics to syntax (e.g., grammaticality judgements, Verb Network Strengthening Treatment; [1]), we use an on-line processing paradigm within a computerized therapy, informed by usage-based construction grammar. In particular, we use a word monitoring task (WMT) to achieve structural priming of target constructions.

The WMT requires participants to press a button as quickly as possible once they detect a pre-determined target word in a sentence [2]. It uses reaction times (RTs) to investigate sensitivity to targets appearing in varying sentential contexts. Sentences are often recorded with a similar speed to typical discourse and therefore WMTs support real-time spoken language processing. In aphasia, WMTs have mainly been used to explore sensitivity to disruption of language processing at various levels [3]. However, the task has the potential to shed light onto the processing demands of well-structured sentences manipulated by psycholinguistic variables such as usage frequency [4,5]. Furthermore, WMTs require only a button-press response, particularly suitable for gamification (e.g., 'best time' feedback), thus enhancing motivation for engagement in often repetitive therapy tasks. Because of its implicit nature, it is also compatible with structural priming (where a participant is repeatedly presented with a specific syntactic schema in listening or reading and subsequently, an increase in the use of that schema is observed in production; [6]): A WMT may be used as a 'first part', with subsequent testing of availability of the primed structure(s) in a production task.

We present data from an auditory WMT as part of a new usage-based aphasia therapy, UTILISE (Unification Therapy Integrating LexIcon and SEntences; [7]), aiming to improve sentence-level processing by targeting 20 high-frequency constructions (e.g., "I made it"). There are three therapy activities: a syntactic working memory task (judging whether paired strings were the same or not), a WMT (the focus of this report), and a production task

(training production of high-frequency constructions and their variations). Employing a WM therapy task was motivated by structural priming (many of the strings in the WMT are the constructions targeted in the production task) and training online attention to the whole string (target words may appear at any of the constructions' content word slots). The UTILISE trial employs a randomised control trial design, with deferred trial entry allowing a treatment vs. no-treatment comparison. It includes a series of outcome measures, one of which is an explicit probe of auditory comprehension via sentence-picture matching, the Test for Reception of Grammar (TROG-2; [8]).

The aim of the current study was to answer the following questions: (a) Do participants show faster RTs to targets over the course of the therapy? (b) Does learning in the WMT correlate with TROG-2 pre- vs post-therapy difference scores (DS)? Since the TROG-2 is examining constructions that differ from the therapy targets, we interpret this research question as a 'far' transfer effect.

Methods

Participants

We present data from a subset of 17 individuals from the main trial (7 female, 10 male; mean age=60.29 years, range=45–87, mean time post-onset=81.65 months, median=46, range=9–226) who reported English as their main language. Sixteen participants had aphasia following a single left-hemisphere stroke, and one as a result of a single right-hemisphere stroke.

Materials

In the WMT, the participant indicates detection of a target (e.g., "**made**", presented visually and auditorily) in a spoken sentence (e.g., "He **made** it to the final at Wembley") via button press. RT is measured from target onset. The target may appear at any of the content word slots of the highly functional/frequent constructions (e.g., [PERSON] made [THING] ([ADJUNCT])). The task consisted of test trials, filler trials with constructions not targeted in the production task, and a small proportion of catch trials (sentences in which a target word does not occur) to ensure that participants pay attention to the sentences. Feedback on average RT was given at the end of each block of 20 trials. Results are presented based on test trials only. We present number of blocks correct in the TROG-2 as our pre- versus post-therapy outcome measure of interest.

Results

On average, participants practised the WMT 14 times (SD=1.1; range=12-16) across 6-7

sessions (mean=6.71, SD=.59) during a 4-week therapy block. After removing early responses (button press before target onset) as well as outliers (responses +/- 2 SDs away from individual average RT), we determined the RT difference between the group average RT at block 1 (1,175 ms, SD=708) versus block 14 (based on 10 data points; 447 ms, SD=69). This difference of 728 ms suggests that over time, participants became faster in reacting to and thus more sensitive to the targets embedded in the various constructions.

We explored the relationship between individuals' performance on the WMT (DS subtracting the RT in their final block from RT in their first block), and DS between individuals' post- vs pre-therapy TROG-2 scores, using the nonparametric correlation coefficient Kendall's tau (τ; as the assumption of normality had been violated for WMT DS; $W(17) = .880$, $p = .032$). Figure 1 illustrates this relationship. There was a weak, non-significant negative relationship between the two variables of interest at the group level ($\tau = .008$, $p = .483$, one-tailed). There was individual variation with one participant showing a strong relationship.

[Figure 1]

Discussion

The results indicate that participants are able to engage with a WMT, and show evidence of learning, with faster reactions to the targets over time. This learning does not seem to be related to therapy outcome in auditory processing, with only a weak and non-significant correlation between online WM performance and explicit TROG-2 scores. There was modest evidence of individual variability, with one participant showing stronger association in gains between auditory tasks. The limited transfer between tasks might be explained by a number of factors. Possible factors include insufficient WMT trials, and the challenge of far transfer, i.e., transfer across different sentence constructions and across implicit to explicit processing tasks.

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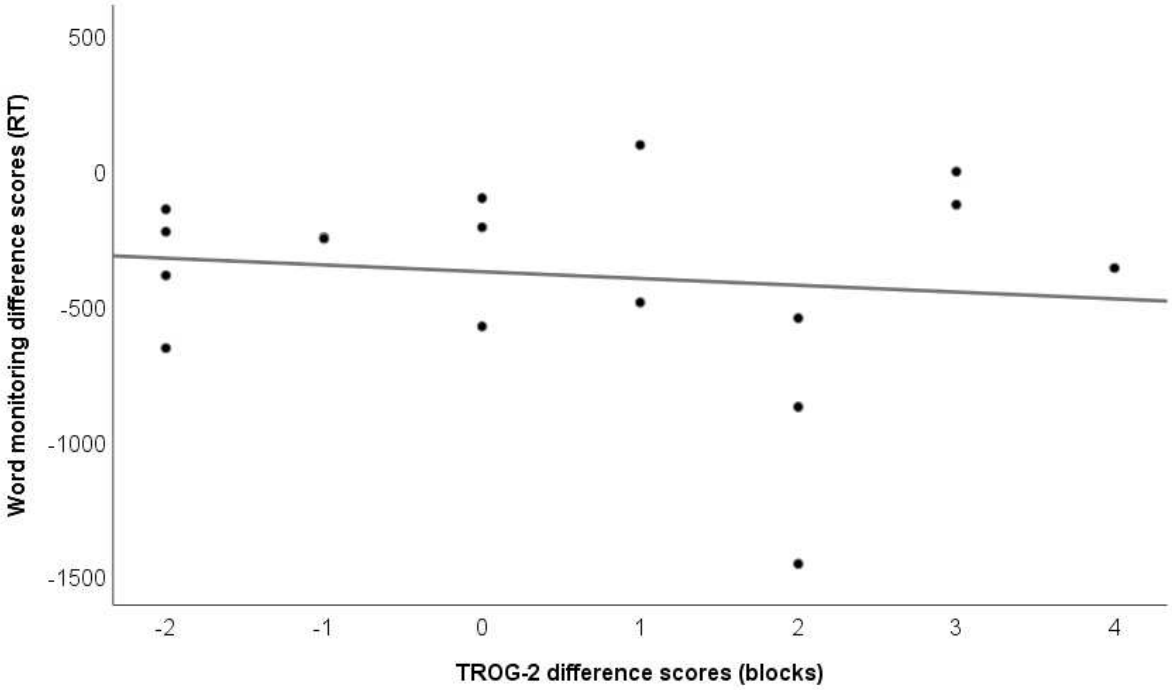

Figure 1: *Relationship between word monitoring- and TROG-2 difference scores across 17 PWA.*

Who can it be now? Processing of reflexives and null object pronouns in non-fluent aphasia in Turkish.

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Introduction and aim

People with aphasia (PWA) often experience difficulty in processing what/who pronouns refer to (see Arslan et al., 2021 for a review). Available studies have evidenced that object pronouns (e.g. him/her) are hard for PWA to work out while reflexive forms are spared (Grodzinsky et al., 1993). Some other studies report object pronouns to be equally impaired as reflexives (Choy & Thompson, 2010). However, we do not know how reflexive forms are affected in aphasia in languages with long-distance reflexives. Another gap in the literature regards null pronoun conditions. The omission of subject/object pronouns is often observed as an error pattern in PWA speaking languages that do not allow pronoun dropping (de Roo, 2003). In a study on Greek, Peristeri and Tsimpli (2013) report that PWA performed less well on overt subject pronouns than on null pronouns. Nothing much has been understood about how object dropping, when object pronouns are dropped, impacts sentence interpretation in aphasia. Turkish has two interesting features. Depending on the discourse constraints, it allows object pronouns to be dropped, and it has two reflexive forms which present a rather flexible binding behaviour. The aim of this study is two-fold: understanding how Turkish PWA process (i) '*kendi/kendisi*' (i.e., itself) reflexive forms, and (ii) overt and null object pronouns.

Methods

We recruited a group of individuals with non-fluent aphasia (n= 6, 1 female, mean age = 48.66) and a control group of non-brain-damaged individuals (n = 26, 13 females, mean age = 42.51). We conducted two eye-movement monitoring during listening experiments.

Experiment 1. Our first experiment investigated the processing of reflexive conditions in Turkish. There are two types of reflexives: *kendi* and *kendisi* 'oneself' which behave rather unconstrained in their binding relation as both local and long-distance reflexives (Gračanin-Yuksek et al., 2017). Our study explored how this reflexive system is impacted by aphasia. The participants were presented with 48 sentences in four conditions (see 1). Two factors were compared: Reflexive Form (*kendi* vs. *kendisi*) and Contextual Bias towards a potential

antecedent (*Local* vs. *Non-Local*).

Experiment 2. Our second experiment explored the processing of overt and null object pronouns in Turkish, in which third-person object pronouns are not gendered and can be dropped. The participants listened to 48 sentences in four conditions (see 2). We compared Pronoun Type (null vs overt) and Contextual Bias towards a potential antecedent (*Non-Local vs. Discourse*).

*(1) Bir [hemşirenin/doktorun] tutuklandığı davada, Hemşire doktorun [**kendini/kendisini]** savunduğu vurguladı.* 'At the court a nurse/doctor was arrested, the **nurse** emphasized that the **doctor** was defending ***kendini/kendisini-***oneself'.

(2) Bir [hemşirenin/hademenin] tutuklandığı davada hemşire doktorun onu savunduğunu vurguladı. 'At the court a nurse/genitor was arrested, the **nurse** emphasized that the **doctor** was defending ***onu/*** '- 3rd.person sg.

In both the experiments the participants listened to the sentences and were presented with four human referents in the visual display referring to the local and non-local referents, discourse/ unmentioned referent entity, and a visual depicting a non-human distractor (e.g., a hospital building). The participants' task was to click on the appropriate referent picture they see on the screen. We used a growth curve analysis approach using a non-linear model following Mirman (2017).

Results

Results from Experiment 1 have shown that the PWA strongly considered a non-local interpretation for both the reflexive conditions compared to the controls (ß=1.54, z = 4.38, p< 0.001), whereas the control group associated '*kendi*' with local and '*kendisi*' form with non-local antecedents. Eye-movement data demonstrated that the PWA had reduced looks for *kendi* conditions to both local (ß= -5.98, z= -3.47, p = 0.001) and non-local antecedents (ß= -3.80, z= -2.61, p = 0.013) as compared to the controls. The PWA had reduced looks towards non-local antecedents in *kendisi* conditions (ß= -4.45, z= -2.92, p = 0.006) but not towards local ones.

Results from Experiment 2 showed that fixed effects for the PWA had reduced preference for discourse antecedents than non-local antecedents in both null and overt pronoun conditions as compared to the controls. The eye-movement data indicated that the PWA did not exhibit critical differences in null pronoun conditions compared to the controls in their looks to the non-local (ß = 0.28, z = -1.99, p = 0.06) and discourse antecedents (ß = 0.13, z = 0.93, p = 0.35). In overt pronouns, the PWA had reduced target looks towards non-local antecedents (ß = -0.29, z = -2.20, p = 0.03) but not towards the discourse antecedents (ß = -0.08, z = -0.70, p = 0.48).

Discussion

This study investigated two interesting pronominal phenomena in processing anaphoric processing in aphasia. Regarding the processing of reflexive forms, we showed that Turkish speaking PWA strongly consider a non-local interpretation for reflexives. With regard to null object pronoun conditions, the PWA had reduced preference for discourse antecedents without a critical difference between overt and null object pronouns. The PWA's eye movements did not differ from the controls in the null pronoun condition, while they had fewer looks towards non-local antecedents in overt pronoun conditions. Outcomes from this study point to a reverse picture to the theory that predicts reflexives to be spared in aphasia because reflexives refer to local antecedents. We suggest that PWA might consider an alternative interpretation during processing unconstrained reflexives. We further indicated that the Turkish PWA have a difficulty in their antecedent choice for discourse referents in their processing of object pronouns. This is consistent with the idea that processing discourse linked entities is harder in aphasia (see e.g., Avrutin, 2006).

