

Analogical Reasoning and Inhibition in Prefrontal Cortex

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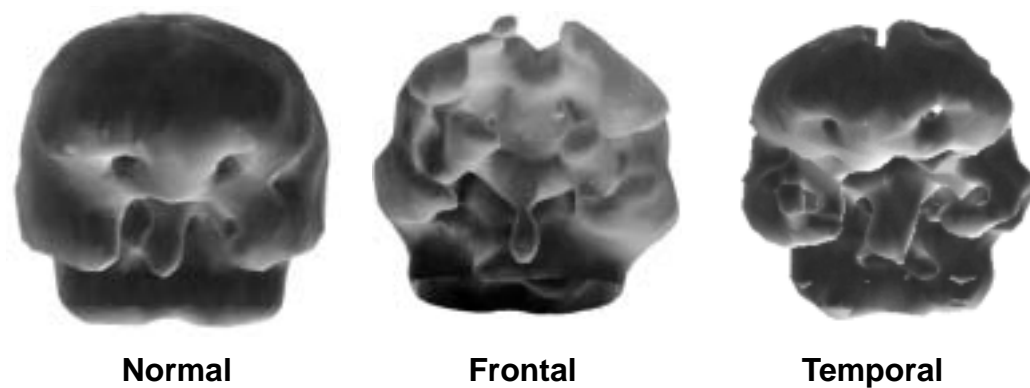
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Introduction

- > Solving 4-term analogy problems involves mapping both relations among objects and the objects that fill those relations.
- > We hypothesize that relational reasoning requires the ability to selectively maintain and manipulate representations in working memory, as well as the ability to screen out inappropriate potential responses. Both of these aspects are thought to rely upon intact prefrontal cortex.
- > We tested these hypotheses with two experiments using a picture-based 4-term analogy task to compare the performance of patients with frontal-variant frontotemporal dementia (FTD) with that of temporal-variant FTD patients and normal controls.
- > We hypothesize that the analogy performance of frontal-variant FTD patients will be lower than that of temporal-variant patients and normals. We also anticipate that frontal patients will likely choose semantically relevant, but incorrect responses when such choices are available, and that their performance will improve when these distractor choices are removed.

Participants

- > Patients were diagnosed with FTD based on neurological and neuroimaging evaluations. Patients were classified as either frontal-variant or temporal-variant FTD. Patients had MMSE scores above 20.
- > Patients had selective damage to either prefrontal or anterior temporal cortex as indicated by neuroimaging.
- > Control participants were matched to patients using age and education.

