Reading faces: The relationship between individual differences in psychosis proneness and face processing

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Outline:

1. Why faces are interesting
2. Psychosis proneness / vulnerability
3. Some data…
    1. Extra-foveal emotion processing
    2. Misattributing facial emotions
    3. Laterality biases
4. Conclusions / Future research

Why are faces interesting?

- They provide powerful cues to our own attentional systems:

Driver et al, 2009 + many others…

Birmingham et al, 2009

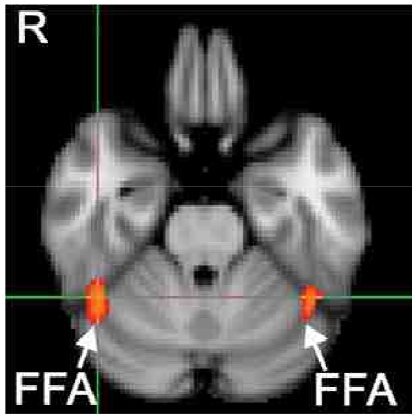
Why are faces interesting?

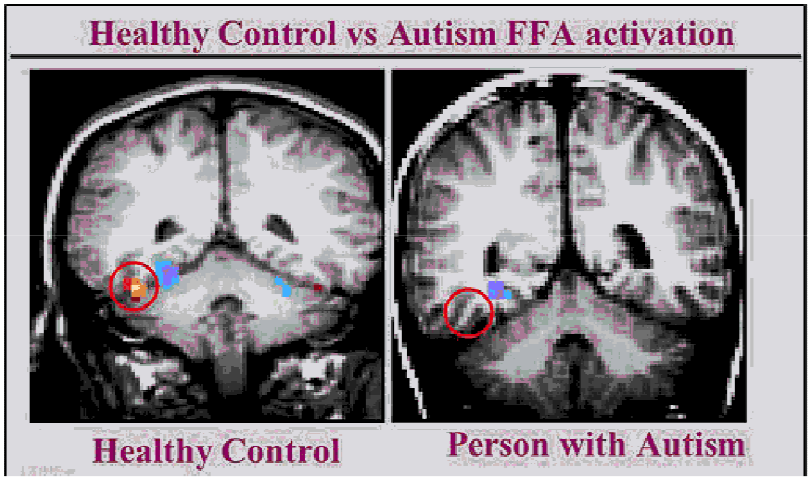
- They convey emotion:

-Links with psychopathology / social cognition

Why are faces interesting?

- We may have specialised neuronal systems for processing faces:





-Rapid / efficient – links with saccadic system
-Peripheral / subliminal processing – conscious awareness

- All these points are illustrated by our tendency to see faces in inanimate objects...

Faces in inanimate objects

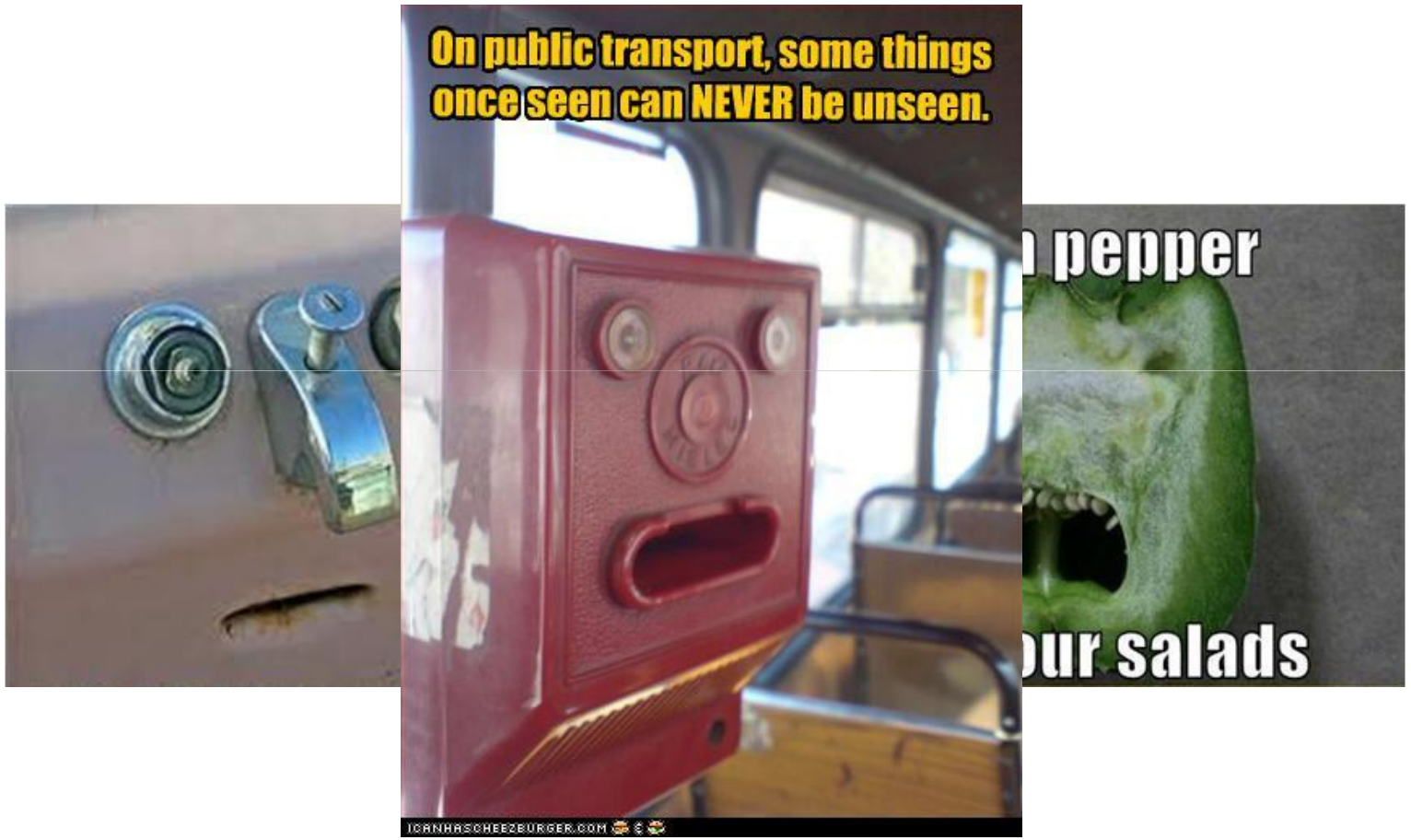
We don't just see faces in inanimate objects – we see emotional faces.

Plenty of examples of the 6 basic "Ekman" emotions.

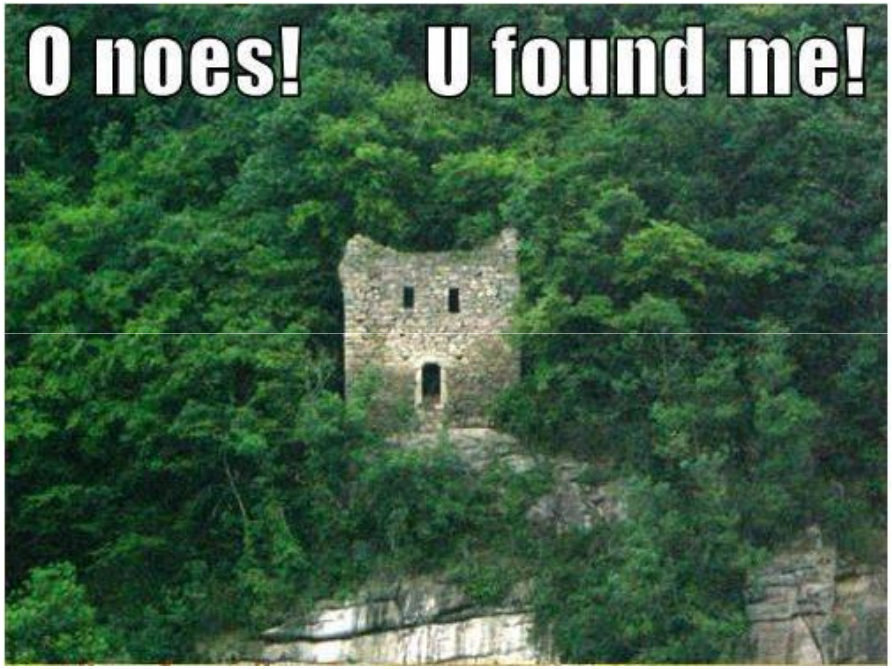
But...
I don't wanna be a flowepot
Happy Chair is Happy .com

BASEMENT FOOTWEAR
plotting to steal your soles
ICANHASCHEEZBURGER.COM

Examples of fear were hard to find



Not many examples of disgust either…


O noes!
U found me!