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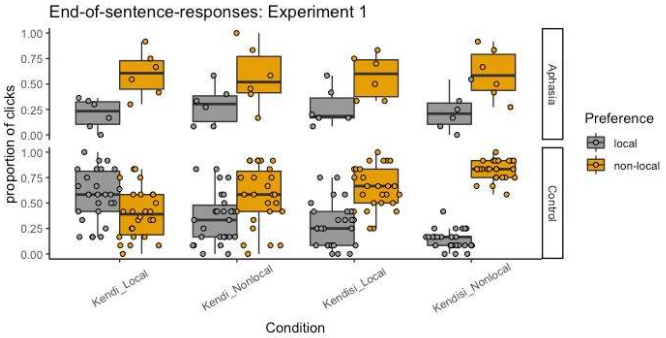
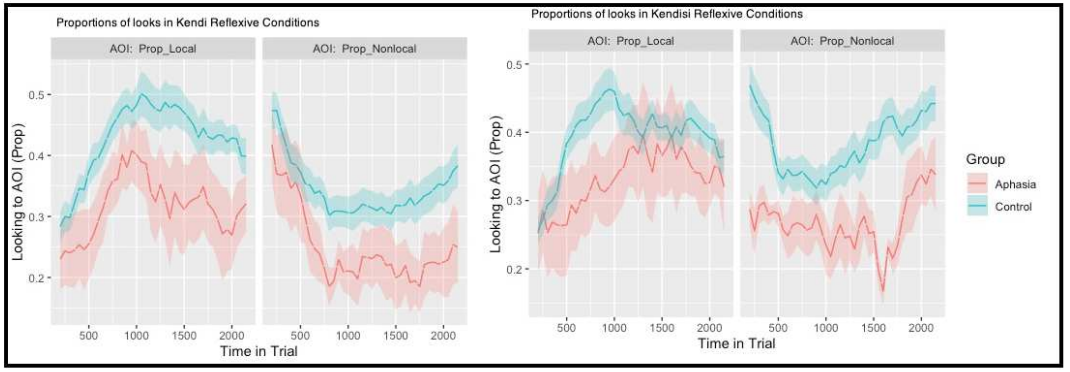
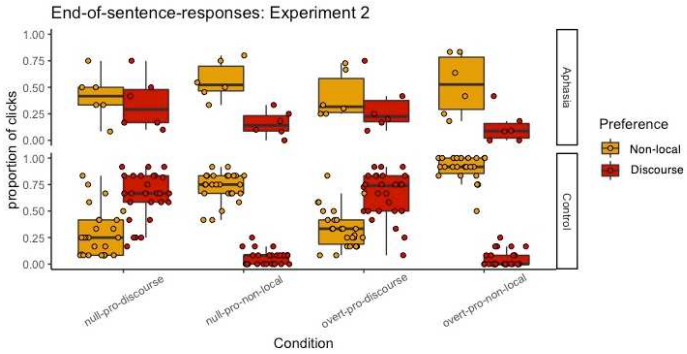
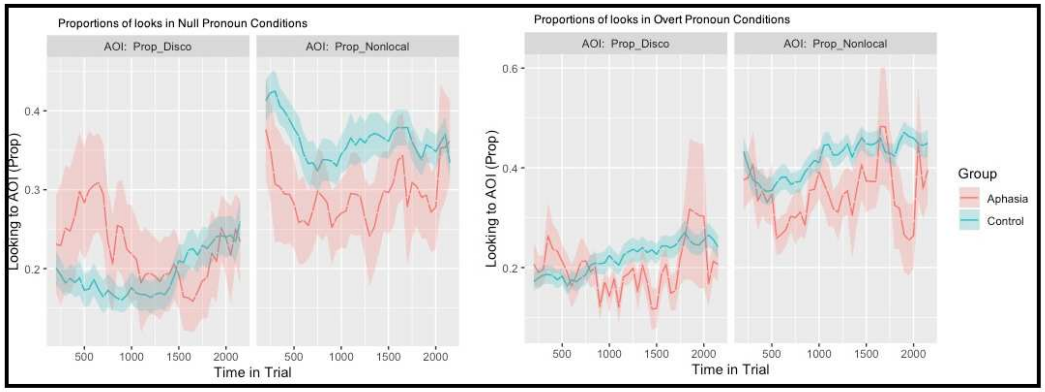
Figure 1. PWA and Control participants' end of sentence responses and eye-movement patterns in proportions of looks









Aphasia Cognitive Screening in Spanish (ACS.esp): a new digital test to asses language in aphasia

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Introduction

The use of technology in the assessment of language capacities in persons with aphasia (PWA) has seen a large increase in recent years[1,2]. Digital tests bring several advantages[3–5], such as (a) the randomization of stimuli presentation, (b) a more accurate measurement of time-related variables (e.g. RTs and response durations), (c) enhanced stimuli and graphics, which are thought to stimulate participants´ engagement, and (d) automatic data storage and analysis. Importantly, assessment using digital devices have been shown to correlate with traditional paper-and-pencil measurements[1].

In Spanish, several analogic instruments are currently available, like the adaptations of the Boston Diagnostic Examination (BDAE)[6], the western Aphasia Battery (WAB)[7], PALPA (EPLA)[8], and BETA[9], which is the most recent tool available. However, these instruments face several validity issues. Here, we introduce Aphasia Cognitive Screening in Spanish (ACS.esp), a new tool for the assessment of aphasia in Spanish. It comprises five factors: discourse, lexical processing, phonology and orthography, and syntax and morphology; with some factors further refined in subfactors. This configuration results in a total of 43 tasks, most of which are available in auditory and visual formats.

Our main motivation with ACS.esp is to overcome the issues associated with currently available tools and also to incorporate the potentiality of computerized solutions.

Aims

The aim of this study is to provide validity evidence to support the use of ACS.esp in the language assessment of PWA. Evidence based on relationships to other variables[10] was analyzed. Scores and information provided by BETA used as criterion were compared with those of ACS.esp, and differences between them were explored.

Methods

For the evidence on ACS.esp´s concurrent relationship with BETA, a selection of tasks common to both tests were administered to a sample of 19 controls and seven PWA (age range 19-69, 50% women, 92% right-handed). Concretely, we focused on object naming, action naming, auditory object lexical decision, pseudoword repetition, semantic association, auditory word-to-picture matching, and auditory sentence-to-picture matching tasks. In this way, we covered a varied range of skills representative of the language domain. For these tasks, we calculated the correlation coefficients between both test scores to evaluate their relationship, and compared mean differences to assess their relative difficulty[1]. In order to compare control and PWA groups` performance, the same tasks were administered to a subset of nine controls and nine PWA matched -means reported- in age (controls=61.11, PWA=58.78, n.s.), gender (controls=0.22 women, PWA=0.22 women, n.s.), education[11] (controls=124.89, PWA=118.11, n.s.) and handedness[12] (controls=1.59, PWA=2.32, n.s.). All PWA were fluent and of low-moderate severity according to BETA scores (mean=0.82).

Results

As for evidence based on a concurrent relationship with BETA, even if ACS.esp was overall more difficult than beta (ACS mean=0.86, BETA mean=0.90, t=-3.44, p<.005), both tests were significantly correlated (τ=0.69, p<.0001) and total scores on ACS.esp significantly predicted scores on BETA [R^2=.89, F(1, 24)=214.9, p<.0001]. The same pattern emerged in all tasks except in word-to-picture matching, where ceiling effects were observed in both tests. That is, in the remaining tasks ACS.esp was more difficult than BETA (although the opposite pattern was evinced in sentence-to-picture matching[1]), but scores showed moderate-to-high relationships and ACS.esp scores significantly predicted scores on BETA. Next, we provide data comparing corresponding tasks from BETA and ACS.esp: mean comparisons, correlation coefficients and F-statistics for regressing BETA scores from ACS.esp scores.

- **Object naming:** BETA mean=0.92, ACS.esp mean=0.78, t=-7.53, p<.0001; R^2=0.49; F(1, 24)=23.24, p<.0001
- **Action naming:** BETA mean=0.88, ACS.esp mean=0.82, t=-3.67 , p<.001; R^2=0.69; F(1, 24)=54.29, p<.0001
- **Pseudoword repetition:** BETA mean=0.96, ACS.esp mean=0.83, t=-5.7 , p<.0001; R^2=0.56; F(1, 24)=30.66, p<.0001
- **Lexical decision:** BETA mean=0.97, ACS.esp mean=0.89, t=-8.54 , p<.0001; R^2=0.28; F(1, 24)=9.24, p<.001
- **Semantic association:** BETA mean=0.97, ACS.esp mean=0.84, t=-4.77 , p<.0001; R^2=0.46; F(1, 24)=20.56, p<.0001

- **Word-to-picture matching:** BETA mean=0.99, ACS.esp mean=0.99, t=.49, ns; R^2=0.02; F(1, 24)=0.42, n.s.
- **Sentence-to-picture matching:** BETA mean=0.61, ACS.esp mean=0.87, t=-17.46 , p<.0001; R^2=0.85; F(1, 24)=133.6, p<.0001

Using groups as criteria, differences between controls ($\bar{x}$=.93) and PWA ($\bar{x}$=.82) were found in ACS.esp totally (t=2.81, p<0.05), and also the rest of the tasks selected for this study. Because this test purports to successfully classify individuals as impaired or non-impaired, it aims at achieving the highest possible accuracy. This criterion enables the provision of additional validity evidence, based on ACS.esp's concurrent relationship with BETA. For each task, we produced ROC curves and determined the threshold that maximized accuracy to classify participants as impaired or non-impaired using BETA cut-off scores as criteria. The cut-off score producing the highest area under the curve (AUC)[13] determined the thresholds for maximal accuracy. The resulting curves (see figure 1) were of high accuracy[14] for object naming (95.5%), action naming (93.8%), pseudoword repetition (100%) and lexical decision (90%), while moderate for semantic association (88.4%). ROC curves could not be produced for word-to-picture matching and sentence-to-picture matching, since BETA failed to differentiate impaired and non-impaired groups.

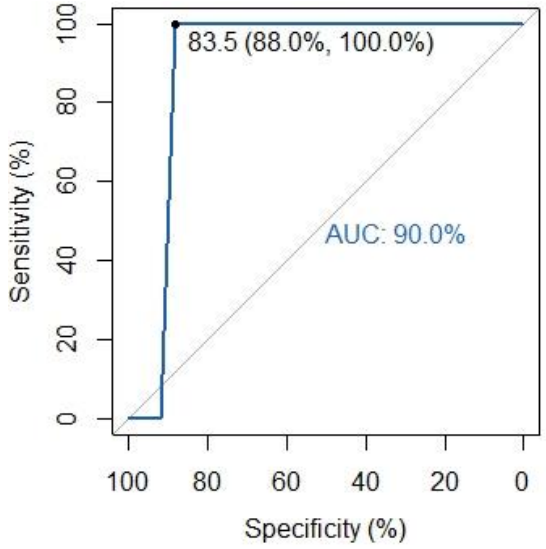
Discussion

In this study, we present a new battery for the assessment aphasia in Spanish, ACS.esp, which brings several advantages with respect to traditional pencil-and-paper tools. We have provided preliminary evidence about its relationship with other variables and groups as criteria. It was shown that even if ACS.esp is in general more difficult than the currently available gold standard, BETA, both tests are highly related. ACS.esp is also capable of classifying participants as impaired or non-impaired accurately, showing high sensitivity and specificity. However, the current sample size is still small and recruitment is ongoing to obtain more robust results. We are also gathering other sources of evidence to defend the test's properties, like reliability measures, additional evidence based on relationships to other variables (e.g. neuropsychological and sociodemographic data) and evidence based on the internal structure (e.g. factor analysis). We hope that these sources of evidence will support the quality of this test, resulting in its wide use in both clinical and research settings.

