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Publication date: 2014

Document Version
Early version, also known as pre-print

Citation for published version (APA):
Event-related potential indices of inter-individual and age differences in visual attention capacity

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Introduction

Individual differences and age-related decline of cognitive abilities depend on the access to a variety of resources. According to the Theory of Visual Attention (TVA, Bundesen, 1990), attentional capacity is limited by two distinct parameters:

1. Visual Processing Speed C: The amount of information that can be processed within a certain time
2. Visual Short-Term Storage Capacity K: The maximum number of objects that can be perceived at one point in time

Research questions & study aim:

- Are inter-individual differences in Processing Speed C and Storage Capacity K supported by distinct neural mechanisms?
- Do the same mechanisms account for age-related decline of the two abilities?

Identification of neuro-cognitive correlates of inter-individual and age differences in TVA parameters of attentional capacity

Methods

Participants

N=40, 20 younger, 20 older

TV-base assessment permits the two abilities to be quantified for a particular individual in a mathematical independent manner.

The theory’s neural interpretation further assumes that C and K are supported by distinct brain mechanisms (NTVA, Bundesen et al., 2005). Combining the methodological advantages of the model-based assessment with EEG offers a promising approach to identify and distinguish between neural underpinnings of inter-individual differences and age-specific decrements in these abilities

Hypotheses:

1. Age-related decline: Both parameters, Processing Speed C and Storage Capacity K, are reduced in the older group.

These may comprise:

- Increased offline +2 µV young
- Compensation +6 µV young

Experimetnal Procedures

TV Whole Report

Task: verbal letter report. 2 sessions: 1.TVA whole report, from which parameter estimates were derived (200 trials). 2.EEG report, adapted to be suitable for ERP analyses (240 trials).

Parameter Estimation

Individual parameter estimates were modeled based on the method described by Daffner et al. (1999, Appendix A), and also Dyrholm et al. (2011), and involved maximum likelihood estimation of the parameters defining the exemplary function above.

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Results & Discussion

Behavioral Data

Performance group differences and age-related decline in Processing Speed C

Higher CDA for younger compared to older participants, and for higher- compared to lower-capacity participants [ME K-Level, p<.05]

Indexing individual and age differences in sustained activations of internal representations (e.g., Vogel & Machiwal, 2004) probably governed by thalamo-cortical feedback loops

Conclusions & Outlook

The presented approach enables to link neural activity to performance in specified cognitive processes.

To further advance our understanding of the variance between age-related brain alterations and behavioral symptoms, future studies will aim at identifying:

- Predictors of decline and compensatory abilities in older age
- Neuro-cognitive indices of pathological aging (e.g., Alzheimer’s disease)

References