Plenty of more “complex” emotions too…

smug billding is smug

And even gaze cues…

Continuum models of Psychosis

- Hallucinatory experiences are not confined to patients with schizophrenia or even to other neurological / neuropsychiatric disorders.
- Auditory and visual hallucinations are experienced by a small percentage of “healthy” adults (e.g. Sidgewick, 1894, Ohayon, 2000).
- Individuals who report “hallucination-like” experiences are at greater risk of developing psychotic symptoms (e.g. van Os et al, 2009; Keheller & Canon, 2011).
- Various questionnaires assess “schizotypal” personality traits / hallucination proneness etc in healthy participants
- It is assumed that the cognitive mechanisms underlying hallucinatory experiences are the same in healthy individuals as in “pathological” individuals.

"Subliminal" emotion processing

- Related to an even bigger literature on "pre-attentive" / rapid processing of facial emotions

3 lines of evidence for subliminal processing of facial affect:

1) Blindsight patients:

de Gelder, Pourtois, et al., 2001 – Patient GY can "guess" at above chance levels the emotion portrayed in faces presented to his blind hemifield
(see also Pegna et al., 2005; Pessoa, 2005 etc).

2) Electrophysiological / neuroimaging studies

Pegna et al (2008): Enhanced N170 to subliminally presented fear faces
Esteves & Ohman (1998): Enhanced amygdala activation to "subliminal" fearful faces compared to happy faces

3) Non-clinical studies:

Typically using rapid / masked presentation strategies show facilitation / inhibition effects e.g. Dimberg et al., 2000; Liddell et al., 2005 ;Tamietto & de Gelder, 2008

"Subliminal" emotion processing

BUT... Lots of controversy:

• Pessoa et al (2002) – Amygdala response only if stimuli "attended to" (e.g. looked at)

• Philips et al (2004) No increased amygdala activation for subliminal compared to supraliminal fear faces.

• Effects can depend on whether faces are presented centrally or peripherally

• Debates over what is subliminal - objective vs subjective measures etc etc.

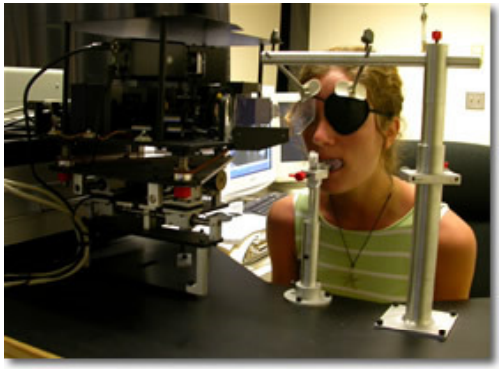
Rapid emotion processing in the periphery

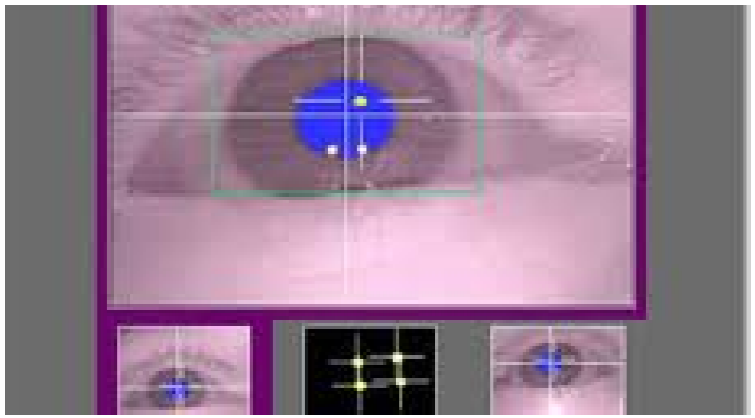
Nummenmaa (2009): Emotional Scene Content Drives the Saccade Generation System Reflexively. *JEP:HPP*

- Two marker boxes / two images: Positive/Negative vs Neutral

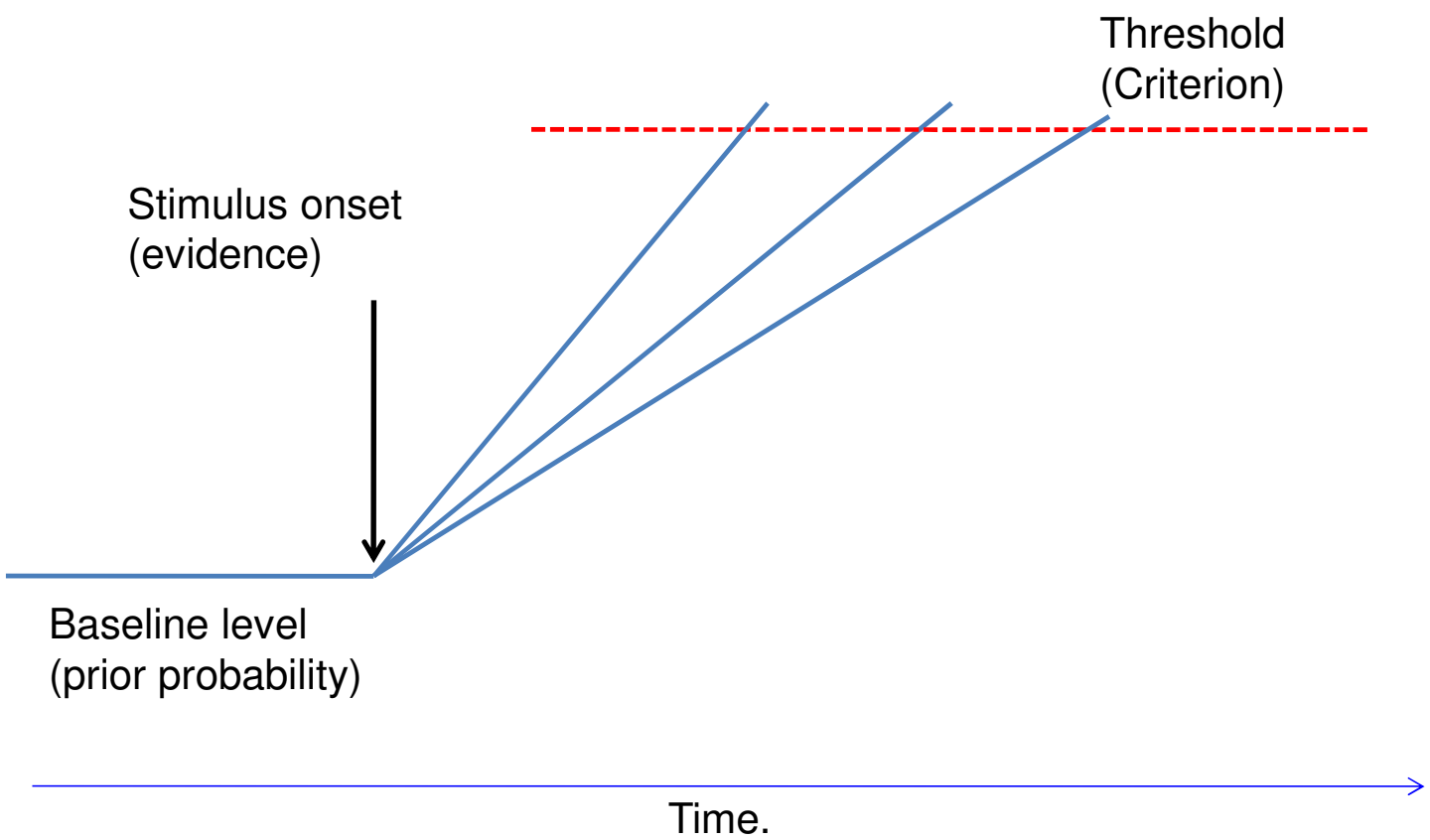
- Participants saccade to the cued location.
- Image-Cue SOA is either -150 or 0ms (e.g. image appears 150ms before cue or image and cue appear at the same time).
- Saccade latencies measured with an eye tracker…

Eye tracking…

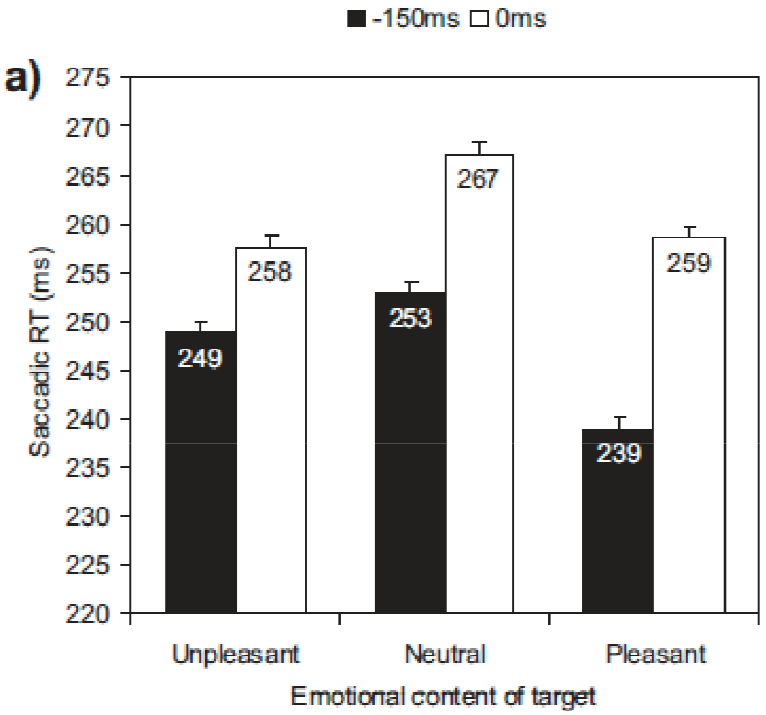




Saccades


Threshold
(Criterion)
Stimulus onset
(evidence)
Baseline level
(prior probability)
Time.