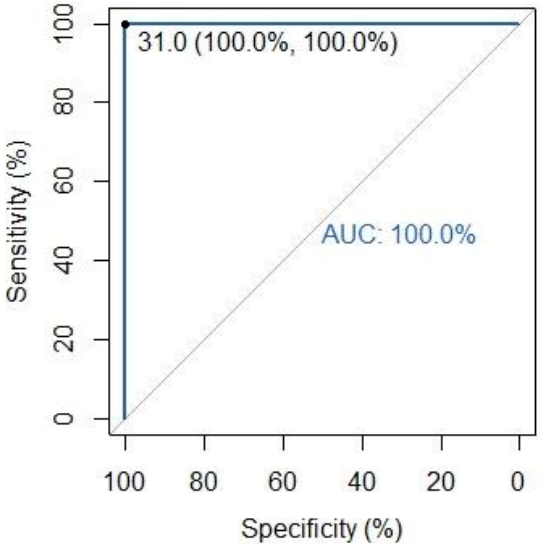
[1] In some items for the sentence-to-picture matching task from BETA, drawings are very similar and hard to associate with their corresponding sentence. In support of this, even controls show much lower means in BETA ($\bar{x}$=.62) than in ACS.esp ($\bar{x}$=.93)

ROC curves to classify participants using BETA criteria

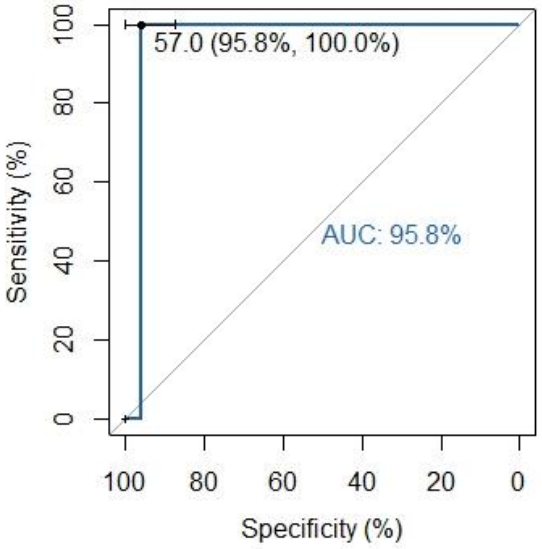
Lexical decision



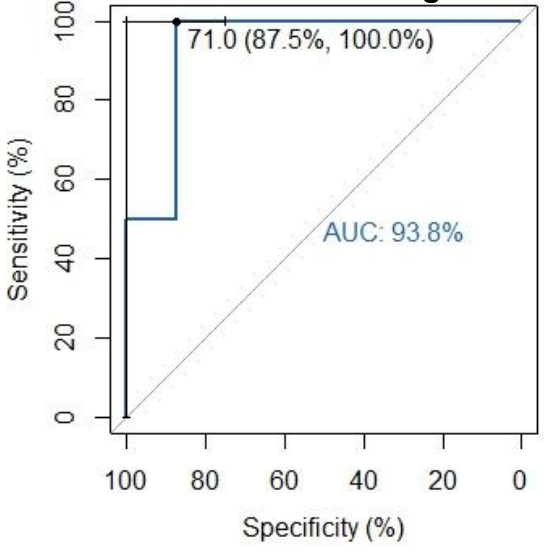
Pseudoword repetition



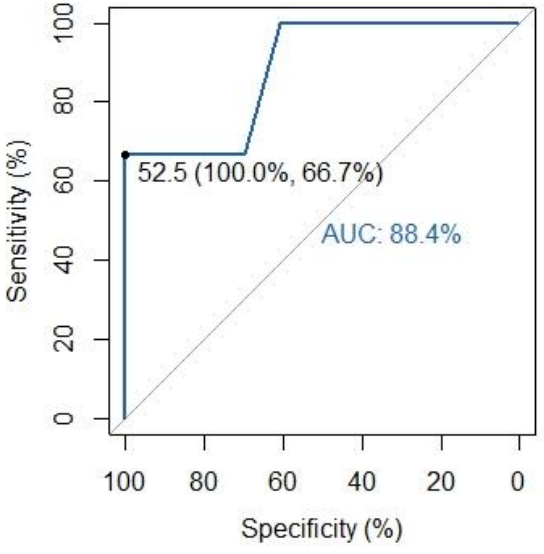
Object naming



Action naming



Semantic association



Strategic language control in voluntary switching in bilingual aphasia: a multiple case study

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Introduction and aim

The literature on healthy bilinguals has shown that ease of lexical retrieval is an important motivation to switch languages in contexts in which both languages are equally appropriate (de Bruin et al., 2018; Gollan & Ferreira, 2009). At the same time, lexical retrieval difficulties are one of the most pervasive problems in persons with aphasia (Goodglass & Wingfield, 1997), which raises the question whether ease of lexical retrieval can also predict language switching behavior in bilinguals with aphasia (BWA). While involuntary language switching in bilingual aphasia has been hypothesized to be due to a problem with language control (Abutalebi & Green, 2007), appropriate language switching may be regarded as an effective way to engage control abilities to compensate for word-finding difficulties and improve verbal functional communication (Goral et al., 2019). A previous case study has provided evidence for the influence of lexical retrieval difficulties on switching behavior in BWA, as more language switches were produced on more difficult lexical items, such as on more abstract words or in the least-proficient language (Lerman et al., 2019).

In the current study, we aim to investigate whether BWA make strategic use of their knowledge of two languages to circumvent word retrieval difficulties. We hypothesize that if BWA report no problems with language control, they will use ease of lexical retrieval to guide their language choice in a free switching task.

Methods

We report on data of two cases of bilingual aphasia who show different patterns of language control after stroke. The first case (C1) is a 65-year-old man who suffers from chronic aphasia as a result of an ischemic stroke in the left hemisphere 11 years ago. His native language is Dutch, and he acquired English as a second language. He is a balanced bilingual who uses both languages on a daily basis and at a high level of proficiency, both pre- and post-morbidly. The second case (C2) is a 54-year-old man with chronic aphasia due to a hemorrhagic stroke in the basal ganglia three years ago. His mother tongue is Dutch, and

he is a second language learner of English. He is a balanced bilingual, who prior to his stroke, predominantly used English and lived abroad for extended periods of time. C1 and C2 completed an online questionnaire about their language history, after which they participated in an online experiment. We report on four of the experimental tasks:

1. *Single language:* picture naming in Dutch or English blocks.
2. *Free switching:* picture naming in the language that first came to mind.
3. *Cued switching:* picture naming in English or Dutch, depending on a cue.
4. *Within-language switching*: picture naming in Dutch with an adjective constituent indicating color (*blue* or *red*) or size (*big* or *small*) of the picture, depending on a cue.

The same 30 pictures of highly frequent nouns were used in all tasks. The experimental procedure was recorded and reaction times, errors, and switch cost (operationalized as reaction times difference between switch and repeat trials) were analyzed.

Results

The reaction times on all tasks are presented in Figure 1. C1 reported no language control issues in daily life. The results of the experimental tasks show a switch cost (216 ms) on the within-language switching task, but a switching benefit (-96 ms) in cued language switching. In the single language task, C1 named English items 1124 ms more quickly than Dutch items, and made fewer errors in English (0% errors, 10% hesitations) compared to Dutch (13% errors, 53% hesitations). In the free switching task, C1 named 92% of items in English. Averaged across languages, his response times in free switching were shortest, followed by the cued switching, single language, and within-language switching tasks. C1 named 100% of trials correctly in free switching, followed by single language naming (93%), cued language switching (88%) and within-language switching (70%).

After his stroke, C2 indicates that it has become difficult to suppress English when he speaks Dutch. He reports that his English is always active and that he needs to deliberately translate each word to Dutch before he speaks. On the experimental tasks, he showed a switch cost (107 ms) in the cued language switching condition, but a very small switch benefit (-14 ms) in the within-language switching condition. In the single language task, C2 was 968 ms quicker naming English than Dutch items, and he made more errors in Dutch (13% errors, 10% hesitations) than English (3% errors, 7% hesitations). In the free switching condition, 56% of items were named in English and 44% in Dutch. Compared to the single language task, his overall response speed increased slightly in the free and cued switching conditions, but response times were longer in the within-language switching task. Accuracy was highest in single (92%) and free switching conditions (93%), followed by cued language switching (78%) and within-language switching (52%).

Discussion

The results of this study show different patterns of language control in two cases of bilingual aphasia, despite similar language backgrounds. C1 reported no control issues and made strategic use of the retrieval advantage he showed on English items by predominantly choosing English in the free switching task. This resulted in higher accuracy and response speed on free switching compared to other tasks. C2, on the other hand, reported problems with language control in daily life. While he also showed easier retrieval of English items, C2 did not make use of this advantage in the free switching task. Instead, he used both languages approximately equally often. These results provide new experimental evidence that BWA can make strategic use of their knowledge of two languages (Goral et al., 2019; Lerman et al., 2019), but also confirm that damage to subcortical areas may result in bilingual language control problems (e.g., Abutalebi & Green, 2007; Adrover-Roig et al., 2011).

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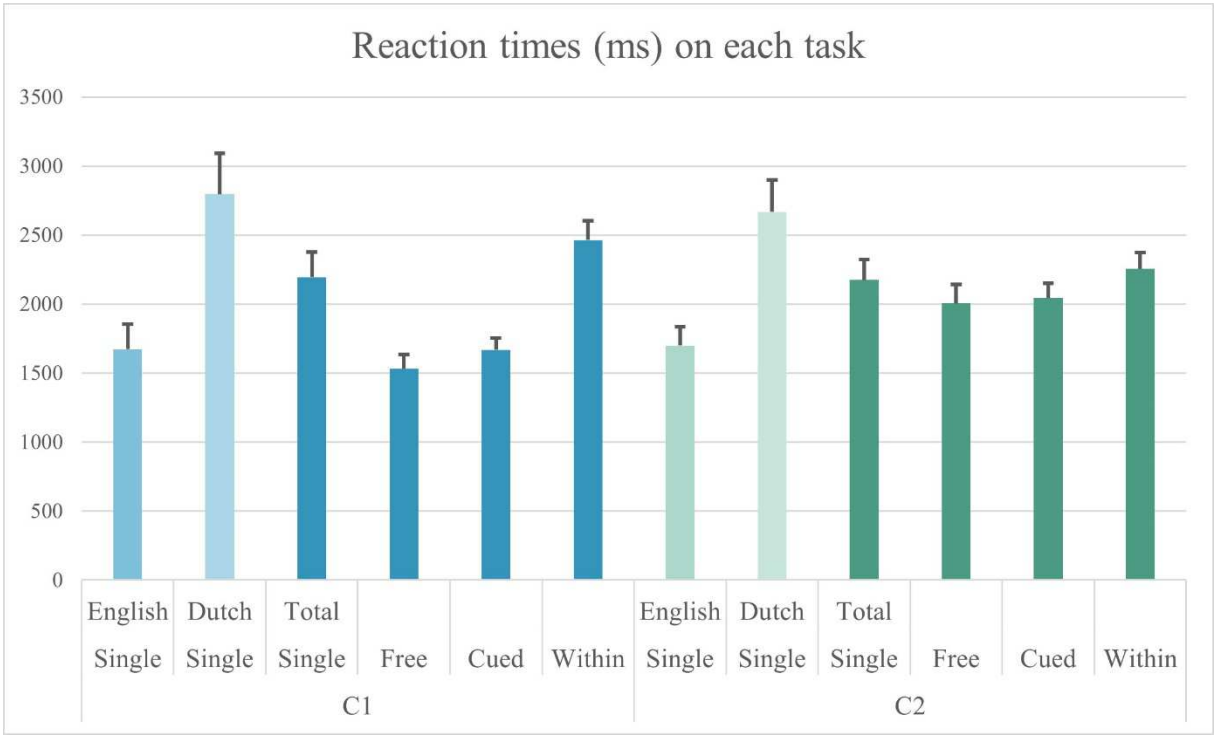
Reaction times (ms) on each task
3500
3000
2500
2000
1500
1000
500
0
English Single
Dutch Single
Total Single
Free
Cued
Within
English Single
Dutch Single
Total Single
Free
Cued
Within
C1
C2

Identification of PPA by automated analysis of word frequency properties in spontaneous speech.

by Roelant Ossewaarde | Roel Jonkers | Antoinette Keulen | Yolande Pijnenburg | Utrecht University of Applied Science and Center for Language and Cognition, University of Groningen and Alzheimer Center, Amsterdam UMC, Amsterdam | Center for Language and Cognition, University of Groningen | Alzheimer Center, Amsterdam UMC, Amsterdam | Alzheimer Center, Amsterdam UMC, Amsterdam

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Introduction and aim

Individuals with Primary Progressive Aphasia (PPA, Mesulam (2001)) form a subclass of individuals with Frontotemporal dementia (FTD). There is commonly a threeway distinction of PPA types into semantic dementia, nonfluent type and logopenic type. The semantic and nonfluent types are often associated with either of the Frontotemporal Lobal Degeneration neuropathies. The logopenic variant of FTD is often associated with Alzheimer's Disease pathology. Each of the three variants is associated with different linguistic characteristics. However, some patients present with language problems even if they do not yet meet the published guidelines for PPA; and some present with language problems that do not clearly follow the threeway distinction. We aim to use machine learning to position participants on a scale such that a more detailed picture of their disease emerges.

Because changes in everyday language are symptomatic for this disease (Mesulam, 2001), it is crucial to analyze that type of language of the speaker. Analyses are usually based on transcriptions, possibly with separate tiers of annotation that provide different levels of detail. Annotation is expensive because it is labor intensive. The required amount of effort increases with the level of sophistication of the annotation scheme (Ossewaarde et al., 2020).

We investigated how the use of technology can automate annotation in such a way that machine learning models can detect whether a given speaker is from the patient group or from the control group; and also whether it can quantify the language in such a way that the progression of the disease or the subtype of the disease can be detected. Any positive result on the classification task may also hint at the types of linguistic variables that are influenced by the disease.

Fragments were analyzed of semispontaneous, connected, language used to describe a given picture. The task was performed both in speech and writing, to investigate whether that modality influences the participant's language. The particular focus of this study is on word use.

The amount of language that speakers produce as a response to a stimulus, is hypothesized to covary between the written and spoken modalities. This is expected to hold equally for participants in the control group as for participants in the patient group, because the ability to conceptualize is assumedly not hindered by the dementia and the influence on the capability to convert thought into language equally affects both modalities.

Methods

Language samples were collected from two different groups of Dutch speaking participants: one group of brain damaged participants (n=17), under the care of neurologists of the Alzheimer Center Amsterdam (NL), and one group with age matched healthy participants as control group (n=17).

