

Tracking the impact of retrieval suppression on neural memory representations

Ann-Kristin Meyer & Roland G. Benoit

Max Planck Research Group: Adaptive Memory, Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig
annmeyer@cbs.mpg.de



MAX PLANCK INSTITUTE
FOR HUMAN COGNITIVE AND BRAIN SCIENCES

Introduction

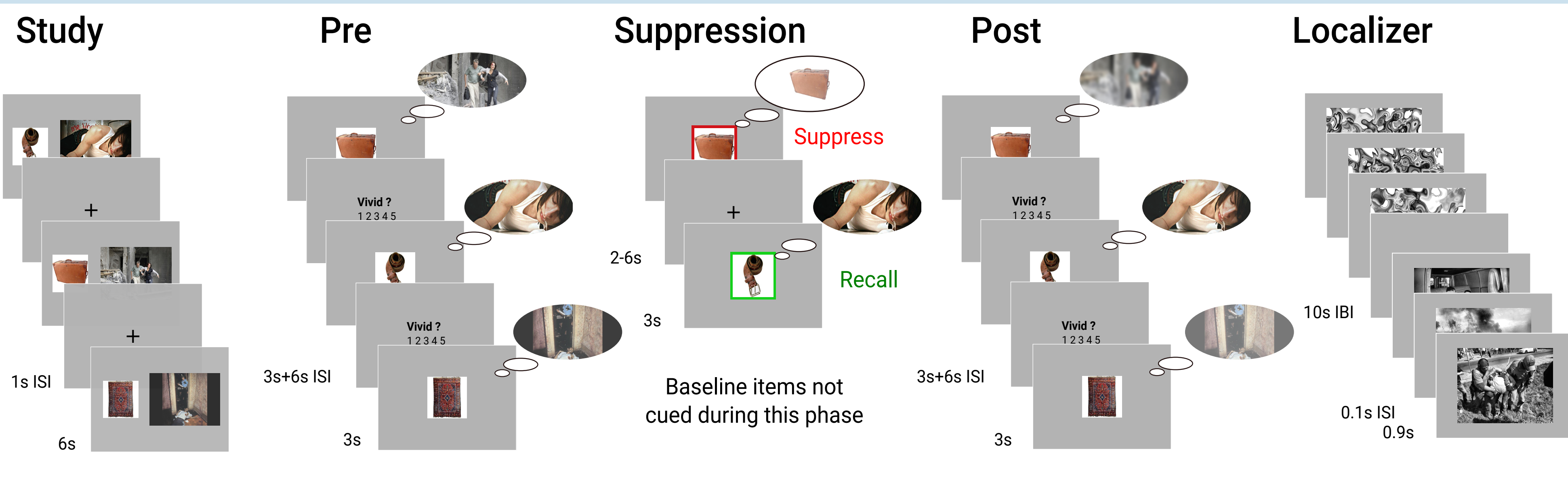
Sometimes we experience negative events that we would rather forget. Simple reminders can elicit the unwanted retrieval of such memories and thereby induce aversive emotional responses. However, previous research indicates that we can intentionally suppress such involuntary retrieval, a process that eventually can cause forgetting¹⁻³.



Hypotheses

- Retrieval suppression weakens the
- perceived vividness,
 - neural representation, and
 - ffective response of an aversive memory.

