

## QUESTION:

**How does musical expertise affect how we pay attention across vision and audition?**

Dividing attention across sensory modalities has been shown to impair performance (e.g. Ciaramitaro et al., 2017), suggesting attention is a limited resource shared across the senses. Musical training often involves the flexible use of two or more senses concurrently (e.g. reading musical scores and listening to sounds) and has been shown to reduce the cost of unimodal dual-task performance (Moradzadeh et al., 2015). Yet, little is known regarding how musical experience might reduce the cost of crossmodal divided attention. Here we compared the cost of crossmodal divided attention in a dual-task in musicians and non-musicians combining psychophysics and pupillometry.

## METHODS

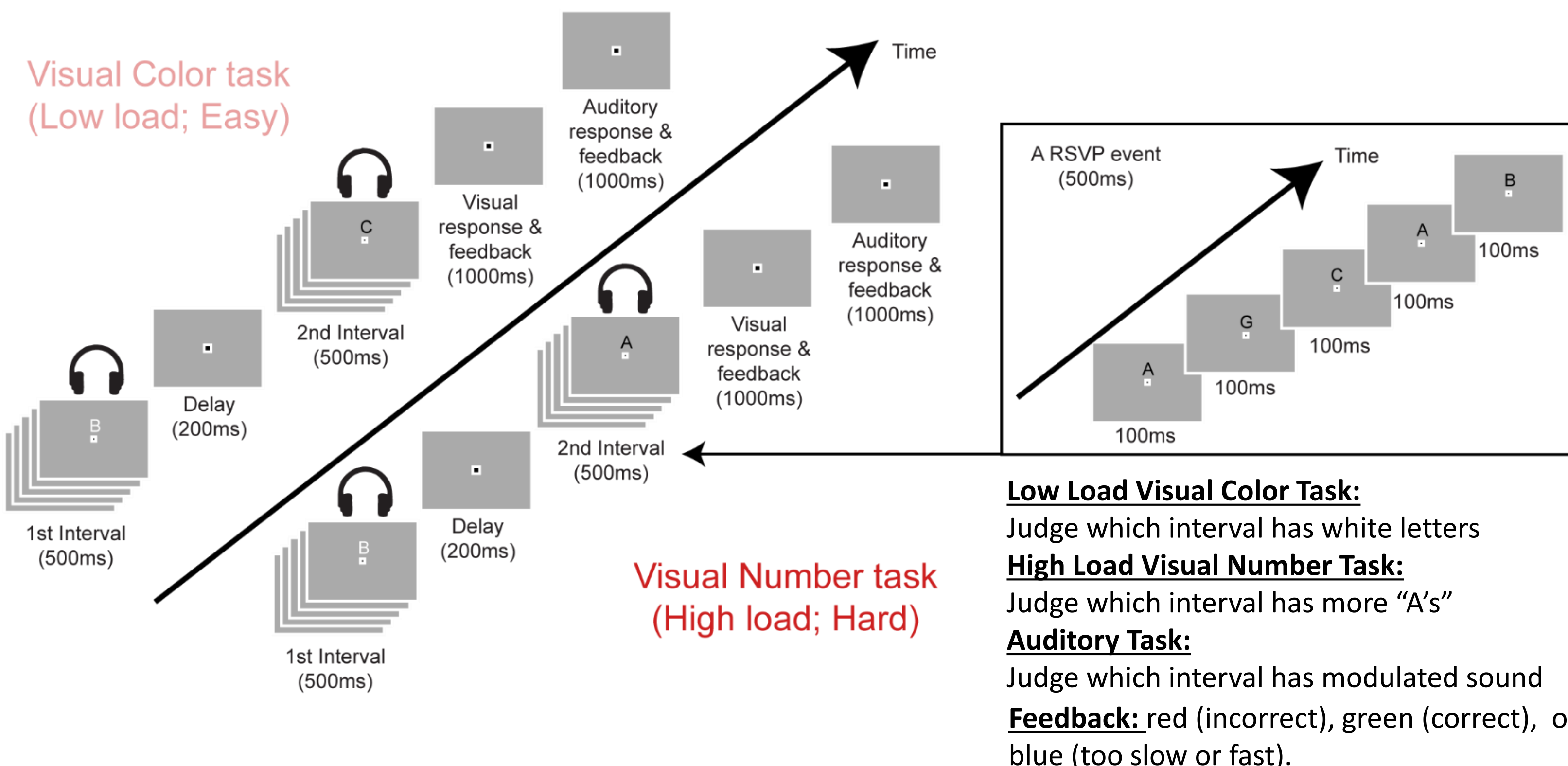
### Day 1: Quantifying musical ability/experience and training

**Brief PROMS** (Profile of Musical Perception Skill, developed by Law & Zentner, 2012; validated by Kunert et al., 2016) – to assess melody, tempo, tuning and rhythmic accent.