Connected language was elicited using the stimulus for the spontaneous speech and writing tasks of the Dutch version of the Comprehensive Aphasia Test (CAT-NL, Swinburn et al. (2004)). Where possible, participants in the brain damaged group were seen again at their second and third visits to the clinic, with a typical duration of 7-9 months between visits.

After broad transcription, part of speech tags were assigned automatically by RNNTagger (Schmid, 2019). The primary variables of interest are:

1. Length of text (tokens).
1. Number of verbs/nouns/adjectives/prepositions/interjections.
1. Duration of the task (seconds).

A group-wise comparison determined if there are linguistic predictors that all patient participants share regardless of their pathology. This isolates linguistic symptoms caused by the particular disorder from general regressions that can be expected in persons with FTD.

Individual predictors were combined using the Support Vector Machine algorithm (Klement et al., 2008) to yield a classification probability for individuals in the study.

Results

Participants use more words in the spoken task than in the written task. This holds true for both the FTD and the NBD groups, Comparing between participants groups, FTD participants use fewer words in the spoken task than NBD participants. There is no significant difference in the lengths of written fragments between the two participant groups.

Participants in the BD group generally speak slower, although the difference only becomes statistically significant after about 275 seconds.

Analysis of the proportions of word classes shows that although the mean average proportions do not differ significantly between the groups, there is a much larger variation in the BD group.

Predictions made by the classifier are presented in Fig. 1. It suggests a link between linguistic output and the presence of the disease, which suggests a correlation between neuropsychological test performance and classifier predictions.

Discussion

The results indicate that a meaningful distinction between healthy and BD participants can be measured in their language use. On an individual variable level, the distinctions are subtle - but taken together, using a machine learning method suitable for multivariate data, yields a reasonably accurate classification.

Participants in the PPA group were diagnosed with any of the three
subtypes. Because the effects on the language system are different for each of the three subtypes, a clear pattern of significant differences is not expected when comparing the control group with the PPA group as a whole. However, a group-wise comparison on this level is still of interest, to determine if there are linguistic predictors that all patient participants share regardless of their pathology or further diagnosis. This can help to better isolate linguistic symptoms caused by the particular disorder from general regressions that can be expected in persons with FTD.

Eloquence commonly has a qualitative and a quantitative aspect. A limitation of this study is that it considers the quantitative aspect, leaving aside the intended meaning of the speaker’s words. This latter, qualitative, aspect is important for the identification of semantic dementia, which pairs the loss of understanding of words with intact fluency.

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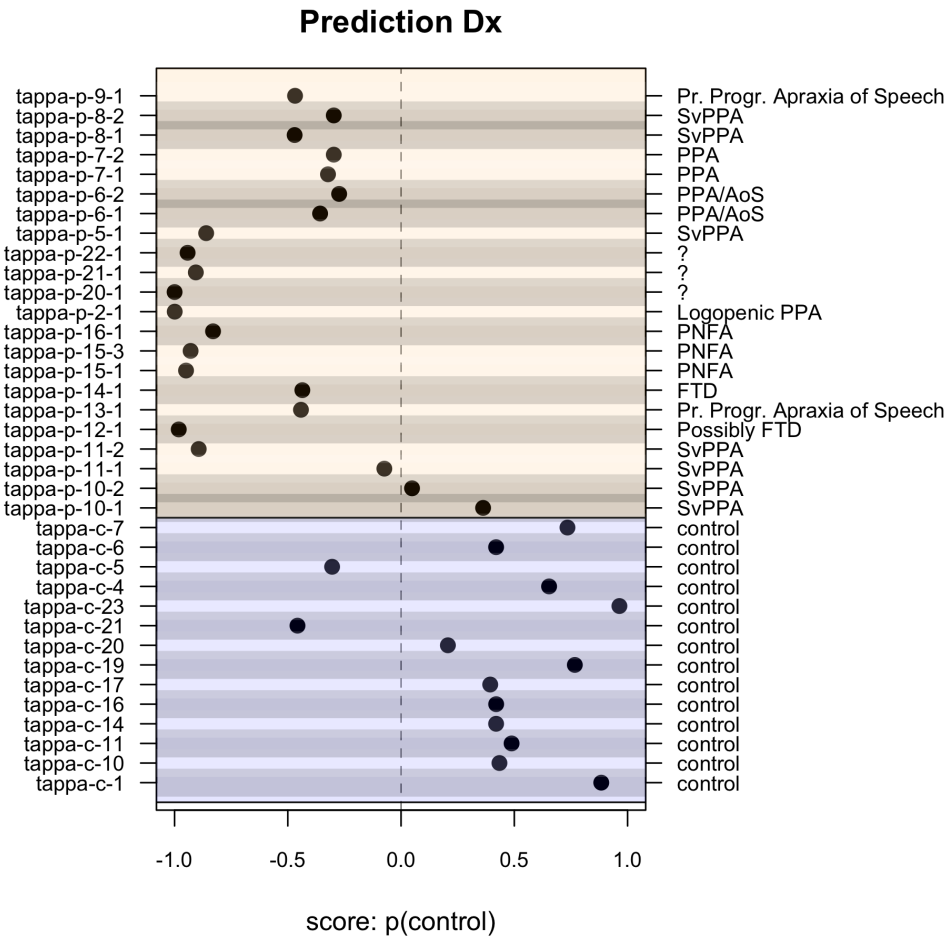

Figure 1. Disease probability for individuals in the study. Participants labeled *tappa-c* and *tappa-p* are, respectively, in the control group or the brain damaged group. The diagnosis in the right margin is based on neurological examination outside this study. The estimated probability is the likelihood that the participant is in the control group.

A Double Dissociation between language and thought: Embedding in Agrammatism and in aTOMia

by Maayan Gabso-Rajuan | Noga Balaban | Naama Friedmann | Tel Aviv University | Tel Aviv University | Tel Aviv University

Abstract ID: 68
Submitted: 01/05/2022
Event: SoA 2022 Bordeaux
Topic: Language and cognition

Structured abstract only

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

Introduction and aim

We examined the fundamental question about the relation between language and thought using a cognitive neuropsychological approach, examining whether a dissociation can be detected between language and thought. We focused on a specific aspect of the relation between language and thought, by examining whether the ability to embed thoughts (as part of theory of mind, TOM) relies on the ability to create and comprehend syntactic embedding structures that express these states (e.g., "Alma thought that the flower is edible").

Methods

We tested eight adults after stroke. Four of them had agrammatic aphasia, which involved a syntactic deficit in embedding, identified using five comprehension, production, and grammaticality-judgment syntactic tasks from the BAFLA battery (Friedmann, 1998). Four others had aTOMia (TOM deficit), diagnosed using 16 stories and 4 cartoons from the aTOMia battery, assessing second-order theory of mind abilities (Balaban et al., 2016). The syntactic assessment also included a novel technique for the assessment of the comprehension of embedding that does not allow for the usual agrammatic strategy of understanding sentences on the basis of agent-theme word order. The task includes 26 sentences with an embedded clause that included a pronoun. The interpretation of the pronoun depends on the correct construction of an embedded sentence. Participants are asked to whom the pronoun refers, answering using a picture selection (e.g., “Shira said that I love Coriander/ Shira said: I love Coriander. Who loves Coriander?” The participant had to select between pictures of Shira and the experimenter holding a coriander leaf).

Results

The results showed a double dissociation between embedding in language and embedding in thinking. The four participants with a TOM deficit performed very well on the comprehension and production of syntactic embedding (95%) while their performance on the aTOMia battery was poor (36%). In contrast, the participants with agrammatic aphasia were able to represent second-order mental states (90%) but still showed a significant impairment in the comprehension and production of syntactic embedding (46%). This created a classical double dissociation between embedding in language and in thought.

Discussion

The double dissociation that was found indicates that unlike developmental studies that reported a dependency between linguistic embedding and mental embedding (de Villiers & de Villiers, 2003; de Villiers & Pyers, 2002), once these two abilities are acquired, they are independent. These findings expand our understanding of the relationship between language and thinking. Philosophers like Kant and Davidson have argued that "speaking a language is not a trait man can lose while retaining the power of thought" (Davidson, 1973, p.4). However, our study indicates that individuals with aphasia *can* retain the ability to think about other people's thoughts even when they lose syntactic abilities. This indicates that at least in this domain thought is not completely dependent on language.

If caretakers believe that people with aphasia cannot think and represent thoughts of others, they may not communicate with people with aphasia about such relations. However, this study shows that one can lose the ability to speak about something, but still be able to reflect about it and understand it. Creating a dialogue about other people's thoughts with those who have lost crucial aspects of their language ability is possible and desirable.

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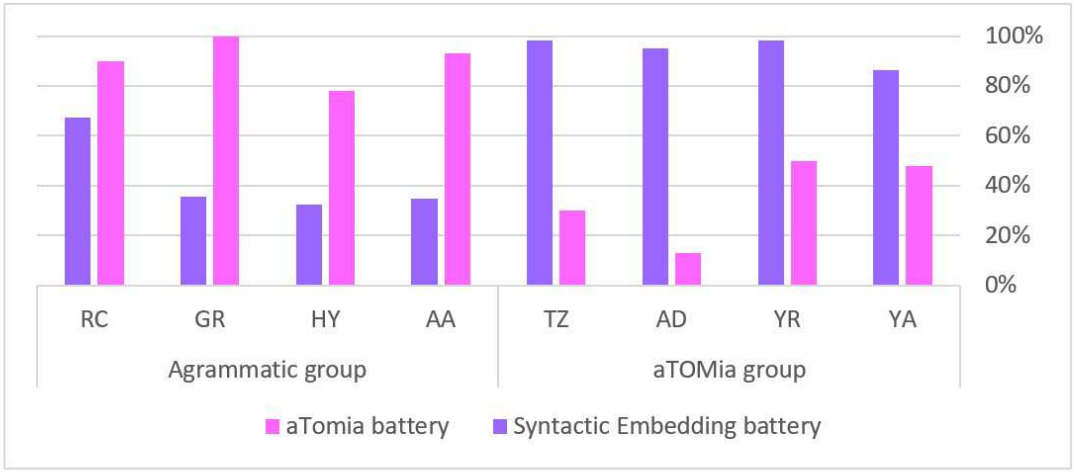

Figure 1. Average score on the syntactic battery and the aTOMia battery of each participant

Dysgraphias in the sublexical route

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Introduction and aims

Writing is a complex process, which is a concert of multiple components, described by the dual route model of writing (Figure 1). The dual route model of writing consists of a lexical route, which enables the writing of familiar words through the orthographic lexicon, and a sublexical route, through which unfamiliar words and nonwords are written, by phoneme-to-grapheme conversion (Barry, 1994; Miceli & Capasso, 2006; Tainturier & Rapp, 2001). The information from the lexical and the sublexical routes flows to the orthographic output buffer, a short-term memory unit that holds the abstract representations of the letters (Tainturier & Rapp, 2001).Dysgraphias are deficits in one or more of the components of the spelling process, or in the connections between them. Impairments in the various components give rise to different dysgraphias, with different error patterns. The aim of this study was to examine dysgraphias that result from impairments to specific functions in the sublexical route in order to get better understanding of the sublexical route and the outcome of an impairment in it. Previous descriptions of impairment in the sublexical route reported developmental and acquired phonological dysgraphia (Barry,1994; Campbell & Butterworth, 1985;McCloskey & Rapp, 2017), with a general effect on sublexical conversion, but also reports of dyscravia (Gvion & Friedmann, 2010) selectively affecting voicing in acquired cases (Luzzatti et al., 2000; Tainturier, 1996).

Methods

We assessed the spelling of 1168 individuals (aged 9-68): 427 who we diagnosed as having dysgraphia on the basis of their error rates in writing words and nonwords (TILTAN, Friedmann, Gvion, & Yachini, 2007), which was significantly higher than that of typical readers their age, and 741 age-matched control participants. For each participant, the type of dysgraphia was determined according to the type of errors they made, and the factors that affected their writing. The dysgraphic participants were tested using further dedicated tests to explore the properties of the dysgraphia they showed.

Results

We found three different types of dysgraphia caused by selective impairments to the sublexical route.

Dyscravia

We identified 15 participants (aged 9-30) with developmental dyscravia who made voicing substitutions. We found a lexical effect in their writing with more voicing errors when writing nonwords than words, which indicates that dyscravia stems from a deficit in phoneme-to-grapheme conversion. Importantly the deficit was specific to writing: none of the participants made such errors in speech production or repetition. Eight of them made no voicing errors in reading and the rest made voicing errors both in reading and in writing.

Sibilant letter dysgraphia

We identified 4 participants (aged 10-45) with sibilant letter dysgraphia, which is manifested in sibilant letter substitutions when writing to dictation or in written naming task. These participants also made voicing substitution, indicating that there could be a connection between the two types of dysgraphia (but not all the participants with dyscravia made sibilant letter substitutions.

