University of Fribourg / Faculty of Science and Medicine / Department of Biomedical Science

The cognitive neuropsychology of special states of mind in light of the biology of religious experience: behavioral, neurological and electrophysiological correlates of worship experiences with music

Yoshija Walter

To date, behavioral, cognitive and biopsychological understanding on religious cognition and experience is still rather scarce. Previous studies have failed to conduct direct measurements of "experience" when it comes to the phenomenon of religious experience because by and large they have focused on "practice", which skews the obtained findings. We set out to remedy this lack and hence performed the first bio-cognitive research on the topic that incorporates direct measures of self-reported religious experiences, here operationalized as sensing the presence of the divine. For this, first a qualitative study with 15 proficient worshippers was conducted. The first result was the *typological model of religious worship experiences* and the second was the *feedback-loop model for religious worship experiences.* The latter was crucial for constructing the subsequent experiments. In the experiments, 60 Swiss participants were recruited (all believers from evangelical churches). They were asked to worship and try to induce a state of mind where they believed to be sensing the presence of God and to rate their intensity of the experience on a continuous bar slider. This was then correlated with behavioral and biometric measurements, such as how strongly they were able to focus on the divine, assessments of the heart rate and pulse as well as electroencephalographic EEG measurements from the scalp. Results showed that believers had stronger religious experiences upon a deeper focus on God and that the body portrayed an activation of the peripheral physiological system upon the experience, measured by respiratory rate and heart rate. The EEG data showed that the religious experience came about with a deep mental state (delta, theta and alpha bands) but as it increased, the correlation with upper frequencies emerged (mainly beta and negative correlations to alpha). There was a relaxation of the frontal as well as the parietal cortex, as indicated by the dominance of lower frequency bands. An EEG microstate analysis showed that three neural networks were involved: (i) the auditory and temporal network, (ii) the default mode network, (iii) and the salience network. The last was the strongest predictor of the measured religious experience.

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