**Musical Experience Questionnaire** – to categorize participants based on 3 criteria: **Training Onset** (5-16 years old), **Years Training** (10+ years), **Practice Intensity** (~15 hours/week average; minimum 7 hrs/week). **Category 0:** met 1 or no criteria; **Category 1:** met 2 criteria; **Category 2:** met 3 criteria

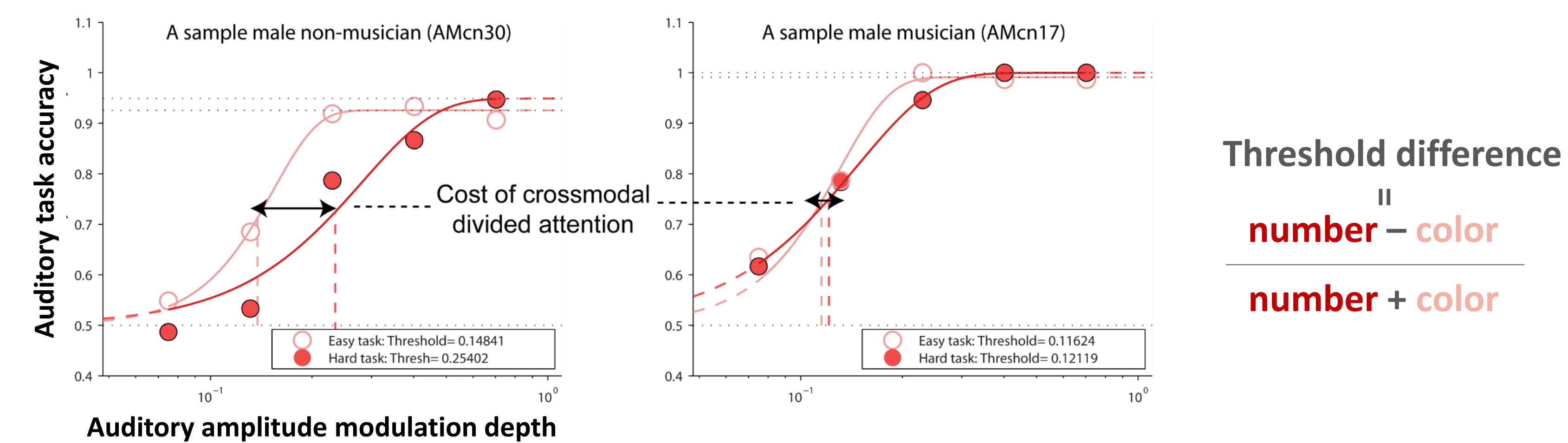
**Training** – to familiarize participants with our crossmodal dual-task (see below), participants were trained first on the auditory task alone, then the visual task alone (color and number separately), then on the visual and auditory tasks altogether (our dual task).