Vowel dysgraphia

We identified 30 participants (aged 8-45) with a selective difficulty in vowel writing. The error types in the participants' writing involved omissions, additions, transpositions, and substitutions of vowels. They made these errors only or almost only in vowels, with significantly fewer errors in consonants. The consonant error rate of 23 of them was within the age-matched control range. Their vowel deficit manifested itself only in nonwords or, in case they also had surface dysgraphia, in words and nonwords, indicating their impairment was in the sublexical route, in the conversion of vowels into vowel letters. We analyzed their error patterns and the effects that influenced their writing, and found that they showed no per-letter length effect, ruling out a buffer impairment. Most of the participants had more vowel errors in the root than in the morphological affix (Wilcoxon $z = 3.28$, $p = .001$). These results indicate that the sublexical writing route includes separate routes for phoneme-grapheme conversion and for the conversion of whole morphological affixes from their phonological to their orthographic representation. Vowel dysgraphia affects only the phoneme-to-grapheme route, but not the morphological route.

Discussion

We found three types of dysgraphia that result from an impairment to the sublexical route: Dyscravia (previously reported in acquired case: Gvion & Friedmann, 2010), and two new types of dysgraphias: Sibilant letter dysgraphia, and vowel dysgraphia.*Dyscravia* is caused by a selective impairment to the conversion of the *voicing* feature. It results in the substitution of consonant-letters that minimally differ in the specification of their voicing feature (e.g., *gap-cap*). Fifteen participants had dyscravia, and we concluded, on the basis of several additional tests, that their functional of impairment was indeed in the sublexical

route.

Sibilant letter dysgraphia, manifests itself in the substitution between sibilant letters that minimally differ in their place of articulation. Four participants had sibilant letter dysgraphia. Their error types and effects in writing indicated that sibilant letter dysgraphia also stems from a selective impairment in the sublexical route, in phoneme-to-grapheme conversion specific to sibilants.

Vowel dysgraphia, a dysgraphia that characterized the spelling of 30 of our participants, is a selective difficulty in vowel-letters. We analyzed their error patterns and the effects that influenced their writing, and found that they showed no length effect, and either had a deficit only in nonwords or, in case they also had surface dysgraphia, also in words. This pointed to an impairment in the sublexical route, in the conversion of vowels into vowel-letters. These findings cast new light on errors in vowel-letters, which until today were attributed to a deficit in the orthographic output buffer.

These three dysgraphias and the writing of the control group have far-reaching implications to the sublexical route, which has been described as a component that converts whole phonemes to letters. Based on these three types of dysgraphia we suggest that the sublexical route does not convert a whole phoneme to a whole letter but is rather converting vowels and consonants separately, and when it converts consonants it is converting in fact bundles of phonological feature into letters.

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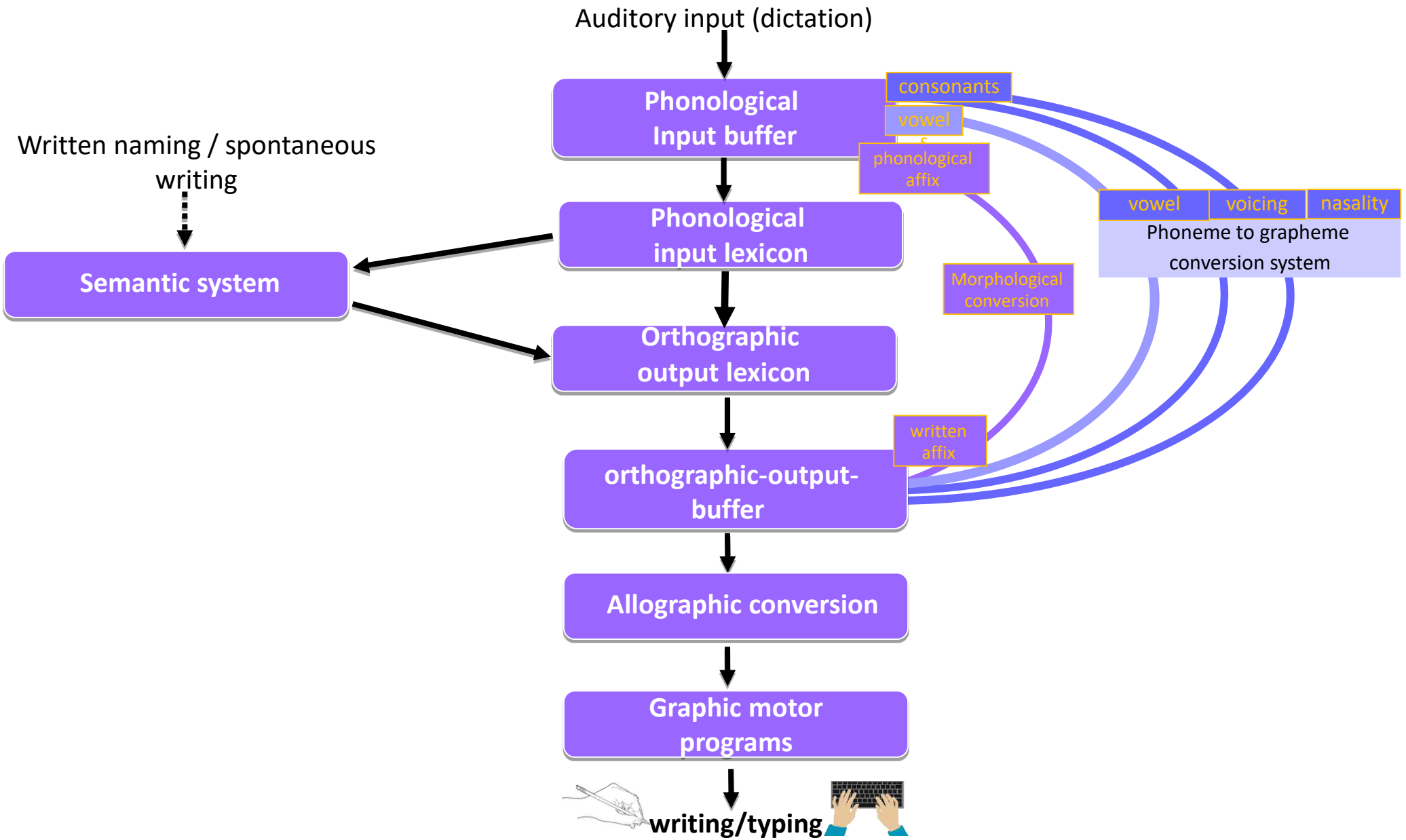

Figure 1. The dual route model of writing

The role of cognitive functions, demographic factors, and locality in verb-related morphosyntactic production

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Introduction and Aim

To date, it is not clear which factors affect morphosyntactic production. Although language processing during production is believed to be a largely automatic process (e.g., Levelt, 1989), there is evidence that controlled cognitive systems such as working memory (WM) are critically involved in verb-related morphosyntactic production (VRMP). For example, in a study investigating the role of verbal WM capacity in VRMP, Fyndanis et al. (2018) found that, in both a group of participants with aphasia (PWAs) and age- and education-matched neurotypical controls (n=16), and in a large group of neurotypical individuals sampling the whole adult age range (n=103), verbal WM capacity was critically involved in VRMP. Interestingly, when the authors analyzed the results from the PWAs and their healthy controls, they found that verbal WM was a better predictor of a participant's morphosyntactic accuracy performance than the presence of aphasia per se. In a more recent study on neurotypical middle-aged and older Greek-speaking individuals (n=80), Fyndanis et al. (under review) investigated the relationship between VRMP and verbal WM, nonverbal WM, verbal short-term memory (STM), nonverbal STM, speed of processing (SOP), education and locality (i.e., critical cue being adjacent to the target or not). The authors found main effects of verbal WM (in line with Fyndanis et al., 2018), verbal STM, education, and locality: the greater their participants' verbal STM/WM capacity, and the higher their educational level, the better their performance on VRMP; moreover, participants' performance was better in local than in nonlocal configurations. In both studies by Fyndanis and colleagues, verbal WM capacity significantly interacted with the production of grammatical aspect, time reference/tense and subject-verb agreement, affecting aspect and tense but not agreement. However, while in Fyndanis et al. (2018) verbal WM affected aspect more than tense, in Fyndanis et al. (under review) verbal WM comparably affected aspect and tense. Moreover, in Fyndanis et al. (under review), locality affected agreement and aspect (with nonlocal configurations eliciting more agreement and aspect errors than nonlocal configurations) but not tense. In both studies, a sentence completion task was used in which participants had to produce a different form of the verb appearing in a source sentence. Therefore, this task required *inhibition* of the non-target value of the relevant feature (e.g., +PAST for TENSE) encoded in the verb form that appeared in the source sentence.

Following up on Fyndanis et al. (2018; under review), the current study investigates the role of cognitive, demographic and task-related factors in VRMP. In particular, it investigates the role of verbal WM, verbal STM, SOP, inhibition, education, age, and locality in the production of aspect and time reference/tense. The study aims at replicating Fyndanis et al.'s (under review) main findings while controlling for participants' inhibition ability, and also addresses whether verbal WM and locality differentially affect the production of aspect and tense.

Methods

A sentence completion task tapping into production of time reference/tense (past, future) and aspect (perfective, imperfective) in local and non-local configurations, and cognitive tasks measuring verbal WM capacity, verbal STM capacity, SOP, and inhibition were administered to 119 Greek-speaking neurotypical adults (83 women; age range=19-81; *M*=45.9; *SD*=16.6; education range (in years)=6-26; *M*=15.11; *SD*=3.65). Generalized linear mixed-effects models were fitted to the dataset.

Results

To examine the role of verbal STM/WM capacity, SOP, inhibition, education, age, morphosyntactic condition (aspect, time reference/tense) and locality (local, non-local) on participants' accuracy on VRMP, we first fitted a model including all the above variables as fixed terms, subjects and items as random intercepts, and morphosyntactic condition as by-subject random slope. In this model, main effects of locality, verbal WM capacity, education, SOP, and age emerged. We then fitted a model including only the variables showing main effects in the initial model. In this model, locality, verbal WM capacity, education, and age remained significant, but SOP did not. Going through the same process (i.e., fitting another model without SOP), age proved to be a non-significant predictor of accuracy. In the final model, which only included morphosyntactic condition, locality, verbal WM capacity, and education as fixed terms, significant main effects of all four predictors emerged (see Table 1, Model 1). These main effects show that significantly fewer errors occur in tense than in aspect, and in local than in non-local configurations; and the greater the verbal WM capacity and the higher the education level, the better the accuracy performance on VRMP. To examine whether the production of aspect and tense significantly interacted with any of the remaining significant predictors, we fitted a model including three two-way interactions (for details and results, see Table 1, Model 2). None of them was significant.

Discussion

Results largely replicate Fyndanis et al.'s (2018; under review) findings as a main effect of verbal WM capacity on VRMP emerged. Moreover, the current study largely replicates Fyndanis et al.'s (under review) findings as education and locality were also found to be significant predictors of accuracy in VRMP. Consistent with Fyndanis et al. (under review) and contra Fyndanis et al. (2018), we found no evidence for a differential effect of verbal WM capacity on the production of aspect and time reference/tense. The main effect of verbal WM capacity and the absence of an effect of verbal STM capacity suggests that it is predominantly the processing component of WM (and not its storage component) that subserves VRMP. This is at odds with Fyndanis et al. (under review). Moreover, unlike Fyndanis et al. (under review), in the current study locality comparably affected aspect and time reference/tense. The main effect of education could be interpreted as pointing to a procedural memory system that also supports VRMP. This tentative interpretation rests on the assumption that education is a proxy for the quality and quantity of an individual's "language skill" which determines the efficiency of this procedural system. The results will also be discussed in light of the experience-based approach to verbal WM advocated by MacDonald and colleagues (e.g., MacDonald, 2016; Schwering & MacDonald, 2020).

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TABLE 1: Generalized Linear Mixed-Effects Models on accuracy.

	Estimate	Std. Error	z value	Pr (> | z |)
Model 1				
Intercept (Morphosynt. Cond. = Aspect; Locality = Local)	3.002	0.189	15.851	< 0.001*
Morphosynt. Cond = Tense	2.130	0.325	6.552	< 0.001*
Locality = Nonlocal	-0.389	0.122	-3.192	0.001*
Verbal WM capacity	0.071	0.012	5.953	< 0.001*
Education	0.122	0.035	3.474	< 0.001*
Model 2				
Intercept (Morphosynt. Cond. = Aspect; Locality = Local)	2.945	0.199	14.792	< 0.001*
Morphosynt. Cond = Tense	2.322	0.400	5.798	< 0.001*
Locality = Non-local	-0.315	0.170	-1.860	0.063
Verbal WM capacity	0.068	0.015	4.479	< 0.001*
Education	0.111	0.045	2.502	0.0123*
Morphosynt. Cond. (= Tense): Locality (= Non-local)	-0.219	0.354	-0.620	0.535
Morphosynt. Cond. (= Tense): verbal WM capacity	0.007	0.026	0.262	0.793
Morphosynt. Cond. (= Tense): Education	0.026	0.078	0.337	0.736

*Note: Model 1 included the additive effect of Morphosyntactic Condition, Locality, (years of formal) Education, and Verbal WM Capacity. It also included Subjects and Items as random intercepts, and Morphosyntactic Condition as by-subject random slope. Model 2 included three interaction terms (Morphosyntactic Condition x Locality; Morphosyntactic Condition x verbal WM capacity; and Morphosyntactic Condition x Education), Subjects and Items as random intercepts, and Morphosyntactic Condition as by-subject random slope. The symbol * indicates significant effects.*

Between-session intraindividual variability in language processing: Links to post-stroke aphasia severity

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Introduction and aim

Neurolinguistics and cognitive neuropsychology have a long-standing tradition to focus on mean-level performance measures such as accuracy and mean reaction times (RTs). However, recent neuropsychological studies suggest that intraindividual variability (IIV) – within-person variations in performance over time – can further complement our understanding of neuropsychological patients' behavioral patterns (Hultsch et al., 2008). Despite the common clinical observation that people with aphasia (PWA) often produce marked variations in their day-to-day performance on a variety of tasks, only a few empirical studies have investigated IIV in aphasia (Creet et al., 2019; Duncan et al., 2016; Galletta & Goral, 2018; Laures, 2005; Naranjo et al., 2018; Stark et al., 2016; Villard & Kiran, 2015, 2018), and to our knowledge, no study has systematically investigated IIV in language processing in post-stroke aphasia. The aims of the current study were to investigate (1) IIV in language processing (i.e., phonological, lexical, and semantic processing) across days; (2) how working memory (WM) demand affects IIV in language processing; and (3) the associations across IIV indices and between IIV indices and standardized measures of language in post-stroke aphasia.

