Neurophysiological study on the effect of various short durations of deep breathing: A randomized controlled trial

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The benefit of doing deep breathing

- Deep breathing involves intense engagement of the diaphragm muscle, allowing more air to enter the lungs to mix with the residual air in the lungs and reducing the wastage of air due to the dead space (Bindu et al., 2013).

- Previous studies on deep breathing have shown its effectiveness in improving the psychological and physiological effects on humans: reducing stresses (Brown and Gerbarg, 2005; Kimura et al., 2005; Paul et al., 2007) decreasing pain perception (Busch et al., 2012; Zautra et al., 2010), improving blood flow (Bindu et al., 2013; Kennedy et al., 2011; Mori et al., 2005; Pramanik et al., 2009), and increasing the heart rate variability (Krasnikov et al., 2013; Lin et al., 2014; Song and Lehrer, 2003; Tharion et al., 2012; Wang et al., 2010).

- Recently, there is a rising interest in the effects of deep breathing on the neuro-physiological level of humans and its implication in the cognitive do-main.

- The question are
- 1. what is the efficient time duration for this exercise?
- 2 How deep breathing can alter our brainwaves ?

Aim of the work

- The aims of this study were two-fold.

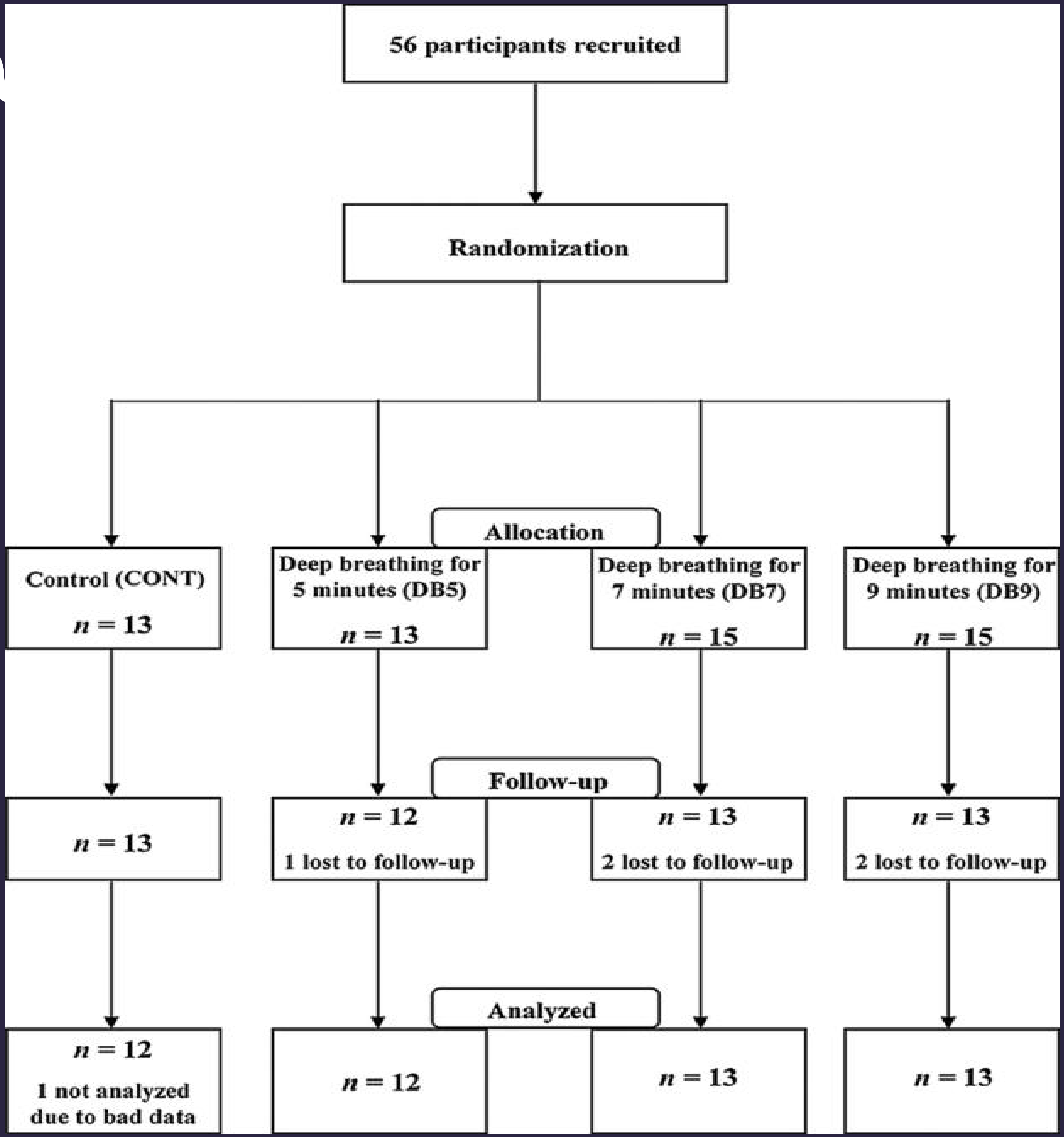
  - First, previous results in the current literature were recreated here using a different experimental design.