Nummenmaa et al results:



Saccades faster when the cued location contains an "emotional" compared to "neutral" image – even when there is a 0ms SOA

BUT: sub-optimal analysis and images not well matched (some had faces / some didn't – not all "neutral" ones were necessarily "neutral" etc. Also found some effects on saccade amplitudes (suggesting different image properties / content).

Rapid emotion processing

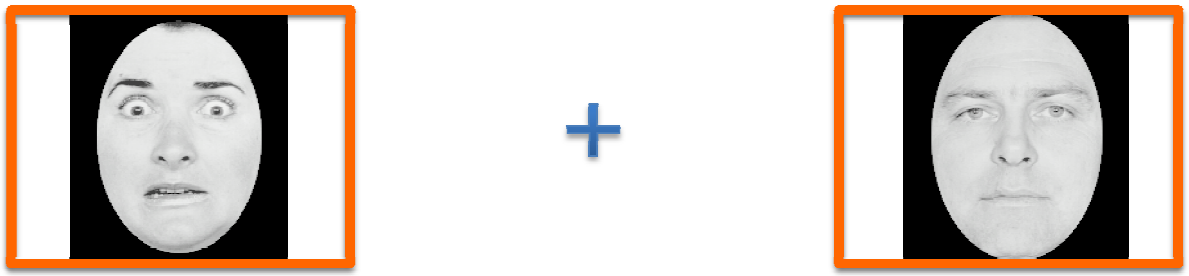
If complex “emotional” scenes can facilitate prosaccade programming, affective faces should too.

And maybe these effects will be moderated by psychosis proneness / anxiety?

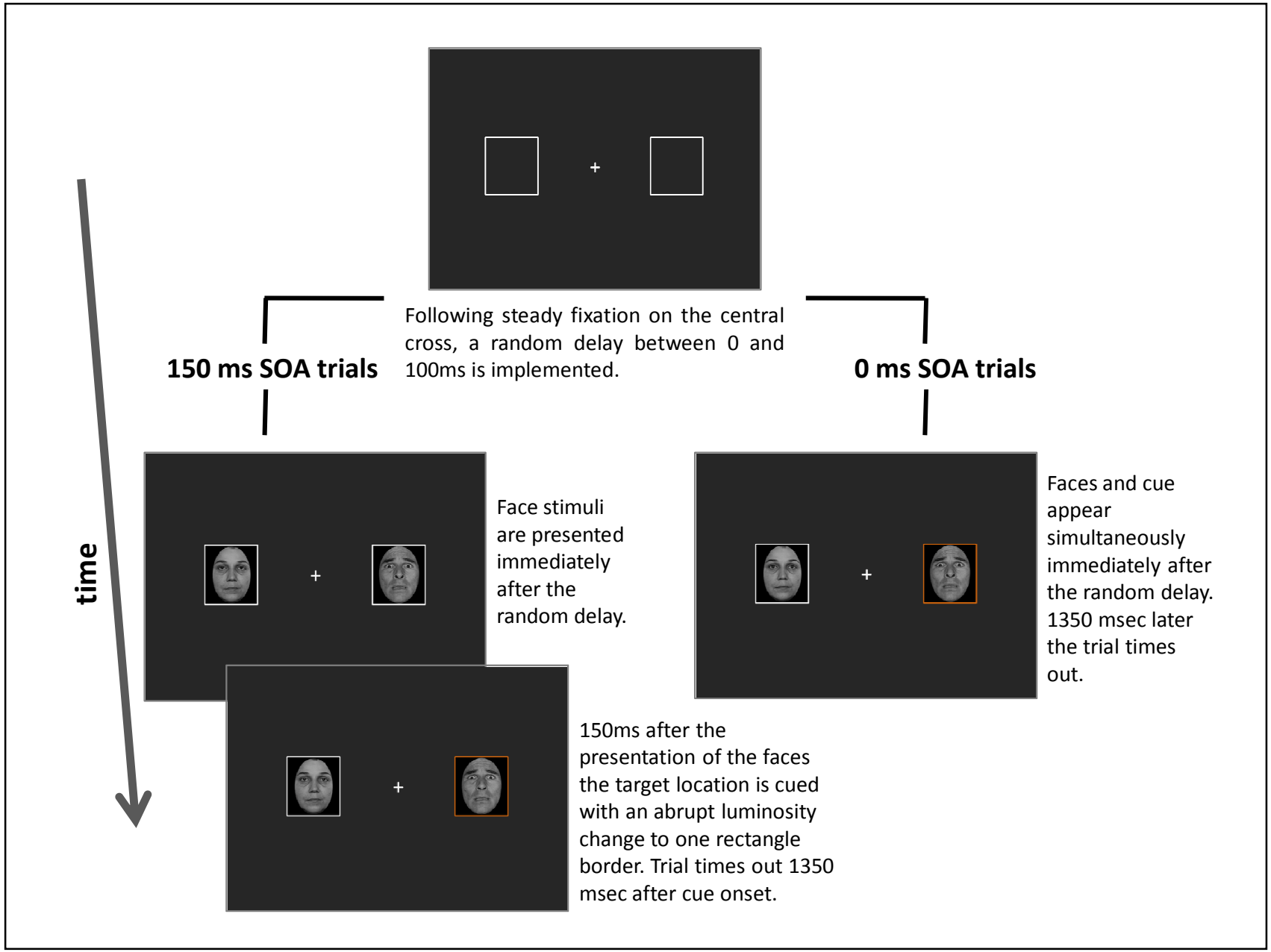
So...

Same expt as Nummenmaa, but with Angry, Fear & Happy vs Neutral faces instead of emotional scenes.

Standard Ekman faces, cropped.



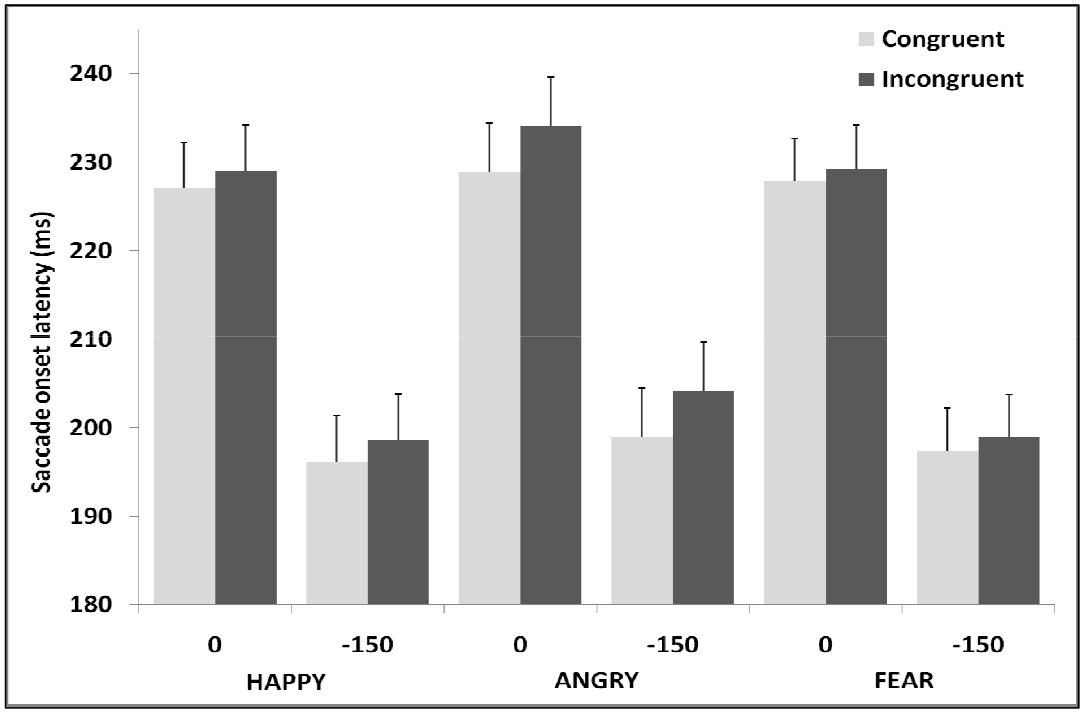
Key measure = prosaccade latency.


Following steady fixation on the central cross, a random delay between 0 and 100ms is implemented.
150 ms SOA trials
0 ms SOA trials
time
Face stimuli are presented immediately after the random delay.
Faces and cue appear simultaneously immediately after the random delay. 1350 msec later the trial times out.
150ms after the presentation of the faces the target location is cued with an abrupt luminosity change to one rectangle border. Trial times out 1350 msec after cue onset.