Methods

Thirty-two PWA predominantly with unilateral left hemisphere stroke participated in the study (17 female; mean age = 59.69 years, range = 33–81 years; mean post-onset = 1.59 years, range = 14 days–19 years). Participants were assessed on four different days (mean time between session 1 and 4 = 5.91 days) using the same set of six auditory experiments on each day. The experiments tested phonological, lexical, and semantic processing with low and high WM demand. In addition, the Western Aphasia Battery (WAB; Hungarian adaptation: Osmánné-Sági, 1991) and the Comprehensive Aphasia Test-Hungarian (CAT-H; Zakariás & Lukács, 2021) were administered to assess aphasia severity and language profile. To control for practice effects and accuracy, we adjusted each participant's raw RTs in the following manner: We ran a multiple regression for each task, where y = raw RT, x1 = Time (1–4) and x2 = mean accuracy, producing a standardized residual value for each raw RT. We used these standardized residuals to calculate an SD_{adj} for each participant for each task on each condition, using the following formula: SD(Time$_i$ M standardized residuals),

where i = Time 1–4. We (1) compared the IIV indices between the two conditions in each task using the non-parametric Wilcoxon matched-pairs test and (2) investigated the associations across IIV indices, and between all IIV indices and the WAB and the CAT-H using Spearman rank correlations.

Results

SD_{adj}-s were significantly greater in the "high WM demand" than in the "low WM demand" condition in the lexical ($V = 92$, $p < 0.01$) and the semantic task ($V = 118$, $p < 0.01$). SD_{adj} in the "low WM demand" condition in the semantic task showed a significant negative correlation with the WAB ($r = –0.66$, $p < 0.01$) and the CAT-H ($r = –0.67$, $p < 0.01$). SD_{adj} in the "low WM demand" condition in the phonological task showed a trend for a negative correlation with the CAT-H ($r = –0.33$, $p = 0.07$). We observed negative but non-significant correlations between all other SD_{adj}-s in the "low WM demand" conditions and standardized measures of language ($p > 0.05$). All correlations between SD_{adj}-s in the "high WM demand" conditions and standardized measures of language were positive but non-significant ($r = 0.08–0.22$, $p > 0.05$). SD_{adj}-s between the "low" and "high WM demand" condition showed a positive correlation in the phonological task ($r = 0.37$, $p = 0.03$) and a trend for a positive correlation in the lexical task ($r = 0.32$, $p = 0.08$).

Discussion

In sum, we detected negative relationships between standardized measures of language and IIV indices in a semantic and a phonological task. More specifically, higher IIV in tasks with low WM demand was associated with more severe aphasia. In addition, we detected positive relationships between IIV indices within a lexical and a phonological task. In particular, in these tasks, IIV was coupled across low and high WM demand conditions. Taken together, PWA show IIV in language processing across days, and language tasks with high WM demand elicit higher IIV than tasks with low WM demand. Greater IIV in language tasks with low WM demand may be associated with more severe aphasia. Understanding the mechanisms underlying IIV in language tasks with low and high WM demand necessitates further research.

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Developmental deep dyslexia in Palestinian Arabic

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Structured abstract only

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

Introduction and aim

Deep dyslexia is a deficit in reading aloud that causes reading via semantics: the person with deep dyslexia sees the written word, understands it, and then produces it via the naming route. What happens when the language in which this patient reads is different from the one they use for naming? This is the case in the diglossic situation of Arabic-speakers. They read words written in Standard Arabic, but speak a different language, the spoken language, which, for our participants was Palestinian Arabic.

Here we report, for the first time, on developmental deep dyslexia in a language in a diglossic situation.

Deep dyslexia is a reading disorder characterized primarily by semantic errors in reading aloud, as well as by morphological and visual errors, a severe deficit in reading nonwords and in reading of function words that results either in substitution for another function word or inability to read them, and imageability and morphological complexity effects (Coltheart, Patterson, & Marshall, 1987; Ellis, & Young, 1996).

This reading pattern was interpreted within the dual-route model as impairments in both the sublexical grapheme-to-phoneme conversion route and the direct lexical route between the input orthographic lexicon and the phonological output lexicon. This double deficit forces the reader to read via meaning: the readers with deep dyslexia understand the word and then name it.

Arabic readers are in a diglossic situation: they read in one language, Standard Arabic, and speak in another – in our participants' case: Palestinian Arabic. This forms an interesting testing ground for reading via meaning: because if they understand the word in Standard Arabic, they may name it in the spoken vernacular.

Another property of Arabic that is relevant for the study of deep dyslexia is that Arabic, as a Semitic language, has a rich morphological structure in both nouns and verbs. All verbs are

built from three-consonant roots that are incorporated in verbal templates, and many nouns are similarly constructed from a three-consonantal root incorporated in nominal templates. This allows for the investigation of the types of morphological errors that occur in deep dyslexia: In addition, since some syntactic properties such as passive voice and tense are signaled in verb inflection, inflection plays a crucial role in the probability of correct reading. The reading of various types of inflection (tense, passive, subject agreement) was therefore assessed.

Methods

We tested the reading of 126 Arabic-readers with various types of developmental dyslexia. They were asked to read a reading screening test (ARABIC TILTAN, Friedmann & Haddad Hanna, 2009) that includes a long list of words and nonwords. The stimuli in the reading task were selected so that they were sensitive to the the detection of the various kinds of dyslexia. Specifically for deep dyslexia, the word list included abstract words, morphologically complex words, function words, and nonwords.

Results

We identified 6 Arabic-speaking individuals with developmental deep dyslexia. They showed the classic pattern of semantic, morphological and visual errors, visual-then-semantic errors, function word substitutions, morphological errors, and lexicality effect.

We ran for each of the participants several additional tests to examine in detail the properties of the deep dyslexia. In the talk we will describe the various results with respect to morphology, dissociation with picture naming, reading of words that have synonyms and more,

An important finding was that their errors were affected by diglossia: they saw a word written in SA and read it in Palestinian Arabic. In fact, some of the words they even said in Hebrew/English when these were the words used in Palestinian Arabic. They also read target words with the voweling of the spoken language rather than of the target standard Arabic.

Discussion

The reading pattern exhibited by our participants supports the perception of reading in deep dyslexia that proceeds via the semantic system. In this study we present, for the first time, what happens when reading via meaning involves reading words written in one language and producing words in another language.

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Investigating the influence of structural damage on the synchronization between the language and MD networks in post-stroke aphasia

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Introduction and aim

Functional imaging studies have shown that language recovery in post-stroke aphasia is mediated by the upregulation of spared left-hemisphere language regions (Fridriksson et al., 2010) and homologous right-hemisphere regions (Saur et al., 2006). Previous studies also suggested that regions of the fronto-parietal multiple-demand (MD) network, involved in cognitive control, are recruited alongside core language regions to support language function in aphasia (Meier et al., 2016). However, to our knowledge, the impact of structural damage on the synchronization between the language and MD networks has not been investigated. The goal of this study is to investigate whether 1) the extent and 2) the location of structural damage in the language and MD networks influence the degree of synchronization between these two networks in post-stroke aphasia.

Methods

Thirty individuals with chronic post-stroke aphasia underwent an MRI scan. T1-weighted images (TR/TE = 2300/2.98 ms, TI = 900 ms, flip angle = 9°, FoV = 256x256 mm2, voxel size= 1x1x1mm3, 176 slices) and a gradient-echo T2*-weighted sequence (TR = 2.4 sec, TE = 20 ms, flip angle = 90°, voxel size = 1.72×1.72×3 mm3, 210 slices) were collected. Lesion maps were drawn manually using MRIcron and normalized to MNI space. Resting-state fMRI data were preprocessed with fMRIPrep and CONN toolbox. An ROI-to-ROI (Region Of Interest) analysis was conducted in CONN using probabilistic functional atlases of the language and MD networks. The probabilistic atlas of each network represents the probability of each voxel to be contained within the top 10% of responsive voxels for language and MD tasks contrasts and is estimated from 806 and 691 healthy controls, respectively (Lipkin et al., 2022). In order to identify specific ROIs, each probabilistic atlas was overlapped with parcels corresponding to language and MD functional ROIs defined using a Group- constrained Subject-Specific method on a large group of healthy controls (Fedorenko et al., 2010), thresholded, and binarized to locate the top 10% probabilistic values within each ROI mask. Averages of pairwise bivariate fisher-transformed Pearson correlations were computed for each pair of inter-network ROIs (i.e., computed between MD and language ROIs). The proportion of damage in each left-hemisphere ROI of each network was computed in FSL. Linear regressions were calculated to investigate whether whole

brain and inter-hemispheric average inter-network connectivity were predicted by a) lesion extent (overall lesion size vs. the proportion of damage in all language/MD ROIs) and b) location of damage in language/MD ROIs (frontal vs. temporo-parietal).

Results

Neither overall lesion size nor the proportion of damage in all MD ROIs, frontal MD ROIs, or parietal MD ROIs were significant predictors of average inter-network connectivity both in whole brain and inter-hemispheric connectivity analyses. Proportion of damage in all language ROIs significantly predicted inter-hemispheric inter-network connectivity ($R2 = .19$, $F(1,28) = 6.677$, $p = .015$). The proportion of damage in temporal language ROIs predicted whole-brain inter-network connectivity ($R2=.16$, $F(1,28)= 5.677$, $p=.024$). In contrast, the proportion of damage in frontal language ROIs was not a significant predictor of inter-network connectivity, at any level (i.e., whole brain and inter-hemispheric). Therefore, a higher proportion of damage in all language ROIs was associated with higher inter-network connectivity between hemispheres, and a higher proportion of damage specifically in temporal language ROIs was related to higher connectivity between language and MD ROIs in the whole brain.

Discussion

This study demonstrated that, in individuals with chronic aphasia, the connectivity between the language and MD networks depends on the extent of stroke damage in left language areas and more specifically in the left temporal lobe. These results further our understanding of the structural-functional phenotype in post-stroke aphasia.

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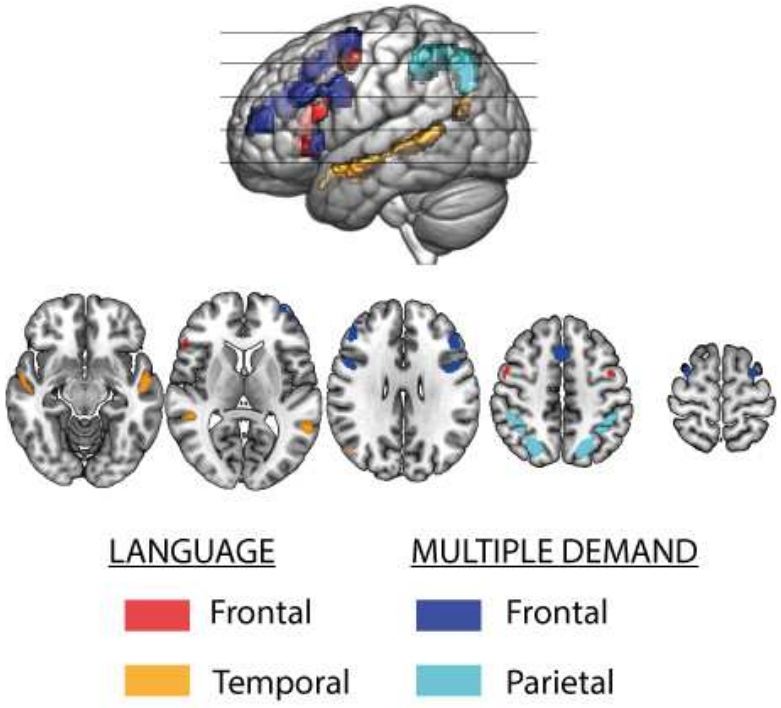
Figure 1. Functional language and multiple demand ROIs



Using error analysis to distinguish between phonological output buffer deficit and apraxia of speech

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Introduction

Both phonological output buffer (POB) deficit and apraxia of speech (AOS) result in phoneme errors in speech production. This makes the differential diagnosis between these disorders difficult (Haley et al., 2013).

