Neurofunctional connections supporting mindfulness-based pain relief

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Discussion Section
Pain Imaging and Perception IV
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Introduction

Mindfulness meditation, a self-regulatory practice premised on cultivating non-reactive awareness of arising sensory events, and reliably reduces experimental [1, 2, 3] and chronic [4, 5] pain

Mindfulness meditation-induced pain relief is associated with **vlPFC activation** and **thalamic deactivation**

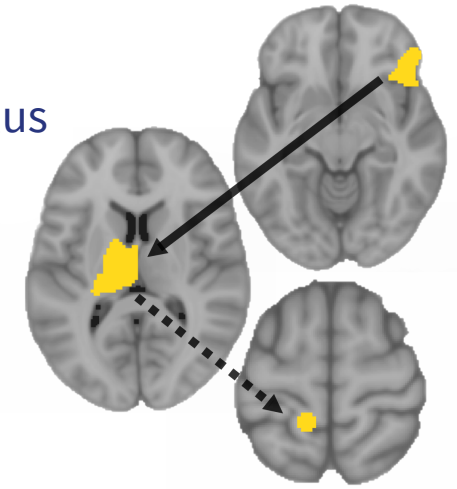
There are no known studies that have identified the neurofunctional connections supporting pain relief in response to noxious stimulation

We tested our theoretical model [1, 2, 3] that mindfulness-induced pain relief is driven by a PFC regulation of the thalamus to suppress ascending nociceptive input

Hypotheses (NCT0341438)

1. Mindfulness-meditation will reduce **behavioral** and **neural pain responses** to a noxious stimulus

2. Mindfulness-based pain relief will be associated with
   a) **stronger vlPFC-thalamic connectivity**
   b) **weaker thalamic-SI connectivity** (corresponding to the stimulation site; right calf)

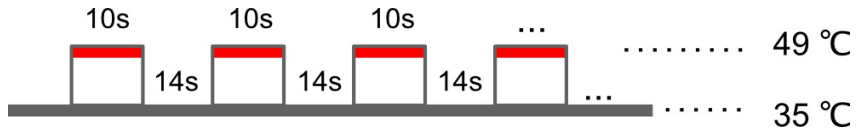


Experimental Design

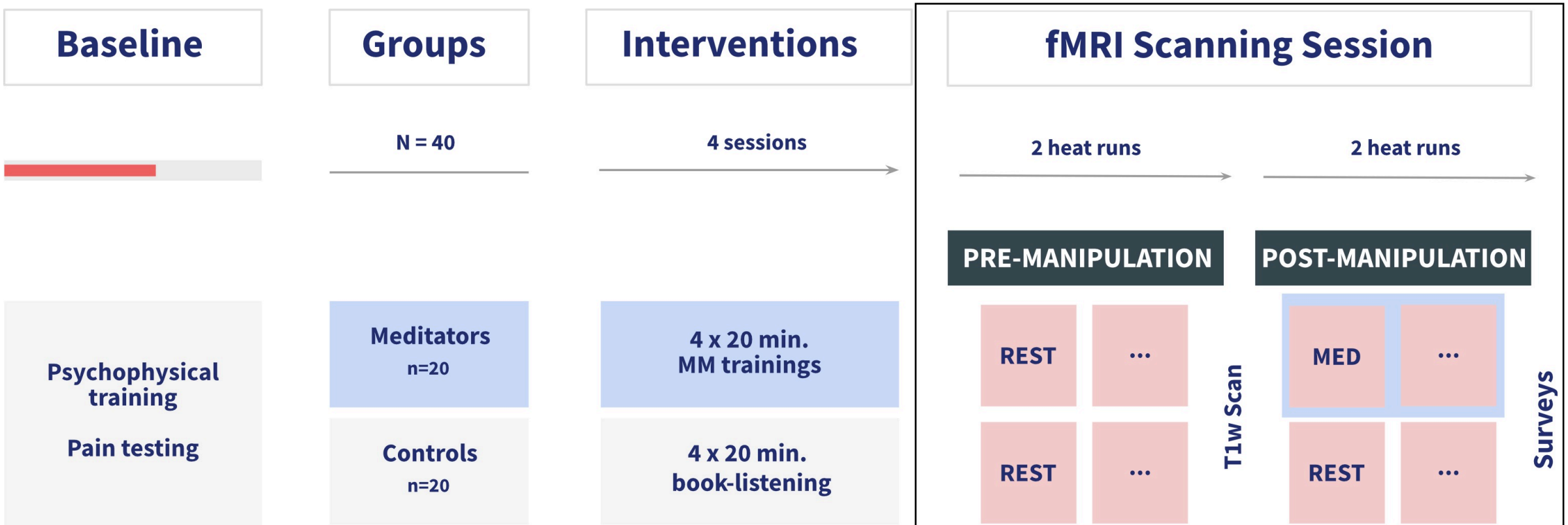
Participants: 40 healthy, pain-free subjects (30 ± 10 years; 20 females)