### Day 2: Quantifying crossmodal divided attention

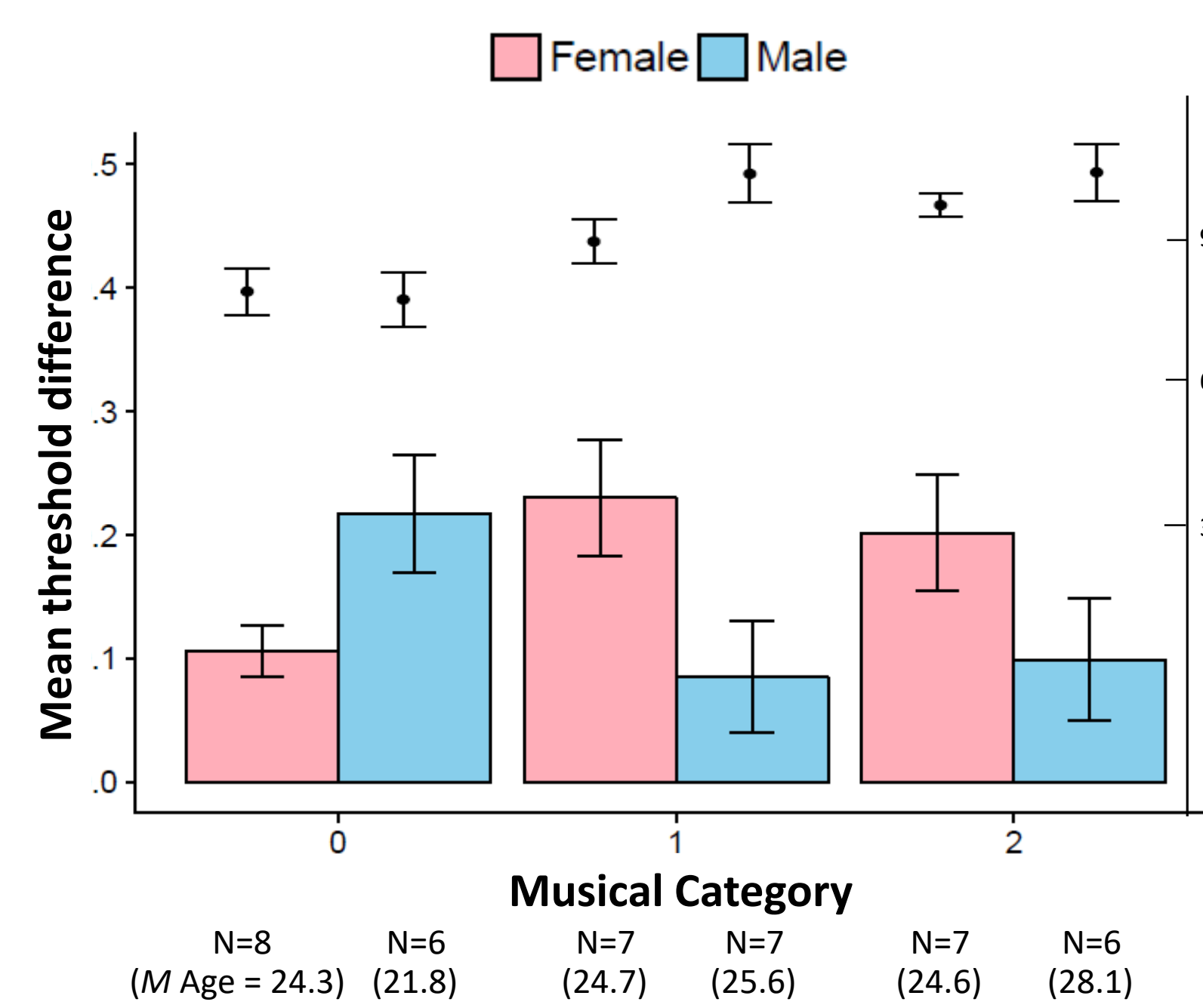


## Analysis (Behavioral data)

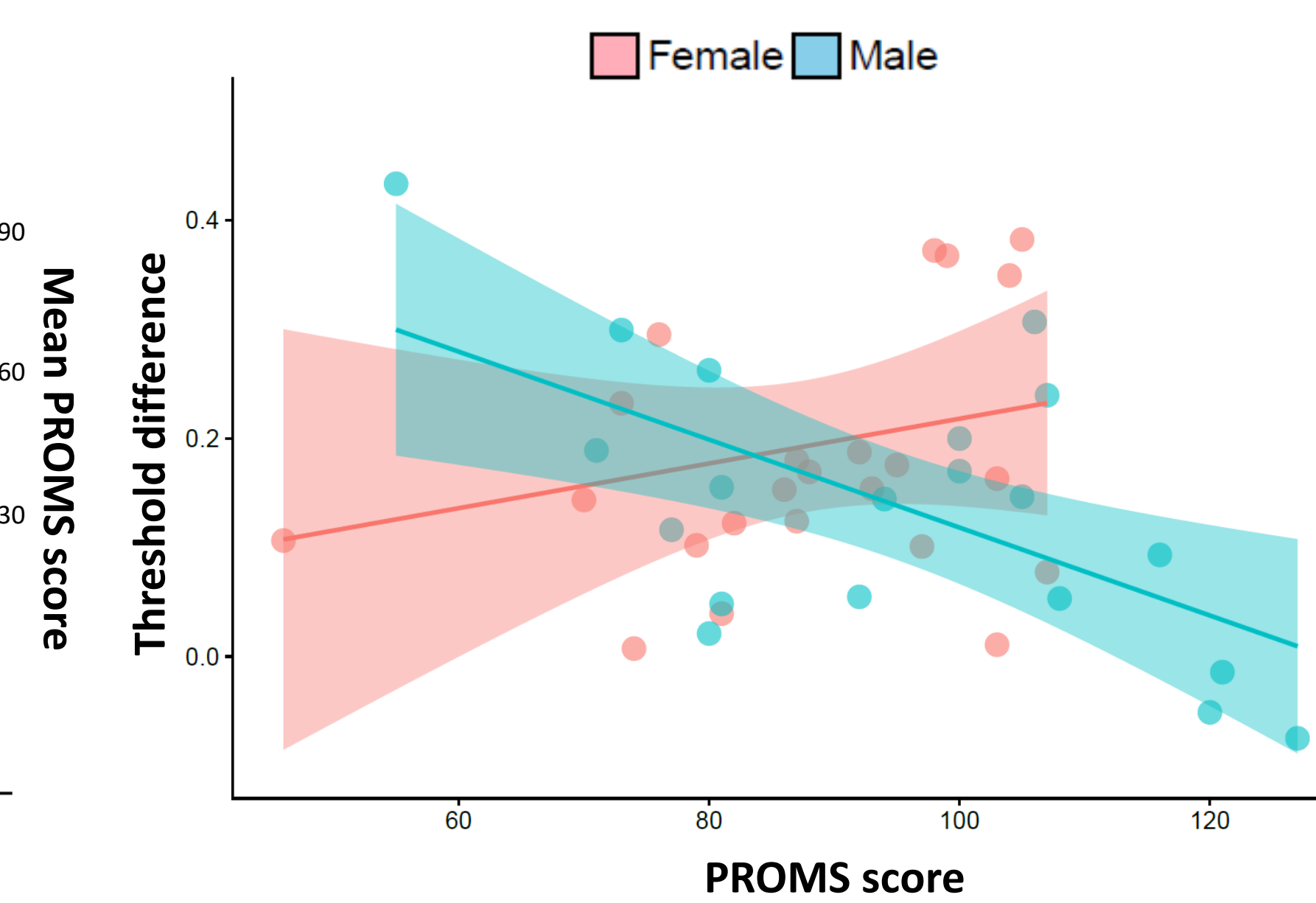
Hypothesis: Musicians would show a smaller cost of crossmodal divided attention, smaller auditory threshold differences across easy and hard visual tasks, than non-musicians.