Previous studies (Dotan & Friedmann, 2015) have shown that the POB holds phonological units of different sizes: beyond phonemes, it also holds pre-assembled phonological units such as whole morphological affixes, whole number words, and function words. This is based on the finding that individuals with POB deficits produce words (and nonwords) with phoneme errors (e.g., parrot: carrot/larrot/parro) but substitute/omit/add morphological affixes, number words, and function words, so that they may substitute a whole unit with another whole unit of the same kind (faster- fastly/fast; nine- seven; on-at).

Aims

We examined whether it is possible to distinguish between individuals with POB deficits and individuals with AOS based on the size of the unit that is substituted, omitted, or added. We surmised that in affixes, number words, and function words, individuals with POB will mainly make errors at the whole unit level (seven- four; in-at; slowly -slower) whereas individuals with AOS will produce phoneme errors that affect a phoneme within the unit, and may not create another existing unit (seven- sevet; slowly -slowry). Additionally, given that the POB immediately follows the phonological output lexicon in the lexical processing, we assume that it may still enjoy lexical feedback, whereas AOS affects later stages, so it may no longer be affected by the lexicon. We therefore expect that individuals with POB deficits would show advantage for the production of existing words in comparison to nonwords, whereas individuals with AOS would show similar production of words and pseudowords.

Methods

The participants were 7 individuals who produced phonological errors in spontaneous speech, repetition, naming, and reading aloud: 4 with POB-deficit and 3 with AOS. Three of these individuals were diagnosed by experienced SLTs as having AOS, mostly based on the manifestation of dysprosody, distortion of sounds, effortful speech. Five others were suspected to have POB deficits. Their production of nonwords, morphologically simple and complex words, number and function words was tested in tasks of repetition, oral reading, and naming. Types of errors were analyzed for each individual and for each group.

Results

POB-impairment and AOS indeed caused different types of errors (see Figure1). Individuals with POB-impairment produced significantly more substitutions, omissions, and additions of whole morphological affixes, whole number words, and function words, whereas they produced phonological errors in the root phonemes. In contrast, individuals with AOS made mainly phoneme substitutions, omissions, and additions even within affixes and number words, and even when these phonemic errors did not create other existing affixes/number words. Another difference between the groups was that individuals with POB deficit showed a significant lexicality effect, with better production of words compared to pseudowords, whereas individuals with AOS showed no lexicality effect.

Discussion

Clinically, it is challenging to decide whether phoneme errors result from AOS or from a POB-deficit. The results of this study offer a novel way to distinguish between the two, which is also simple to administer: individuals with POB-deficits substitute or omit whole morphological affixes, number words, and function words; individuals with AOS produce mainly phoneme errors regardless of the type of unit, so they substitute or omit phonemes even when they are parts of affixes and number words.

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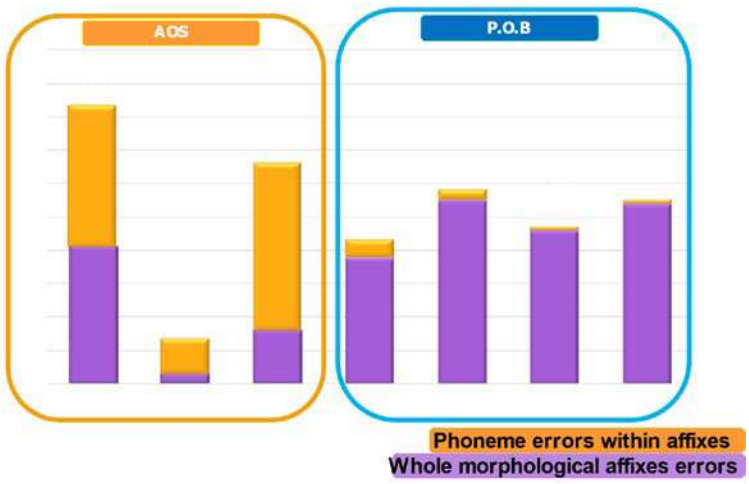

Figure 1. Whole morphological affix errors compared to phoneme errors within affixes for each individual in the two groups.

Syntactic and lexical mapping in awake craniotomy

by Naomi Levy | Naama Friedmann | Zvi Ram | Rachel Grosmann | Tel Aviv University | Tel Aviv University | Ichilov Hospital | Ichilov Hospital

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Topic: Cognitive neuroscience of language

Structured abstract only

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

Introduction and aim

Many aphasic patients we see have aphasia following brain tumor resection. A way to decrease the risk of aphasia following brain surgery is to monitor language abilities during surgery, and prevent damage to language areas. The way this is done is in awake surgery, a procedure that allows continuous monitoring of various linguistic abilities of patients undergoing a brain tumor resection. During awake surgery, on can detect brain areas that are responsible for various language functions and create a "functional language map". Once identified, these areas can be protected from resection.

The gold standard to perform such language-brain mapping in awake brain surgery, allowing maximal resection with minimal postoperative deficits is direct electrical stimulation (DES, De Witt Hamer et al., 2012; Mandonnet et al., 2010; Ojemann et al., 1989). Applying DES to specific cortical or subcortical specific brain area, temporarily interferes with the functioning of the stimulated area. If the stimulation of a specific area yields a specific language impairment, this area is taken to be involved in this function (Bertani et al., 2009; Dufau et al., 2009). Typically, picture naming is the task widely used in awake craniotomies (Dufau et al., 2008). Nevertheless, the more functions evaluated the more language areas will be maintained, leading to larger and safer resections (Dufau, 2009). Although object naming may tap onto several language domains, including lexical-semantics, phonology, and in some cases morphology, it fails to assess language beyond the word level, such as syntactic structures.

The purpose of the current study was to develop tools to identify syntactic areas in the brain during awake resection and to examine the possible added value of utilizing syntax paradigms in cortical and subcortical language mapping in awake craniotomy.

Methods

Participants

47 patients aged > 16 years were scheduled for an awake craniotomy for a removal of de-novo tumor in proximity of regions involved in language, mean age 50.8 (SD = 16.0), harboring frontal (14), temporal (18, 10 insular) or parietal (14) lesions. All lesions but two are left sided, with left hemisphere language dominance. All patients were tested in their native language. Inclusion criteria included lesion due to a tumor and no language or cognitive deficits prior to the tumor. The lesion precise location is acquired pre, one day and three months post-operative via anatomical imaging scans.

Procedure

Data for each patient is collected and analyzed in two time-points: during the week before surgery and three months after the surgery. Each participant undergoes extensive language assessment in order to achieve a detailed evaluation of their syntax, including Wh-movement, V-C movement, embedding and naming function, as well as reading, phonological buffer and lexical abilities.

According to the patient's preoperative status of syntax and naming we assessed those functions intra-operatively, via cortical and sublexical language mapping during awake surgery. To assess Wh-movement (with and without intervention) we used a subject- and object relative clause elicitation task, a relative clause comprehension task, and a sentence repetition task. The sentence repetition task also included sentences with sentential embedding to verbs, to assess embedding without movement, and sentences with V-C to assess verb movement. If they were intact prior to surgery, these tasks were delivered to the patients while the surgeon performed a temporary Direct Electrical Stimulation (DES).

Results

Figure 1 summarizes the syntax map of cortical left hemisphere by using the syntactic tasks, and the naming map. In the talk, we will describe in detail the types of errors and structures related to each locus, and the implications for the language-brain correspondences. We will also discuss the way white matter tracts, including the AF and the Aslant, participate in syntactic processing.

Discussion

Beside the clinical benefit of implementation of syntax functions mapping during awake language monitoring, DES contributed to our knowledge about the brain cortical and subcortical underpinnings of syntax processing.

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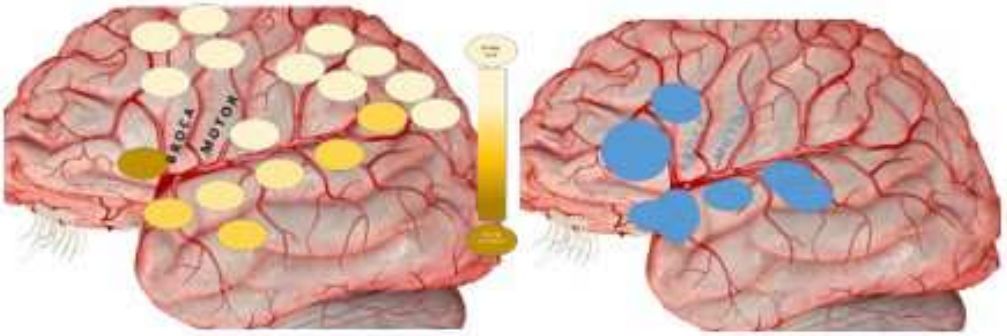

Figure 1. Naming map (darker yellow – naming errors in DES) and syntactic map (blue-syntactic errors in DES)

Transcranial magnetic stimulation for a right post-stroke patient with aphasia: a SCED study

by Arheix-Parras Sophie | Du Puy De Goyne Mathilde | Python Grégoire | Glize Bertrand | Bordeaux University | CHU de Bordeaux | University of Geneva | Bordeaux University

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Introduction and aim

Aphasia affects between one-quarter to one-third of post-stroke patients (1). As it affects communication through language, aphasia has a major impact on the patients' quality of life (2). Speech and language therapy remains the gold standard for the rehabilitation of post-stroke aphasia (3). However, language sequelae will still be present 18 months post-stroke for 43% of patients (4). The modulation of brain activity by repetitive transcranial magnetic stimulation (rTMS) opens up new prospects for recovery (5).

Most of the studies about rTMS for aphasia management implement a protocol based on the interhemispheric balance restoration, using inhibitory stimulation throw the right inferior frontal gyrus, Broca's homolog (5). Indeed, a majority of post-stroke aphasia is linked with left-brain injury.

However, some patients with aphasia also suffered from right hemispheric stroke. Two rTMS studies have proposed stimulation in the context of post right-hemispheric stroke aphasia in right-handed subjects, thus corresponding to crossed aphasias. These are two clinical cases that both found benefits of inhibitory stimulation of the left hemisphere in the recovery of aphasia (6,7). To our knowledge, only one study has explored the effect of inhibitory rTMS in left-handed patients with aphasia post right hemisphere stroke (8). However, their results have not been explored over time or using an approach adapted to small numbers, and remain inconclusive as to the real impact of a "mirror" approach compared to right-handed patients. This highlights the value of individualizing rTMS based on imaging data.

An fMRI study (9) observes differences of activation during a language in healthy subjects. Tsourio-Mazoyer et al. sorted the participants into 3 groups: group with classic (typical) left-hemispheric activation, group with atypical right-handed activation (highly atypical), group with bilateral activation with low lateralization. Comparing these differences in activation between the groups, the authors found asymmetrical activation between the left-lateralized

(typical) and right-lateralized (highly atypical) participants in the majority of language activation areas. For example, typical subjects activate the left inferior frontal gyrus while highly atypical subjects activate the homologous region located in the right hemisphere.

Based on this principle of highly atypical activation, we propose in our protocol to inhibit the left inferior frontal gyrus via rTMS for a left-handed patient with aphasia following a stroke in the right hemisphere. We expect that inhibition of the left inferior frontal gyrus via rTMS in a left-handed person with aphasia following a right stroke will induce clinical improvements and electrophysiological changes in temporal windows crucial for language processes.

Methods

Patient

The patient with aphasia has been recruited at the Bordeaux University Hospital. He suffered from a large ischemic stroke (Figure 1a) at a chronic phase (2years post stroke), confirmed by imaging. He was a native French speaker. He was left-handed. Written consent was obtained.

Repeated measures

The repeated measures consisted of the D120 naming task (M. Laganaro) which was presented alternately in two different orders. The data collected were the accuracy of the responses and reaction time RT i.e. the latency of the word production.

Procedure

The experimental design was a multiple baseline randomized study (Single-Case Experimental Design (SCED) format) (10). We performed 3 sessions per week during the 6 weeks of the protocol Figure 1b.

For the subject had 9 pre-stimulus baseline sessions, 6 sessions during the intervention followed by 3 post-intervention sessions.

Intervention: rTMS

We applied continuous Theta-Burst stimulation, bursts of 3 pulses (50Hz) at 5Hz, 600 pulses, 3 times a week during 2 weeks at 90% of the motor threshold.

Results

At the end of our protocol, we note clinically:

- A learning effect during the baseline with an improvement of the naming accuracy, due to learning / test re-test effect. After the first rTMS sessions, the naming accuracy decreased. This pejorative effect seemed to stop during the follow-up However, the short duration of the follow-up did not permit to conclude to another phase of improvement (Figure 1c). Statistical approach confirm the lack of effectiveness of rTMS for naming accuracy that does not vary significantly (Tau = 0,129 ; p = 0,564, SE Tau = 0,331).
- A similar effect can be observed for RT, with greater latencies during and after rTMS.

Discussion

The concept of interhemispheric imbalance following a stroke, which is the basement of rTMS studies (5) might be moderated, particularly for patients with a large lesion. Hence, the usual approach based on this concept should be adapted when the language networks are largely damaged, and the possible beneficial role of the contralesional hemisphere should be taken into account. These results should be compared to a similar approach in patients righthanded and suffering from a large left-brain lesion. This is suggested by another pilot study that explored some patients with a large left brain lesion and noted better outcomes after right hemisphere facilitation rather than inhibition (11). Indeed, facilitation of the contralesional hemisphere could be a more appropriate approach to improve functional language recovery.

