Do Parkinson's Disease patients exhibit a reduced use of action words? – A semantic vector analysis of action verb usage in spontaneous production

Arne Lohmann[1], Regina Stodden[2], Laura Kallmeyer[3], Julia Henkel[4], Katja Biermann-Ruben[5]
[1]Universität Leipzig, arne.lohmann@uni-leipzig.de, [2,3]HHU Düsseldorf, [4]Universitätsklinikum Schleswig-Holstein Lübeck, [5]Universitätsklinikum Düsseldorf

Keywords: Action words, Parkinson's Disease, Embodied cognition, Semantic vectors

This study investigates whether German-speaking Parkinson's Disease (PD) patients exhibit a reduced use of action verbs when producing semi-spontaneous narratives. A large body of evidence has been accumulated showing that parts of the motor system contribute to the processing of motor language (e.g. Pulvermüller 2013). These findings are in line with views of Embodied Cognition (Barsalou 1999), which are a cornerstone of Cognitive Linguistic theories. PD is a disease that primarily affects the motor system, leading to an impairment that is expected to also affect the processing of action language. Indeed evidence has been acquired showing that PD patients exhibit difficulties when processing action verbs (see e.g., Boulenger et al. 2008). This evidence comes exclusively from studies employing controlled experimental paradigms, leaving the question unaddressed to what extent this processing difficulty is reflected in the spontaneous language use of PD patients. The present study aims to fill that gap by analyzing the use of action verbs by PD patients in semi-spontaneous narratives, testing the hypothesis that PD patients use less motor action vocabulary than healthy speakers.

More specifically, the present study compares the use of language denoting motoric actions by 15 PD patients and 15 healthy matched controls who produced narratives based on a sequence of pictures depicting parts of well-known fairy tales. Since in previous research processing difficulties have been shown predominantly for the verbal domain, the present study tests the hypothesis of whether the verbs produced by PD patients are less similar to typical action verbs than those produced by healthy controls. Semantic similarity was measured via a semantic vector analysis that calculates the semantic distance of all verbs produced to lists of hand and foot action verbs from Klepp et al. (2017). For the distance measurements we used pre-trained vectors with 100 dimensions trained on verb lemmas (Ehren et al. 2020) of a variant of the German web corpus DECOW16 (Schäfer & Bildhauer, 2012). Initial analyses of the data suggests that the verbs used by PD patients are on average less similar to typical hand and foot action verbs, in line with the hypothesis. This finding would correspond to previous research about the impaired processing of action language in PD patients and extends this result to the domain of spontaneous language use. A reduced usage of motor action vocabulary may be explained by an impaired mental and neural representation of action concepts in PD patients, resulting in a processing burden during language production.

References

Barsalou, Lawrence W. 1999. Perceptual symbol systems. *The Behavioral and Brain sciences* 22(4). 577-609.

Boulenger, Véronique, Laura Mechtouff, Stéphane Thobois, Emmanuel Broussolle, Marc Jeannerod & Tatjana A. Nazir. 2008. Word processing in Parkinson's disease is impaired for action verbs but not for concrete nouns. *Neuropsychologia* 46(2). 743–756.

Ehren, Rafael, Timm Lichte, Laura Kallmeyer & Jakub Waszczuk. Supervised Disambiguation of German Verbal Idioms with a BiLSTM Architecture. *Proceedings of the Second Workshop on Figurative Language Processing.* 211–220.

Klepp, Anne, Valentina Niccolai, Jan Sieksmeyer, Stephanie Arnzen, Peter Indefrey, Alfons Schnitzler & Katja Biermann-Ruben. 2017. Body-part specific interactions of action verb processing with motor behaviour. *Behavioural Brain Research* 328. 149–158.

Schäfer, Roland & Felix Bildhauer. 2012. Building Large Corpora from the Web Using a New Efficient Tool Chain. *Proceedings of the Eighth International Conference on Language Resources and Evaluation (LREC'12).* 486–493.

Pulvermüller, Friedemann. 2013. How neurons make meaning: brain mechanisms for embodied and abstract-symbolic semantics. *Trends in Cognitive Sciences* 17(9). 458–470.