Stimuli: 16x16mm thermode was used to deliver noxious heat to the right calf (TSAII, Medoc Inc)

Noxious heat: ten 10-second trials of noxious 49°C interleaved with 35°C



Pain Visual Analog Scale (VAS): pain intensity/unpleasantness assessed with a 0 (no pain) to 10 (worst pain imaginable) VAS



Statistical analyses

Behavioral

pain ratings 2 (meditation- vs control- group) x 2 (pre- vs post-manipulation) mixed-ANOVA

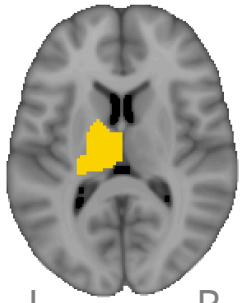
Neuroimaging

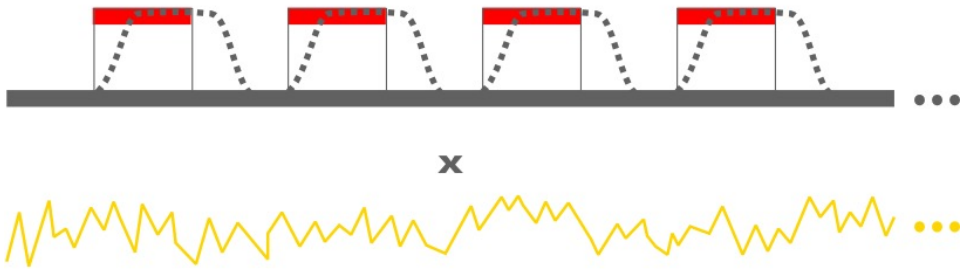
functional MRI preprocessing standard preprocessing including 5mm spatial smoothing (FSL FEAT v6.00)

general linear modeling convolved stimulus regressor + temporal derivative + motion estimates + WM eigenvariate

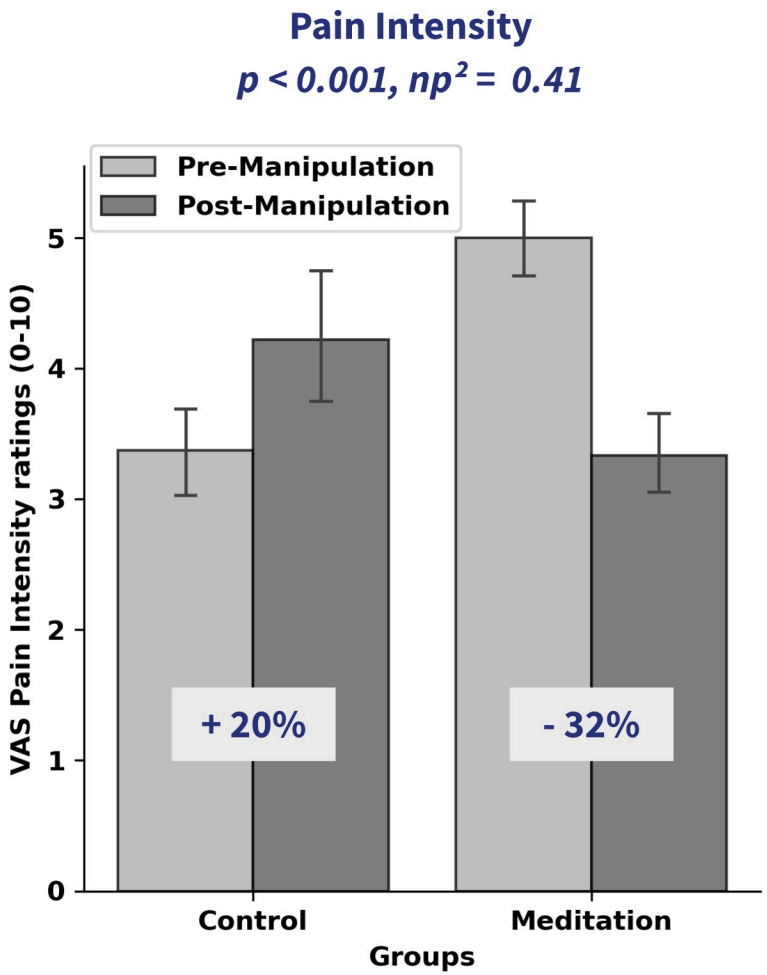
psychophysiological interaction (PPI) convolved stimulus regressor x seed timeseries (from DiFuMo atlas)