Experiment 1 Results

Participants: N = 39:

Design: 3 (Emotion) x 2 (SOA) x 2 (Congruency)



Analysis used Hierarchical Linear Modelling – a very powerful and useful technique for many types of eye tracking data.

Avoids the problem of averaging over different numbers of trials.

Main effect of SOA, main effect of Congruency – no main effect of Emotion or any interactions

Experiment 1 Results

So what about psychosis proneness???

All participants completed the: O-LIFE, RISC, BDI and STAI

OLIFE produces four "dimensions"

1) Cognitive Disorganisation
2) Unusual Experiences
3) Impulsivity
4) Introvertive Anhedonia

The only effect of interest was a main effect of impulsivity – higher scoring participants made faster saccades.

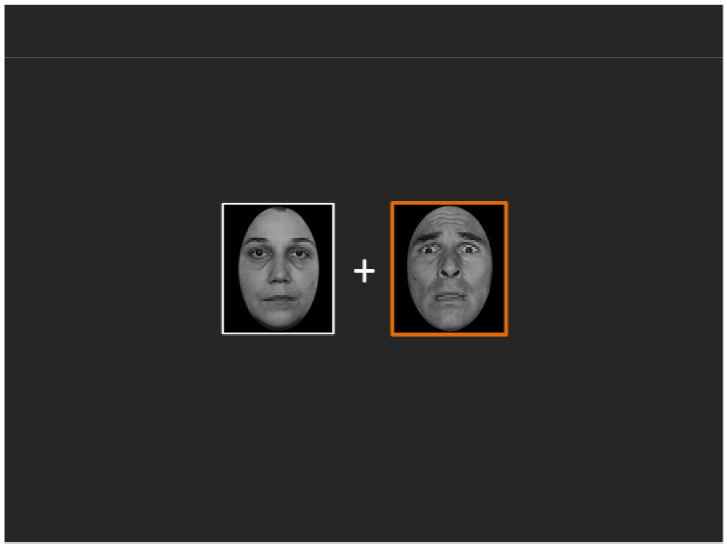
Not entirely uninteresting (confirms that saccades are like any other "decisions" the brain makes)

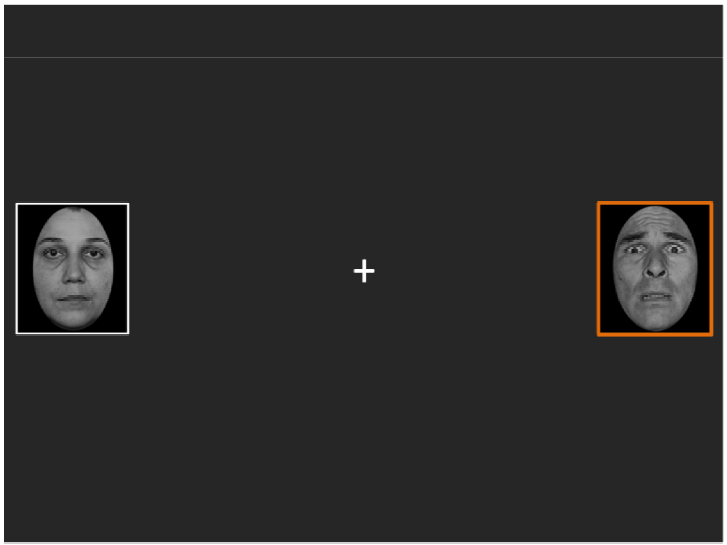
Perhaps saccadic system is already "optimal" – not much room for effects of psychopathology?

Experiment 2

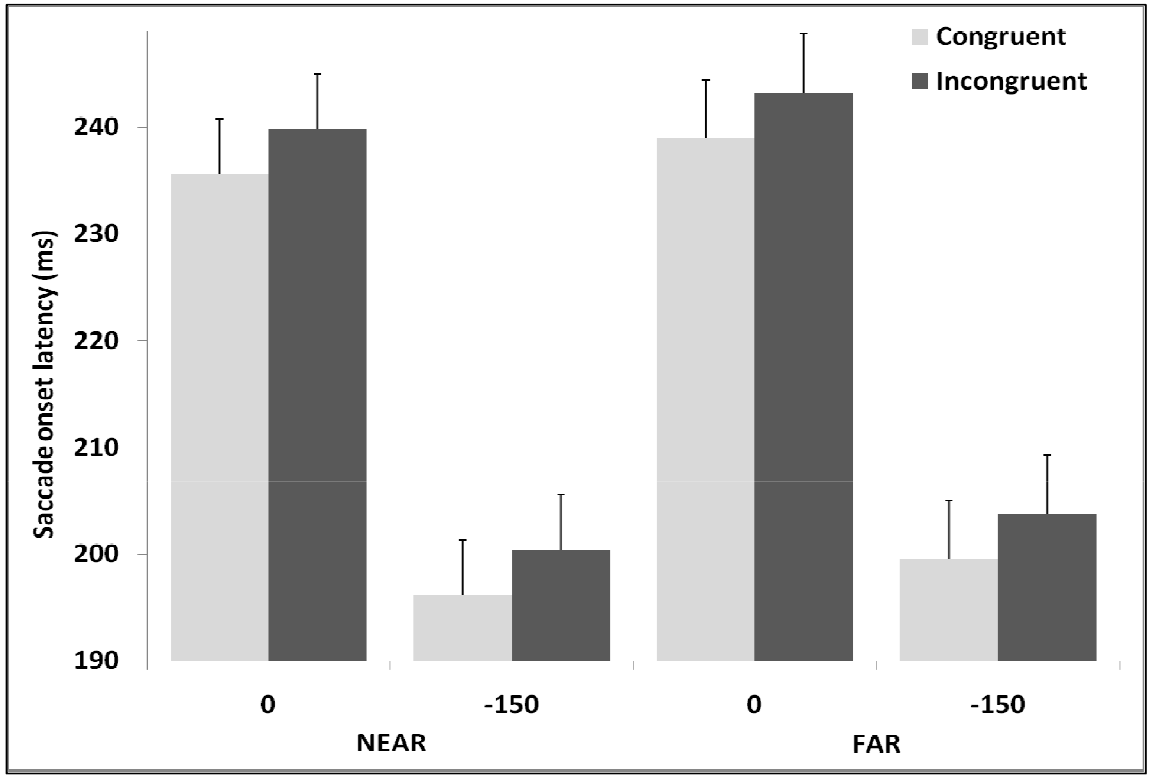
(run in parallel with Expt 1)

Method: N=44, dropped anger and happy. Everything else the same but with faces presented “near” (4 degs) or “far” (12 degs) from fixation.





Expt 2 Results

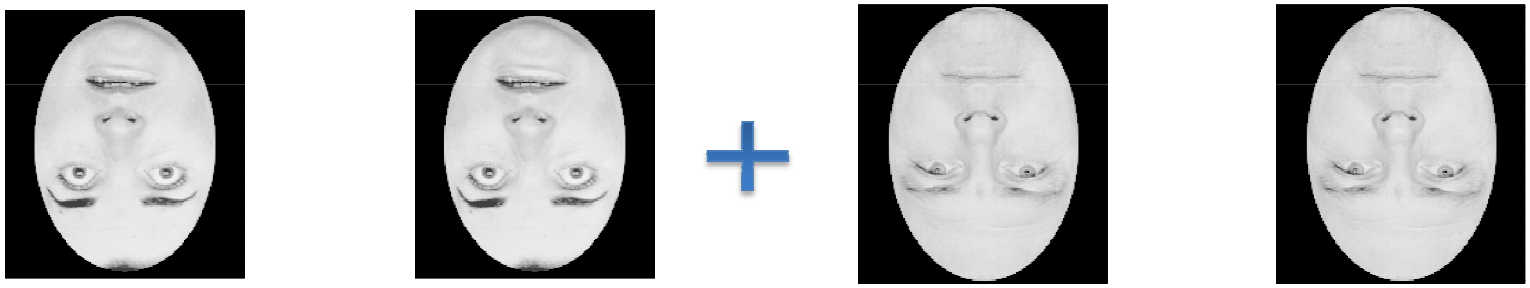


Main effect of SOA, main effect of congruency, no main effect of distance or congruency by SOA or congruency by distance interactions.

