



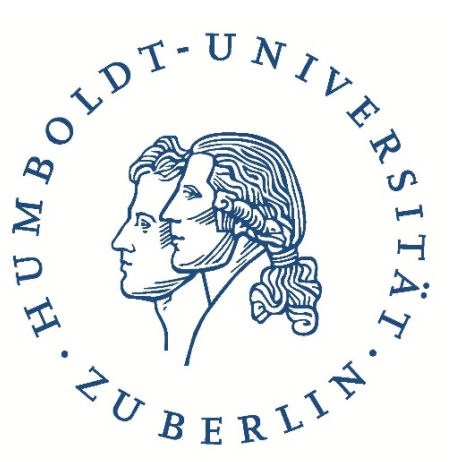
Altered Event Processing in Persons with Parkinson's disease

Michelle Wyrobnik^{1,2,3}, Elke van der Meer^{1,2}, & Fabian Klostermann^{2,3}

¹ Institute of Psychology, Humboldt-Universität zu Berlin

² Berlin School of Mind and Brain, Humboldt-Universität zu Berlin

³ Department of Neurology, Charité Universitätsmedizin Berlin, Campus Benjamin Franklin



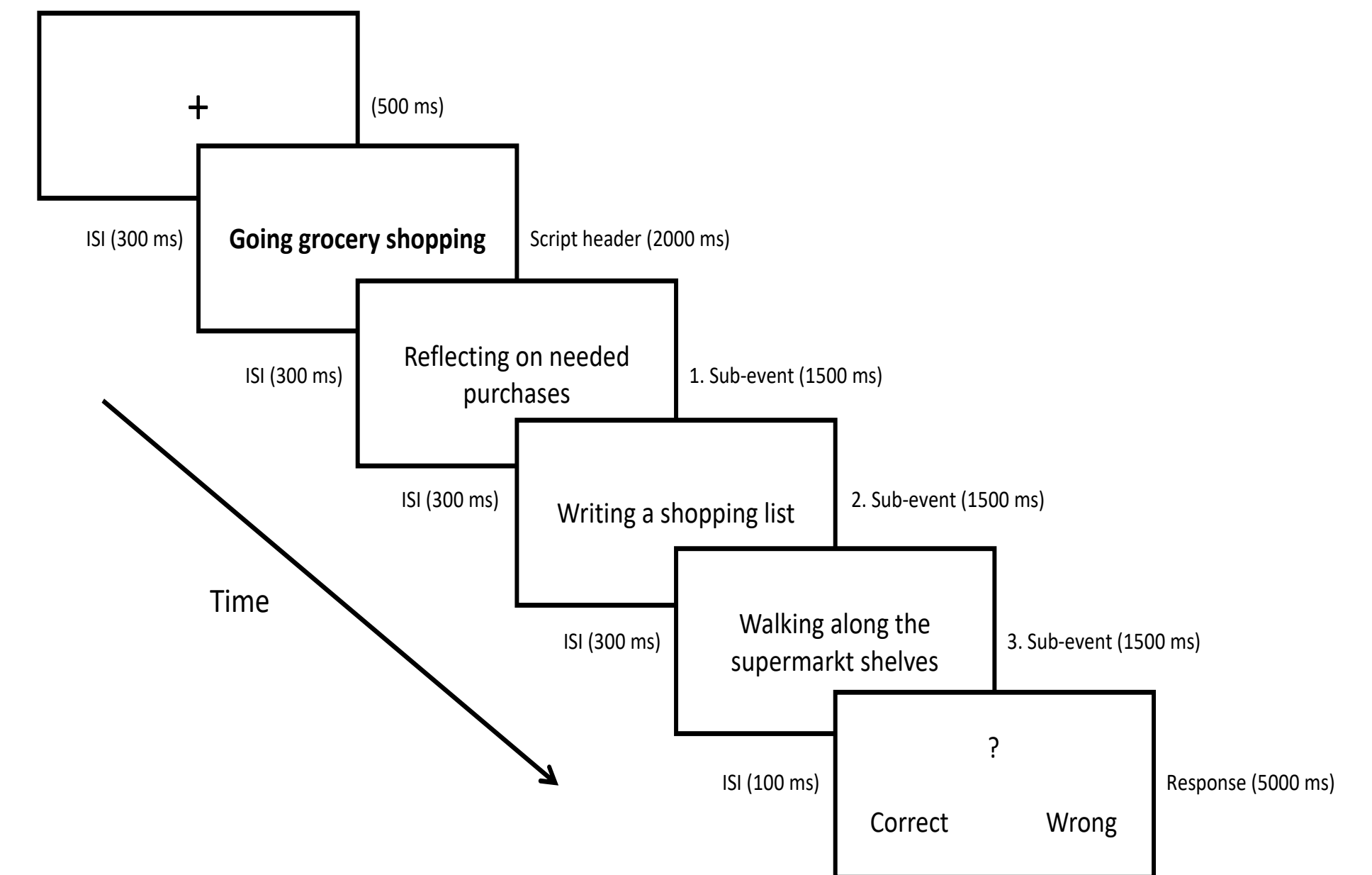
michelle.wyrobnik@charite.de
@michelle_wyro