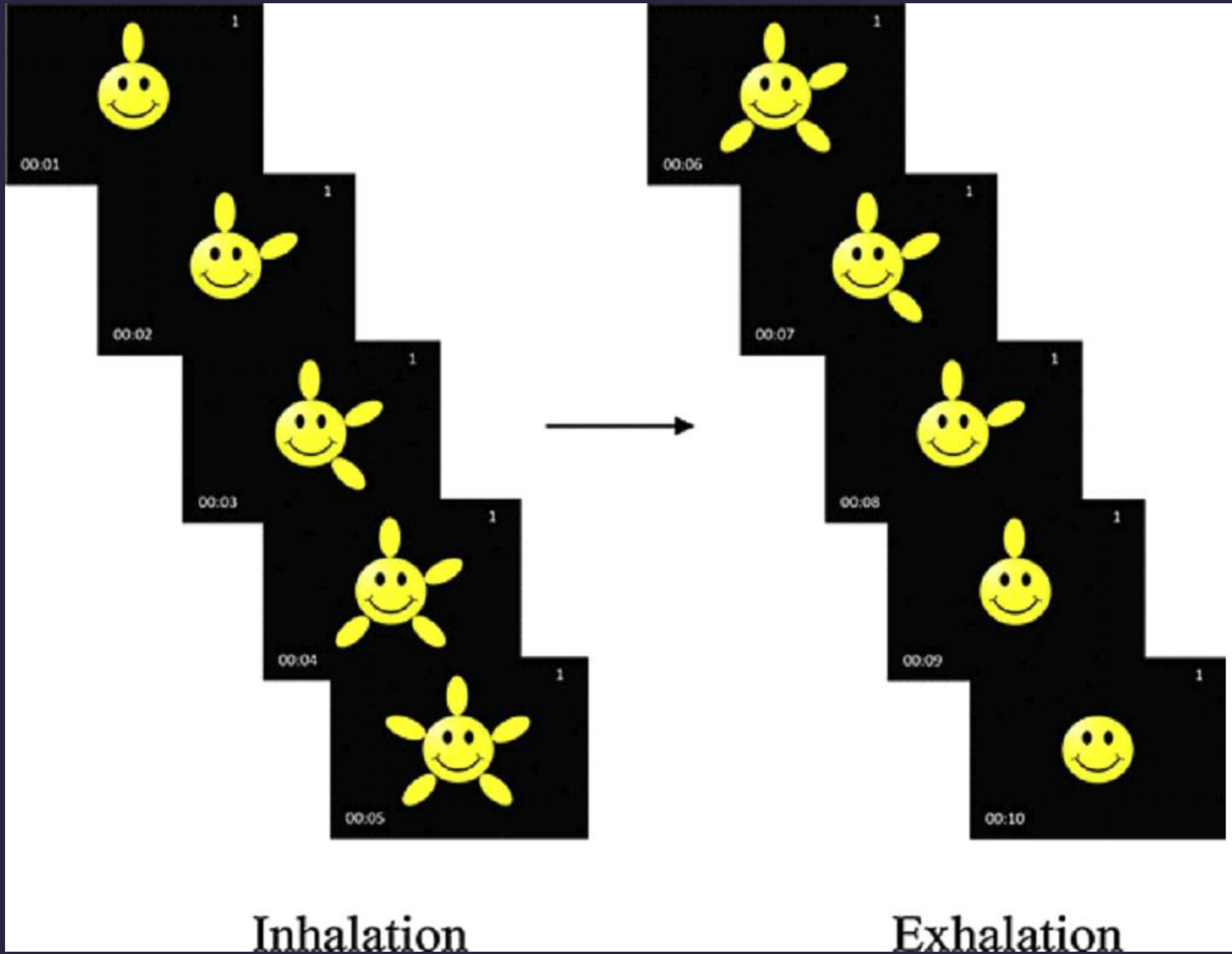
  - Second, the differences across the control and deep breathing groups in terms of the mean power and topography were assessed during deep breathing, immediately after and a follow-up after 7 days of consecutive practice.