Experiment 3

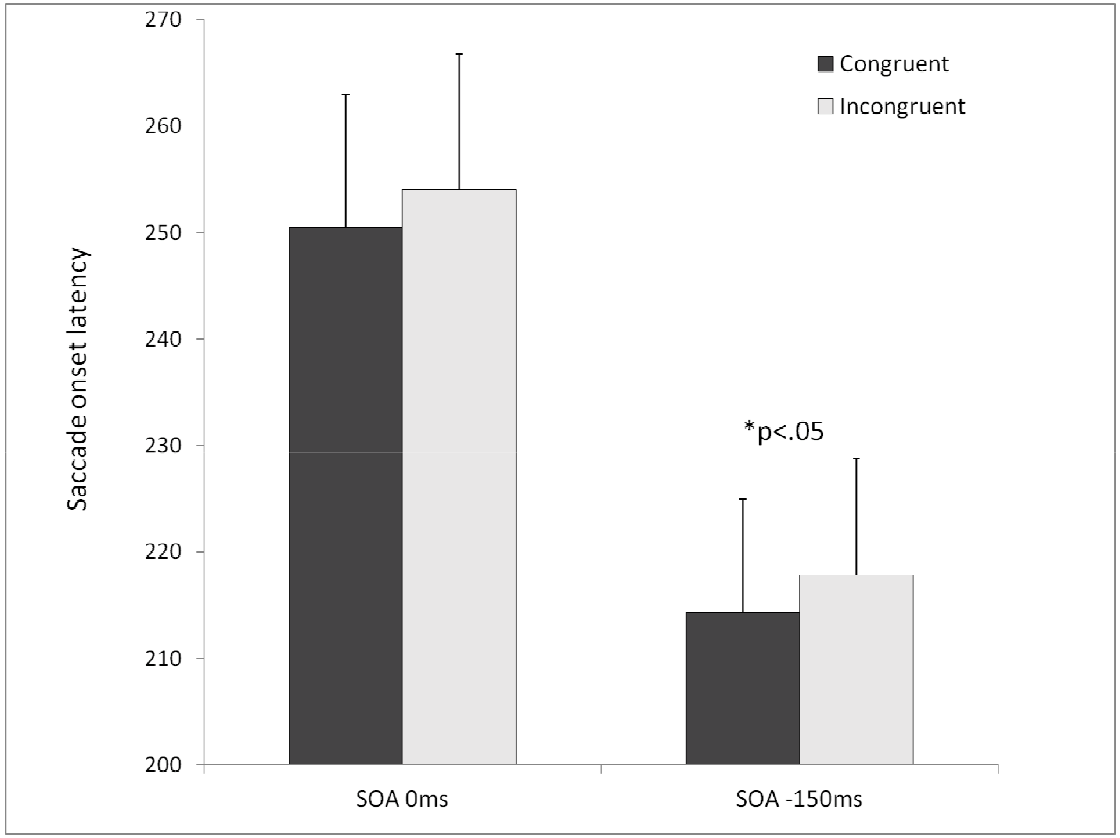
Numenmaa reported no effects on latency when their scenes were inverted, so…

Same as expt 2, but with upside down faces…



- N = 28.

Expt 3: Results



- No main effect of congruency but Cong x SOA interaction... Congruency effect sig for -150 but not 0ms.

Summary / Conclusions

- Prosaccades are made more quickly towards emotional (compared to neutral) faces presented in the periphery.
- This effect is present at 0 ms SOA.
- The effect is also present for faces presented at 12degs
- The effect may also be present for upsidedown faces…

The results provide further evidence for rapid processing of facial affect

And support suggestions that facial affect processing can occur with the relatively low grade visual information available in the periphery.

Compared to the complex emotional scenes used by Nummenmaa, emotional faces have comparatively small effects on saccade latency (3-6ms)

Misperceiving Facial Affect

- The cognitive processes underlying hallucinatory experiences can be explored in the lab with tasks that generate “false positives”
- Such tasks include detecting a tone embedded in noise – e.g. Bentall & Slade (1985) – high schizotypes are more likely to say a tone was present when it wasn’t.
- Most research has explored auditory false positives
- People with schizophrenia have well documented deficits in processing facial affect (see Philips & Siedman, 2008)
- Ultra-high risk individuals, and high schizotypes tend to misattribute “negative” and particularly “threat-related” (fear / anger) emotions to neutral faces.
- Certain types of hallucinatory experience may be the by-products of a cognitive system that has evolved to detect threats - hypervigilance(Dodgson and Gordon, 2009)

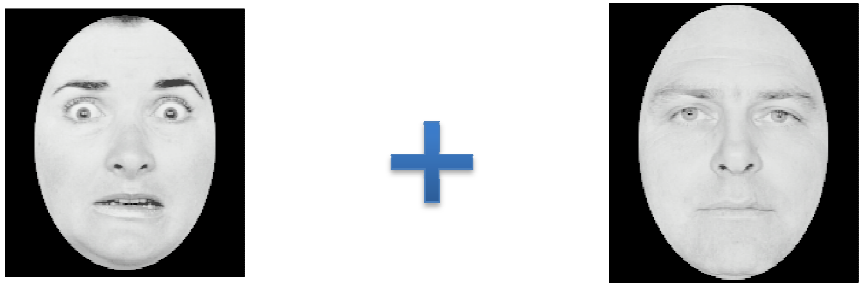
Misperceiving Facial Affect

SO:

259 first year psychology students filled out the Revised Visual Hallucination Scale (RVHS) based on Morrison et al (2002) and performed a novel "emotion detection task"

Data from 68 highest and 68 lowest RVHS scorers analysed.

Two faces presented briefly (250ms) left and right of fixation.



Participants task is to press "f" if they think left face displayed an emotion, "j" if the they the right face displayed an emotion and "space bar" if they think neither face was emotional.

Misperceiving Facial Affect

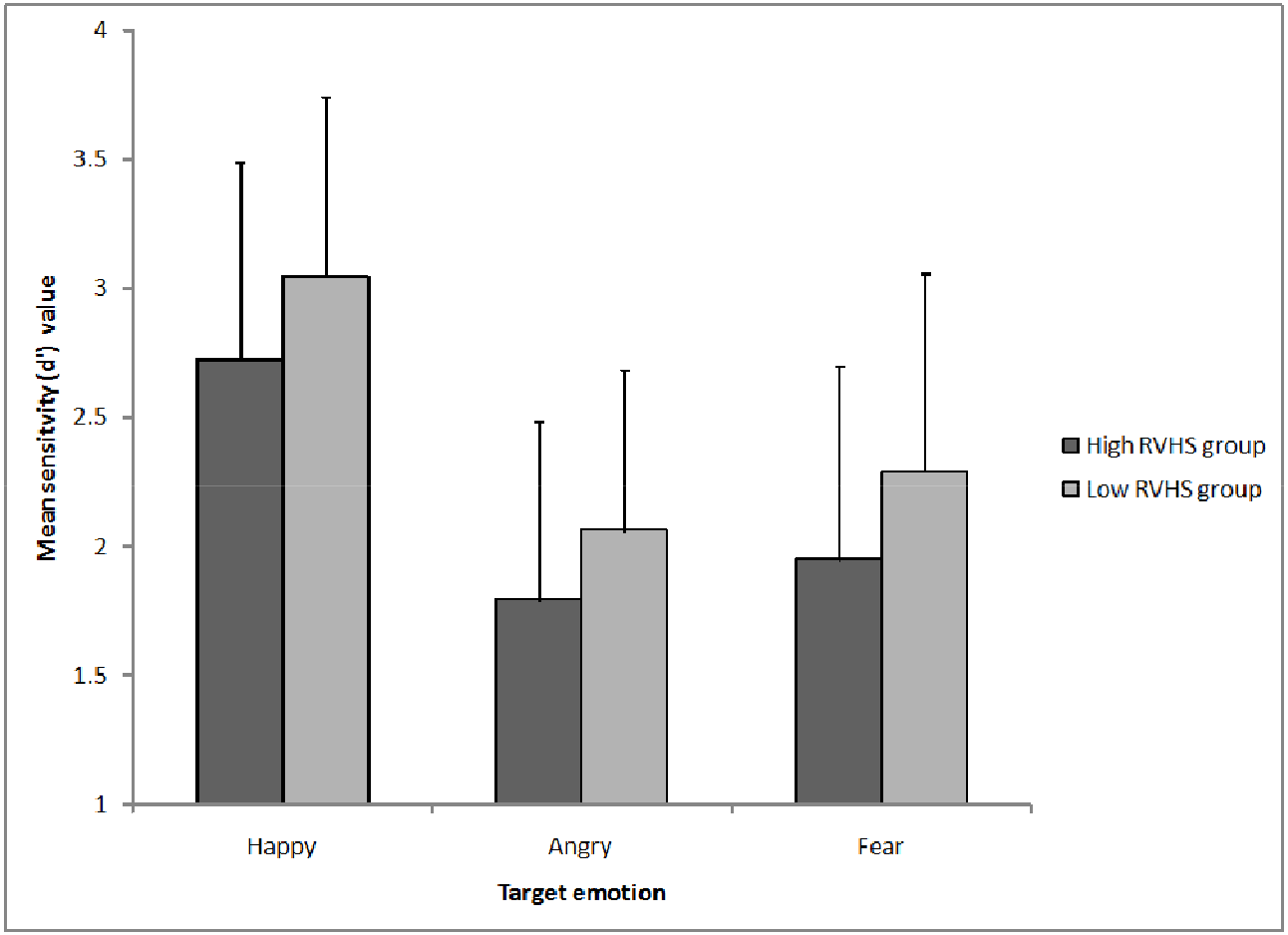
- 196 trials in total, in 3 blocks.
- Each block had a target emotion (Happy, Fear, Angry)
- Half the trials in each block were neutral/neutral
- Faces presented at two distances: near vs far.

