

Ambiguity in social cognition

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Overview

- Social cognition in the brain
- Ambiguity in social cognition and cognitive bias
- Social-cognitive bias in mental disorders
- Processing of ambiguous stimuli in EDs – pilot fMRI study



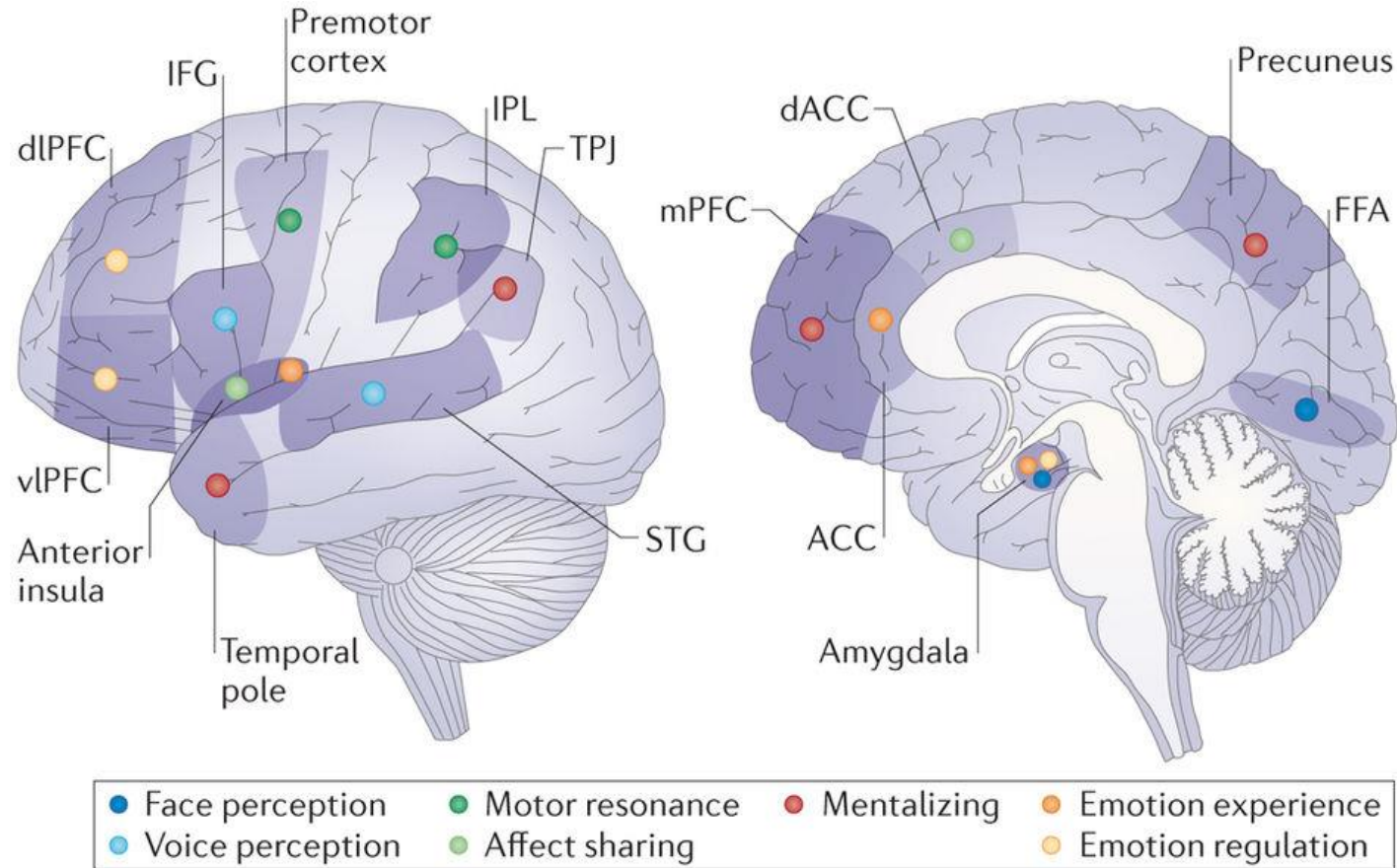
Social cognition

- **Social Cognition** (SC) is an umbrella term for **cognitive** and **affective** processes and abilities involved in social interaction