Experiment design

- In this study, a parallel group design was employed to investigate the effects of three different deep breathing durations (5, 7, 9 min, and a control group with no deep breathing) on the mean relative power in the theta, alpha, and beta bands.

- This ensured that any possibility of carry-over effects would not be present. Further, the topographical distributions of each power bands were investigated as well.





Screenshots from the deep breathing video. The video has two sections one with appearing petals for the inhalation and one for the exhalation with disappearing petals. The breathing rate was set to 6 breaths per minute.

Electroencephalogram

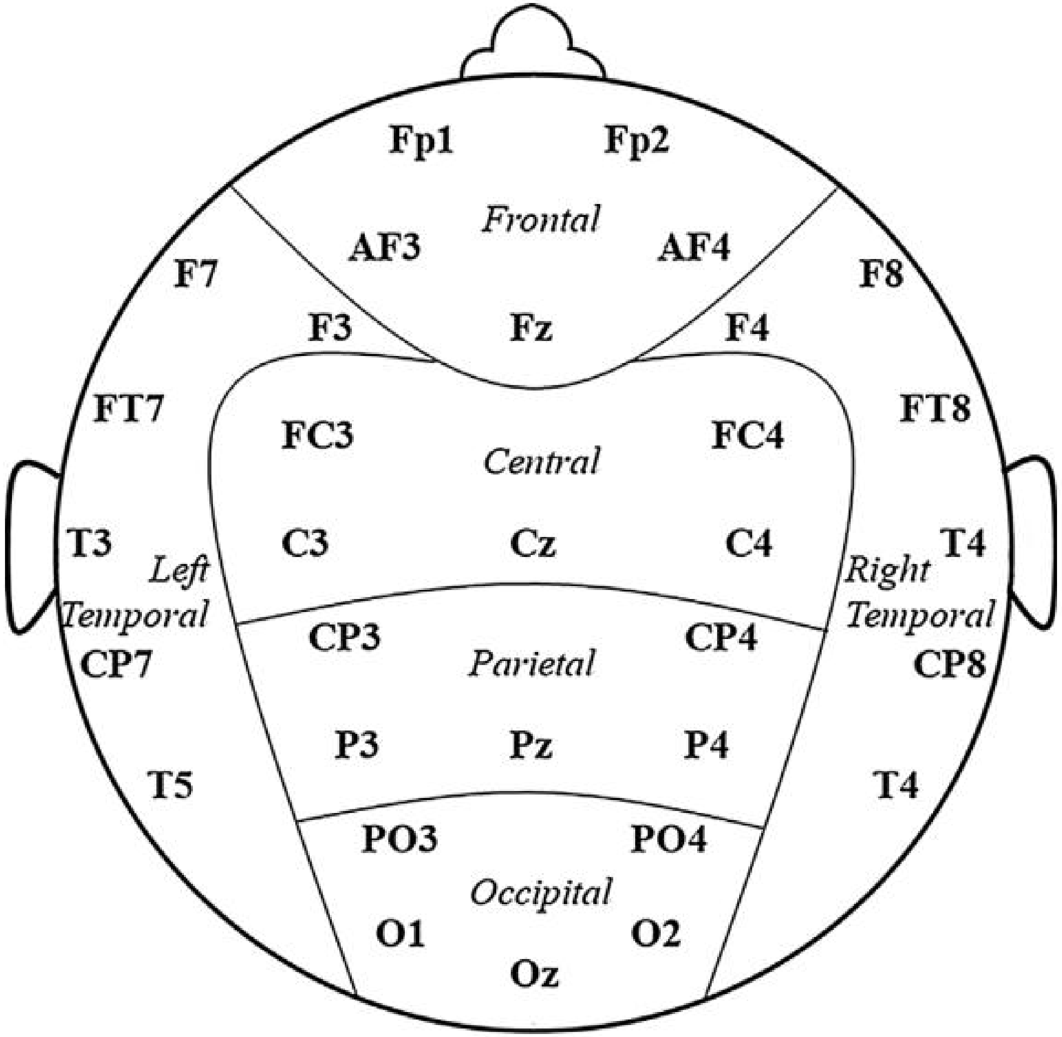


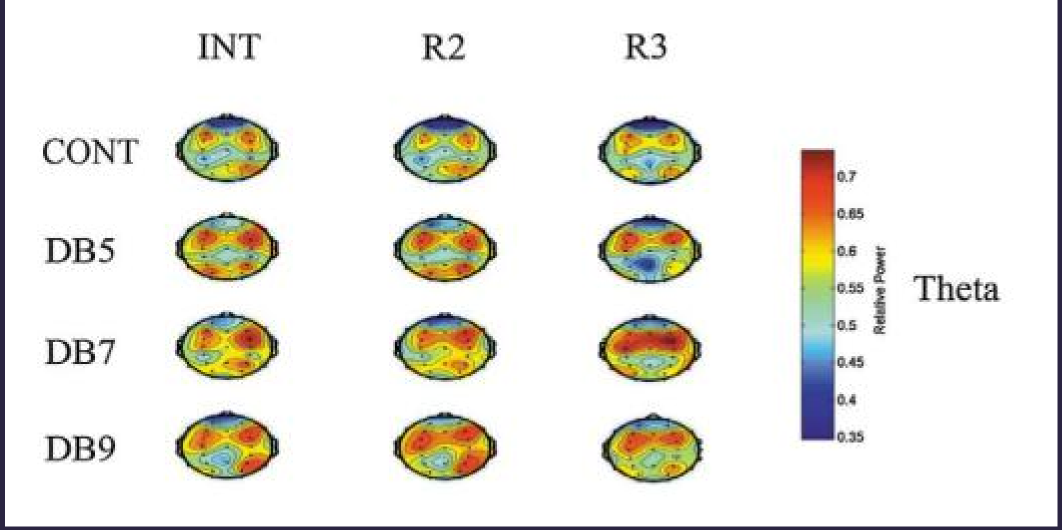
Fig. 3. The placement and groupings of the 32 electrodes. The electrodes are grouped into the frontal, central, parietal, occipital, left temporal, or right temporal location.

