



Identifying the component processes of mental simulation: Evidence from repetition-related decreases of the BOLD response.

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OVERVIEW

- * In recent years, cognitive neuroscientists have grown increasingly interested in the capacity for healthy human adults to mentally simulate hypothetical experiences (Schacter et al., 2008).
- * A number of functional brain imaging studies have identified a “core” network of brain regions believed to support mental simulation (e.g., Addis et al., 2007; Botzung et al., 2008; Okuda et al., 2003; Szpunar et al., 2007).
- * Little remains known about the manner in which various aspects of this “core” network are related to the component processes that contribute to mental simulation.
- * In the present experiment, we inquired about what regions of the brain are responsible for representing (1) the locations in which our mental simulations take place and (2) the objects that our mentally simulated actions often revolve around.
- * To help accomplish this goal, we made use of a variant of the well-known repetition suppression paradigm. Specifically, we were interested in what regions of the brain might be sensitive to repeated simulations of familiar locations and objects.

METHODS

Participants

* 24 right-handed healthy young adults (14 woman, mean age = 20.1 years)

fMRI

* Images were collected on a Siemens Trio 3T scanner using a 12-channel coil

* BOLD functional scans were acquired with a T2*-weighted EPI pulse sequence (TR = 2500 ms; TE = 30 ms; 90° flip angle; 39 axial slices parallel to anterior-posterior commissure plane; 3.0 mm isotropic voxels)

fMRI analysis

* Data were preprocessed and analyzed using SPM8 software

* Primary analysis reported here was based on the results of a One-Way ANOVA and subsequent t-tests contrasting conditions of interest

EXPERIMENTAL DESIGN

Stimulus Collection

Locations

One week prior to scanning, participants generated a list of 72 familiar locations

Objects

Pilot testing with 12 subjects generated a list of 72 object-action pairings

Scanning Session (Event-related design)

Run 1 Participants simulate 16 scenarios (“Imagine yourself in location using object”)

Run 2 Participants simulate same 16 scenarios in new random order

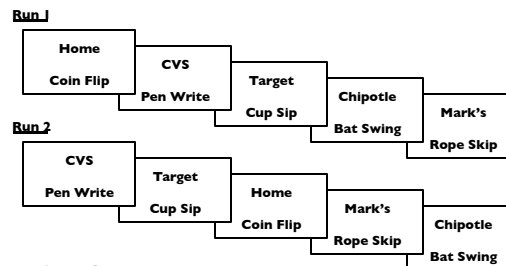
Run 3 Participants simulate 20 scenarios that vary in the extent to which elements from original 16 simulations are repeated (see below)

This cycle is repeated 3 times, each cycle involves a new set of stimuli

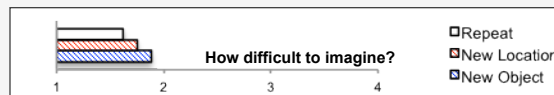
Sample Trial

Simulate...	Home	Difficult?
	Coin Flip	1 2 3 4
2.5 s	7.5 s	2.5 s

Sample Cycle

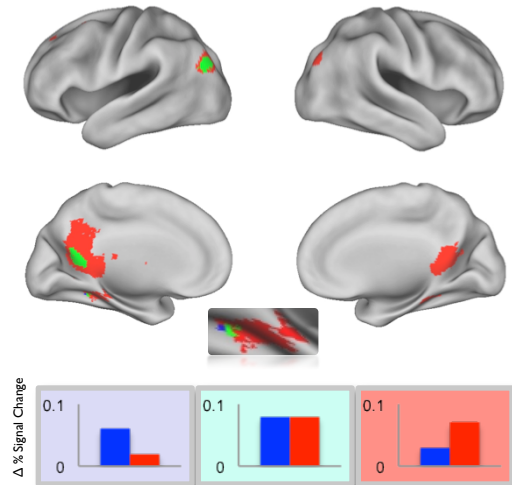


BEHAVIORAL RESULTS



IMAGING RESULTS

New Location > Repeat
New Object > Repeat
Conjunction



CONCLUSIONS

- Various regions of the brain are responsible for helping to forge representations of familiar locations and objects during mental simulation:
- *Locations.* Right lateralized regions within posterior parietal cortex, posterior cingulate cortex, and parahippocampal cortex.
- *Objects.* Left lateralized region of fusiform cortex.
- *Overlap.* Left lateralized regions within posterior parietal cortex, posterior cingulate cortex, and parahippocampal cortex.

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