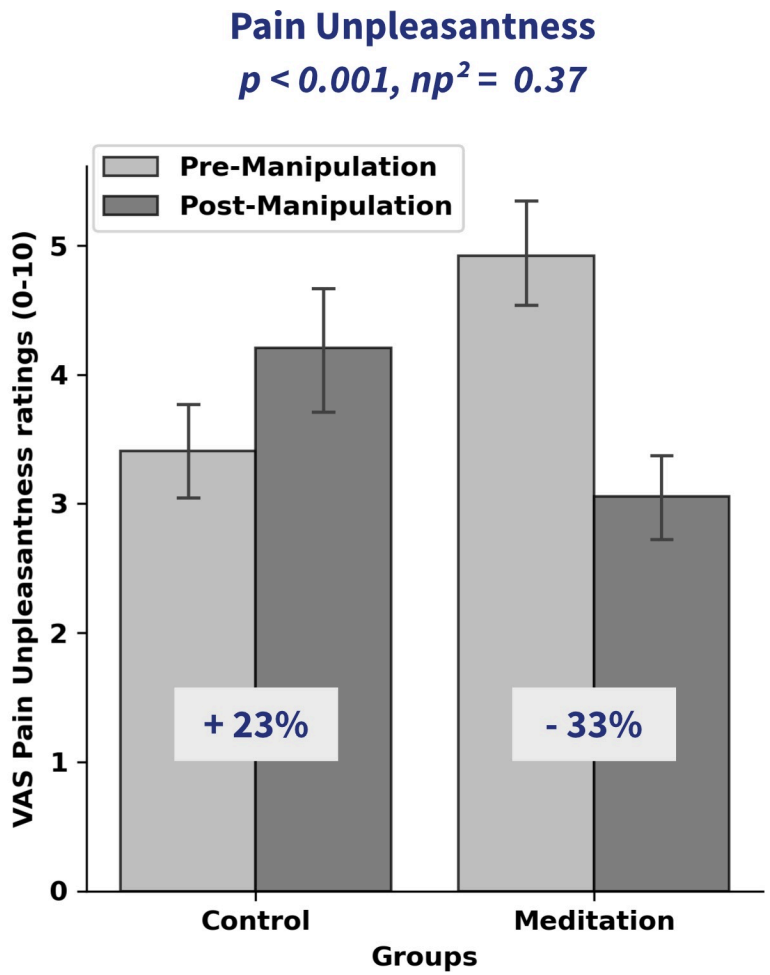
group analyses within (pre- vs post-manipulation) and between group whole-brain analyses accounting for mixed effects