Statistical analysis

- The mean powers were analyzed using a 4 × 3 × 6 repeated mea-sure ANCOVA with the Group (CONT, DB5, DB7, and DB9) as the be-tween-subject factor and the Time (INT, R2, R3) and Location (frontal, central, parietal, occipital, left temporal, and right temporal) as the within-subject factor.

Findings

Theta band



- (CONT, DB5, DB7, and DB9) during each time sections (INT- immediate
- , R2– right after deep breathing, and R3—follow up day 7 , no DB).

One of the major findings in this study was the significantly larger frontal theta power in the DB5 and DB9 groups as compared to CONT ($p = 0.027$ and $p = 0.006$, respectively) whereas there was no difference in the frontal theta power between DB7 and CONT ($p > 0.05$).

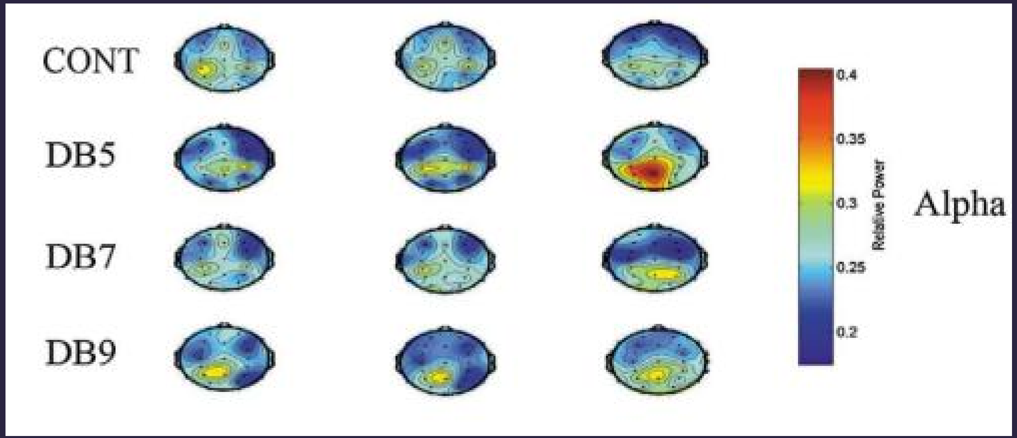
The larger frontal theta power was not present after 7 days of consecutive practice.

