Transcranial ultrasound (TUS) reduces worry in a five-day double-blind pilot study

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Introduction

- Anxiety and depression are highly prevalent and often comorbid disorders with significant personal and economic burdens.
- Current interventions have limitations, highlighting the need for alternative treatment methods
- Transcranial ultrasound (TUS) is an alternative, noninvasive brain modulation method that has greater spatial precision than existing methods such as tDCS and TMS.
- TUS has been found to excite neurons in animal brains (1), and our previous studies (2,3,4) have found TUS increases positive mood in psychiatrically healthy humans.

Specific Aim

- To examine TUS as a potential mood intervention in a small sample, to determine if estimates of effect size support the promise of a future larger trial

Method

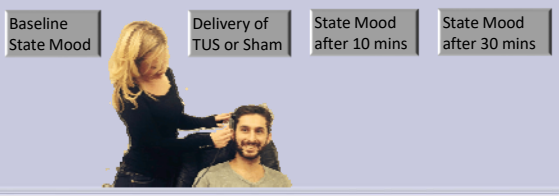
Participants: 26 young adults with Beck Depression Inventory (BDI) scores of 10-25, indicating mild to moderate depressive symptoms.

TUS Parameters: 30 secs, 500 kHz; PRF 40 Hz; lower power than previous studies (11% versus 21%) due to repeated stimulation.

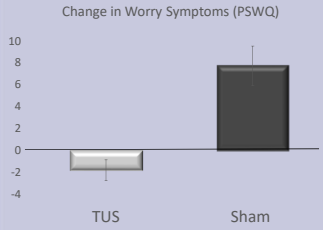
Procedure:

- Random assignment to TUS or sham, both with transducer over right inferior frontal gyrus (rIFG)
- Five sessions over 5 days
- State mood assessed before TUS/sham, and at 10, and 20 minutes after TUS/sham
- Worry (PSWQ) and Depression (BDI-II) assessed before 1st day and after 5th day

Daily Procedure

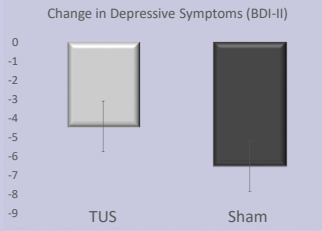


Results: Worry Symptoms



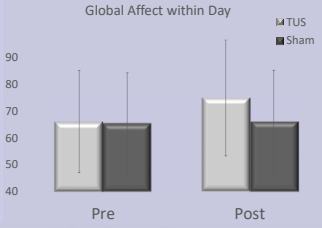
Worry decreased from Day 1 to 5 specifically in the TUS group, and increased among those receiving sham, r(22)=.363, p=.097 (a medium effect size).

Results: Depressive Symptoms



Contrary to expectation, depression scores did not change as a function of receiving TUS vs sham, r=-.237, p=.288.

Results: Acute Mood Effects (Replicating prior work)



In order to compare directly to prior research, statistical analysis of mood on Day 1 was conducted. Replicating past effects, TUS stimulation compared to TUS sham improved mood 10 minutes after stimulation Day 1, r=.757, p<.01.

Discussion

- The lower power of ultrasound used in the present study compared to our previous studies may have contributed to shorter-lived mood effects.
- TUS over the right IFG may impact anxiety rather than depression-related symptoms, via reducing repetitive thought that is future- rather than past-focused (5).
- The intervention context may have induced self-focused thinking, by asking subjects to sit doing "nothing" for 30 minutes, an experience other studies have identified as aversive (6). The fact that active TUS reduced worry in this context is noteworthy.
- We have found that TUS reduces Default Mode Network resting state connectivity, and increases connectivity within the Cognitive Control Network (see poster P2-150), consistent with the idea that TUS to the rIFG may create it's positive mood effects by reducing perseverative thinking.
- These results suggest the promise of TUS over the rIFG as an intervention for disorders involving perseverative thinking.

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