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Opponent's review on Annamária Kiss's doctoral thesis titled as The impact of working memory on the recovery from aphasia

Annamária Kiss created a very well established experimental study and wrote a PhD dissertation with a really clear structure. Her aim is presented in an understandable way, and she structured the chapters of her thesis in a logical manner.

There are 5 main chapters in the dissertation and some very important appendices after the list of limitations of the study and future research, and the references. Figures, tables and abbreviations are also listed in an appropriate way in the first part of the document.

There is only one point which can be criticized: it is the title of the dissertation. As it was mentioned at the home defense of her PhD dissertation, she had no chance to modify it after she had formulated the first version. I have to mention it as a reviewer, because I do hope, that there will be some concrete therapeutic consequences of her thesis in the development of aphasia therapy solutions in the future. Probably, this problem can be solved if she would publish the revised version of the thesis as a book some day.

I think the candidate had a very ambitious plan to reach, when she established the design of the study. We can agree with her, that the uniqueness of this research is based on a special scientific view. As she claims, there is a significant gap between the relevant literature on the characteristics of aphasic patients' cognitive flexibility and working memory, a system responsible for temporal holding and manipulating information, which is crucial for language processing and communication.
„This study seeks to bridge this gap by providing data acquired by testing executive functions in monolingual and bilingual individuals with aphasia, thereby exploring the potential for a bilingual advantage in aphasia population."
We have to see that this aspect of the candidate's scientific work is not just important but really rare in Hungary. Her research is innovative and brings useful results for both Hungarian and international neurolinguistics.

On page 50 there is a well established table (3) where all hypothesis and the applied tests are listed. The author had 9 hypothesis as they are listed on page 48 and 49.

„1.5.2 Hypotheses
(1) The first hypothesis proposed that the impairment of executive functions would negatively affect naming in participants with aphasia, resulting in slower performance, increased response time and decreased accuracy. It was assumed that the longer the time to complete the task was, the more mistakes were made. This was thoroughly investigated in the Boston Naming Test (BNT).
(2) The second hypothesis was that impaired executive functions would also affect auditory comprehension of grammatical structures and complex sentences, resulting in decreased accuracy in participants with aphasia. To identify the

expected impairments, the Token Test and the Test for Reception of Grammar were employed.
(3) The relationship between word retrieval and executive functions in participants with aphasia as well as in individuals from the healthy reference groups was investigated using verbal tasks including semantic and letter fluency ones. Lower performance was expected in participants with aphasia in both fluency tasks because of a possible impairment in inhibitory control due to aphasia (Patra et al., 2020). In addition, both aphasic and healthy participants were expected to demonstrate lower performance in the letter fluency task as it requires greater recruitment of executive control (Bose et al., 2022).
(4) Regarding cross-linguistic comparison in the semantic fluency task, it was expected that the bilingual aphasia group would demonstrate similar performance, without significant cross-linguistic differences, in contrast to healthy bilinguals (Kiran et al., 2014; Patra et al., 2020).
(5) Furthermore, this paper compared performance in terms of semantic verbal fluency with regard to naming in the BNT to investigate the potential relationship between the two. It is known that the performance of aphasics in semantic fluency tasks may show dissociation with naming, here measured by the BNT. It was expected that if an individual performed poorly or successfully in the semantic fluency task, they might not perform similarly in naming.
(6) It was assumed that impaired cognitive flexibility has a negative effect on performance in non-linguistic shifting tasks. It was anticipated that as response time increases, the number of mistakes will also increase for both aphasia groups in comparison to the reference groups. This was thoroughly investigated in the
49
Trail Making Test (TMT) as well as in the Number and Letter Sudoku tasks. Furthermore, it was expected that both aphasic and healthy participants would demonstrate lower performance in part B of the TMT and in the Letter Sudoku task, due to the presence of a greater number of linguistic elements.
(7) The study proposed that participants with aphasia would demonstrate impaired working memory in the visual, as well as in the auditory tasks (Choinski et al., 2020). To identify the expected impairments, the Visual Sequential Memory Test, the Rey-Osterrieth Complex Figure B Test and the Auditory Sequential Memory Test were employed. Furthermore, it was assumed that bilinguals with aphasia will perform better in working memory tests than monolingual aphasics, while significant performance differences were expected between aphasic participants and neurologically healthy participants as matched reference, for both bilinguals and monolinguals.
(8) Additionally, it was assumed that the severity of aphasia has an impact on the outcomes of executive functions. Specifically, it was expected that the difference in the EFs of individuals with milder forms of aphasia (fluent aphasics) would be greater between the monolingual and bilingual groups than those with more severe symptoms of aphasia (non-fluent aphasics), suggesting that EFs may be more readily accessible in milder forms of aphasia.
(9) Finally, regarding the impact of age and education on performance, it was hypothesized that older bilinguals would perform better in non-linguistic tasks compared to monolinguals in both the aphasia and healthy groups (Bialystok et al., 2014). In the monolingual groups, it was expected that higher age would correlate with lower scores. In terms of healthy mono-and bilingual participants, higher education was expected to correlate with higher scores. However, in case of both

aphasia groups, more education was expected to have a reduced effect (Roberts, et al., 2024"

Regarding on the sample on page 51 we can find the following: „A total of 54 participants were recruited for this study, divided into four groups: monolingual people with aphasia (N=10), bilingual people with aphasia (N=8), monolingual healthy participants (N=18), and bilingual healthy participants (N=18). All participants with aphasia had suffered a cerebrovascular accident."

From a researcher's perspective it is not a very large sample, but from a clinician's perspective we can say that it is not so easy to find patients with cerebrovascular incident who are ready to be tested with these type of tests voluntarily, especially if they have to be bilinguals.

While the whole data is analyzed in great detail, for me the results of the TROG-H test still hold surprises if they would be compared to executive functions. Different items of the test could rely on different grammatical rules. That is why I think that qualitative data analysis from this test would have been also reported while nonverbal tasks are explored in a high quality. I think it is also important because of the findings of the candidate on Auditory Sequential Memory Test (ASMT) discussed on page 143 („The significant differences in mean scores in the ASMT in the monolingual aphasia group in comparison with the monolingual reference groups highlight the impact of aphasia on cognitive functions, particularly in tasks requiring retention and manipulation of verbal information.)"

Working memory tests and tests measuring cognitive flexibility showed general slowness and reduced accuracy in the aphasic patients' groups. People with aphasia also performed significantly worse in fluency tasks. Her findings revealed that the impairment of executive functions can have a negative impact on naming, comprehension, and fluency.

I would really like to know what the author thinks, what impact of her findings will have on the current interpretation of aphasia, which has mostly been interpreted as a language disorder. I have noticed that she follows scholars who claim that aphasia is not only a problem of the linguistic system but associated with cognitive, especially executive functions. Do we have a reason to change our definitions based on the conclusion of the thesis?

What kind of (aphasia) therapeutic consequences does the author's position have? Would there be a cognitive transfer or a direct relation between the items in a concrete task for aphasic patients?

Overall evaluation:

This dissertation is a valuable contribution to neurolinguistics, and I highly reccomend that the Candidate, Annamária Kiss be awarded the doctoral (PhD) degree, Her scientific work meets all the requirements.

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