Since deep breathing forms an elemental part in the majority of mindfulness meditations (Brown and Gerbarg, 2005) the increase in frontal theta could be interpreted as a greater focused attention (Aftanas and Golocheikine, 2001; Nakashima and Sato, 1993; Park et al., 2002).

- Furthermore, the frontal theta power is inversely correlated to anxiety such that a greater frontal theta power indicates a lower anxiety (Inanaga, 1998).

- Collectively, the video-guided deep breathing is able to act as a meditation technique for achieving the state of ‘focused yet not anxious' that is common in most mindfulness meditations (Tomasino et al., 2014).

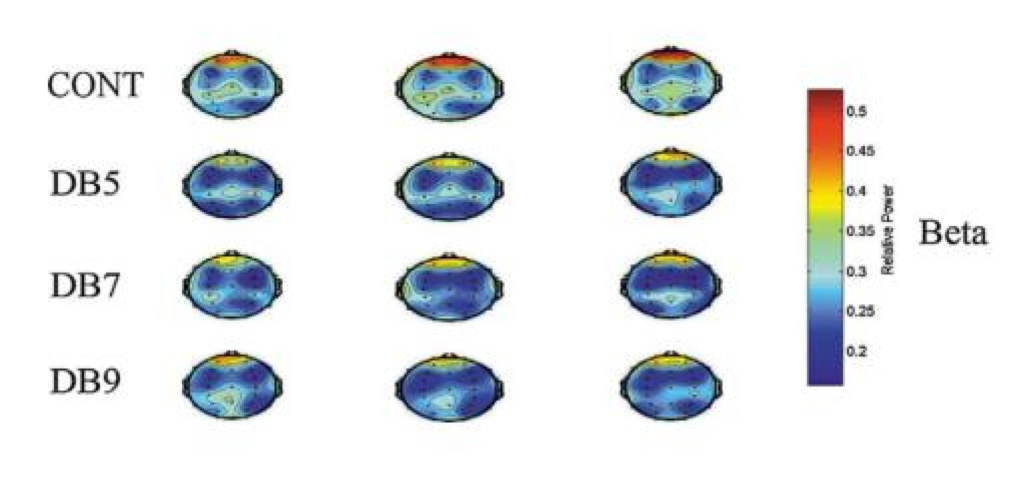
Alpha band



(CONT, DB5, DB7, and DB9) during each time sections (INT-immediate , R2– right after deep breathing, and R3—follow up day 7 , no DB).

- Analysis on the relative alpha power showed that there was no group difference between the control and the deep breathing groups during INT, R2, and R3.
- In terms of the topography, a shift of power spectrum from the central location towards the occipital location was evident in the DB groups but not in the CONT group.
- The lack of difference between two groups for the relative alpha power magnitude contrasts markedly with literature reporting a heightened alpha power after deep breathing (Arambula et al., 2001; Fumoto et al., 2004; Park and Park, 2012; Sherlin et al., 2010; Yu et al., 2011) that is normally interpreted as an induction of a relaxation state.