To conclude, the extend of the lesion and the quasi absence of plasticity on the side of the lesion might impact much more than typical or atypical lateralisation of the language.

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Pilot Study: Effects of rTMS in temporal processes during naming tasks in patients with chronic aphasia

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Introduction-Objectif

Advances in cortical neuromodulation, particularly rTMS (repetitive Transcranial Magnetic Stimulation), suggest the possibility of optimizing recovery from post-stroke aphasia. While the effects on brain activation in fMRI have been widely explored, the rTMS effects on the temporal aspects of language processes remain unknown to date. Also, these aspects are crucial to understand the disturbances at the linguistic level according to Indefrey's (2011) model (phonological, semantic disturbances, etc.). This pilot study aimed to explore changes in ERP (Event-Related Potential) of these temporal processes after right inhibitory or left facilitation with rTMS in close succession.

Material and Methods

Seven patients with chronic post-stroke aphasia from Bordeaux hospital center received two close stimulation sessions: a facilitative rTMS session aimed at activating Broca's area on the left hemisphere, using high-frequency (HF) rTMS (10Hz), and the following day, an inhibitory continuous Theta Burst Stimulation (cTBS) targeting its right homolog. This protocol could be reversed following the random patient’s selection (Figure 1). The evaluation of the resting motor threshold (RMS) was carried out according to a standard protocol, i.e. the achievement of a minimal power to obtain a muscle contraction in 50% of situations. The hot spot (precise and anatomically localized stimulation area) was memorized by neuronavigation with the TMS Navigator software (Localite®) from the patient's anatomical MRI. We recorded an EEG during the first pre-test during a naming task. The following two days the patient received an rTMS stimulation (inhibition or activation) which was preceded and followed by an EEG recording during the same naming task. EEG was recorded with a 128-channel EEG (Active-Two Biosemi EEG system, Amsterdam, Netherlands) covering the entire scalp. The signal was sampled at 512Hz with an online bandpass filter set at 0.16 - 100Hz. Offline, ERPs were bandpass filtered at 0.2-30Hz and recalculated with the reference mean. All trials were retained for the image naming task, regardless of the correctness of the responses to obtain a minimum number of trials greater than 20 epochs. All analyses were performed using Cartool software. Marina Laganaro's naming task has two versions, A and B, which differ in presentation order for the items. Patients were asked to try naming the 120 images aloud. We used this task as a comparative measure according to the correctness of the answers (accuracy) and the

latency before oral production. After familiarization (presentation of the pictures with written words to be named, oral feedback, and repetition if necessary) with the D120 naming task, we presented this task repeatedly using versions A or B alternately. Clinically, verbal responses were recorded using headphones. After analysis of the audio recordings, we separated the errors in phonological or semantic paraphasias. Reaction time analyses were performed using CheckVocal software.
Inclusion criteria were stroke confirmed by imaging, aphasia confirmed by a speech and language therapy, post-stroke time > 6 months, sufficient comprehension of simple instructions, native French speaker, and age > 18 years. Non-inclusion criteria were unstabilized epilepsy, severe depression, vascular or psychiatric history, illiteracy, known neurodegenerative disorders, and major uncorrected hearing/visual impairment.

Results

As shown in Figure 1a, all patients have pathological pretests except for P4.

In particular, we observe for P3 and P7 mainly lexicosemantic errors (Figure 1b). For patient number 3, after right inhibition, the number of phonological errors decreased from 5 to 4 and lexico-semantic errors from 7 to 4. After left activation, there was a decrease from 3 to 2 lexicosemantic errors and no phonological errors before or after stimulation. For P 7, we note a predominantly lexico-semantic impairment. There was no change after inhibition or lexico-semantic errors. Phonological errors decreased after left facilitation from 4 to 1.

At the same time, with EEG acquisition, we showed that the inhibition of the right inferior frontal gyrus, Broca's homolog, induced electrophysiological modifications. Indeed, we found electrophysiological modifications located in early windows, corresponding to lexicosemantic processes (around 150ms), for 2 patients out of 4 analyzed at present. We also found for these 2 patients a clinical improvement in the naming task. As for the modifications induced after left facilitation, they did not lead to any modification in the crucial language time windows.

Discussion - Conclusion

The literature suggests that the involvement of intact perilesional areas of the left hemisphere may have a role in language recovery ((Stefaniak et al., 2020)), yet we noticed little improvement in language functions after left facilitation for our patients and even an increase in errors for patient number 6. However, the activation of the perilesional areas of the left hemisphere occurs mainly when the lesions in the left hemisphere are limited, whereas the lesions have moderate’ size for our patients. Our results showed that HF rTMS

leads to a decrease in the number of phonological errors for the P3 and P7 who have hada lexical-semantic impairments.

Also, we note EEG changes in time windows corresponding to processes related to the type of impairment like in the literature (Indefrey; 2011). Indeed, a study showed a link between language impairment and ERP difference between healthy controls and patients with aphasia: a patient with a lexico-semantic impairment showed ERP difference between 100 and 250 ms, and a patient with a lexico-phonological impairment between 300 and 450 ms (Laganaro;2014). According to our present results, P3 has significant differences after right inhibition in the early temporal windows, corresponding rather to early lexical-semantic processes. However, we do not find significant differences after left facilitation.

In conclusion, this study provides results on the neurophysiological basis of the effect of right inhibitory and left facilitative neuromodulation on ERP during a naming task for chronic vascular aphasia.

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Impaired production of time reference in aphasia: Disentangling encoding from retrieval deficits

Valantis Fyndanis, Marielena Soilemezidi, Theodora Kalpakidi

Introduction and Aim

The present study focuses on impaired production of time reference in aphasia. Following up on Fyndanis et al. (2018), it investigates whether the significant differences between past and future reference that emerge in some persons with stroke-induced aphasia (PWAs) (e.g., Bastiaanse et al., 2011; Fyndanis et al., 2018; Nerantzini et al., 2020) stem from tense-related encoding or/and retrieval deficits. Relatedly, this study seeks to find out whether there are task effects when exploring production of time reference with constrained tasks.

Methods

Two sentence completion tasks tapping into production of time reference were administered to seven Greek-speaking PWAs and seven Greek-speaking age- and education-matched healthy controls. Task 1 was a transformational completion task tapping into tense-related encoding and retrieval processes to a similar extent, and Task 2 was a non-transformational completion task predominantly tapping into tense-related retrieval processes. In Task 1, participants were auditorily presented with a source sentence (SS) (e.g., *Yesterday the aunt watered the flowers*) and the beginning of a target sentence (TS) (e.g., *Tomorrow the aunt…*). They were required to complete the TS producing the correct form of the verb phrase included in the SS (i.e., *will water the flowers*). In Task 2, participants were cross-modally presented with the 1st.singular.present form of the target verb and its internal argument (object) (e.g., *bake cakes*). Subsequently, they were cross-modally presented with a SS (e.g., *Yesterday the aunt watered the flowers*) and the beginning of a TS (e.g., *Yesterday the aunt…*). They were instructed to complete the TS producing the correct form of the verb phrase appearing on the computer screen (i.e., *baked cakes*). Both tasks included 40 items tapping into time reference, of which 20 tapped into past reference and 20 future reference. Either task was split into two lists, and each participant completed one list. Task 1 and Task 2 also included 40 and 20 items tapping into subject-verb agreement, respectively. Since agreement has been consistently found to be better preserved than time reference in aphasia, it was included as a "control condition". That is, although this study focuses on time reference, participants' performance on agreement will also be reported, as potential task effects that do not relate to the distinction between encoding and retrieval processes will be easier to be determined if they appear in both the more demanding and less demanding conditions.

Results

All healthy participants performed at ceiling. As shown in Table 1, in the time reference condition, five PWAs (P1, P2, P3, P4, and P5) fared poorly on at least one of the two tasks. In the same condition, four PWAs (P1, P3, P4, and P5) showed between-task dissociations. Importantly, a double dissociation emerged, as P1 and P5 performed significantly better on Task 1 than on Task 2, whereas P3 and P4 performed significantly worse on Task 1 than on Task 2. Furthermore, dissociations between past and future reference were exhibited by P1 (in Task 2), P4 (in Task 1) and P5 (in Task 1). All these dissociations had the same direction, with the past reference condition eliciting significantly better performances compared to the future reference

condition. In the agreement condition, two PWAs exhibited between-task dissociations that had the same direction: Task 2 elicited significantly worse performances than Task 1.

Discussion

The worse performance of P3 and P4 on Task 1 than on Task 2 (in the time reference condition) suggests that these PWAs had selective tense-related encoding problems. This is so because Task 1 tapped into encoding and retrieval processes to a similar extent, whereas Task 2 predominantly tapped into retrieval processes. The comparably poor performance of P2 on the two tasks (in the time reference condition) points to a selective deficit in tense-related retrieval processes. That P1 and P5 performed better on Task 1 than on Task 2 (in the time reference condition) could be accounted for by assuming that, overall, Task 2 is harder than Task 1. This is also supported by the fact that both between-task dissociations in the agreement condition had the same direction, with Task 2 eliciting significantly worse performances than Task 1. The better performance of P3 and P4 on the "harder task" (Task 2) than on the "easier task" (Task 1) (in the time reference condition) could be accounted for by assuming that Task 2's increased demands were wiped out and overridden by these PWAs' selective deficit in tense-related encoding processes.

The between-task dissociation exhibited by P1 was driven by the past-future dissociation exhibited by this participant in Task 2. This result suggests that, when the task taxes the processing system, this participant reveals a selective difficulty retrieving future-referring verb forms. That a past-future dissociation only emerged in Task 1 for P5 could reflect a floor effect, as this participant performed extremely poorly in Task 2 (5% correct). Assuming that P5's extremely poor performance on Task 2 reflects the combined effects of her severe deficit in retrieval processes (predominantly tapped by Task 2) and Task 2's increased processing demands, one could attribute the past-future dissociation that this participant exhibited in Task 1 to a selective deficit in retrieving future-referring verb forms. Finally, the past-future dissociation displayed by P4 in Task 1 –in the presence of her ceiling performance on Task 2– suggests that this participant had a selective deficit in encoding future reference-related abstract/ prephonological features during morphosyntactic production. Concluding, although Task 2 seems to be harder than Task 1, the experimental set-up employed in this study appears to have the potential to disentangle tense-related encoding deficits from tense-related retrieval deficits.

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Table 1. PWAs' accuracy performance on production of Time Reference and subject-verb Agreement and within-participant comparisons using the Fisher exact test for count data.

Condition/Subject	PWAs						
	P1	P2	P3	P4	P5	P6	P7
TR-Transf	20/20 (100%)	11/22 (55%)	13/20 (65%)	11/20 (55%)	8/20 (40%)	20/20 (100%)	17/20 (85%)
TR-Nontransf	7/20 (35%)	5/20 (25%)	19/20 (95%)	20/20 (100%)	1/20 (5%)	17/20 (85%)	14/20 (70%)
TR-Transf vs TR-Nontransf (*p*-value)	**<0.001**	0.105	**0.044**	**0.001**	**0.020**	0.231	0.451
Past-Transf	10/10 (100%)	3/10 (30%)	5/10 (50%)	10/10 (100%)	7/10 (70%)	10/10 (100%)	8/10 (80%)
Future-Transf	10/10 (100%)	8/10 (80%)	8/10 (80%)	1/10 (10%)	1/10 (10%)	10/10 (100%)	9/10 (90%)
Past-Transf vs Future-Transf (*p*-value)	1	0.070	0.350	**<0.001**	**0.020**	1	1
Past-Nontransf	7/10 (70%)	1/10 (10%)	10/10 (100%)	10/10 (100%)	1/10 (10%)	9/10 (90%)	7/10 (70%)
Future-Nontransf	0/10 (0%)	4/10 (40%)	9/10 (90%)	10/10 (100%)	0/10 (0%)	8/10 (80%)	7/10 (70%)
Past-Nontransf vs Future-Nontransf (*p*-value)	**0.003**	0.303	1	1	1	1	1
Agr-Transf	20/20 (100%)	13/20 (65%)	18/20 (90%)	19/20 (95%)	20/20 (100%)	20/20 (100%)	19/20 (95%)
Agr-Nontransf	3/10 (30%)	1/10 (10%)	10/10 (100%)	10/10 (100%)	10/10 (100%)	10/10 (100%)	10/10 (100%)
Agr-Transf vs Agr-Nontransf (*p*-value)	**<0.001**	**<0.01**	0.540	1	1	1	1

Note: Significant p-values are bolded. Participants P1, R2, P3 and P4 are persons with nonfluent aphasia. Participants P5, P6 and P7 are persons with fluent aphasia. PWAs = Persons with aphasia; TR-Transf = Time Reference tested with the transformational sentence completion task; TR-Nontransf = Time Reference tested with the non-transformational sentence completion task; Past-Transf = Past Reference tested with the transformational sentence completion task; Future-Transf = Future Reference tested with the transformational sentence completion task; Past-Nontransf = Past Reference tested with the non-transformational sentence completion task; Future-Nontransf = Future reference tested with the non-transformational sentence completion task

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