Perception -> interpretation -> response



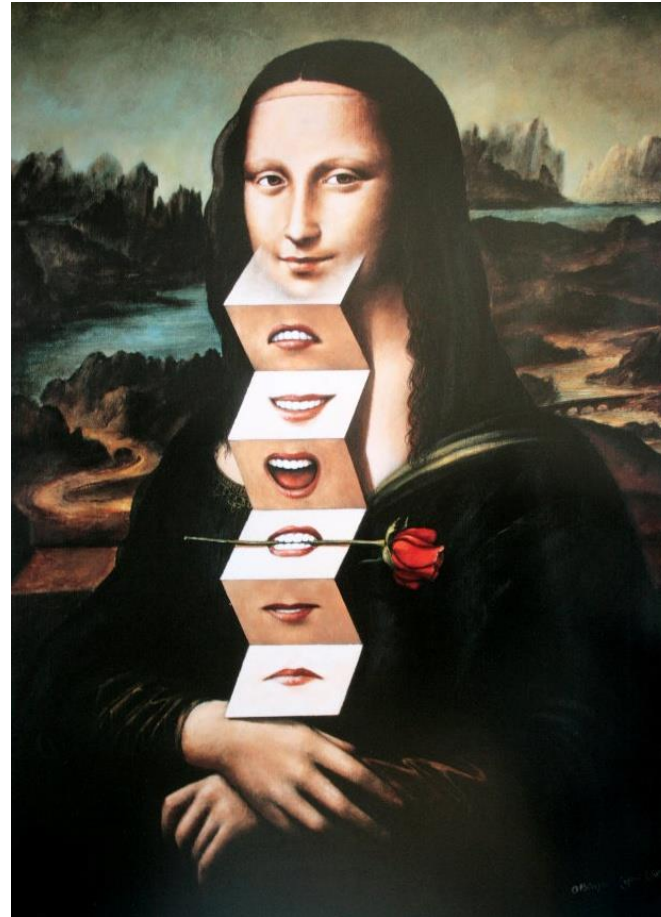
Social cognition in the brain



Nature Reviews | **Neuroscience**

(Green et al., 2015)

Ambiguity in social contact

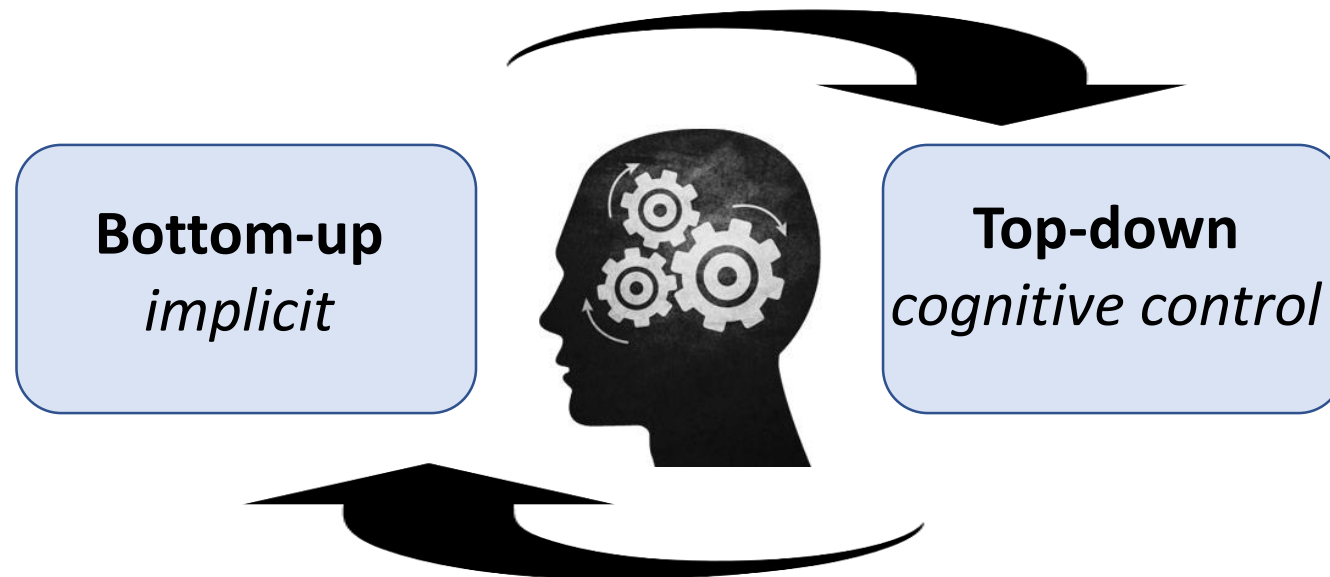


Situational and dispositional factors influence the decision making process

We are „meaning making machines“

- Judgement under uncertainty (Tversky and Kahneman, 1974)
- Better understanding of heuristics and biases (representativeness, availability, adjustment from an anchor)