Beta band



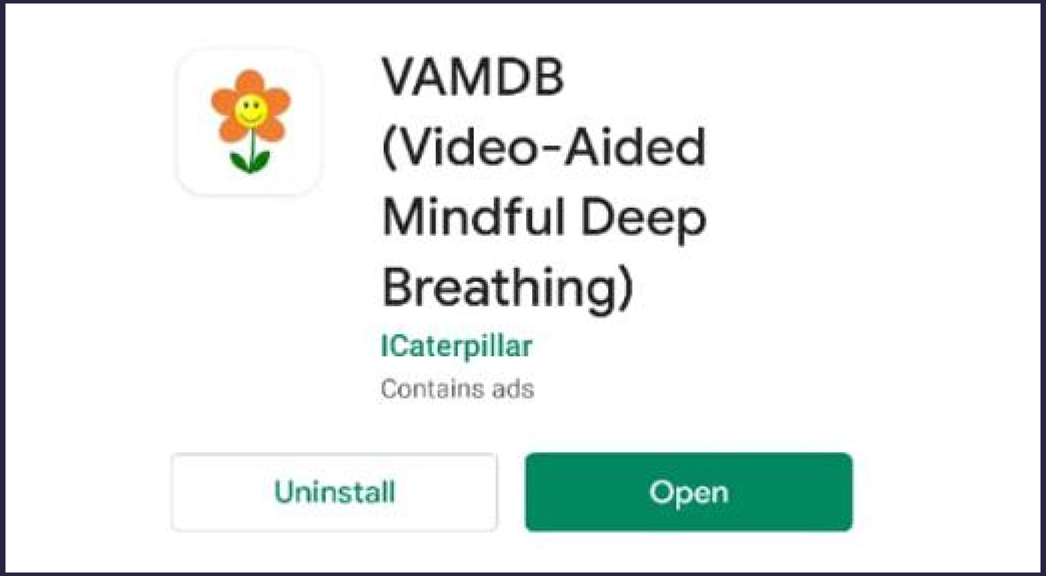
(CONT, DB5, DB7, and DB9) during each time sections (INT-immediate
, R2– right after deep breathing, and R3—follow up day 7 , no DB).

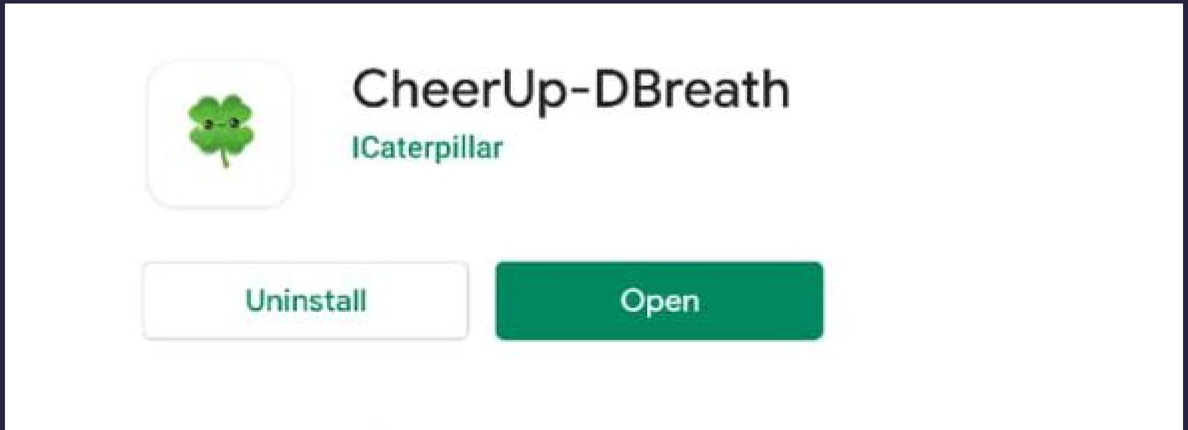
- As for the beta power, there was a reduction in the overall relative beta power during deep breathing (INT), immediately after (R2) and also, after a 7-day follow-up in the DB groups (R3).
- This reduction of beta power is interpreted as a decrease in anxiety (Pavlenko et al., 2009) and again, this is consistent with the shifting towards to the parasympathetic nervous system during deep breathing, which reduces anxiety (Miu et al., 2009).
- Even though there are relatively fewer studies on the beta power, current literature has produced mixed results.

Summary

- Frontal theta power of DB5 and DB9 was significantly larger than that of CONT after the deep breathing session ($p = 0.027$ and $p = 0.006$, respectively) and the profound finding showed that the theta topography obtained a central-focused distribution for DB7 and DB9.
- The result obtained was consistent with previous literature, albeit for certain deep breathing durations only, indicating a possible linkage between the deep breathing duration and the neurophysiology of the brain.

Google play store





Thank you for your attention
Wish you all well and happy always

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