Brain correlates of intentional binding: An EEG study in mindfulness meditators

Han-Gue Jo$^{1,2}$, Marc Wittmann$^3$, Thilo Hinterberger$^4$, Stefan Schmidt$^{1,2,*}$

$^1$Department of Psychosomatic Medicine, University Medical Center Freiburg, Freiburg, Germany
$^2$Institute for Transcultural Health Studies, European University Viadrina, Frankfurt (Oder), Germany
$^3$Institute for Frontier Areas of Psychology and Mental Health, Freiburg, Germany
$^4$Department of Psychosomatic Medicine, University Medical Center Regensburg, Regensburg, Germany

Abstract

When a voluntary action causes a sensory outcome, actions and their subsequent effects are perceived as being closer together in time, this effect being called intentional binding. Since studies on perceived time are highly dependent on subjective reports, an avenue to gain more reliable subjective reports regarding the precise moment of a temporal event is to work with experienced meditators. It has been shown in many studies that experienced meditators are able to keep attention more consistently on a task and they have increased attentional control and report more accurately their body sensations. In this study, we performed an intentional binding paradigm with twenty experienced meditators and compared the results with matched controls. Moreover, the pre-supplementary area (SMA) is regarded as key structure for voluntary movement and contributing to the sense of agency. For example, it has been shown that disrupting neural activity in the SMA leads to less intentional binding. Therefore, brain dynamic (EEG) was recorded and a single-trial analysis technique of the task was performed to estimate whether intentional binding is correlated with spontaneous slow cortical potentials (SCP). We observed that self-initiated movements following positive and negative potential shifts of SCPs in meditators, which are related to SMA activation, have different effects on intentional binding, especially the error regarding timing of sensory outcome rises. The difference between groups in timing accuracy and its correlate of brain dynamics will be discussed in detail.

© 2014 The Authors. Published by Elsevier Ltd. Open access under CC BY-NC-ND license. Selection and peer-review under responsibility of the Organizing Committee of the International Conference on Timing and Time Perception.

Keywords: Intentional binding; time perception; EEG; Slow cortical potential; Mindfulness

* Corresponding author. Tel.: +49 761 270 69280; fax: +49 761 270 68813.
E-mail address: stefan.schmidt@uniklinik-freiburg.de