### Threshold difference x Musician category



### Threshold difference x Musical ability



**Male musicians tend to show smaller auditory threshold differences than male non-musicians. Male participants with better musical test scores also tend to show smaller auditory threshold differences. We did not find similar effects of musical expertise in female participants.**

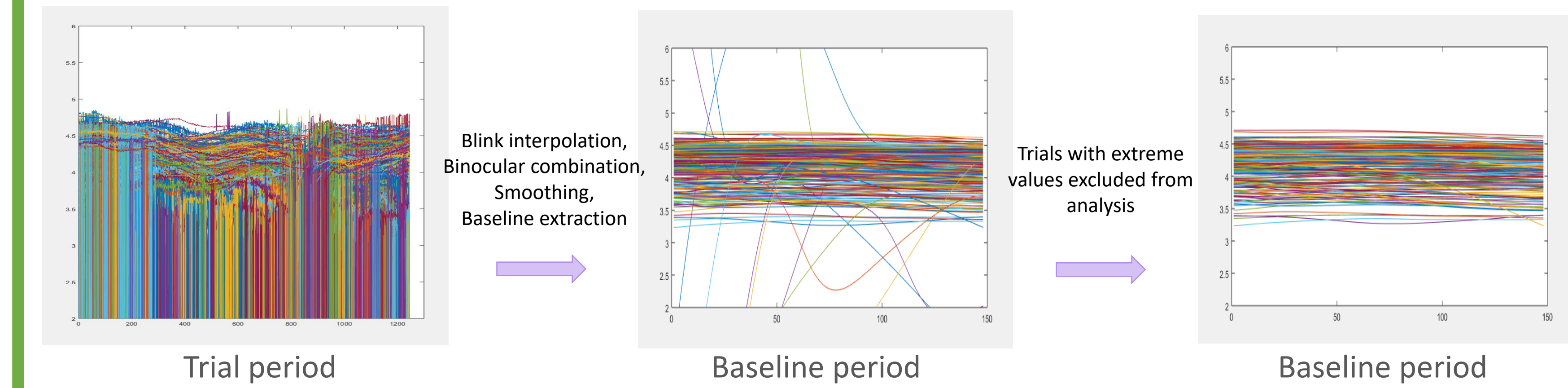
## CONCLUSION:

