Neural pattern change of memory control of personal strengths and weaknesses

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Introduction:

To suppress negative thoughts and retrieve positive thoughts of the self is fundamentally important for individuals to maintain the positive view of self and mental health. Substantial behavioral studies have well-documented the memory suppression effect (decreased memory performance after suppression manipulation), and neuroimaging studies have shown that found the hippocampus and DLPFC served as the critical brain regions for memory retrieval and suppression (1, 2).

However, it remains unknown whether and how the neural patterns of these regions are changed by memory control and whether these neural patterns underlie the memory suppression.

Moreover, as people are motivated to maintain and enhance positive self-views but to avoid negative ones (3), we further investigated whether and how the memory control manipulation (i.e., memory suppression and retrieval) would influence the neural representation of self-related positive and negative traits.

To address these issues, the current fMRI study (N = 46) employed the typical think/no-think paradigm (TNT), as well as memory test scanning before and after TNT, to uncover the neural patterns changes induced by suppression and retrieval of personal strengths (10 pros of the self) and weaknesses (10 cons of the self).

Methods:

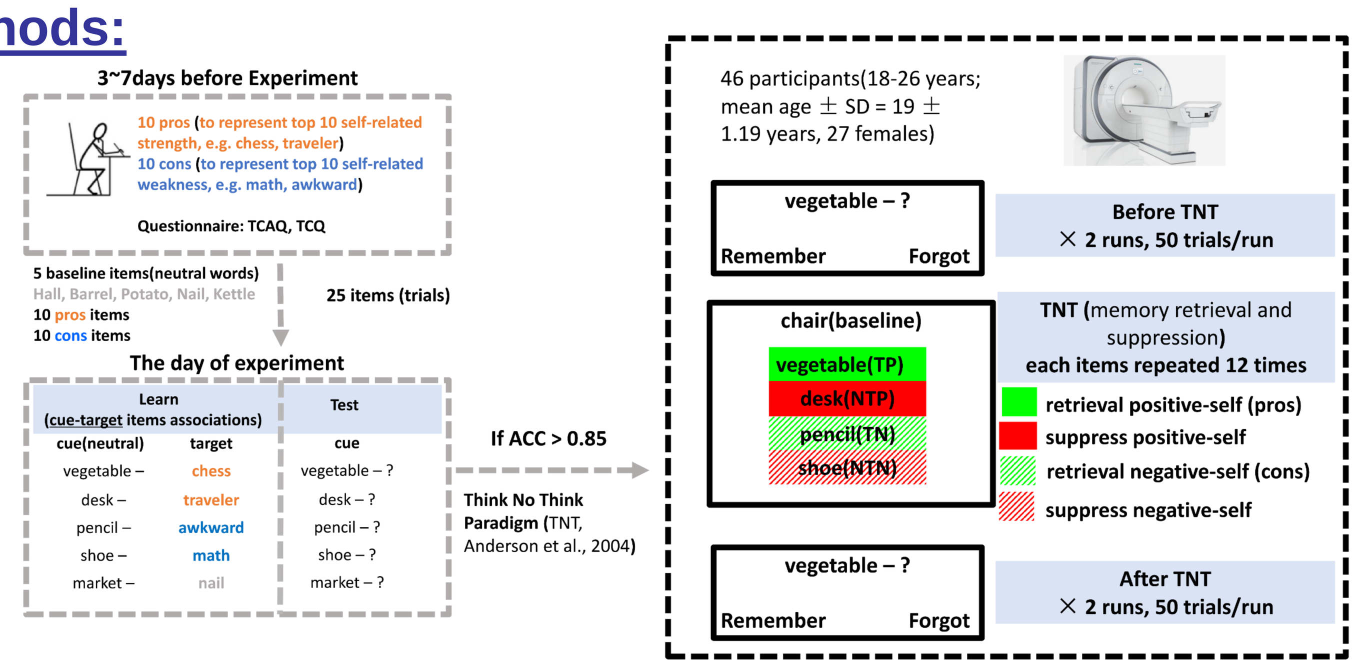

Fig 1. We first asked participants to provide their personal strengths (10 pros of the self) and weaknesses (10 cons of the self) before the experiment (3 to 7 days). On the experiment day, participants completed the word-pair association training, and fMRI scanning. There were 25 word pairs: 5 fillers (neutral cue-neutral target pairs, baseline condition), 10 neutral cue-strength target pairs (positive condition) and 10 neutral cue-weakness target pairs (negative condition).Participants were entered into fMRI scanner only when their memory performance is better than 85% in the training session . During scanning, participants completed two pre-TNT memory test sessions (to report whether they remembered the target item of each presented cue), six sessions of TNT (to either Not-Think or Think of the strength or weakness target of each presented cue) and two post-TNT memory test sessions. Participants were asked to press a left button when presented with the cue associated with neutral target (baseline).

Results:

Behavior results:

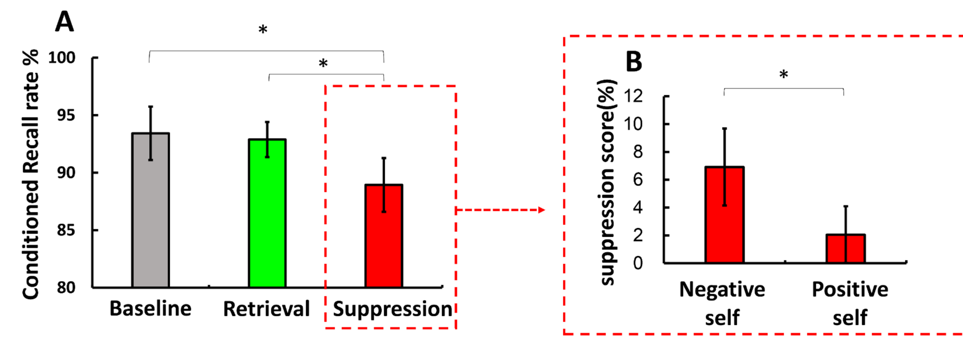

Fig 2. *Behavioral results.* (A) The conditioned recall rate (calculated based on remembered items before TNT) was significantly smaller in the suppression condition than the baseline (P = 0.041) and retrieval (P = 0.018) conditions. (B) Suppression of personal weakness is better than that of strengths (P = .047).

Univariate analysis results:

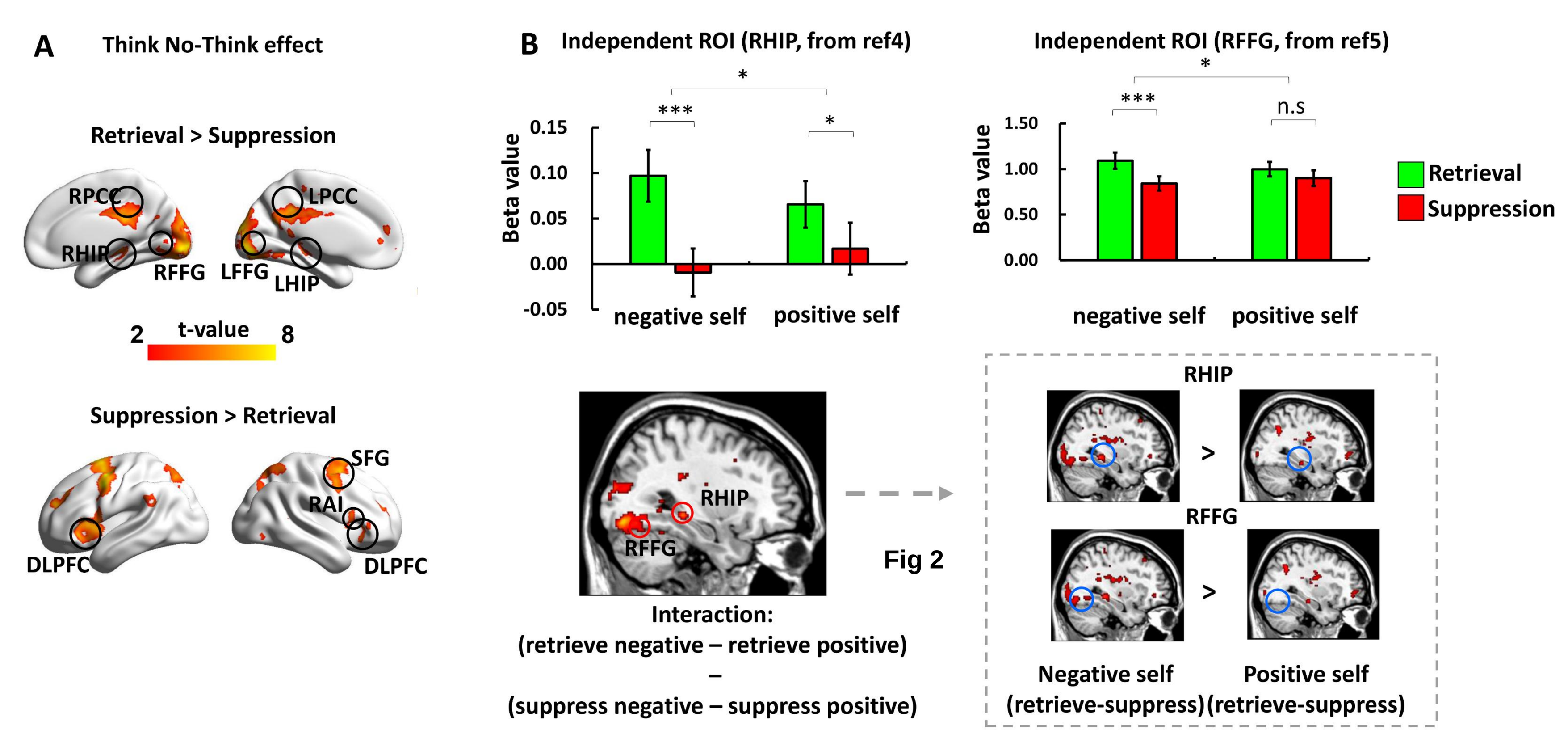

Fig 3. (A) Memory retrieval was associated with bilateral hippocampus (HIP), fusiform gyrus (FFG) and posterior cingulate (PCC), whereas the activity in the superior frontal gyrus (SFG) bilateral DLPFC and anterior insula (AI) underlay memory suppression. (B) Independent regions of interest (ROIs) analysis revealed that the memory-retrieval effect were significantly larger for negative than positive self in right hippocampus (small volume correction, brodmann structural map, FWE P < .05) and bilateral FFG. Figures showed in uncorrected P < .001 threshold, all results were FWE cluster level (P < .05) corrected. RN = negative-self retrieval; RP = positive-self retrieval; SN = negative-self suppression; SP = positive-self suppression.

RSA results:

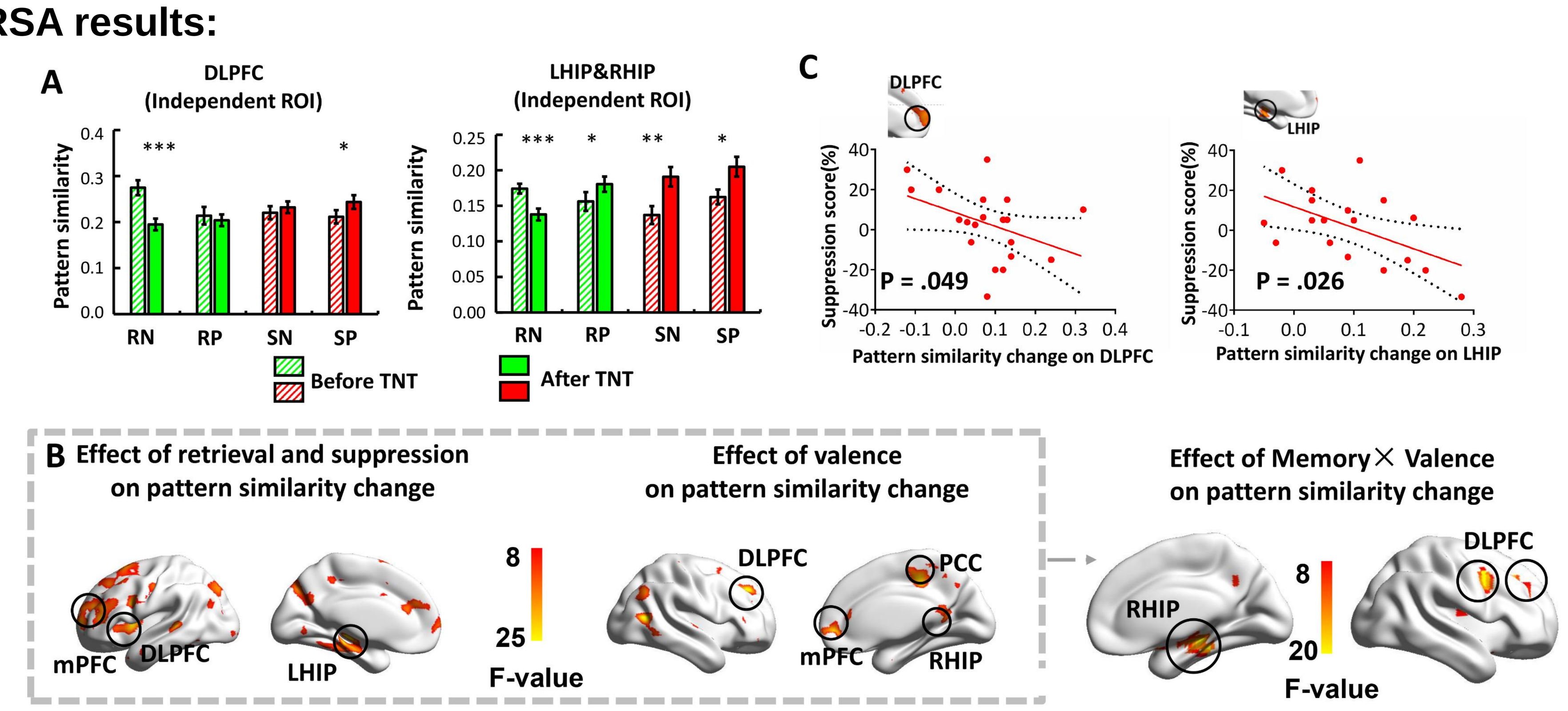

Fig 4. (A) Pattern similarity in independent ROI showed pattern similarity change in each single condition. These results were confirmed by the whole brain trial-wise representational similarity analysis.

(B) The ANOVA with Memory (Retrieval vs. Suppression) and Valence (Positive vs. Negative) on the pattern similarity showed the main effect of Memory in the left hippocampus and left DLPFC and main effect of Valence in right DLPFC and right hippocampus, as well as in the mPFC and PCC, which was recognized in the self-related processing. The significant interactive effect of Memory and Valence on pattern similarity change was found in right hippocampus and bilateral MFG. (C) The pattern similarity changes in left hippocampus and left DLPFC predicted the suppression score in positive-self suppression (SP) condition. Figures showed in uncorrected P < .005 threshold, all results were FWE cluster (P < .05) level corrected.