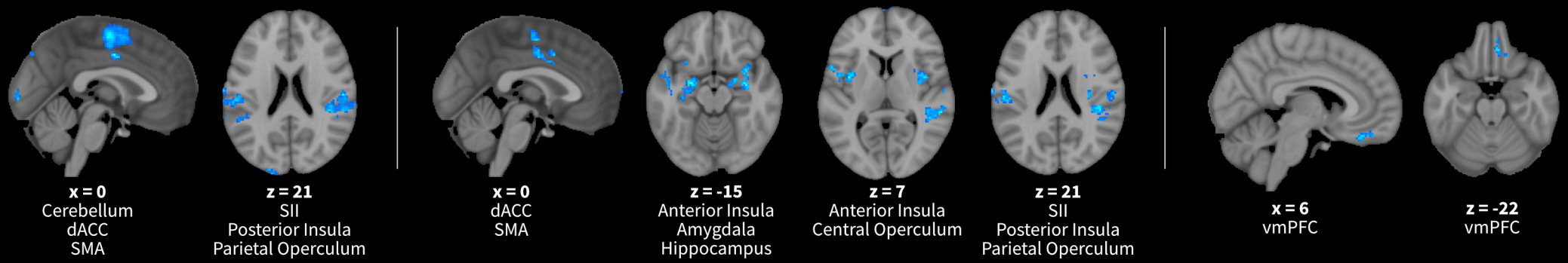


Results: Mindfulness significantly reduces experimentally-induced pain after brief mental training relative to rest and the control group



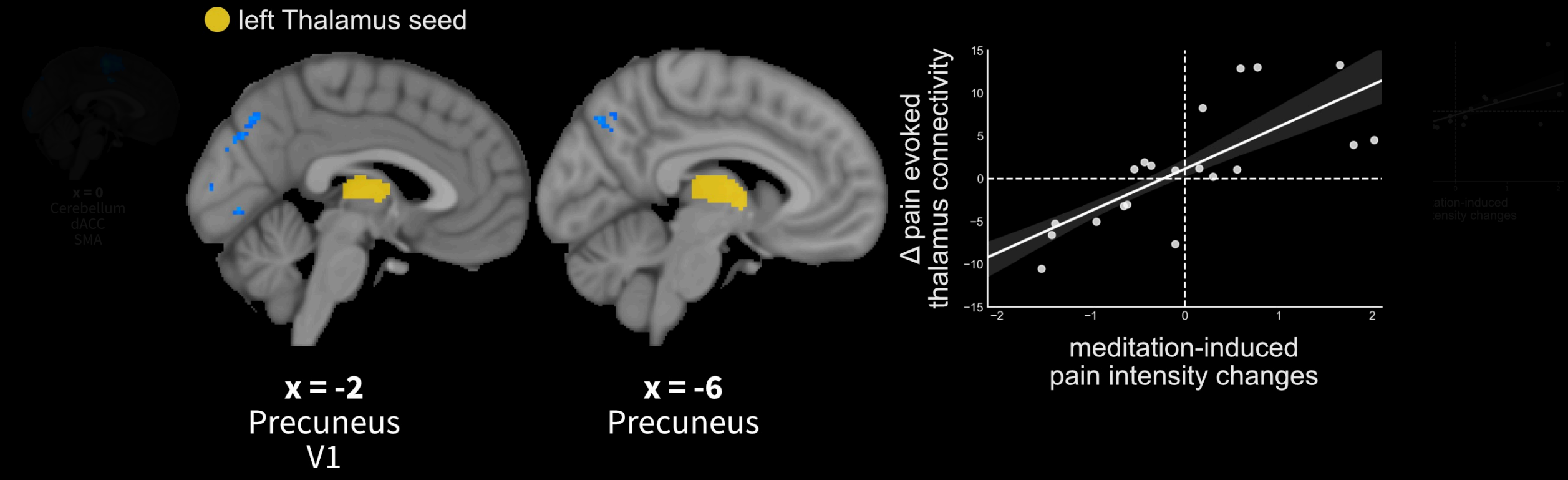


Results: Mindfulness significantly reduces activation in areas that process ascending nociception
Mindfulness-induced pain relief is associated with deactivation of **vmPFC**



whole-brain analyses, using a cluster-forming threshold of ***z = 3.1*** and family-wise error rate of ***p < 0.05***

Results: Mindfulness-induced pain relief is associated with contralateral **thalamic** decoupling from **precuneus**



whole-brain analyses, using a cluster-forming threshold of ***z = 3.1*** and family-wise error rate of ***p < 0.05***

Discussion

Mindfulness meditation, after 4 x 20-min trainings, reduces pain intensity (-32%) and activation in brain regions that process ascending nociception

Pain relief is associated with down-regulating neural mechanisms that support the integration of the sensory environment with internal references of self and value

PCU and **vmPFC** process self-relevance in the context of nociception to compute the affective value and subjectivity of the pain experience, and both structures are down-regulated during meditation [7]

References

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Thank you

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