- So design is 2 (hi vs lo RHS) x 3 (emotion) x 2 (distance)

- Key dependent variable is the number of false positives on neutral/neutral trials.
- Also measured “detection” – e.g. correctly detecting emotions when they were present.

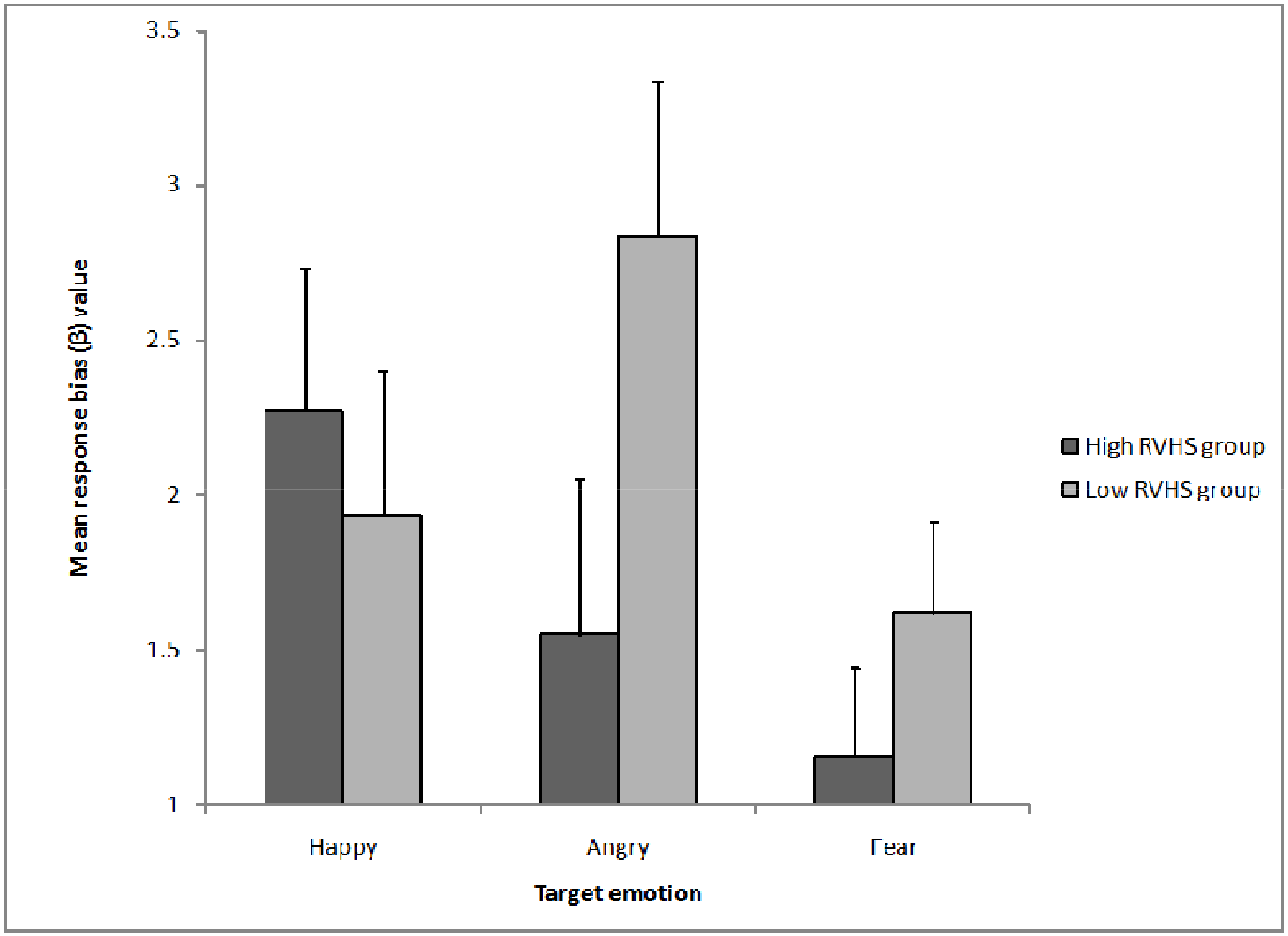
- Both of these measures recalculated using signal detection theory to yield Beta and d-prime...

Detection



Main effect of emotion –happy faces easiest to detect
Main effect of group – Low RVHS better at detecting emotions.

False alarms



Group x Emotion interaction: High RVHS more likely to report seeing an angry face when it was not in fact present.

Misperceiving Facial Affect

• Our novel task successfully elicited large numbers of false positive responses in a sample of healthy individuals.

• High RVHS scorers were more likely to misperceive neutral faces as angry than low RVHS scorers – supporting previous research in Sz patients (Kohler et al., 2003), ultra-high risk adolescents (van Rijn et al., 2010) and high schizotypes (Brown and Cohen, 2010; Van't Wout et al., 2004).

• Provides some support for hypervigilance hypothesis –that our perceptual system has evolved to tolerate false positives to potentially threatening information.

• But why misperceive anger and not fear? Both are threat related…

Laterality biases

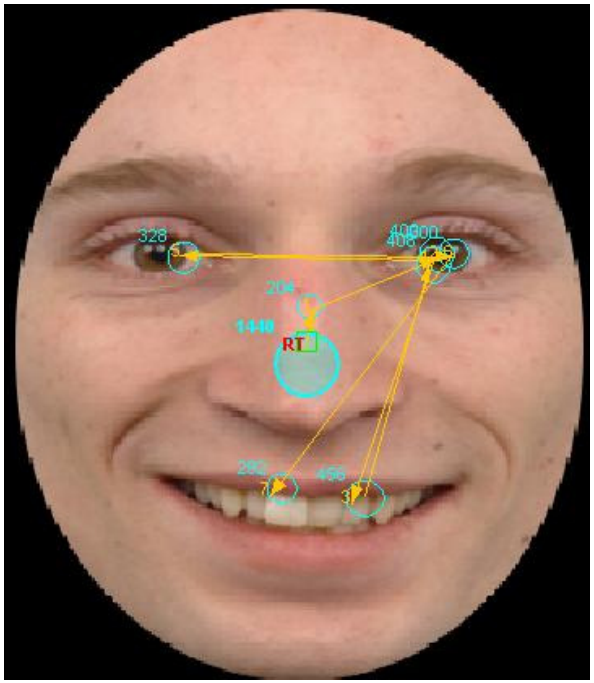
- In the previous experiment we found that people were much better at discriminating neutral / emotional faces when they appeared on the left
- And also more likely to misperceive emotion in a neutral face presented on the right.

- There is an extensive literature detailing various laterality effects in face processing – left hemifield / right hemisphere advantage.

Laterality biases

- When looking at a face, we tend to pick one eye…

- This preference is very replicable, but appears unrelated to handedness…



Laterality biases

• Leonards & Scott-Samuel, (2005) – used eye tracking to measure scanpaths whilst people looked at faces - 28/37 participants made their first saccade to somewhere on the left of the face.

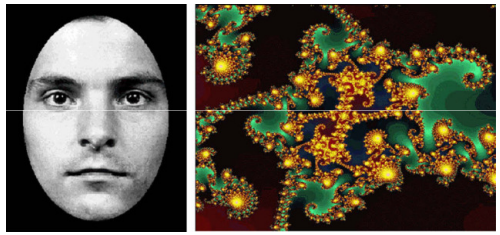
• Majority of fixations on left side of chimeric faces when attempting to judge gender / age (Butlera et al, 2005).

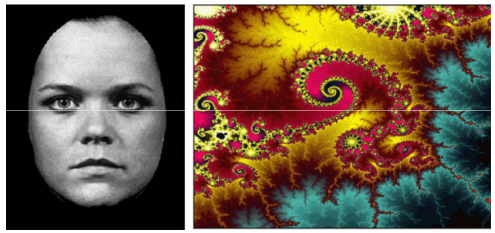
• Early research suggested patients with schizophrenia make fewer fixations when looking at faces.

• Philips and David (1997) looked at initial saccades of 8 patients – controls tended to go left, patients tended to go right.

Laterality biases

• Van Wout (2004) – left visual field bias associated with schizotypy (just…)
• But are these biases specific to faces? (reading influences…)
• Leonards & Mohr (2009) – compared scan paths of high / low Magical Ideation (MI) scorers to faces and fractals.