Introduction

- Due to dopaminergic frontal-striatal network dysfunctions, persons with Parkinson's disease (PD) may show impaired event processing (Godbout & Doyon, 2000; Zacks & Sargent, 2010; Zalla et al., 2000)
- Temporal event knowledge = temporal order in which sub-events occur in an activity
- Content event knowledge = information about the sub-events of an activity
- The N400 and late positive component (LPC) are associated with temporal and content violations in event sequences in healthy persons (Drummer et al., 2016)
- Hypothesis: Persons with PD show slower and less accurate performances along with altered ERP patterns (e.g., regarding the N400 and LPC) in response to temporal and content violations

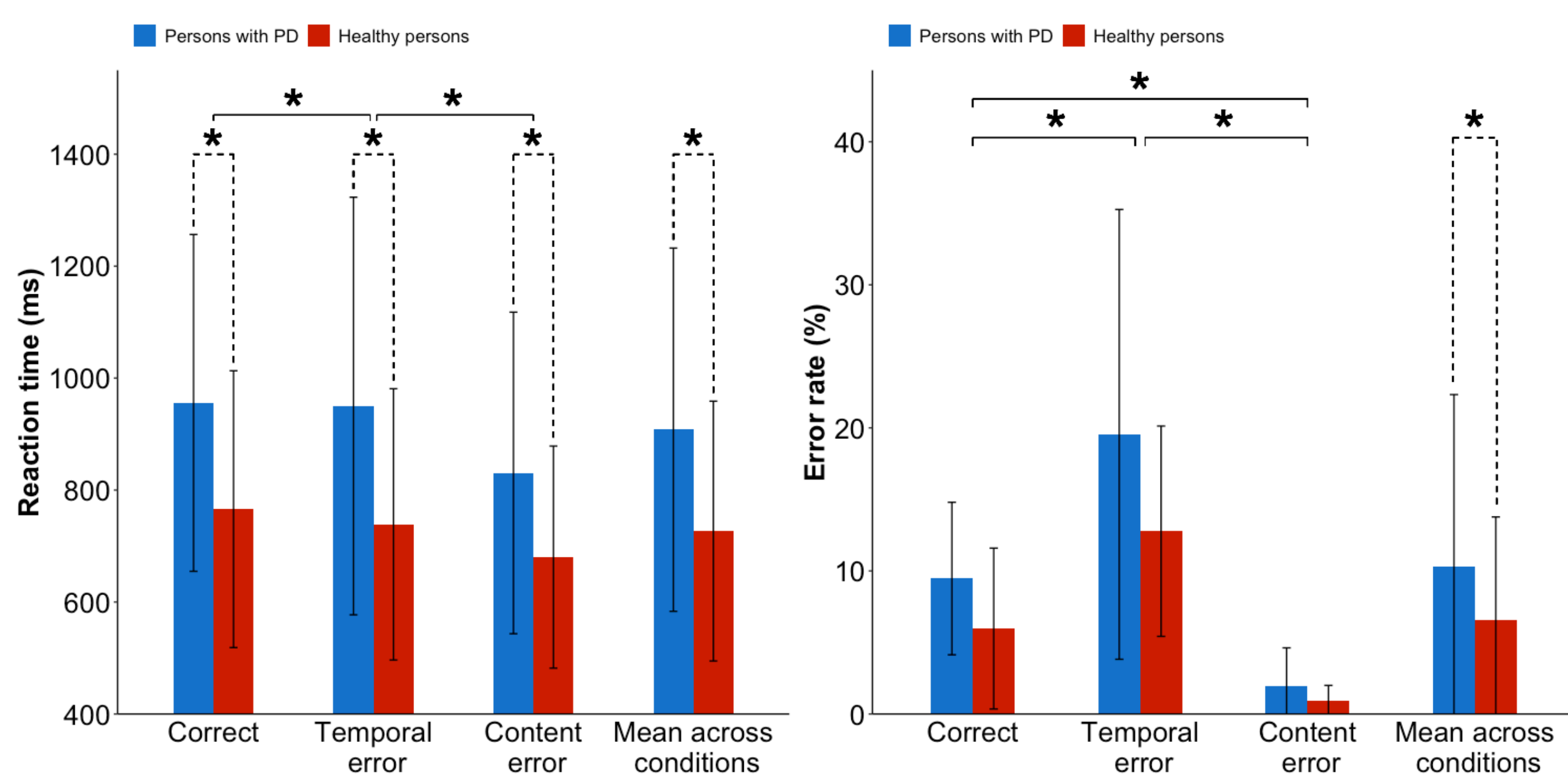
Methods

- 22 persons with PD: 8 females; *mean age* = 64.82, *SD* = 11.03
