

A critical role of the right temporo-parietal junction in empathic responses to sad and fearful events: a low-frequency TMS study

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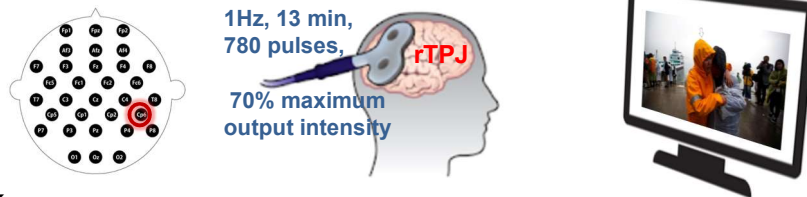
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Introduction

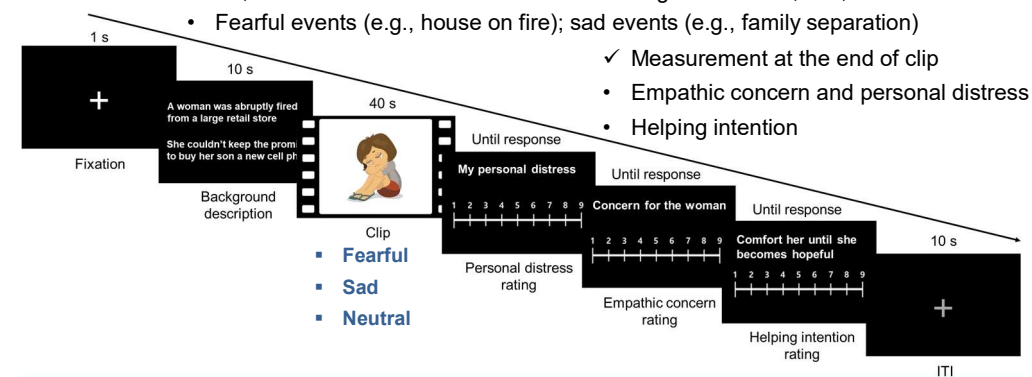
- The right temporo-parietal junction (rTPJ) plays a critical role in perspective-taking and understanding others' emotional states.
- Although functional neuroimaging studies also highlighted activations in the rTPJ during prosocial decision-making, the direct relationship between the rTPJ and prosocial decision has been less frequently investigated.
- The rTPJ may differentially mediate empathy for sad and fearful events because these emotions dissociably rely on successful perspective-taking.
- The present study aimed to investigate the causal role of the rTPJ in eliciting empathy and prosocial intention by temporarily disrupting neural activity in the rTPJ using low-frequency repetitive transcranial magnetic stimulation (rTMS) techniques.

Methods

- **Participants:** 25 healthy adults (10 women, mean age = 24, SD = 2.8) participated in this study
- **Repetitive Transcranial Magnetic Stimulation**
 - ✓ Two sessions: 1-Hz rTMS and sham stimulation over the right temporo-parietal junction (rTPJ, CP6 according to 10-20 system), separated by 1 week
 - ✓ During stimulation, participants were instructed to viewed a series of picture stimuli while taking the perspective of the suffer depicted in the picture



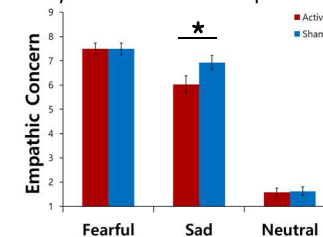
Task

- ✓ Following each stimulation, participants viewed a series of video clips made of excerpts from movies or tv dramas, which were divided into 3 emotional categories: fearful, sad, and neutral.
 - Fearful events (e.g., house on fire); sad events (e.g., family separation)
 - Measurement at the end of clip
 - Empathic concern and personal distress
 - Helping intention
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- Timeline: 1 s Fixation (+), 10 s Background description (A woman was abruptly fired from a large retail store. She couldn't keep the prom to buy her son a new cell ph.), 40 s Clip (Image of a woman), 10 s Personal distress rating (1-9), 10 s Empathic concern rating (1-9), 10 s Helping intention rating (1-9), 10 s ITI (+).
- Fearful
 - Sad
 - Neutral

Results

Empathic concern and personal distress

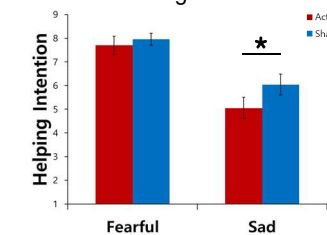
- ✓ Two-way ANOVAs with emotion (fearful/sad/neutral) * rTMS (active/sham) on empathic concern and personal distress rating were conducted respectively



- ✓ Personal distress:
 - EMOTION main effect
- ✓ Empathic concern:
 - EMOTION main effect, EMOTION X rTMS interaction effect
 - Sad events: rTMS < Sham condition
 - Fear events: rTMS = Sham condition

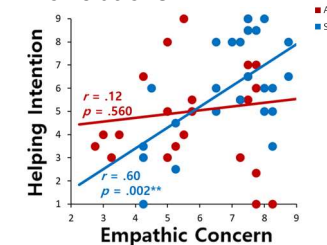
Helping intention

- ✓ Paired t-tests between rTMS active and sham conditions on helping intention rating were conducted for fearful and sad video clips.



- ✓ Sad events: rTMS < Sham condition
- ✓ Fear events: rTMS = Sham condition

Correlations



- ✓ Sad events
 - Sham condition: a positive correlation between empathic concern and helping intention was found
 - rTMS condition: no correlation
- ✓ Fear events: no such relation was found

Summary and Discussion

- These results indicate that the rTPJ is critically involved in empathic concern, prosocial intention and the relationship between them.
- Moreover, our findings suggest that the rTPJ plays different roles in sad and fearful events although they both are empathy-evoking.