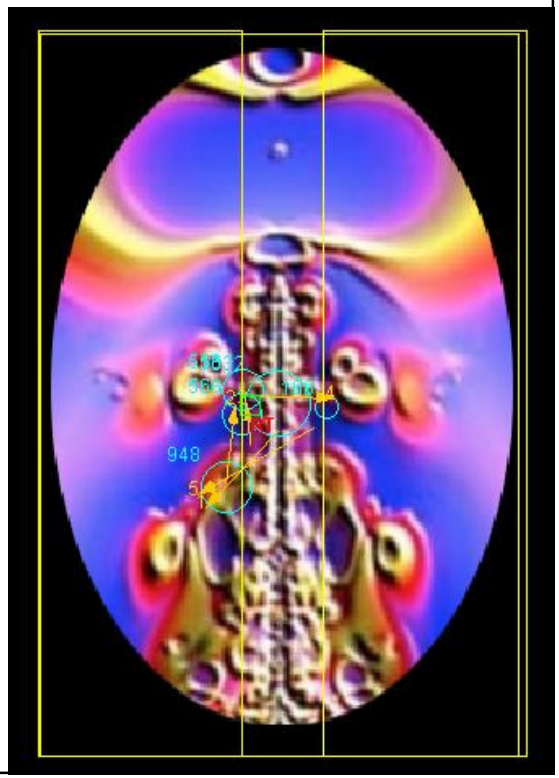


• General leftward bias for faces – particularly pronounced for high MI scorers. , no laterality bias for fractals.

• But lots of problems with experiments – fractals in colour, faces B&W, fractals different size and asymmetrical, very unclear what they actually measured with eye tracker etc etc…

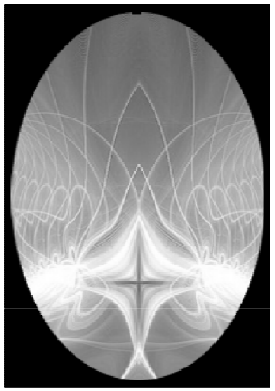
Laterality biases

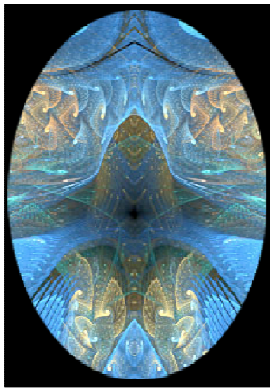
- So….
- 38 Participants – median split into Hi vs Lo Magical Ideation scores.
- Happy / Angry / Fearful / Neutral faces
- Symmetrical fractals same shape and size
- Both stimuli types in B&W and Colour
- Also measured handedness
- Key DVs:
  - first saccade laterality index
  - Dwell time laterality index
  - Extreme dwell time laterality index

