

## **The neurophysiological effect of repetitive religious chanting on the connectivity between brain regions and heart**

Repetitive religious chanting such as chanting the name of Amitabha or mantra is broadly practiced. It is assumed that this kind of religious chanting can help practitioners to achieve mental stability. The purpose of this study is to examine the effect of religious chanting on stress reduction and psychological wellbeing, from a behavior and neuroimaging perspective. Stress is a prevailing condition in the current society, especially during an unprecedented pandemic. Religious chanting has been practiced in both East and West, indicating its universal capacity to engage spiritual and mental wellbeing.

Two approaches will be used to testify its beneficial effect on stress reduction and sleep quality. First, a cross-sectional study will use psychological questionnaires to quantify the psychological profiles of participants with experience of repetitive religious chanting and those without. Mediation analysis will be applied to delineate the potential causal relationship between those psychological profiles with religious chanting experience.

Second, electroencephalogram (EEG) and other physiological instruments will be used to measure the corresponding neurophysiological activities during religious chanting. Resting-state EEG, event-related potential (ERP), and cardiac activities will be recorded. Their potential correlation with psychological profiles will be calculated. To investigate the brain activities in a large population, wearable EEG devices will be applied to measure the frontal activities and the pulse rate of participants simultaneously. Entrainment of brain and heart activities among the participants during their religious chanting will be investigated using connectivity and correlation analysis.

It is hypothesized that religious chanting can improve psychological wellbeing due to its relation with the brain network, including the prefrontal and parietal lobes. The brain activity during group religious chanting may be different from that during individual religious chanting. Finally, potential coordination between the brain and heart activities during religious chanting will be investigated.

### **Hypothesis**

Religious chanting is a practice with a strong sense of meaning in life, and thus they may have better mental resilience and lower perceived stress when confronted with negative events. It may result in a reduced stress as measured by SOC, NAS, and sleep quality.

The neurophysiological correlates of reduced stress may be contributed to the changes in brain activities in the parietal lobe, e.g., reduced late-positive potential (LPP). The role of the prefrontal lobe, which is related to meta-cognition, will be examined.

The balanced function of the autonomic nervous system may mediate the reduction of the perceived stress. The ratio of high/low frequency of heart rate variability will be calculated to reflex this change.

The neurophysiological activities among multi-participants may be entrained during religious chanting, as shown by connectivity and correlation analysis.

### **Potential Results**

1. Participants with religious chanting experience will show more psychological resilience as measured by the questionnaires.
2. The brain activities differ significantly between the two religious groups and the atheist group, mainly in the frontal-parietal brain network.
3. Possible correlation between EEG measurement and psychological questionnaires will be significant.
4. Network analysis of neurophysiological data during group religious chanting will be different than that of individual religious chanting.
5. Meditation may improve the quality of sleep, especially the N3 stage of sleep time.
6. Together with tDCS, religious chanting can help on emotion regulation.