**Musical expertise improves crossmodal divided attention\*.**

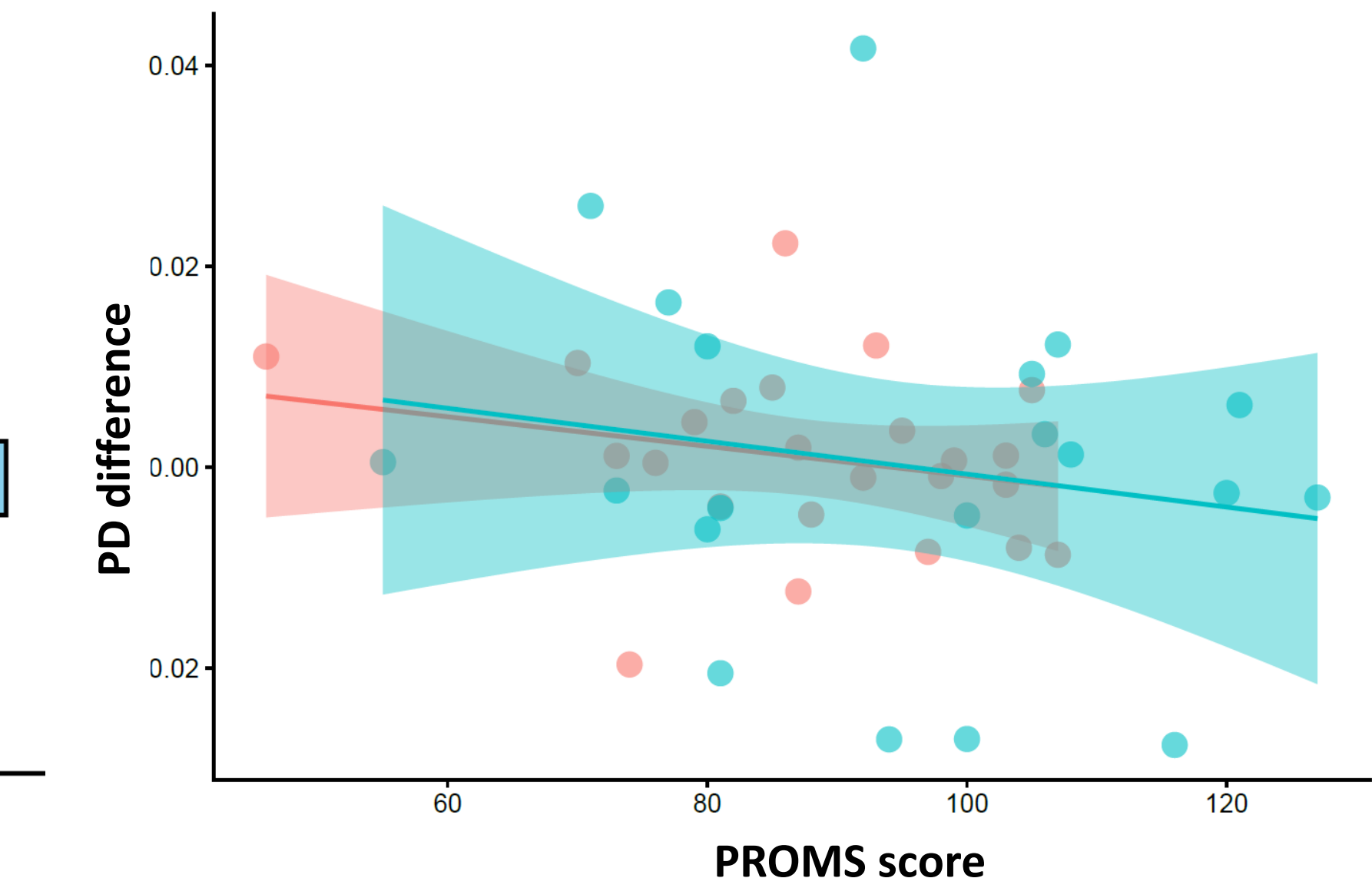
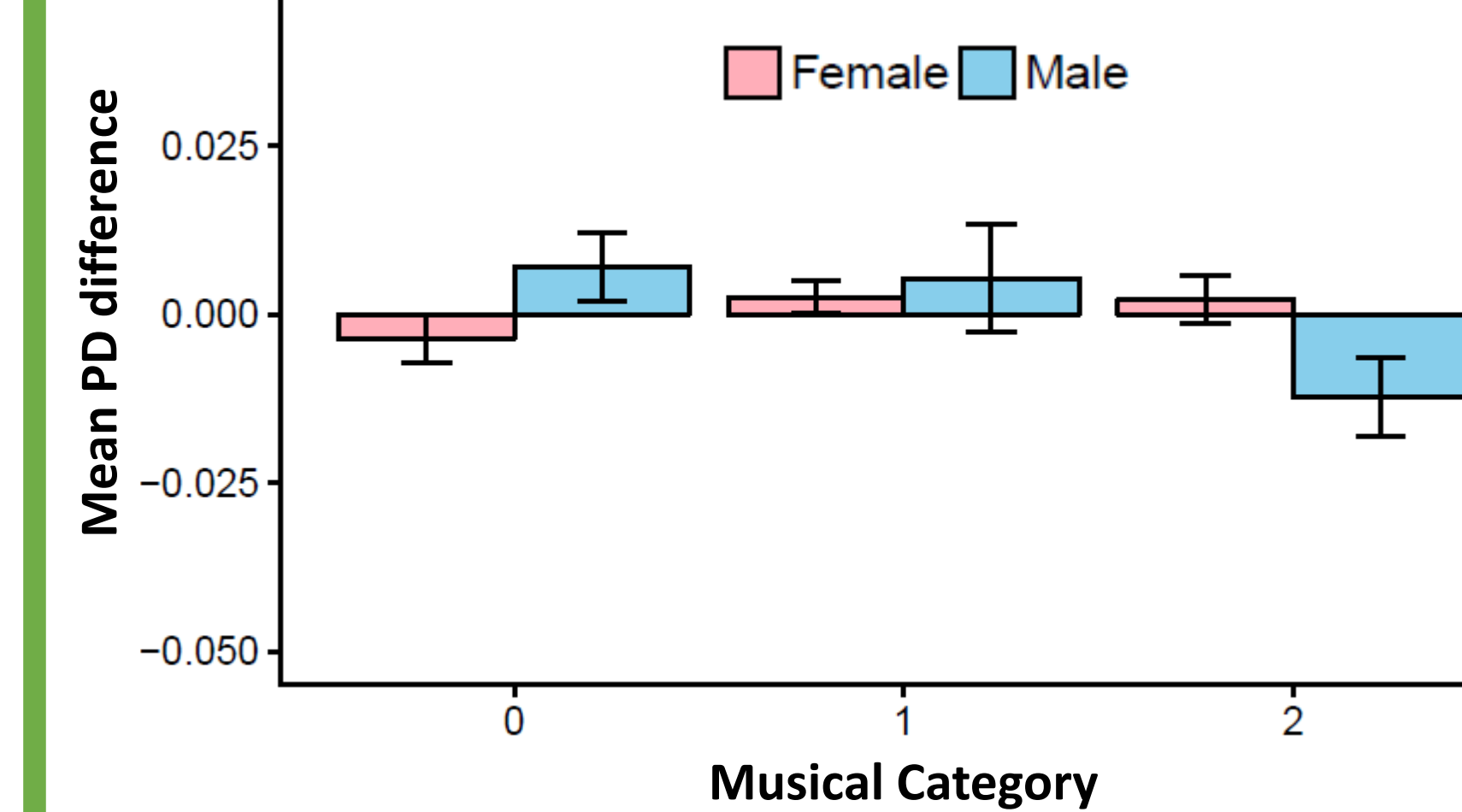
\* In male participants only. Our pupil analysis rules out the possibility that individuals with a high cost in crossmodal divided attention devoted less effort to the number task as differences in baseline pupil dilation (PD) did not change much with musical expertise. Further research is needed to understand what contributes to the observed sex difference.