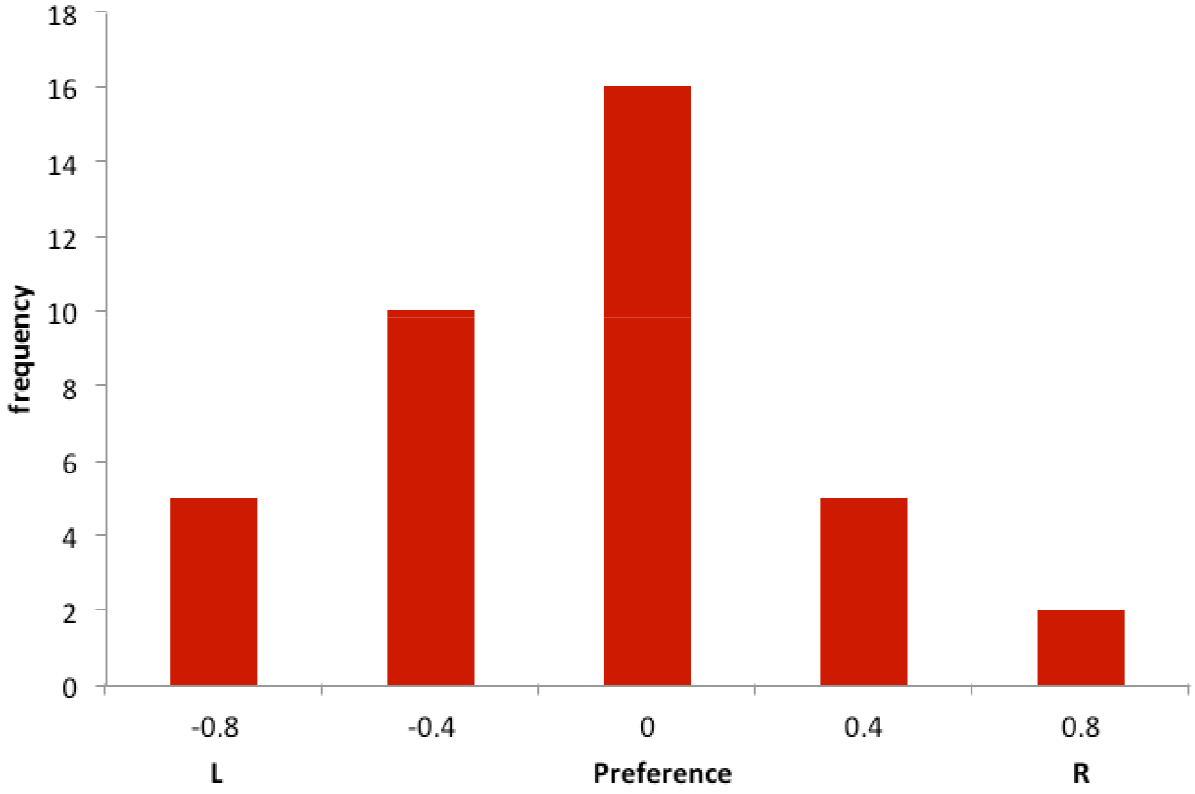


Laterality biases

Laterality bias for first saccade: FRACTALS

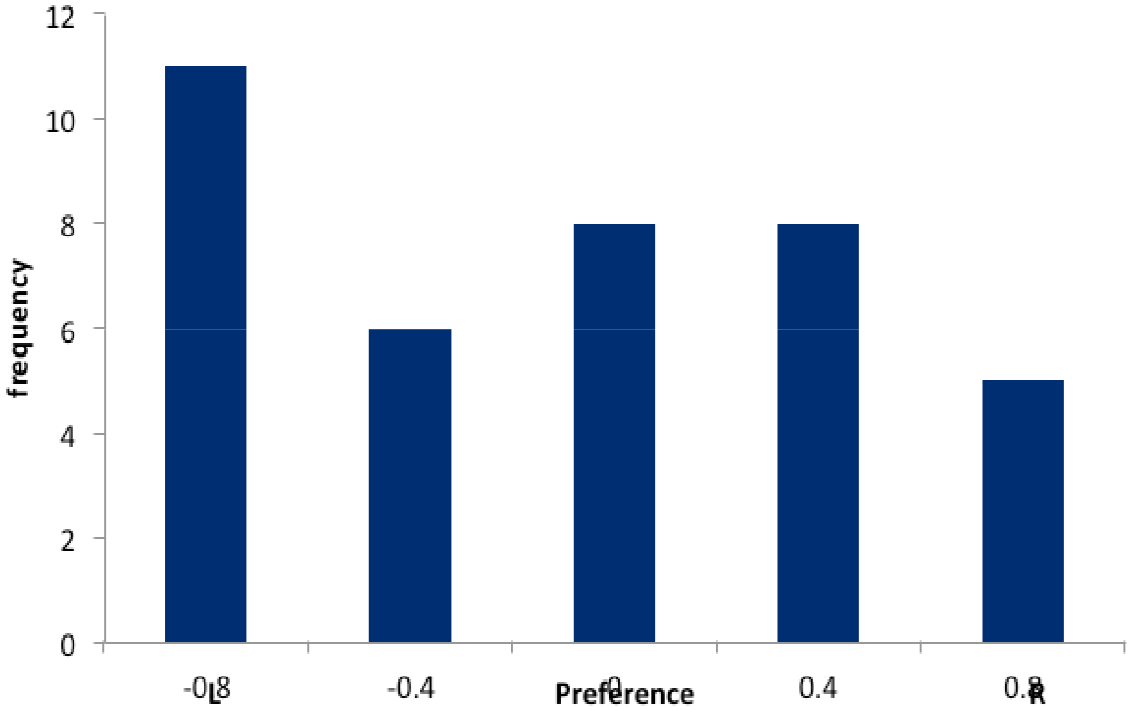






Laterality biases

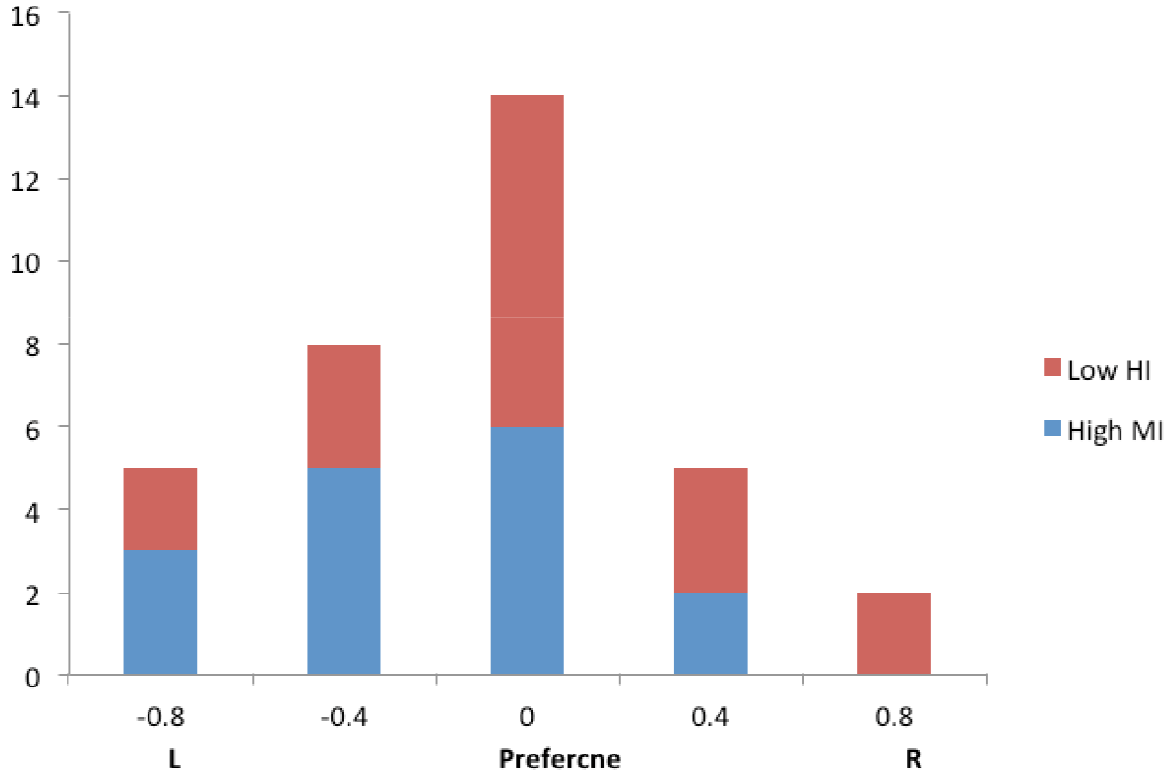
Laterality bias for first saccade: FACES



Laterality biases

What what about psychosis proneness???

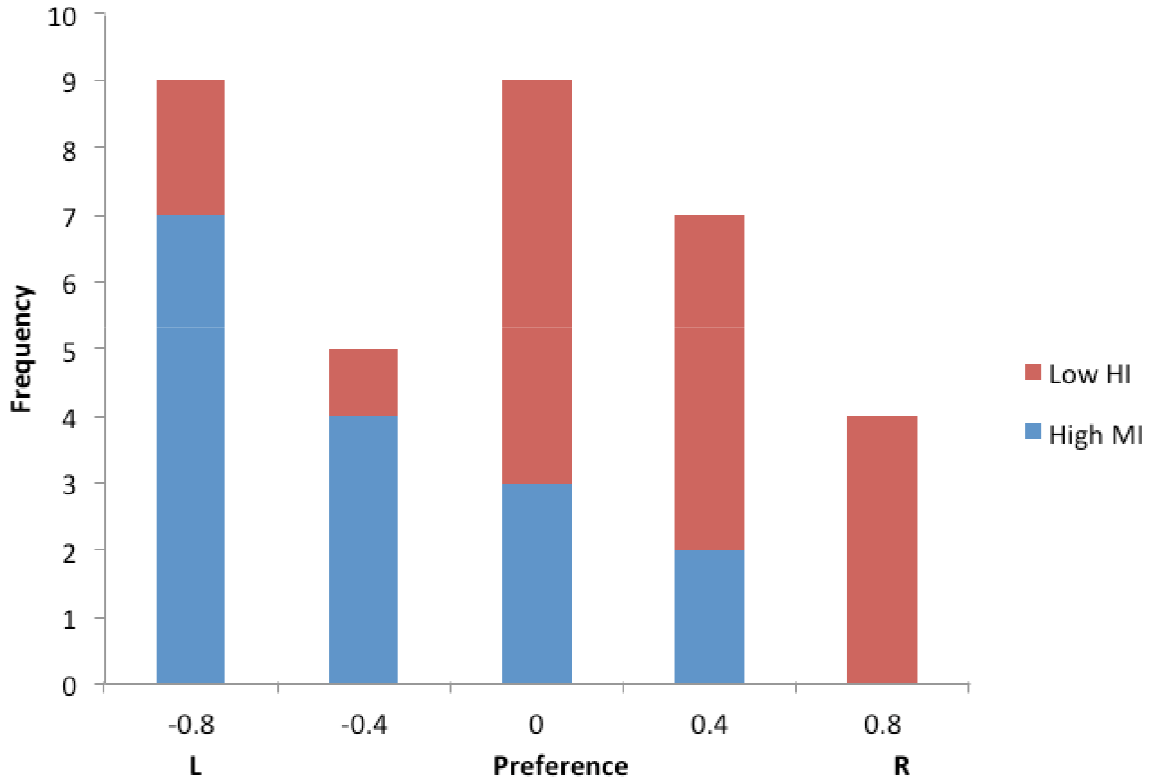
First saccade bias for fractals:



Laterality biases

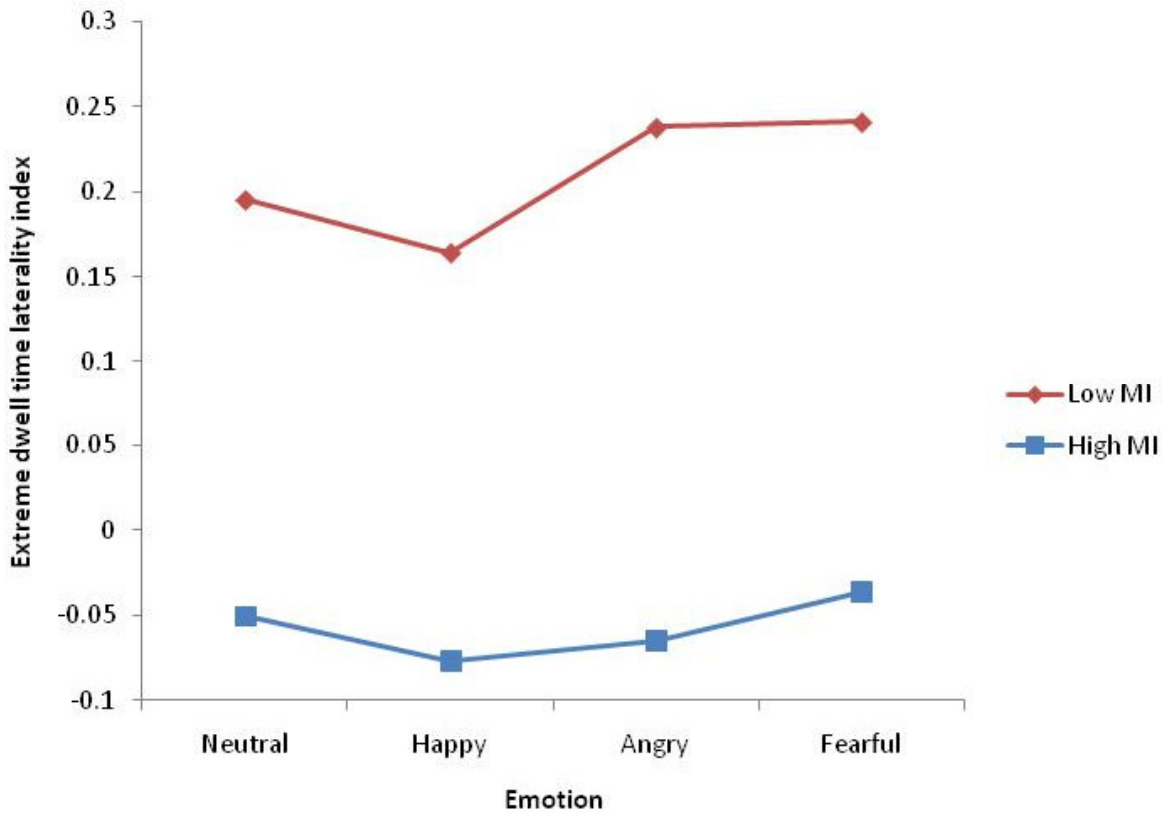
What what about psychosis proneness???

First saccade bias for faces:



High MI participants show a bias towards the left side of the face.

Laterality biases



Current / Future research

1) Faces and time processing – angry faces slow time down most for high MI participants.

2) Faces and "agency" – Libet clock type experiments.

3) Follow up the impulsivity finding on saccade latency.

Might be nice to do some proper schizophrenia research again….

Summary / Conclusions

- Very subtle differences in facial features can be resolved even in peripheral vision and influence saccade latency.
- Perhaps our tendency to focus attention on the eye region (which may take a bit longer to find when faces are upside down) allows subtle differences in contrast / luminance (due to increased visibility of sclera) to influence saccade programming?
- Healthy individuals who report comparatively high numbers of visual hallucinatory-like experiences tend to misperceive neutral faces as personally threatening (angry).
- Some support for hypervigilance theory
- Psychosis prone individuals show a very different pattern of eye movements when looking at faces
- Possible implications for diagnosis / risk assessment?

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