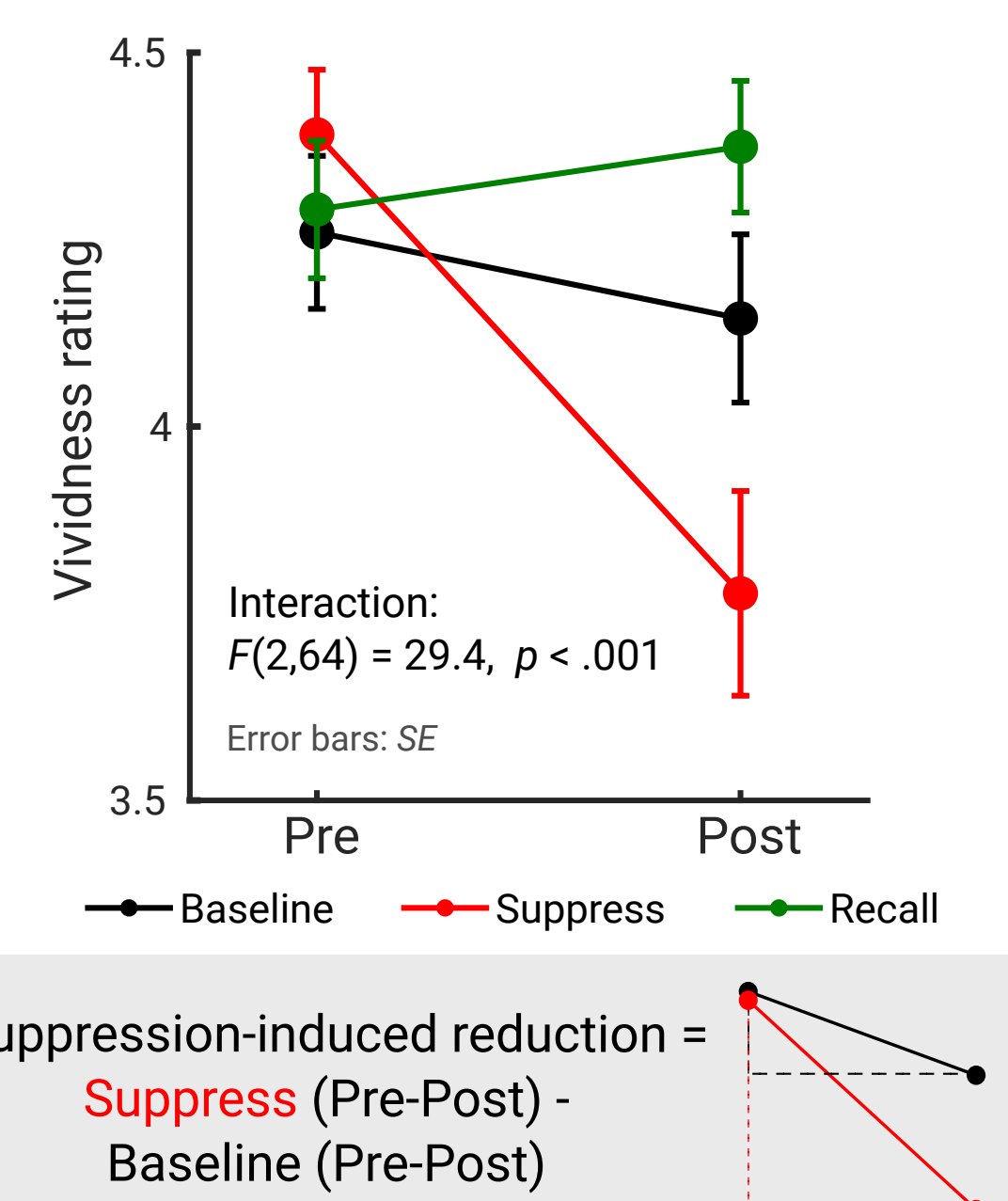
Procedure



- fMRI study, $n = 33$ (17 female, age: $M = 24.85$, $SD = 2.14$)
- Adaptation of the *Think/NoThink*-procedure with aversive scenes³, 48 object-scene-pairs
- Additional pre and post phases, including vividness ratings and heart rate measurement (pulse oxy)
- Localizer with aversive and morphed scenes, 16 trials per block, 30 blocks, 1-back task