Across Subjects RSA Results

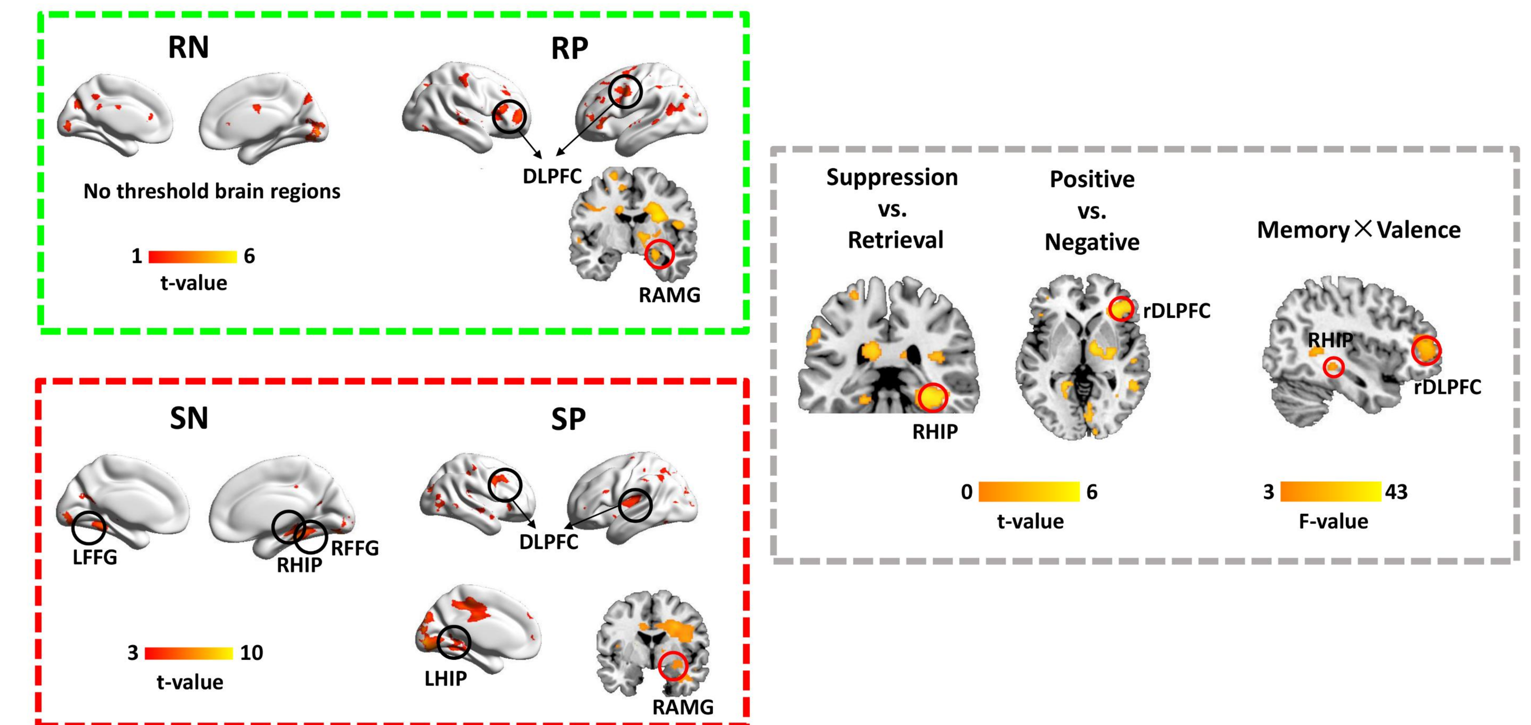

Fig 5. The across-subjects, trial-wise RSA showed some interesting between-subjects similarity brain patterns. When participants tried to retrieval their own weakness, there was no similarity across all subjects' brains, but retrieving the strengths lead the activity in common brain regions (i.e. DLPFC and Amygdala). The suppression condition seems showed more between-subjects similarity in hippocampus and fusiform gyrus. Similarly, suppressing the strengths showed common activity in DLPFC and Amygdala, and left hippocampus. The ANOVA with Memory (Retrieval vs. Suppression) and Valence (Positive vs. Negative) on the across-subjects pattern similarity showed the main effect of Memory in the right hippocampus and main effect of Valence in right DLPFC. These results suggested that participants did memory manipulation for their weaknesses differently but showed similar brain patterns when manipulated their strengths. And the memory manipulation process may be common in hippocampus across participants. Figures showed in uncorrected P < .001 threshold, all results were FWE cluster level (P < .05) corrected. RN = negative-self retrieval; RP = positive-self retrieval; SN = negative-self suppression; SP = positive-self suppression.

Conclusion:

We show that individuals are better at suppression of personal weakness than that of their strengths. Moreover, the hippocampus and fusiform gyrus is more strongly engaged in memory-retrieval of personal weakness, which may suggest more effort to retrieve one's own weakness than strengths. Pattern similarity analysis further reveals that the memory-suppression mainly results in increased representational similarity across items in the hippocampus and DLPFC regardless of valence, providing a neural account for the typical memory-suppression effect. Interestingly, we uncover that the memory-retrieval effect is valence-dependent, decreasing representational similarity for negative items in the right hippocampus and DLPFC, but increasing that for positive items in left hippocampus. These results suggest that memory retrieval allows finer-grained representation of personal weaknesses, whereas blurs the representation of the strength of the self. And the results of across-subjects RSA indicated that people may synchronize with each other when think or not think strengths but be different when think nor not think their weaknesses.

Reference:

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