Two step processing model



Examples of cognitive bias in social cognition

- Attentional bias
- Negativity bias/mood congruent bias
- Projection bias/egocentricity bias



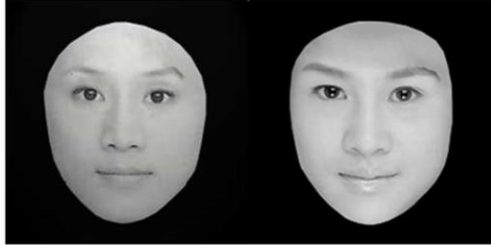
Attentional bias

- Bias in selective attention – towards either **positive** or **negative** stimuli (e.g. facial expressions)
- Increased attention towards information representing person's concerns or any recurring thoughts

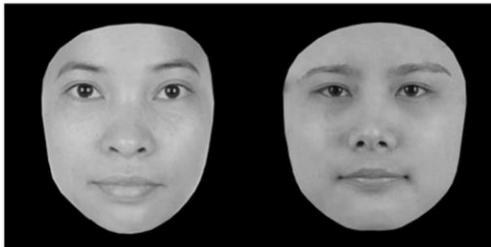
Example: People who often think about the shoes they wear, pay more attention to shoes of others



Attentional Biases toward Face-Related Stimuli among Face Dissatisfied Women



(1)



(2)



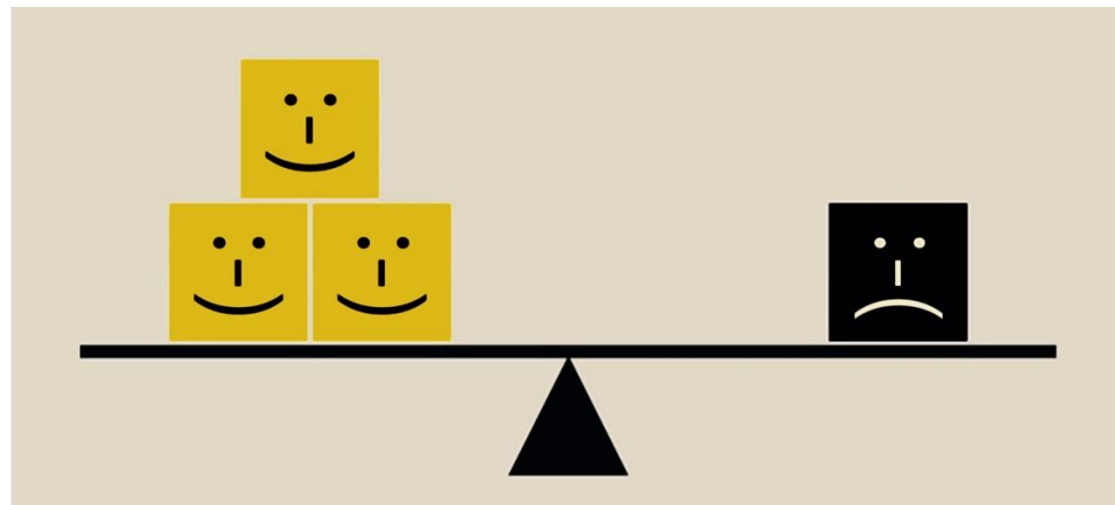
(3)

(Kou et al., 2016)

