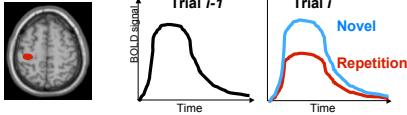


The effect of functional network structure on Repetition Suppression

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INTRODUCTION

Repetition Suppression (RS) is a region-specific carryover effect in the BOLD signal characterized by an amplitude reduction on a repeated exposure to specific stimulus feature values [1].

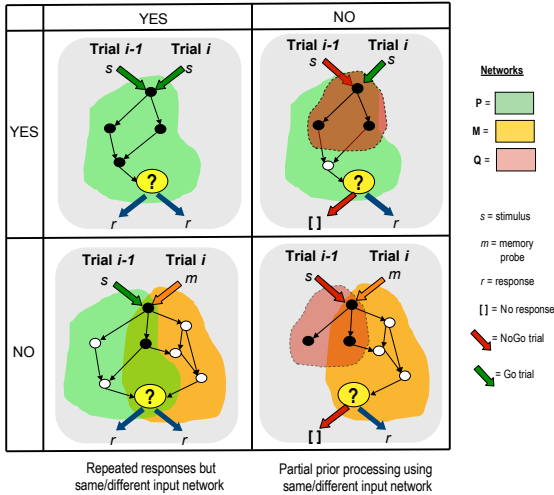


The specificity of RS makes it a valuable method to localize function but it remains a poorly understood phenomenon. One such poorly understood aspect is the common assumption that RS depends only on a repetition of the information represented by a neuronal population from the previous exposure, **independent of the input network** [2]. We tested this assumption by examining the inter-trial carryover properties of the BOLD signal while being driven by different functional networks that eventually result in the same or different information from trial to trial.

EXPERIMENT DESIGN

We designed a Stimulus-Response choice task to engage three different kinds of networks: a primary function network **P** engaged on trials requiring a stimulus-instructed response; a second network **M** engaged on trials requiring a memory-based response; and a third network **Q** engaging a portion of the primary network **P** engaged by NoGo trials that had similar stimuli to the primary trials but requiring subjects to withhold their responses. The trials were sequenced (pseudo-randomly) to produce various types of repetitions shown as a 2 x 2 design below. The dependent variable was the BOLD signal on trial *i* based on the network engaged on trial *i-1*.

PRECEDED BY FULL NETWORK PROCESSING



PRECEDED BY SAME NETWORK

To evaluate differences in task-context, two independent conditions that manipulated **M** and **Q** were tested using the same design. In the **1-BACK** condition, memory-driven responses required the memory of the stimulus seen on the previous trial. In the **1-FORWARD** condition, the response associated with the stimulus on trial could be used to prepare (and hold in memory) the response to the next trial.

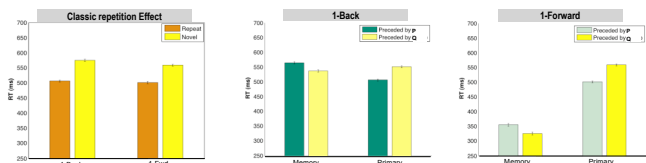
METHOD

STIMULI: The stimuli for the primary task were arrows having four possible orientations. Each orientation was associated with a unique response digit on the right hand. The color of the arrows indicated whether a response was required (Green = Go, Red = NoGo). The memory-instructed stimulus was a blue disc, and required subjects to make a response based on the arrow orientation on the previous trial. In the **1-FORWARD** condition, a cue preceded every instance of the memory probe; and this cue was absent in the **1-BACK** condition. Stimulus duration = 600ms; Max response time = 1200ms; ISI = 2000 or 4000ms. A customized version of an m-sequence [3] was used to sequence the different trial types.

SUBJECTS: Twelve subjects took part in 3 sessions on different days. The first behavioral training session outside the scanner involved 200 trials of each condition. Each of the two sessions in the scanner involved 400 trials of each condition, giving an overall total of 800 trials in each condition.