- 24 healthy persons: 10 females; *mean age* = 67.67, *SD* = 7.59
- Similar cognitive functions assessed with the Parkinson Neuropsychometric Dementia Assessment (PANDA) ($t(44) = -1.06$, $p = .296$)



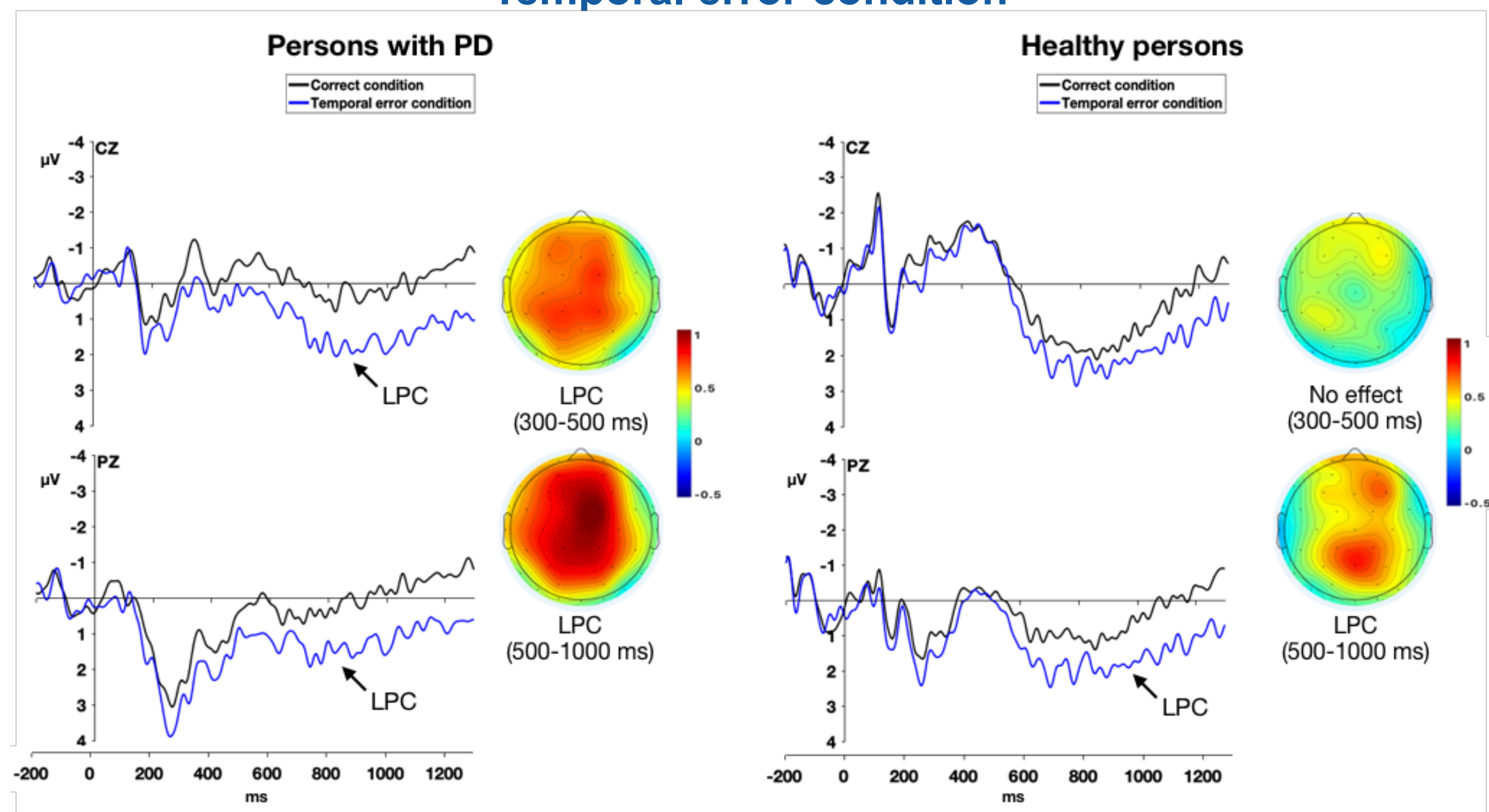
- Presentation of script header (e.g., going grocery shopping) followed by event triplets in three conditions:
 1. Correct condition: *Reflecting on needed purchases* – *Writing a shopping list* – *Walking along the supermarket shelves*
 2. Temporal error condition: *Getting a shopping cart*– *Lining up at the checkout counter* – *Working through the shopping list*
 3. Content error condition: *Getting a shopping cart* – *Opening the water tap* – *Walking along the supermarket shelves*
- Decision if presented events are correct or incorrect

