

Emotion Prosthetics for Augmentation of Mindfulness: Statistical Plan

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Canonical Analysis Strategy

Our canonical strategy for all aims in which outcome measures (e.g., physiology) are examined pre-intervention and post-intervention will as follows:

Quality Control: Data will be inspected visually and using our lab's standard algorithms to eliminate subjects, blocks, and trials in which data do not appear to be representative of the obtained measure, e.g., for EEG, data are eliminated when >3 channels have outlying means, standard deviations, are interpolated, or have unacceptably high levels of impedance.

Preprocessing: Data will be preprocessed using our lab's standard procedures which are consistent with industry standard procedures, e.g., via guidelines for psychophysiology from the Society for Psychophysiological Research. Outliers will be rescaled via windsorization.

Data Reduction: if more than one outcome measure of a given type (e.g., electrodes, for EEG) are employed, principal components analysis (PCA) will be used to yield aggregate indices across proposed outcome variables.

Analysis: Pre-intervention index values will be interacted with intervention type (mindfulness alone vs. TVS added to mindfulness) to explain variance in post-intervention index values using hierarchical regression; in the absence of an interaction, preintervention values will be regressed from post-intervention values before using intervention type as an independent variable to explain variance in post-intervention values in a residual regression analysis. The change in R^2 will be used as an effect size. Type I error will be controlled across the number of examined factors. Each type of outcome listed separately below will be interpreted as a statistically separate family for control of familywise error.

Primary Outcome Measures

1. Positive Affect Score from The Positive and Negative Affect Schedule

The Positive Affect Score will be obtained after mindfulness meditation alone and after mindfulness meditation with TVS intervention. The Positive Affect Score will add the score on items 1, 3, 5, 9, 10, 12, 14, 16, 17, and 19. Scores can range from 10-50, with the highest score representing higher levels of positive affect

Analysis: Our canonical analysis will be used on positive affect scores

2. Heart Rate Variability (HRV) during mindfulness meditation

HRV, an index of parasympathetic reactivity, will be obtained during mindfulness meditation alone and during mindfulness meditation with TVS intervention. Increased HRV indicates increased parasympathetic reactivity, which suggests an increased physiological indicator of emotion regulation.

Analysis: Our canonical analysis strategy will be employed on HRV measured during the intervention

Secondary Outcome Measures

3. Negative Affect Score from The Positive and Negative Affect Schedule

The Negative Affect Score will be obtained after mindfulness meditation alone and after mindfulness meditation with TVS intervention. The Negative Affect Score will add the score on items 2,4,6,7,8,11,13,15,18, and 20. Scores can range from 10-50, with lower score representing lower levels of negative affect.

Analysis: Our canonical analysis will be used on negative affect score

4. Global local visual processing task - percent local identifications

There will be 40 images for each task. This task determines which attention is first directed, either at the local features (details, parts) or global features (the whole). Out of 40, we can determine how many local features were picked and how many global features were picked. The task will be done twice and the amount of global features vs. local features chosen will be compared with one another.

Our canonical analysis will be used on performance measures on the global local visual processing tasks

5. Mind in the Eyes Test - percent correct identifications

Participants will see a picture of a person only with the eyes present. There will be four words that describes the possible mood of the participant. The participant will be asked to choose the adjective that fits best with eye mood conveyed by picture of the person when only the eyes can be observed. This task will be done twice, and the amount of correct answers will be compared with one another

Our canonical analysis will be used on performance measures on the mind in the eyes test

6. Heart Rate Variability (HRV) during information processing tasks (composite)

HRV, an index of parasympathetic reactivity, will be obtained during tasks (Mind in the Eyes, Global-local processing tasks) after mindfulness meditation alone and mindfulness meditation with TVS intervention. Increased HRV indicates increased parasympathetic reactivity, which suggests an increased physiological indicator of emotion regulation.

Analysis: Our canonical analysis strategy will be employed on HRV measured during the follow-up tasks

7. Galvanic skin response (GSR) during mindfulness meditation

GSR, index of sympathetic reactivity, will be obtained during mindfulness meditation alone and during mindfulness meditation with TVS intervention. Decreased GSR indicates decreased sympathetic reactivity, which suggests an increased physiological indicator of emotion regulation.