ANALYSIS: Imaging data was analyzed using SPM5. Only correct trials that were preceded by a correct trial were analyzed. Based on the precedence relationships, 10 different trial-types were modeled. In the **1-FORWARD** condition, the cue trials were modeled separately.

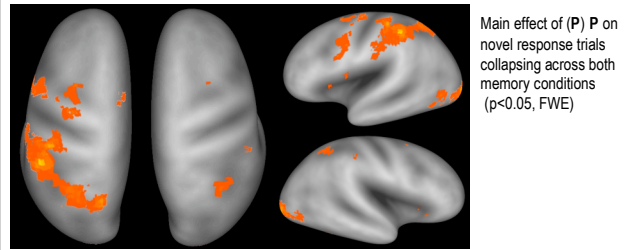
RESULTS: BEHAVIOR



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- Rizzolatti, G. and Sinigaglia, C., 2010. The functional role of the parieto-frontal mirror circuit: interpretations and misinterpretations, *Nature Reviews Neuroscience*, 11, 264-274.
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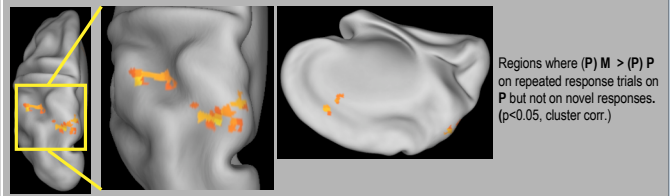
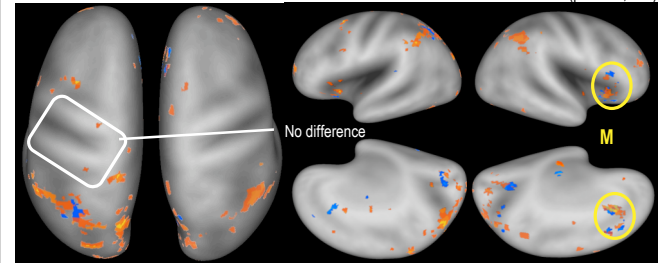
PRIMARY NETWORK (P)



Main effect of (P) on novel response trials collapsing across both memory conditions (p < 0.05, FWE)

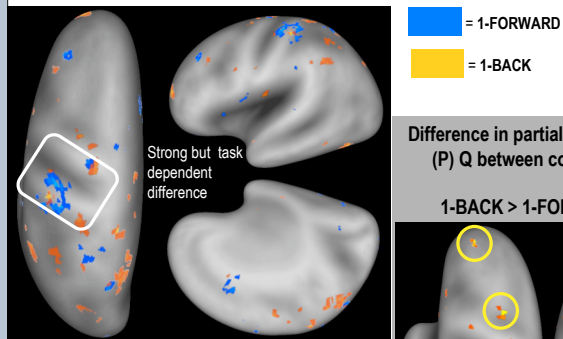
Repetition of response on different input networks

1-BACK condition ■ = (P) M > (P) P ■ = (Q) M > (Q) P (p < 0.001, unc)



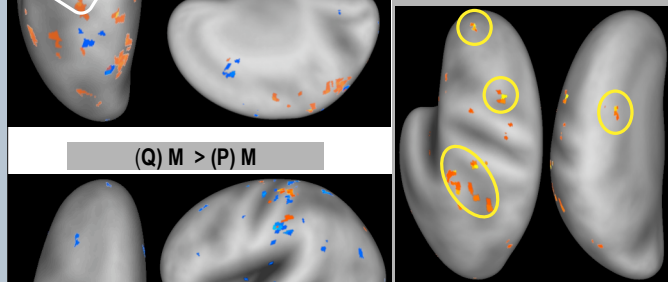
Repetition of response-related information but not response

(Q) P > (P) P



Difference in partial processing (P) Q between conditions

1-BACK > 1-FORWARD



CONCLUSIONS

Our data provide evidence supporting the assumption that Repetition Suppression in a functional region does not necessarily require a repetition of the functional network driving the information in that region. However, a key finding is the strong task dependence of this effect despite using the same stimuli which suggests that RS is not completely network invariant.