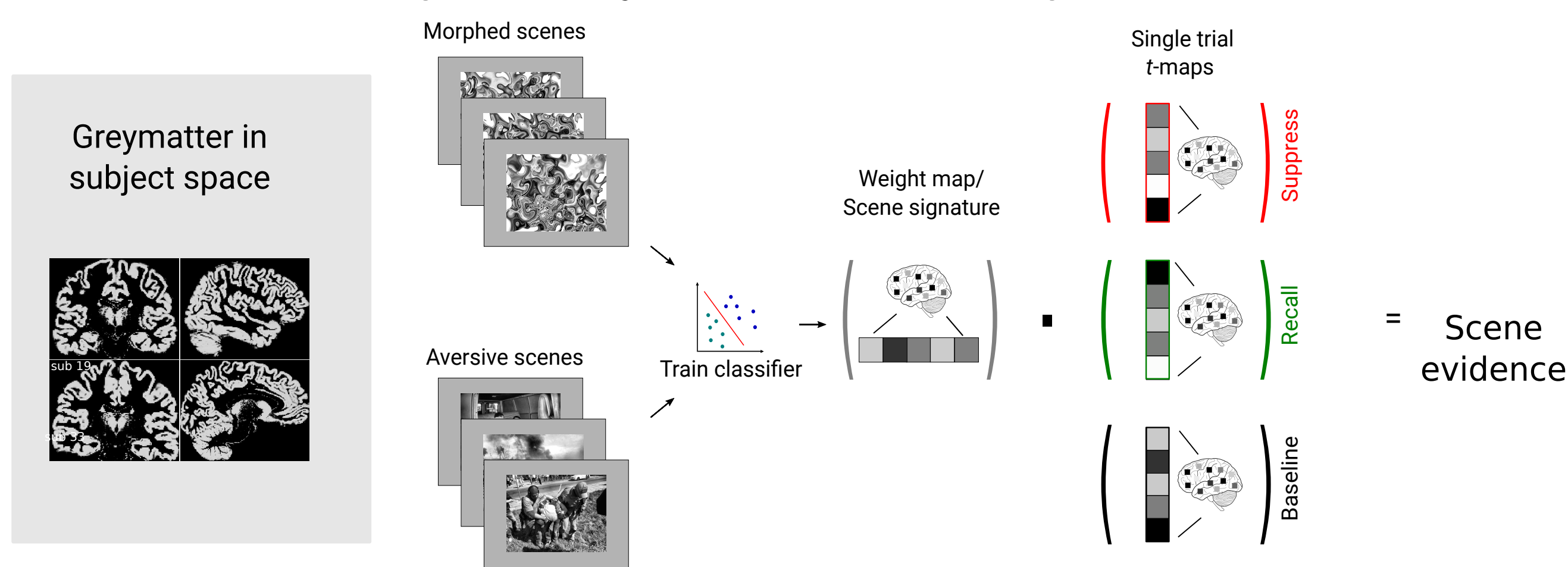
i. Vividness

Suppression renders memories less vivid



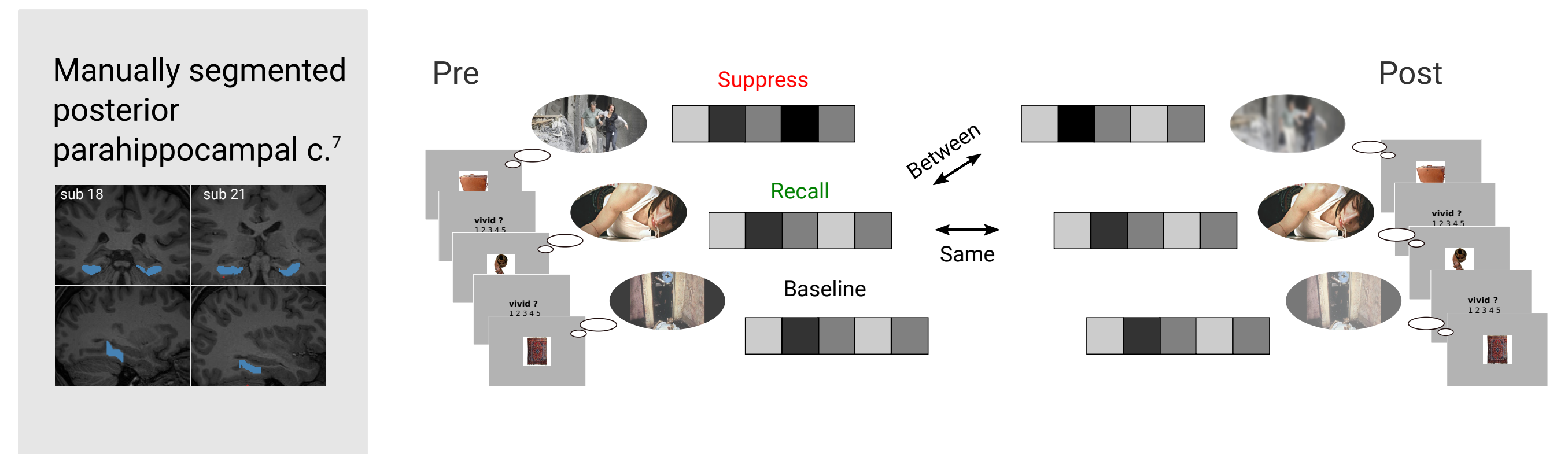
ii. Neural representation

Assessing memory reactivation using linear classifier⁵