Analysis: Our canonical analysis strategy will be employed on GSR measured during the intervention

8. Galvanic skin response (GSR) during information processing tasks (composite)

GSR, index of sympathetic reactivity, will be obtained during tasks (Mind in the Eyes, Global-local processing tasks) after mindfulness meditation alone and mindfulness meditation with TVS intervention. Decreased GSR indicates decreased sympathetic reactivity, which suggests an increased physiological indicator of emotion regulation.

Analysis: Our canonical analysis strategy will be employed on GSR measured during the follow-up tasks

9. Prefrontal gamma band EEG during mindfulness meditation

Prefrontal gamma band EEG will be obtained during mindfulness meditation alone and during mindfulness meditation with TVS intervention. Increased prefrontal gamma EEG band indicates increased physiological indicator of emotion regulation.

Analysis: Our canonical analysis strategy will be employed on EEG measured during the intervention

10. Prefrontal theta band EEG during mindfulness meditation

Prefrontal theta band EEG will be obtained during mindfulness meditation alone and during mindfulness meditation with TVS intervention. Increased prefrontal gamma EEG band indicates increased physiological indicator of emotion regulation.

Analysis: Our canonical analysis strategy will be employed on EEG measured during the intervention

11. Prefrontal gamma band EEG during information processing tasks (composite)

Prefrontal gamma band EEG will be obtained during tasks (Mind in the Eyes, Global-local processing tasks) after mindfulness meditation alone and mindfulness meditation with TVS intervention. Increased prefrontal gamma band EEG suggests an increased physiological indicator of emotion regulation.

Analysis: Our canonical analysis strategy will be employed on EEG measured during the follow-up tasks

12. Prefrontal theta band EEG during information processing tasks (composite)

Prefrontal theta band EEG will be obtained during tasks (Mind in the Eyes, Global-local processing tasks) after mindfulness meditation alone and mindfulness meditation with TVS intervention. Increased prefrontal gamma band EEG suggests an increased physiological indicator of emotion regulation.

Analysis: Our canonical analysis strategy will be employed on EEG measured during the follow-up tasks

13. Heightened state of awareness using 5-Dimensional Altered State of Consciousness questionnaire (5D-ASC)

Participants will answer which experience (mindfulness alone or mindfulness with TVS) they found most profound, and answer the 5D-ASC based on the more profound experience. Higher scores on the 5D-ASC indicates increased heightening state of awareness. For each question, the score is on a likert scale (1 to 5).

Analysis: Our canonical analysis will be used with variables for prior altered state of awareness in the pre-intervention term.

Other Pre-specified Outcome Measures: Moderation Analyses

Canonical Moderation Analysis Strategy

Moderation analyses will be analyzed by adding a third and fourth level to the hierarchical regressions described in our Canonical Analysis Strategy. On the third level, moderating variables are added. On the fourth level interactions of the moderating variables with primary and secondary outcome variables will be added. The change in R^2 from the third to the fourth level will be used as an effect size, and the significance of adding the interaction term on the fourth step will be interpreted as the significance of the moderation effect. Statistically significant moderation effects will be followed with creation of level curves for the 25th, 50th, and 75th percentiles for relevant variables to understand simple effects of the moderator on primary and secondary outcomes .

14. Moderation of primary and secondary outcomes by Trait mindfulness using Mindful Attention Awareness Scale (MAAS)

MAAS will be given at the beginning of the study. It is a 15-item scale designed to assess a core characteristic of mindfulness. Score is 1-6 (average from 1-6 for 15 items). High scores is correlated with increased mindfulness. MAAS may be a predictor of objective and subjective primary and secondary outcome measures

Analysis: Our canonical moderation analysis will be used with variables for group and trait mindfulness in the pre-intervention term.

15. Moderation of primary and secondary outcomes by modified Differential Emotions Scale (mDES)

For this scale, emotions scores are created by computing the mean of 10 positive and 10 negative emotions respectively. (0-4 for negative, 0-4 for positive). These scores may may be a predictor of objective and subjective primary and secondary outcome measures

Analysis: Our canonical moderation analysis will be used with variables for trait positive affect and subjective stimulus rating measures in the pre-intervention term

16. Moderation of primary and secondary outcomes by Meditation Frequency Questionnaire (whether they meditate, and weeks/hours of meditation per week)

The questionnaire, which we have created, asks whether the participant meditates and how many minutes/hours a week do they meditate. The number of minutes/hours per week of meditation may be a predictor of objective and subjective primary and secondary outcome measures.

Analysis: Our canonical moderation analysis will be used with variables for meditation frequency and subjective stimulus rating measures in the pre-intervention term