## Analysis (Pupillometry data)

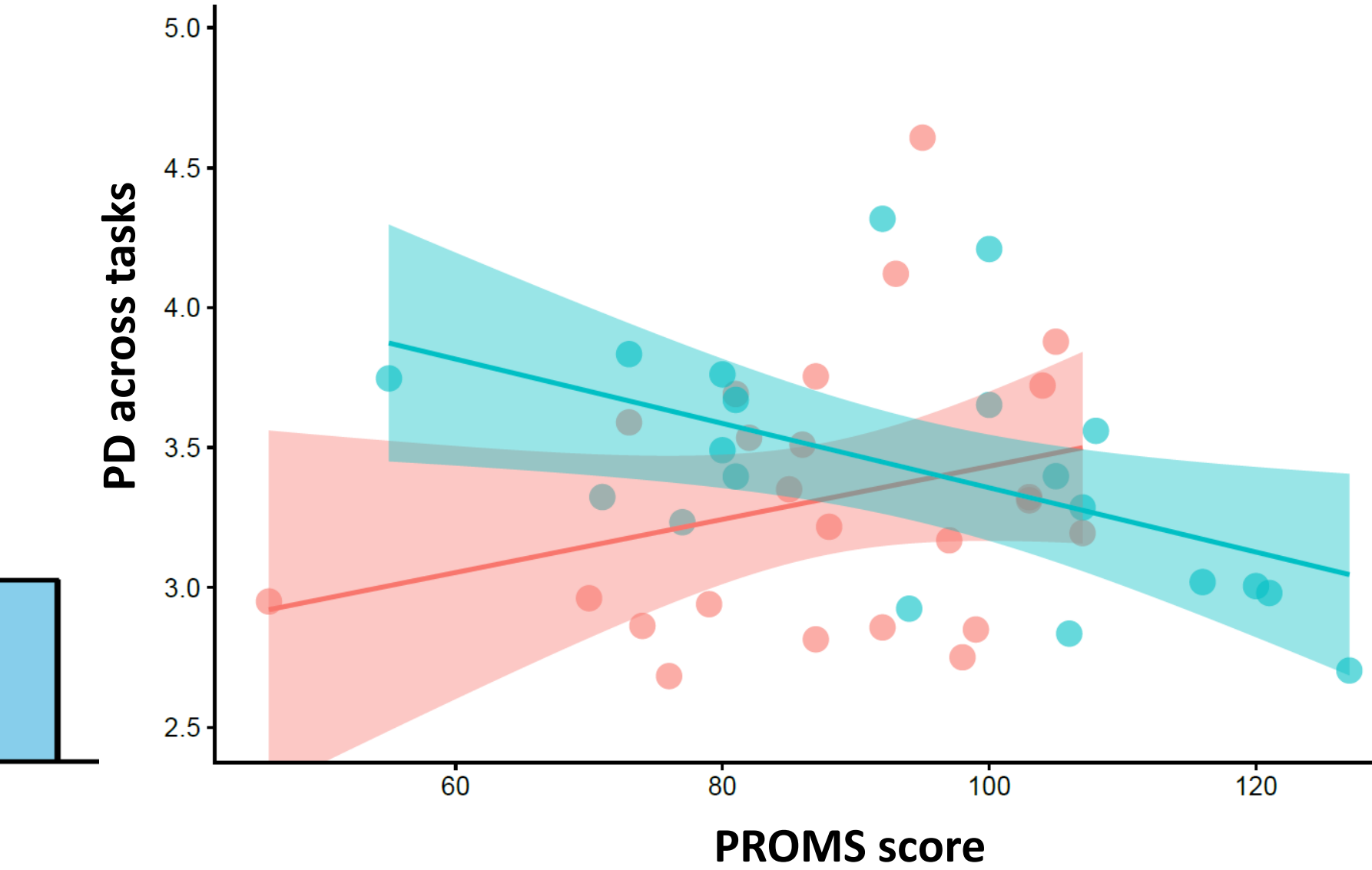
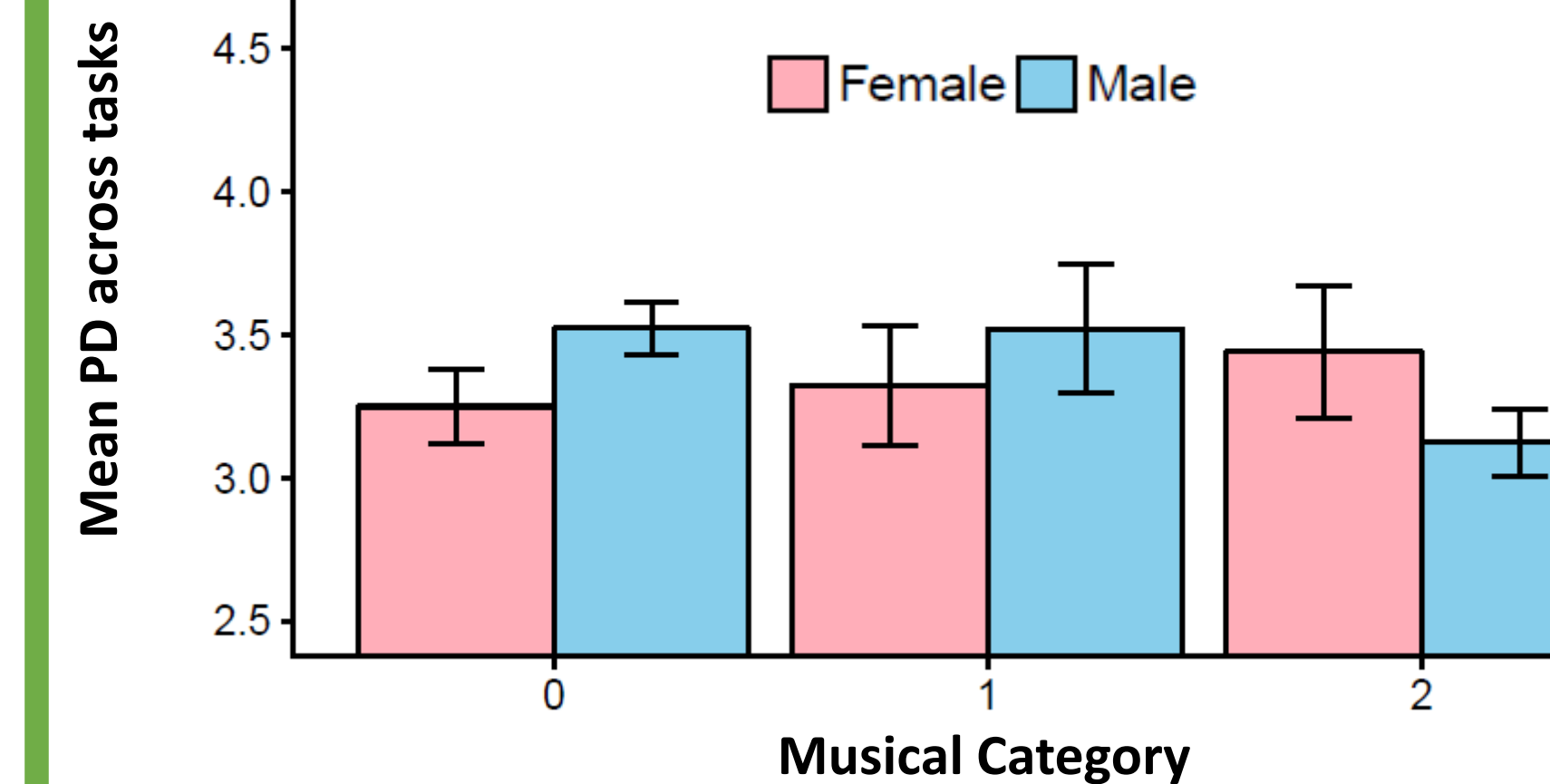
Hypothesis: Musicians would show a smaller change in tonic pupil dilation (sustained alertness/effort), across easy and hard visual tasks, than non-musicians, as well as a smaller tonic pupil dilation overall.