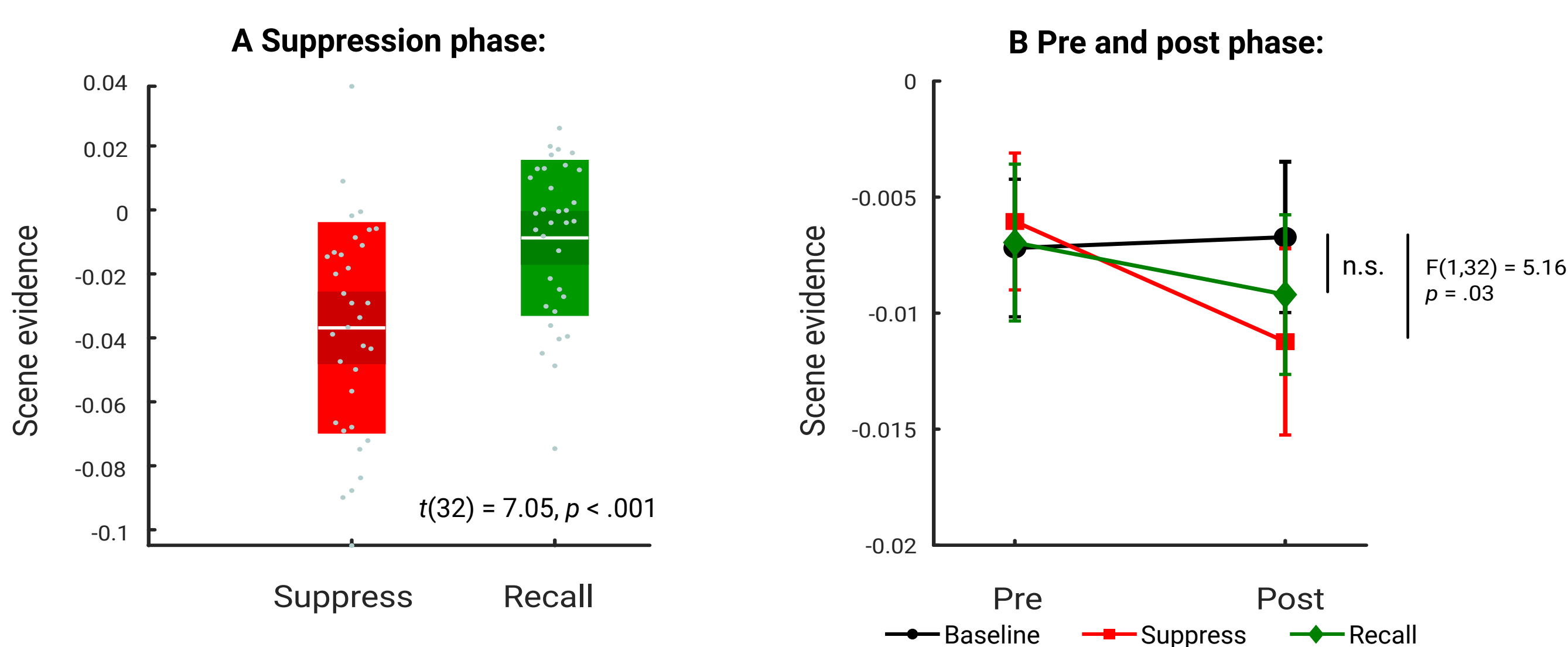
- Support vector machine training: aversive vs. morphed scenes on localizer data
- Leave-one-out cross-validation, mean accuracy: 80%
- Resulting weight map applied to single-trial t -maps, indicating scene reactivation

