

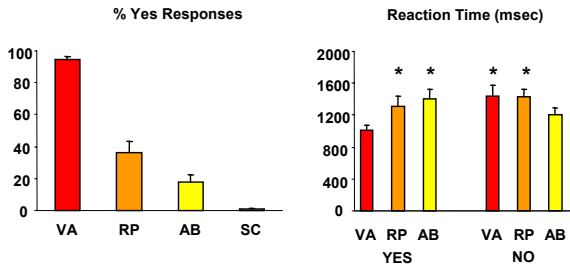
## Introduction

Indeterminate art invokes a perceptual dilemma in which apparently detailed and vivid images resist identification. We used event-related fMRI to study visual perception of representational, indeterminate and abstract paintings, and hypothesized increased activation along a gradient of posterior-to-anterior ventral visual areas with increased object resolution. We further predicted that indeterminate, ambiguous paintings would invoke visual imagery-related activation in parietal and prefrontal cortices.

## Methods

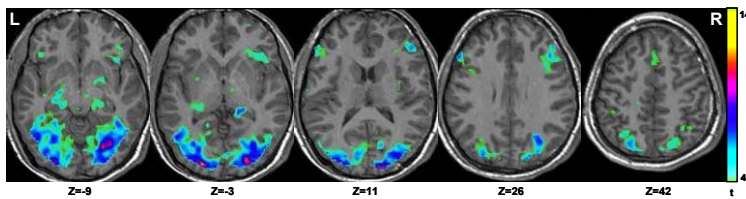
- Twelve Subjects (5 females, mean age 25 years) performed an object recognition task ('do you recognize any familiar objects?').
- Representational, indeterminate, abstract and phase scrambled painting were randomly presented in four runs. Each stimulus was presented for 3 seconds.
- Functional and anatomical images were collected on a 3T Philips scanner.
- Data were analyzed in SPM5.

## Behavioural Results



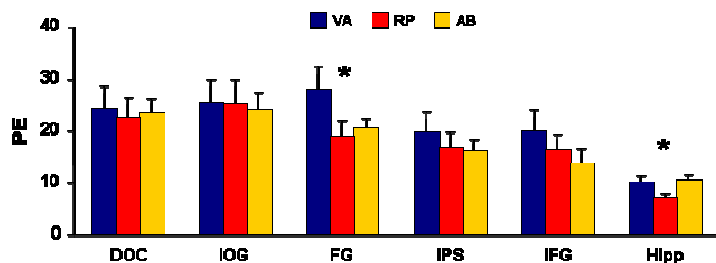
- Subjects perceived familiar objects in virtually all VA paintings, 36% of the RP paintings and 18% of the AB paintings.
- Reaction times were faster for 'yes' responses to VA paintings than for either 'yes' or 'no' responses to RP and VA paintings ( $p < .01$ ).

## Imaging Results

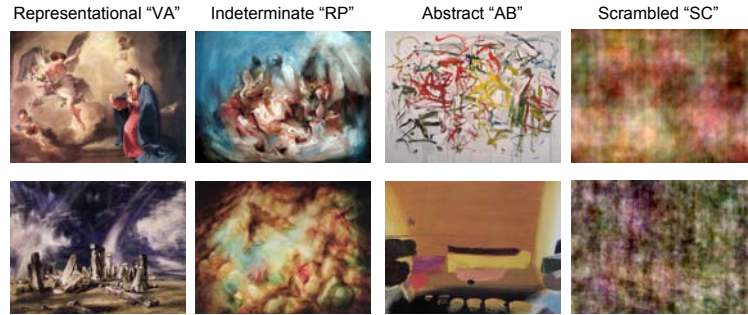


The main effect (all paintings vs. scrambled paintings) revealed activation within a distributed cortical network that includes the dorsal occipital cortex (DOC), inferior occipital gyrus (IOG), fusiform gyrus (FG), inferior parietal sulcus (IPS), inferior frontal gyrus (IFG) and the hippocampus.

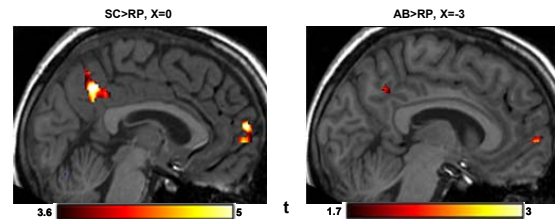
## ROI Analysis



- In the right FG, activation evoked by the VA paintings was significantly stronger than activation evoked by either RP ( $t_9=2.82$ ,  $p < .017$ ) or AB ( $t_9=2.21$ ,  $p < .05$ ) paintings.
- In the right hippocampus, the response evoked by the RP paintings was significantly weaker than both activation evoked by VA ( $t_9=2.99$ ,  $p < .024$ ) and AB paintings ( $t_9=2.87$ ,  $p < .028$ ).

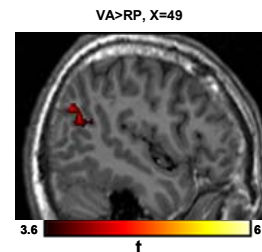


## The Indeterminacy Effect



To identify the neural correlates of object indeterminacy, we compared the response evoked by scrambled paintings with activation evoked by the indeterminate paintings. This contrast revealed significant clusters of greater activation for scrambled paintings in the precuneus ( $p_{\text{corrected}} < .001$ ) and in the medial frontal gyrus ( $p_{\text{corrected}} < .001$ ). A similar effect was observed when AB paintings were compared to RP paintings.

## The Effect of Meaningful Content



To identify the neural correlates of meaningful content in art works, we contrasted activation evoked by representational paintings with activation evoked by indeterminate ones. Bilateral clusters of activation were observed in the temporo-parietal junction (TPJ;  $p < .001$ ).

## Summary

- All paintings activated a distributed network of visual, parietal, limbic and prefrontal regions.
- Content-related modulation in the FG reflects object perception, whereas hippocampal activation may reflect memory consolidation.
- Stimulus ambiguity (in RP and AB paintings) results in delayed latency of the BOLD response.
- Imagery-related activation was observed for scrambled paintings, which never contained meaningful objects, and thus reflect the subject's strategy to resolve object indeterminacy.
- Interpreting composite scenes relies on higher order associations in the TPJ.

## Conclusions

Our results suggest that in the human brain conscious awareness of familiar objects in indeterminate visual input is automatic. Perception of recognizable content in art works is mediated by various cognitive processes (i.e., object recognition, memory recall and mental imagery).

## Acknowledgements

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