Results



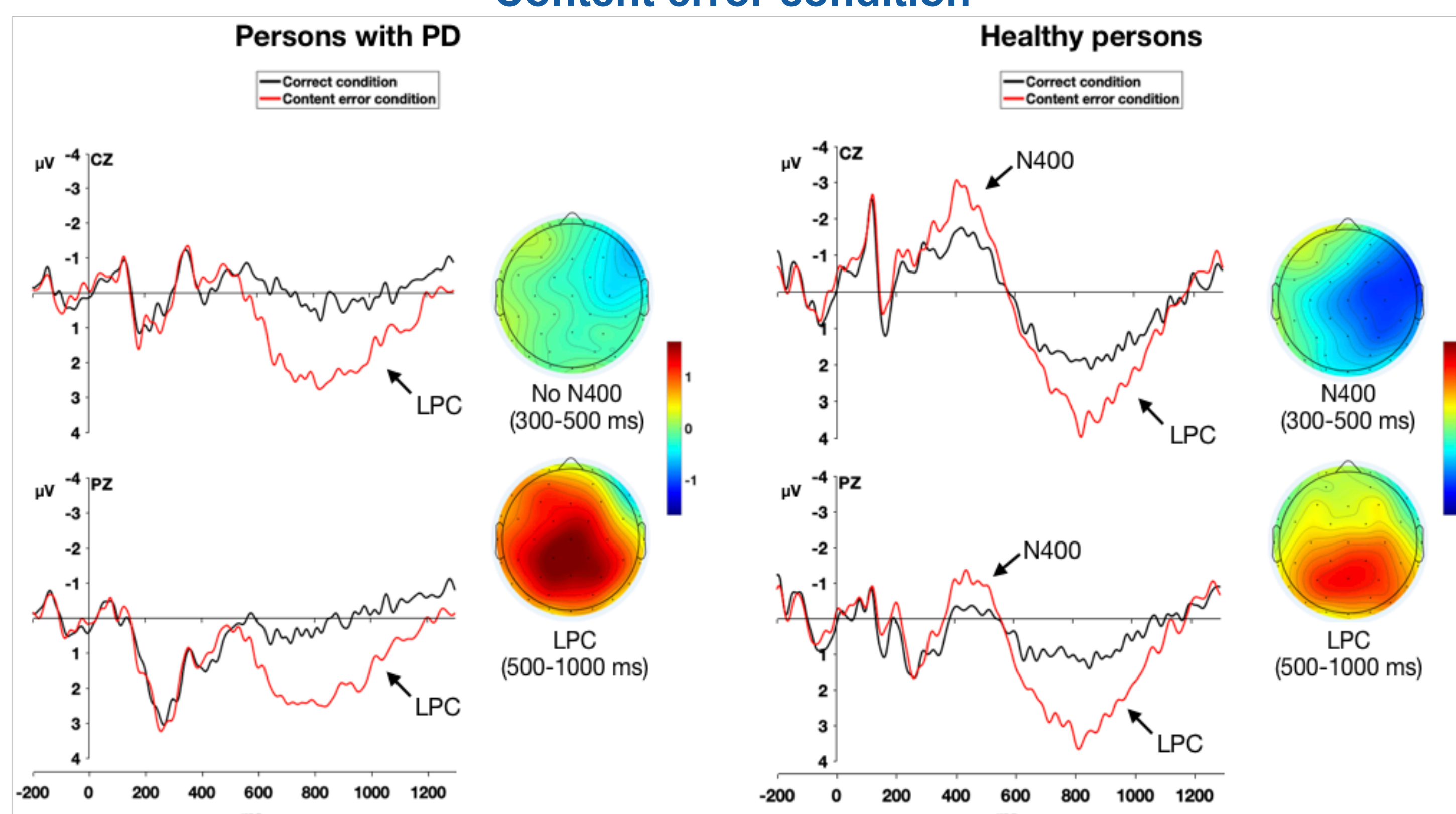
- Persons with PD are generally slower ($F(2, 44) = 5.60$, $p = .009$, $\eta_p^2 = .11$) and are more inaccurate ($F(2, 44) = 6.42$, $p = .015$, $\eta_p^2 = .13$) than healthy persons