Assessing reinstatement using representational similarity analysis^{4,6}



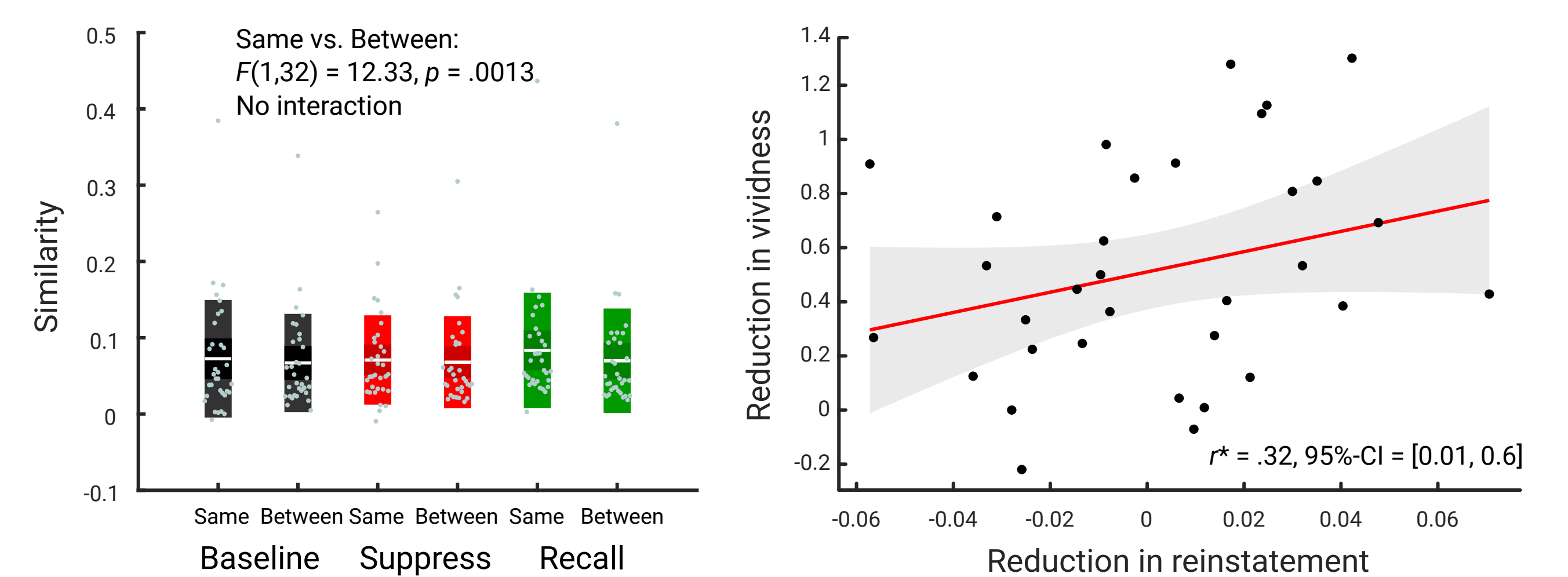
- Similarity between single trial t -maps in pre and post phase
- Reinstatement = *Same-item* > *Between-item* similarity (i.e. all other scenes from the same condition)

