Individual Variation in Amygdala Involvement in Theory of Mind: an fMRI Study

Individual Variation in Amygdala Involvement in Theory of Mind: an fMRI Study

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Background

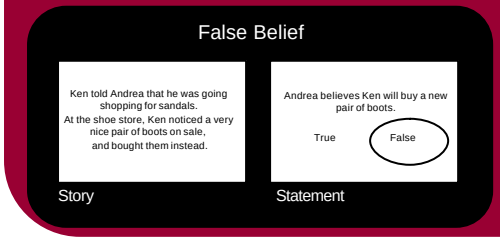
- A key component of social cognition is "theory of mind" (ToM) - the ability to infer others' mental states. In particular, longitudinal research shows that early ToM predicts later prosocial orientation [Eggum et al., 2011].
- A network of core regions, including temporoparietal junction (TPJ), dorsomedial prefrontal cortex (dmPFC) and precuneus is thought to underpin ToM abilities [Saxe 2006].
- Amygdala also implicated in social cognition, including ToM processing [Stone 2003], but it is unclear if it forms part of the core ToM network. One reason is that there might be considerable individual variation in amygdala involvement in ToM.
- Reduced amygdala response to social stimuli is seen in individuals with extremely low prosocial motivation – e.g. conduct disorder [Jones et al., 2009], suggesting a link between amygdala function, social cognition and prosocial orientation.

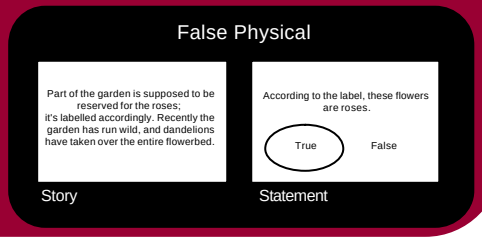
Aims

- To examine the relationship between amygdala involvement in ToM, advanced social cognition ability and prosocial orientation.
- Specifically: To examine whether advanced ToM ability mediates the relation between amygdala function and prosocial orientation.

fMRI Methods - Theory of Mind (False Belief) Task

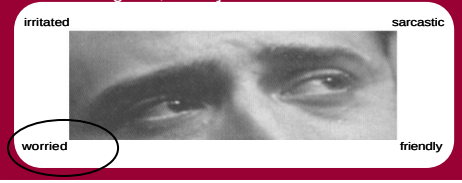
- 40 healthy females scanned (mean age = 22)
- Designed to probe the mental (as opposed to the physical) causes of events [Saxe & Kanwisher 2003].
- GE 3 Tesla
- Blocked design with 2 block types: False Belief and False Physical
- Story shown for 10 seconds followed by statement for 4 seconds which participants need to make a response to (true/false).
- 24 stories and corresponding statements shown, 12 for each condition.





Reading the Mind in the Eyes (RMIE) Task

- Circle which word best describes what the person is thinking or feeling [Baron-Cohen, et al., 2001].
- Advanced test of ToM (RMIE). Predicts real world "social intelligence" [Woolley et al., 2010].
- False belief understanding predicts RMIE performance [Peterson & Slaughter, 2009].



Prosocial Orientation

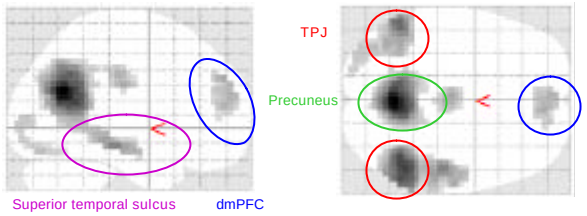
- Prosocial orientation measured using the 7-item agreeableness scale of the BFI-44 [John et al., 1991]. This is a well-validated, highly reliable measure. It has been shown to predict e.g. real world helping behaviour.

Sample item: Are you someone who is helpful and unselfish with others? Rated 1 – 5 for strength of agreement.

Acknowledgement
Many thanks to R Saxe and J Andrews-Hanna for providing stimuli for the False Belief task.

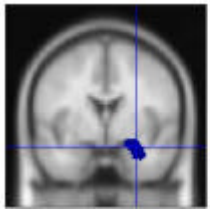
Results

Whole brain analysis FB>FP
p<0.05 cluster corrected, SPM8

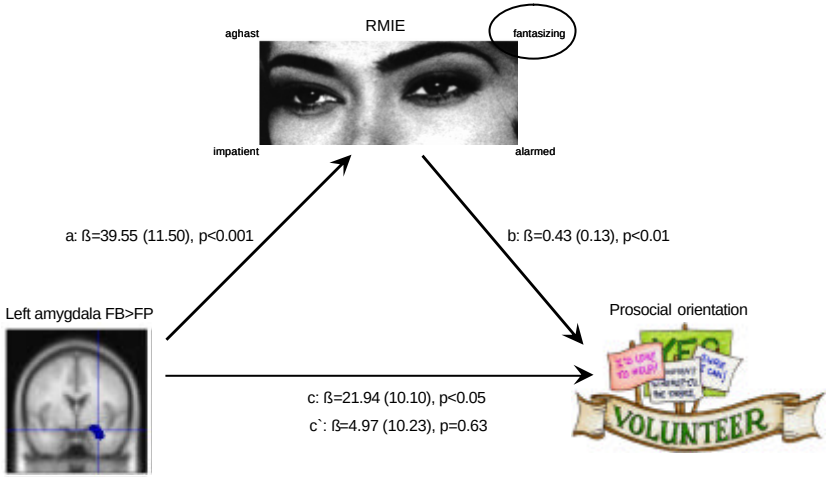


Amygdala SVC p<0.05 FWE-corrected

Left Amygdala
AAL ROI



Results – Mediation Analysis



- Amygdala activity during FB predicts prosocial orientation (agreeableness) and RMIE
- RMIE predicts agreeableness.
- Relation between amygdala response during FB and agreeableness mediated by advanced ToM performance (RMIE).

Discussion

- Variation in amygdala response during FB processing importantly related to prosocial orientation.
- This was mediated by ToM ability. Consistent with a role for amygdala in processing mentalistic significance of social stimuli (high-road), not just basic affective or orienting responses (low road) [Pessoa & Adolphs 2010].
- Supports utility of continuum-based approaches to personality-psychopathology relations.