Temporal error condition



- Persons with PD show an early starting positive response (e.g., after 300 ms) ($F(2, 36) = 42.92$, $p \leq .001$, $\eta_p^2 = .34$) and a broadly distributed (anterior, posterior) LPC ($F(3, 63) = 5.74$, $p = .002$, $\eta_p^2 = .21$)
- For healthy persons, the LPC starts only at 500 ms after stimulus onset and is distributed solely posteriorly ($F(3, 63) = 4.81$, $p = .001$, $\eta_p^2 = .17$)

Content error condition



- Persons with PD do not show a N400 effect but a broadly distributed (anterior, posterior) LPC ($F(3, 63) = 5.74$, $p = .002$, $\eta_p^2 = .21$)
- Healthy persons show a right lateralized N400 effect (anterior, posterior) ($F(3, 67) = 3.44$, $p = .023$, $\eta_p^2 = .13$) and again a solely posteriorly distributed LPC ($F(3, 63) = 4.81$, $p = .001$, $\eta_p^2 = .17$)

Discussion

- Overall lower **behavioral performances** in persons with PD → the present task has high demands on executive functions (e.g., updating), which are typically impaired in PD (Owen, 2004)
- **LPC** responses are associated with reanalysis (e.g., updating) processes of sensory input which is inconsistent with prevailing predictions (Brouwer et al., 2012)
- Persons with PD might recruit additional cognitive resources to reanalyze their mental representation (i.e., event model) in working memory upon temporal and content violations in event sequences
- Increase use of less specialized brain regions to compensate for deficits in event model formation (Faustmann et al., 2007)
- **N400** effects are associated with a semantic mismatch with the event model (Drummer et al., 2016)
- Persons with PD seem to have no expectation regarding the upcoming sub-event and may show impaired retrieval of content event information (Delogu et al., 2019)
- Persons with PD show weak event model representation and / or retrieval, resulting in low event prediction and error identification
- As the processing of events is fundamental in daily routines, alterations may cause behavioral dysfunctions in persons with PD

Literature

- Brouwer, H., Fitz, H., & Hoeks, J. (2012). Getting real about Semantic Illusions: Rethinking the functional role of the P600 in language comprehension. *Brain Research*, 1446, 127-143.
- Delogu, F., Brouwer, H., & Crocker, M. W. (2019). Event-related potentials index lexical retrieval (N400) and integration (P600) during language comprehension. *Brain and Cognition*, 135, 103569.
- Drummer, J., van der Meer, E., & Schaadt, G. (2016). Event-related potentials in response to violations of content and temporal event knowledge. *Neuropsychologia*, 80, 47-55.
- Faustmann, A., Murdoch, B. E., Finnigan, S. P., & Copland, D. A. (2007). Effects of Advancing Age on the Processing of Semantic Anomalies in Adults: Evidence from Event-Related Brain Potentials [Article]. *Experimental Aging Research*, 33(4), 439-460.
- Godbout, L., & Doyon, J. (2000). Defective representation of knowledge in Parkinson's disease: evidence from Owen, A. M. (2004). Cognitive Dysfunction in Parkinson's Disease: The Role of Frontostriatal Circuitry. *The Neuroscientist*, 10(6), 525-537.
- Zacks, J. M., & Sargent, J. Q. (2010). Chapter 7 - Event Perception: A Theory and Its Application to Clinical Neuroscience. In H. R. Brian (Ed.), *Psychology of Learning and Motivation* (Vol. Volume 53, pp. 253-299). Academic Press.
- Zalla, T., Sirigu, A., Pillon, B., Dubois, B., Agid, Y., & Grafman, J. (2000). How patients with Parkinson's disease retrieve and manage cognitive event knowledge. *Cortex*, 36(2), 163-179.