

An investigation of verbal vs. tonal working memory using non-invasive brain stimulation

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Introduction

- There are clear differences in working memory (WM) for auditory vs visuospatial information, but it is unclear whether there are further distinctions between different types of auditory stimuli (verbal vs. musical).
- Past research has observed separate WM processes for timbres compared to words and tones (Schulze & Tillmann, 2013).
- Anodal transcranial direct current stimulation (tDCS) is thought to increase neural excitability, which has the potential to influence cognition
- tDCS has been shown to be beneficial to WM in some studies (e.g. Hill, Fitzgerald, & Hoy, 2016) but not others (e.g. Hovarth, Forte, & Carter, 2015).
- The left supramarginal gyrus (SMG) has been shown to be associated with aspects of musical WM (Schaal, Krause, Lange, Banissy, Williamson, & Pollok, 2015).

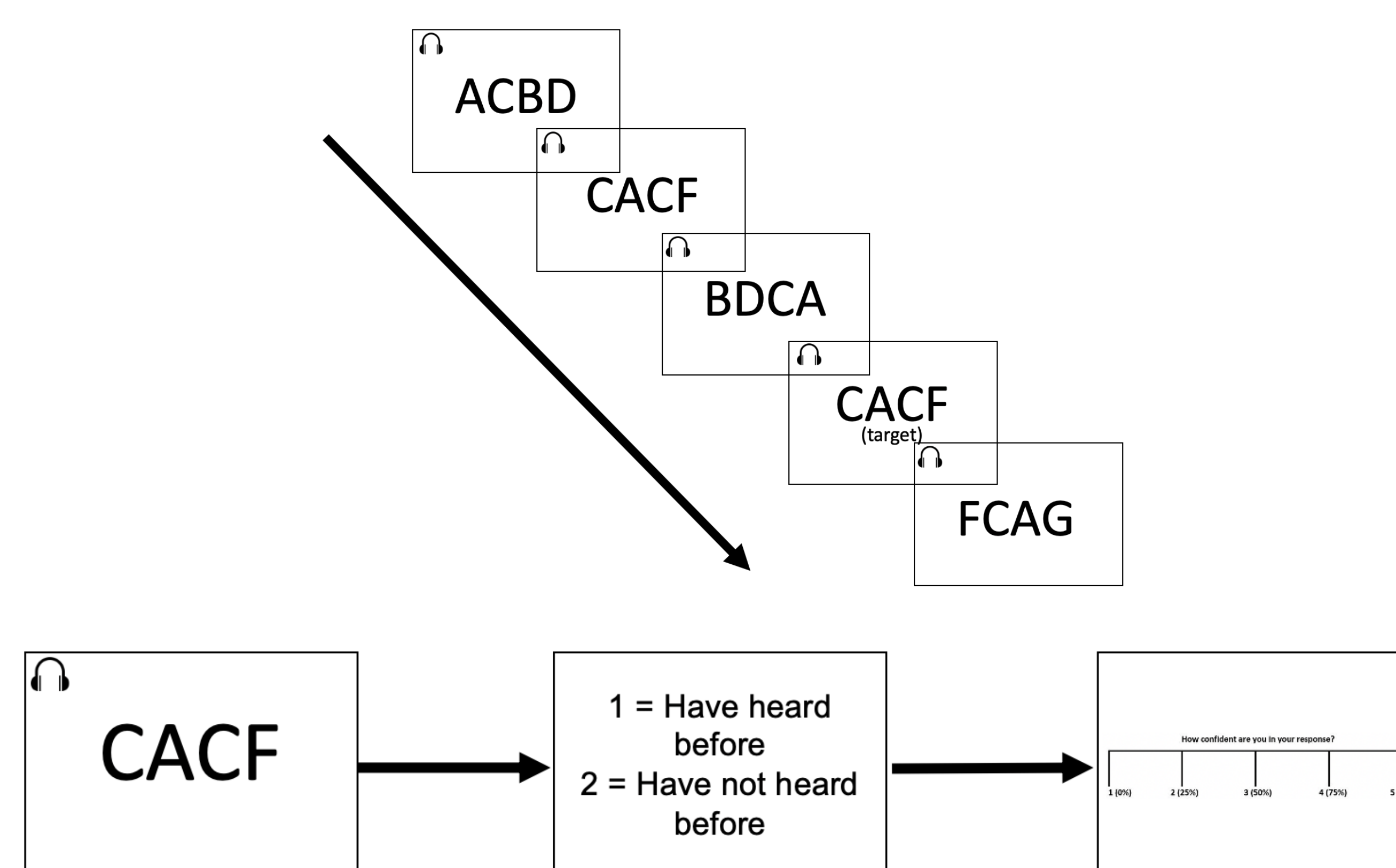
Research Questions

- Determine whether neural dissociations exist between musical and verbal WM.
- Determine if tDCS can enhance musical WM.
- Investigate if tDCS has an effect on long-term memory (LTM).