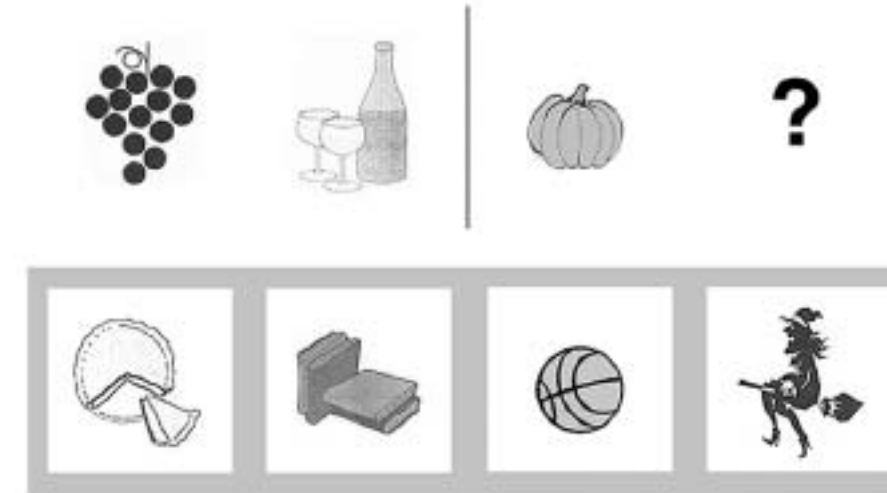


SPECT image of normal, frontal-variant, and temporal-variant FTD patients

Experiment 1

Method

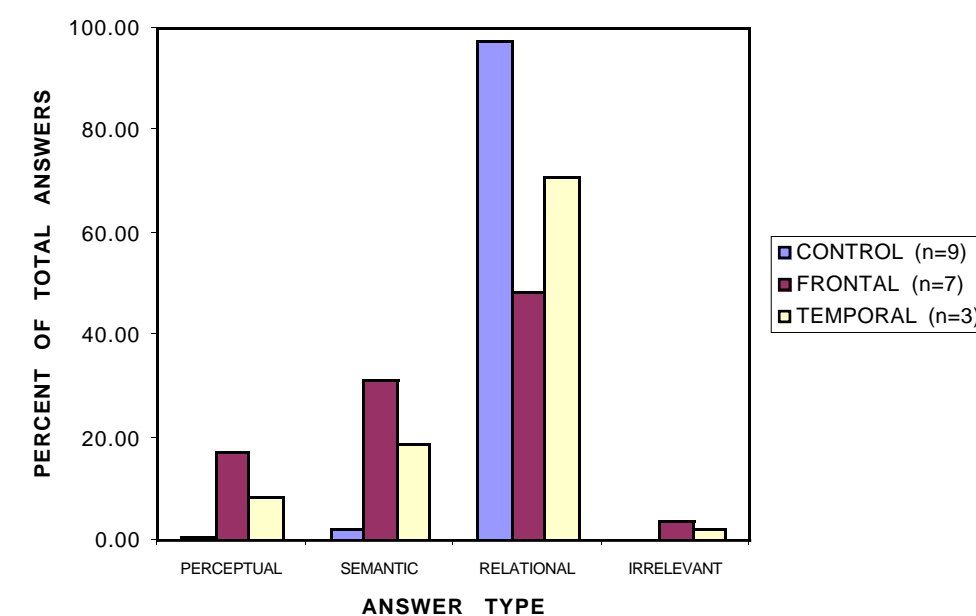
- > A:B::C:D forced choice picture analogies were used. Each problem included 4 types of answer choices.



Relational Choice Irrelevant Distractor Perceptual Distractor Semantic Distractor

- > 16 problems were presented on a computer as a part of a one hour testing session. Participants first saw only the problem and were asked to think about what might fit as a D term. The answer choices were then revealed and participants pointed to an answer on the screen while the experimenter recorded responses.

Results

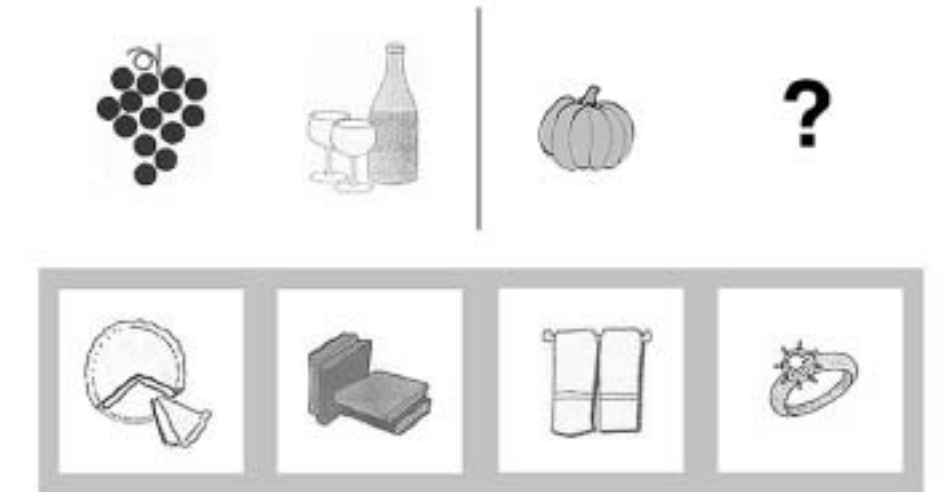


- > Normal control subjects provided the correct relational answer more often than both patient groups ($p < .05$).

Experiment 2

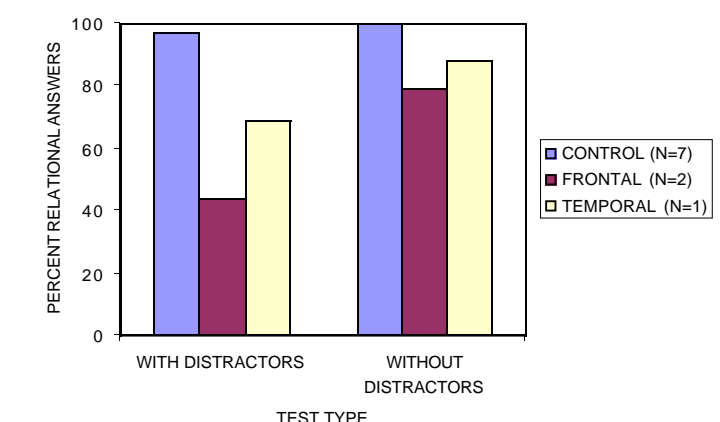
Method

- > The same set of picture analogies from Exp. 1 was used, along with a second set containing the same problems with distractors that were all irrelevant.



- > Participants first completed the problems with distractors. The non-distractor problem set was then administered after a task-filled delay of approximately 45 min.

Results



- > Frontal-variant patients showed a trend toward improving more in the second test (without distractors) than the temporal-variants ($p < .06$).

Discussion

- > While both patient groups showed depressed performance in relational responding compared to controls, frontal-variant FTD patients showed lower performance than temporals and a tendency to choose semantically-related incorrect answers.
- > Results suggest that the frontal patients' deficit is due to impaired WM manipulation and an inability to screen out semantic and perceptual distractors, as their performance increased in the non-distractor version; however, it remained lower than controls.
- > In contrast, the deficit for temporal patients is likely attributable to their loss of semantic concepts.