### Baseline PD difference



### Mean baseline PD across tasks



**Male participants with better musical test scores tend to show smaller baseline pupil dilation across trials and tasks. We did not find similar effects of musical expertise in female participants, or the expected tonic pupil dilation differences between tasks.**

References:  
 Ciaramitaro, V.M., Chow, H.M., & Eglington, L.G. (2017). Cross-modal attention influences auditory contrast sensitivity: Decreasing visual load improves auditory thresholds for amplitude- and frequency-modulated sounds. *J Vis*, 17(3), 20.  
 Jackson, I. & Sirois, S. (2009). Infant cognition: going full factorial with pupil dilation. *Dev Sci*, 12(4), 670-9.  
 Kunert, R., Willems, R., & Hagoort, P. (2016). An independent psychometric evaluation of the PROMS. *PLoS ONE*, 11(7), e0159103.  
 Law, L.N.C. & Zentner, M. (2012). Assessing musical ability objectively: Construction and validation of the PROMS. *PLoS ONE*, 7, e52508  
 Mathôt, S. (2013). A simple way to reconstruct pupil size during eye blinks. doi:10.6084/m9.figshare.688001  
 Moradzadeh, L., Blumenthal, G., & Wiseheart, M. (2015). Musical training, bilingualism, and executive function: A closer look at task switching and dual-task performance. *Cog Sci*, 39, 992-1020.