Methodology

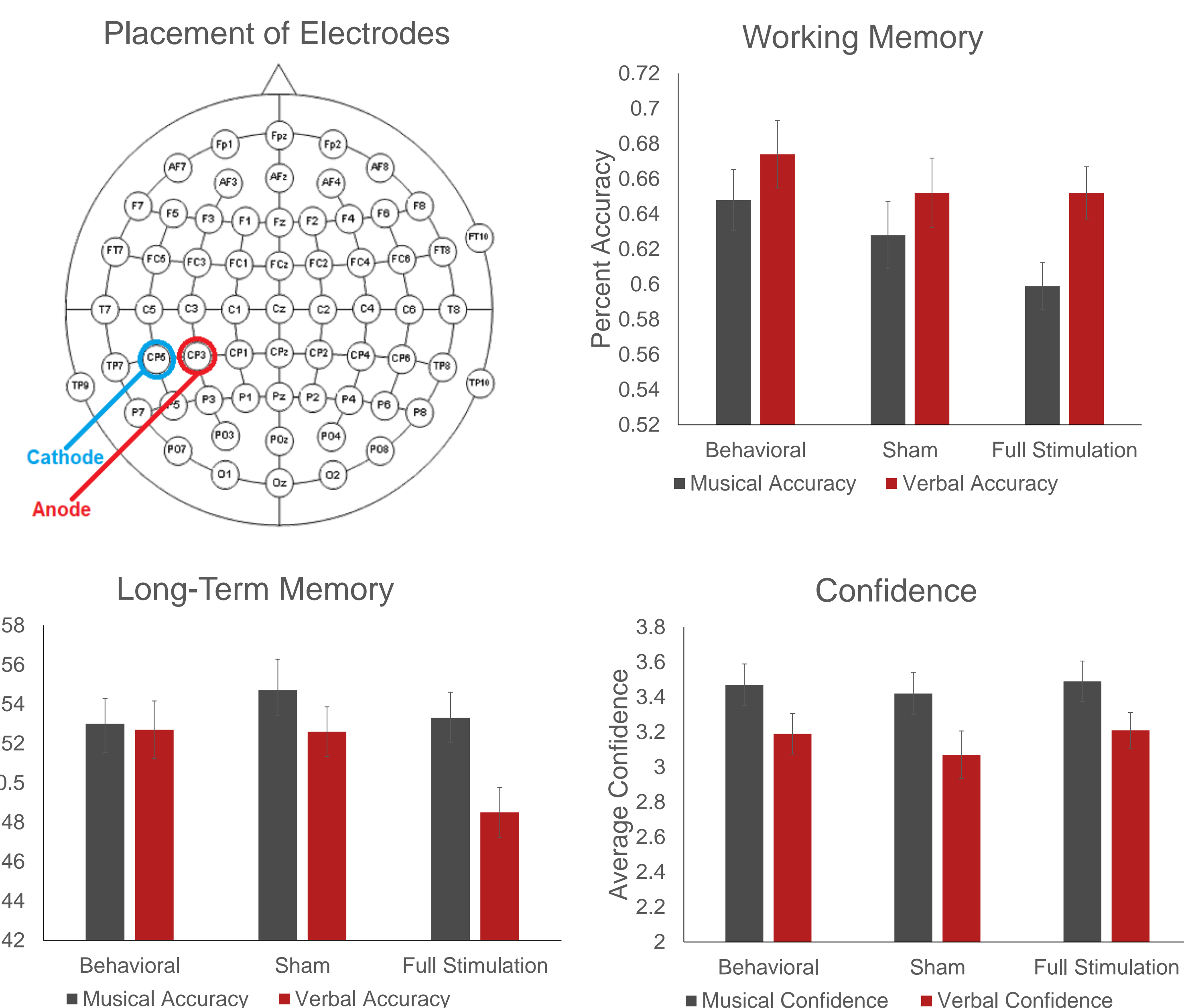
- Participants ($N = 72$, 81.9% Female) were recruited through the Texas State University human subject pool.
- Randomly assigned to one of three tDCS conditions (full stimulation, sham, or behavioral).
- Sham and behavioral conditions served as controls. tDCS device was present, but not active, during sham whereas no device was present during behavioral only.

- Stimulation occurred for 20 minutes over the left supramarginal gyrus at 1.0 mA anodal stimulation prior to completing tasks.
- Participants completed a verbal WM task and a musical WM task (2-back tasks 100 trials each; counterbalanced across participants) followed by a LTM recognition task.
- Confidence in LTM responses was assessed.



Results

- Significant differences in task accuracy between musical and verbal tasks in WM, $F(1, 69) = 11.086, p = .001, \eta^2 = .138$. Participants performed better on verbal task.
- Significant difference in confidence ratings between LTM tasks, $F(1, 69) = 43.298, p < .001, \eta^2 = .386$. Participants more confident in musical stimuli.
- No significant tDCS main effects or interactions observed.
- Gamma Correlations (measure of ordinal association between confidence and accuracy)
 - Behavioral not significantly different than 0, $t(23) = 0.445, p = .661$.
 - Sham significantly different than 0, $t(23) = 2.962, p = .007$.
 - Full significantly different than 0, $t(23) = 2.649, p = 0.014$.
 - No significant difference in gammas between tDCS stimulation conditions, $F(2, 69) = 1.795, p = .174$



Conclusion

- Musical and verbal information may be processed differently in WM but results still unclear.
- Participants appear to be more confident in LTM judgements when the information is musical.
- Future research should continue to investigate tDCS methodology and the effect on WM.

References

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- Schaal, N.K., Karuse, V., Lange, K., Banissy, M.J., Williamson, V.J., & Pollok, V. (2015). Pitch memory in nonmusicians and musicians: revealing functional differences using transcranial direct current stimulation. *Cerebral Cortex*, 25(9), 2774-2782. DOI: 10.1093/cercor/bhu075
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