Supplemental Material

Materials and methods

Participants

Twenty-four food-deprived (fasting for 6h) participants (age range 22–47 years, fifteen females) were recruited by the Leibniz Research Centre for Working Environment and Human Factors (IfADo) by online advertisements. Participants were compensated with 10 euros/h for their time spent and travel expenses. They were asked to attend 3 stimulation sessions in random order with an inter-session interval of at least 48 hours (i.e., anodal, cathodal, sham). In each session, participants were first asked to rate their hunger (baseline) via a visual analogue scale (VAS). Two participants provided an outlier response (> 3 SD) in the anodal and cathodal sessions. Therefore, we decided to remove these data from the analysis. Participants provided written informed consent and procedures were approved by the local ethics committee. Standard transcranial direct current stimulation (tDCS) exclusion criteria were applied for participant screening. Participants were excluded from the study if they met any of the following criteria: intake of psychoactive medication, presence of a metal object/implant in their brain, skull, scalp, or neck, implantable devices (e.g. cardiac pacemaker), any neurological or psychiatric diseases, epilepsy or cardiac disease, history of traumatic brain injury, pregnancy.

Questionnaires and Measures

The Council on Nutrition Appetite Questionnaire (CNAQ) was used to detect appetite disorders in our participants. The overall score was 30.04± 2.86, and thus not pathologic. A score lower than 28 indicates a significant risk of at least 5% weight loss within six months. We also calculated the Body Mass Index (BMI) by using self-reported height and weight scores. The average score was 24.13 ± 3.54, which is also not pathological. Subjective hunger was detected by using a VAS with the indication of the minimum and maximum at the ends of the segment (not hungry vs. extremely hungry). Participants were asked to bisect the line according to their subjective sensation of hunger.

Electromyogram recording and TMS

Tongue Motor-evoked potentials (MEPs) were recorded from both tongue sides in order to identify the hotspot (i.e. the stimulation positions that induce MEPs of maximal amplitude from the corresponding muscle), of the left tongue muscle-representing area of the primary motor cortex (tnM1). Surface electromyographic (EMG) signals were recorded using disposable surface electrodes (Vitrode V, Nihon Kohden, Tokyo, Japan). Signals were amplified and filtered using D440-2 (Digitimer, Welwyn Garden City, UK), and were digitized (CED 1401, Cambridge, UK). TMS was administered using a figure-of-eight focal coil (diameter of one winding, 70 mm; peak magnetic field, 2T) connected to a PowerMag magnetic stimulator (Mag&More, Munich, Germany) held 45° to the midline and applied over the left tongue motor cortex. The coil intersection was placed tangentially to the scalp to induce current flows in a posterior–anterior direction.

tDCS

tDCS was delivered by a battery-powered stimulator (DC-Stimulator Plus, NeuroConn, Ilmenau, Germany). Two 5 × 7 cm rubber electrodes (one anode and one cathode) were covered with saline-soaked sponges (5 × 7 cm, 35 cm^2). The sponge pocket was saturated with physiological saline solution (0.9% sodium chloride). The target electrode was placed over the left tongue muscle-representing area of the primary motor cortex (tnM1). The return electrode was placed over the contralateral mastoid process. Real tDCS (1 mA) was applied for 15 minutes. Previous studies have shown that this intensity of stimulation is safe in healthy volunteers [Bikson et al., 2018]. For sham stimulation, current was ramped up (30 s) and then immediately ramped down (30 s), and then maintained at 0 mA. Participants were blind to the stimulation condition. The order of stimulation conditions was counterbalanced among participants (Latin square balancing).

Visual stimuli

Visual stimuli were randomly selected from google image. A sample of pictures is provided below (Figure 1). The same set of pictures were used for all sessions and presented in full screen modality by using a 10.5" I Pad Air. Participants were invited to provide a short description of each photo in not more than 5 seconds.

Figure 1. Sample of photos used in the experimental session.

Timeline of the experimental procedure

The experiment was conducted over three sessions with an inter-session interval of at least 48 hours, using the same experimental context (time of day, room). Before starting the experiment, participants completed the screening process via email (tDCS screening form). Eligible participants were invited to attend three one-hour experimental session at the IfADo research laboratory. After participants had given informed consent, they completed the CNAQ and provided the demographic information and self-report hunger rating scale. Next, scalp position for tnM1 stimulation was established and marked. Participants were asked not to remove the mark for the whole duration of the study (i.e., over all three sessions). Next, participants provided a short verbal description of the content of a set of 40 photos (presented via a tablet) showing individuals eating different types of food, and rated their hunger again. Next, 2 rubber electrodes were positioned on the scalp for the

stimulation part of the experiment during which the previous photos were presented again for the duration of tDCS. Following tDCS, participants provided another hunger rating.

Statistical Analysis

We performed a repeated measures ANOVA on baseline self-reported hunger scores to exclude a priori differences. Another repeated measures ANOVA was conducted on self-reported hunger scores following stimulation. Scores were calculated by subtracting the rating provided by participants after stimulation from the respective baseline divided by baseline scores (i.e. $\frac{(tDCS\ score - Basel\quad score)}{Baseline\ score}$ x 100). A critical alpha level of $\alpha = 0.05$ applied for all tests of statistical significance. Partial-eta squared (η_p^2) are reported as effect sizes for the repeated measure ANOVAs.

Results

The main results are reported in the article. As further investigation we performed correlation analyses between self-reported hunger ratings and BMI and CNAQ scores. No significant results emerged (see Table 1).

	Anodal	Sham	Cathodal
BMI	r=0.194, p=0.374	r=-0.264, p=0.212	r=0.042, p=0.855
CNAQ	r=-0.027, p=0.900	r=-0.086, p=0.687	r=0.047, p=0.828

Table 1. Results of correlation analyses plotting BMI and CNAQ scores with self-reported hunger ratings in the three stimulation sessions.

Modelling outcome

ROI	Average of EF for tnM1 1mA (V/m)	Average of EF for hnM1 1mA (V/m)
ACC	0.216	0.121
vmPFC-OCF	0.169	0.057
Caudate	0.174	0.065
Putamen	0.241	0.051

Table 2. Average of electrical field (EF) of tnM1 and the motor cortex hand muscle representation (hnM1- return electrode over the contralateral mastoid). ACC (anterior cingulate cortex), vmPFC (ventromedial prefrontal cortex), OFC (orbitofrontal cortex).

References

Bikson M, Brunoni AR, Charvet LE, Clark VP, Cohen LG, Deng ZD, Dmochowski J, Edwards DJ, Frohlich F, Kappenman ES, Lim KO, Loo C, Mantovani A, McMullen DP, Parra LC, Pearson M, Richardson JD, Rumsey JM, Sehatpour P, Sommers D, Unal G, Wassermann EM, Woods AJ, Lisanby SH. Rigor and reproducibility in research with transcranial electrical stimulation: An NIMH-sponsored workshop. *Brain Stimul.* 2018 May - Jun;11(3):465-480.