Weaker scene reactivation for suppressed memories



Plot: white: M, dark: SE, light: SD

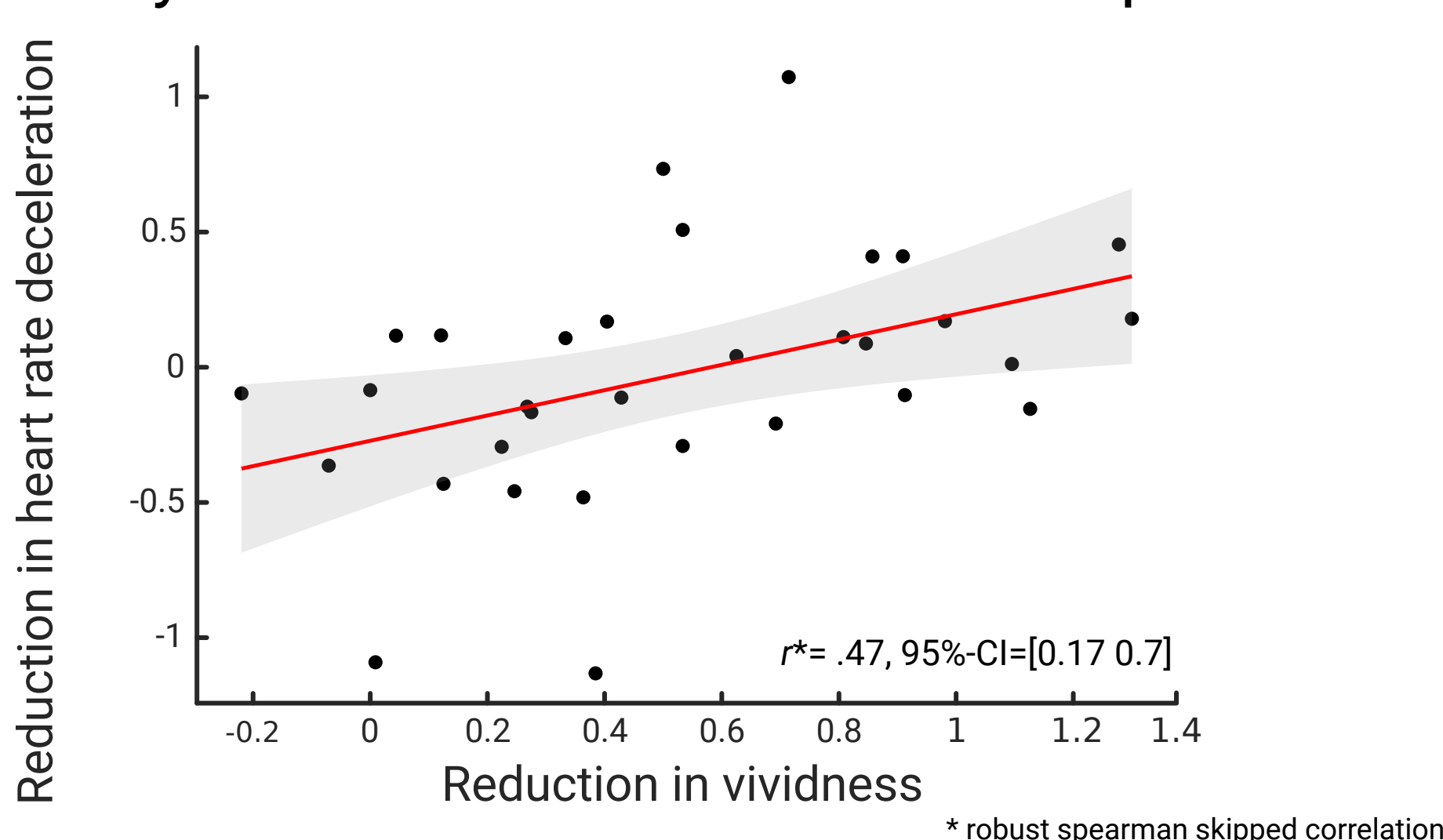
A greater reduction in vividness is associated with weaker pattern reinstatement in right parahippocampal cortex



*robust spearman skipped correlation

iii. Affective response

The reduction in vividness is accompanied by a reduction in the affective response



Discussion

The results extend prior evidence by showing that suppression renders aversive memories less vivid.

They also show that such impoverished recall is associated with a simultaneous decline in affect. Retrieval suppression thus does not just impair the declarative component of a memory but also attenuates its affective component^{8,9}.

Critically, the neuroimaging results relate the effect of suppression to a reduced cortical reinstatement of the memory. By this, they tie the phenomenological consequence of retrieval suppression to its neural basis.

[1] Anderson, M.C., & Green, C. (2001). *Nature*, 410(6826), 366-369.

[2] Benoit, R.G., & Anderson, M.C. (2012). *Neuron*, 76(2), 450-460.

[3] Küpper, C.S., Benoit, R.G., Dalgleish, T., & Anderson, M.C. (2014). *Journal of Experimental Psychology: General*, 143(4), 1443.

[4] Poppenk, J., & Norman, K.A. (2014). *Journal of Neuroscience*, 34(23), 010-8020.

[5] Hebart, M.N., Gorgen, K., & Haynes, J.D. (2015). *Frontiers in neuroinformatics*, 8, 88.

[6] Kriegeskorte, N., Mur, M., & Bandettini, P.A. (2008). *Frontiers in Systems Neuroscience*, 2, 4.

[7] Staresina, B.P., Henson, R.N., Kriegeskorte, N., & Alink, A. (2012). *The Journal of Neuroscience*, 32(50), 18150-18156.

[8] Gagnepain, P., Hulbert, J., & Anderson, M.C. (2017). *The Journal of Neuroscience*, 37 (27) 6423-644.

[9] Depue, B.E., Curran, T., & Banich, M.T. (2007). *Science*, 317(5835), 215-219.