

Conscious Error Detection in an Antisaccade Task

Tilmann A. Klein¹, Tanja Endrass², Norbert Kathmann², Jane Neumann¹, D. Yves von Cramon¹, & Markus Ullsperger¹

¹Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany;

²Humboldt University, Berlin

email:tklein@cbs.mpg.de

MAX PLANCK INSTITUTE FOR HUMAN COGNITIVE AND BRAIN SCIENCES LEIPZIG



Introduction

- Aim: distinction between aware and unaware errors in respect to error processing and/or behavioural consequences
 - Electrophysiological level (Nieuwenhuis et al., 2001, Endrass et al., 2005): modulation of the error positivity (Pe) by error awareness – in case of an aware error, a normal Pe was found, in case of an unaware error, a diminished Pe was observed, the error related negativity (ERN) was present on aware and unaware errors
 - Behavioural: no post error slowing after unaware error but present after an aware error
 - Rostral cingulate zone (RCZ; most likely generator of the ERN) active on error processing (Debener et al., 2005)
1. Are there sizeable differences in RCZ activity or in the activity of other error processing related brain areas due to error awareness?
 2. What are the behavioural correlates of error awareness?

Methods

a) Participants

- Thirteen healthy right handed subjects (8 female, mean age = 26.15 years)

b) Task

- Antisaccade task (Nieuwenhuis et al., 2001; 476 trials; see Figure 1)
- Brief precue (to increase error rate) was presented at the position where the gaze should be directed to
- To reduce the predictability in 33% of the trials the precue was presented at the position of the following peripheral stimulus

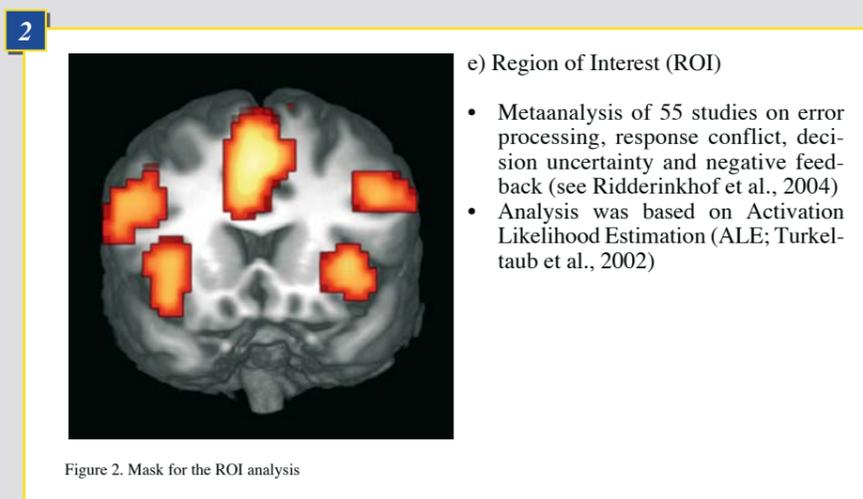


c) fMRI Data acquisition

- Data was acquired at 3 T with a Bruker (Ettlingen, Germany) Medspec 30/100 system
- Twenty slices (thickness 4 mm, 1 mm gap; AC-PC oriented)
- Single-shot gradient echo-planar imaging (EPI) sequence (Tr = 2000 ms, Te = 30 ms ; 64x64 pixel-matrix, flip angle 90°; field of view = 192 mm)
- Data Processing: LIPSIA (Lohmann et al., 2001; 1/120 Hz highpass, FWHM = 5.65 mm)
- Statistical analysis based on a least-squares estimation using the general linear model for serially autocorrelated observations (Friston et al., 1995, Worsley & Friston, 1995)
- $z = 2.33$; $\alpha = 0.01$; volume > 81mm³ (Monte Carlo Simulation: 0.05 corrected)

d) Eyetracker

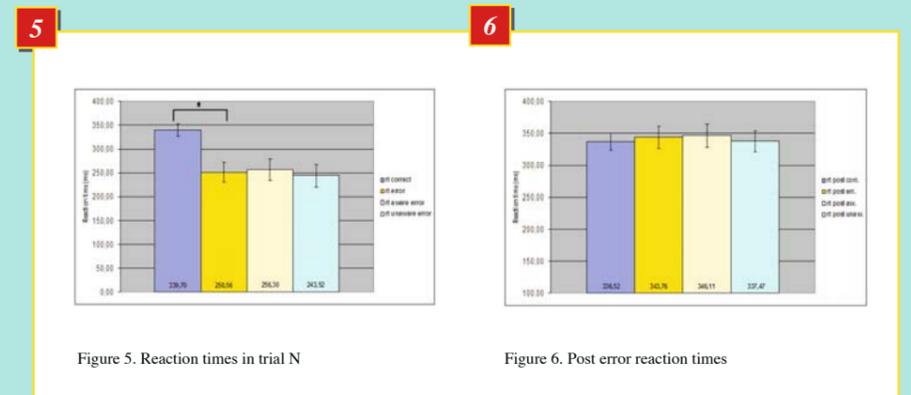
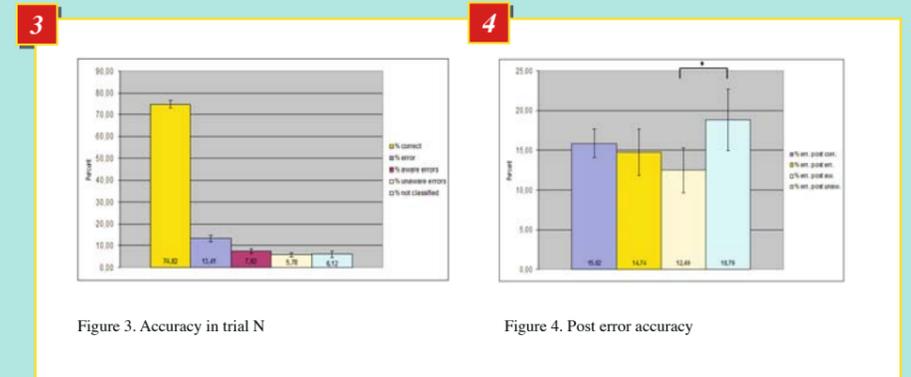
- View Point Eyetracker (infrared based; Arrington Research)
- Temporal resolution: 60 Hz; spatial resolution: app. 0.15° visual arc



Results

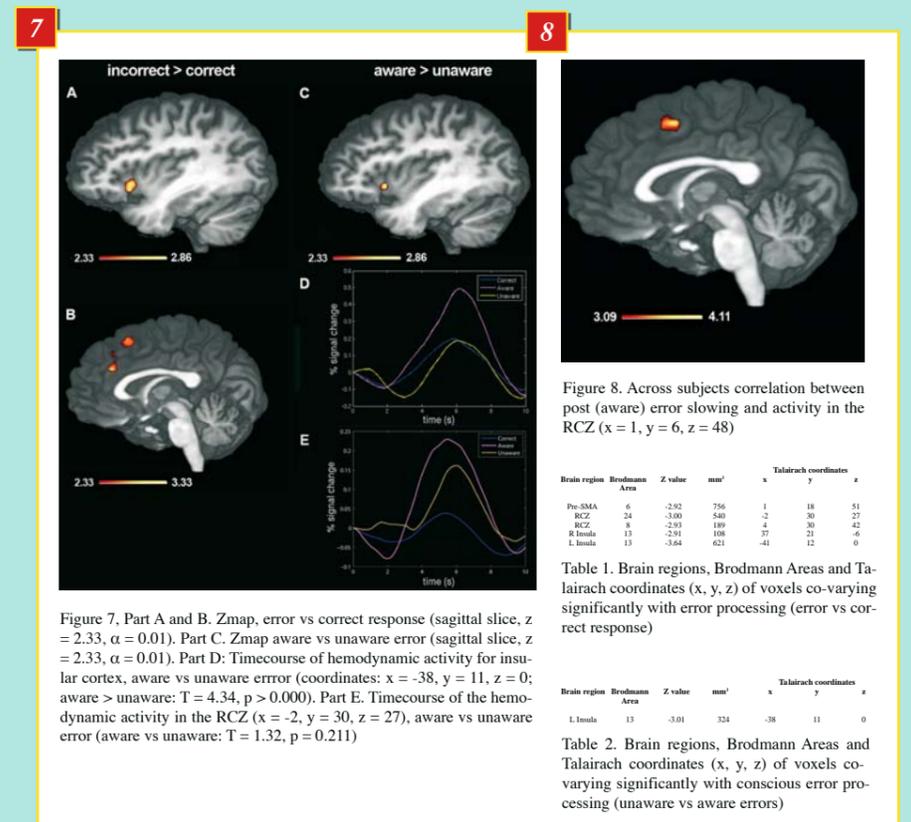
a) Behavioural

- errors faster than correct responses
- Post error slowing in 9 of 13 subjects
- Lower error rate after an aware error
- False alarm rate: 3%; rate of not classifiable trials due to technical problems: 6.1%
- See Figures 3 to 6 for details



b) fMRI

- Error > correct: Pre-SMA, RCZ and Insula (see Table 1 & Figure 7)
- aware > unaware: Left insula (see Table 2 & Figure 7)
- Timecourses: Greater activity in the insular cortex for aware errors (aware > unaware: $T = 4.34$, $p < 0.001$), no such difference can be found in RCZ (see Figure 7)
- Second level analysis: correlation post error reaction times/activity for response errors: the more a person slowed down after an aware error, the more activity can be found in the RCZ area ($x = 1$, $y = 6$, $z = 48$; see Figure 8)



Discussion

- RCZ active in both error types (aware and unaware)
- In line with the results of Nieuwenhuis et al. (2001) and Endrass et al. (2005) who found no modulation of the ERN due to error awareness
- Reduced error rate after an aware error may be attributed to increased compensatory activity after an aware error (see Figure 4)
- Higher insular activity after an aware error may be attributed to enhanced awareness of the emotional reaction to the error, or to the higher visceral response (e.g. heartbeat) to an error itself (Critchley et al., 2004)

Literature

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