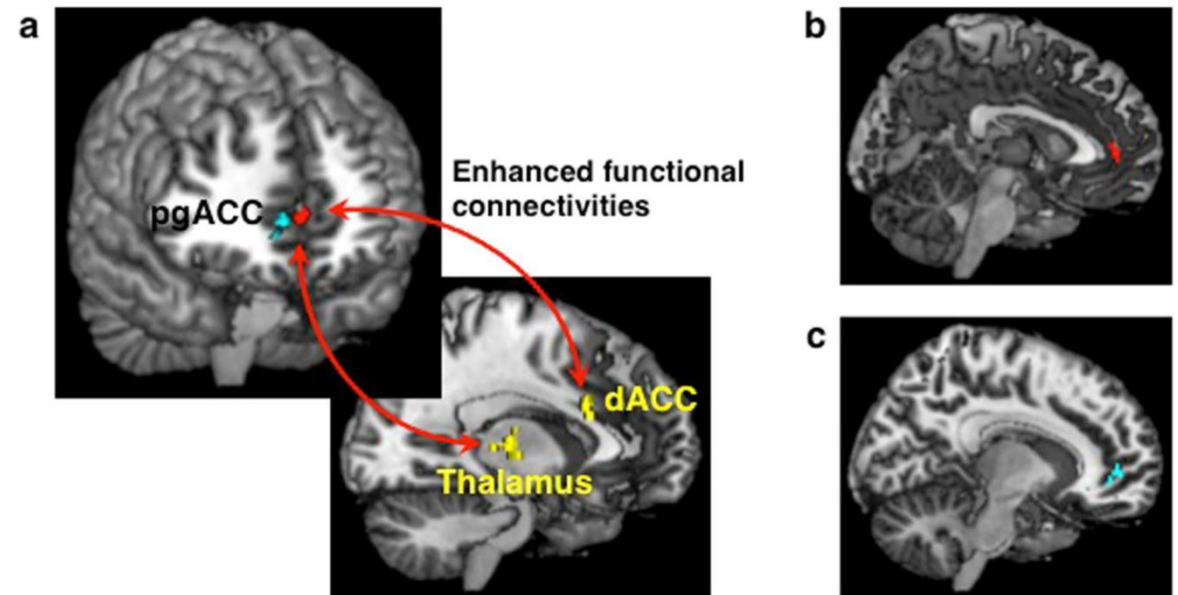
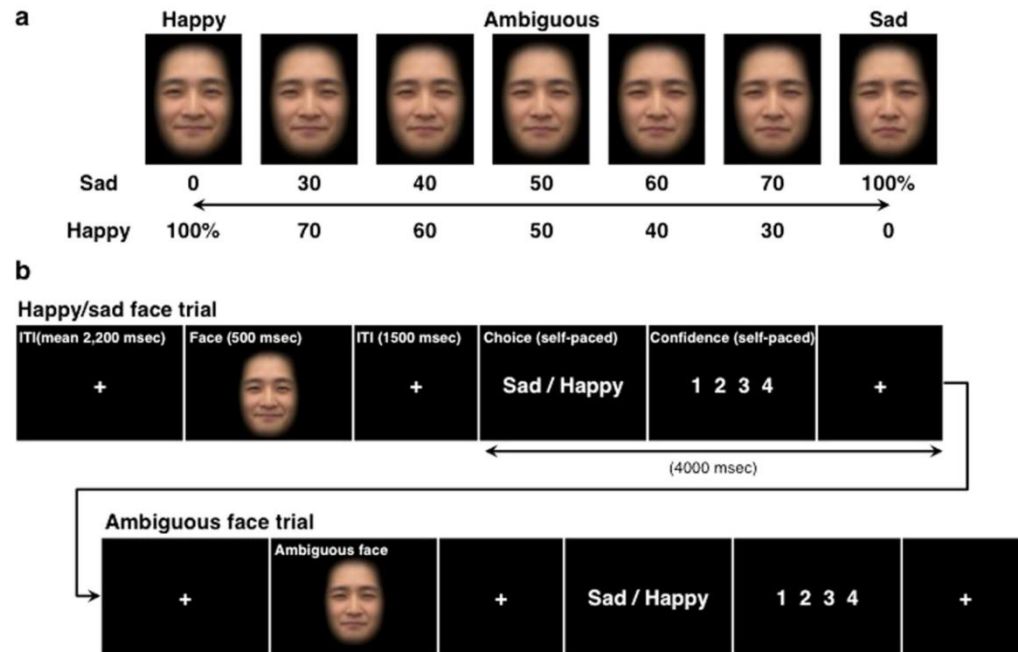
- Face-dot probe paradigm, eye tracking, women with high and low face dissatisfaction (HFD/LFD)
- First fixation, duration of fixation, reaction times for probes after stimuli
- Under the condition of faces-neutral stimuli (vases) pairs, **HFD** women directed their **first fixations** more often toward faces, directed their **first fixations** toward **unattractive faces more quickly**, and had **longer first fixation** duration on such faces
- All participants had longer overall gaze duration on attractive faces than on unattractive ones

Negativity bias

- propensity to attend to, learn from, and use negative information far more than positive information
- May prevent psychological well-being
- Tendency to interpret ambiguous stimuli as negative
- Evolutionary adaptive functions



Negativity bias neural mechanism

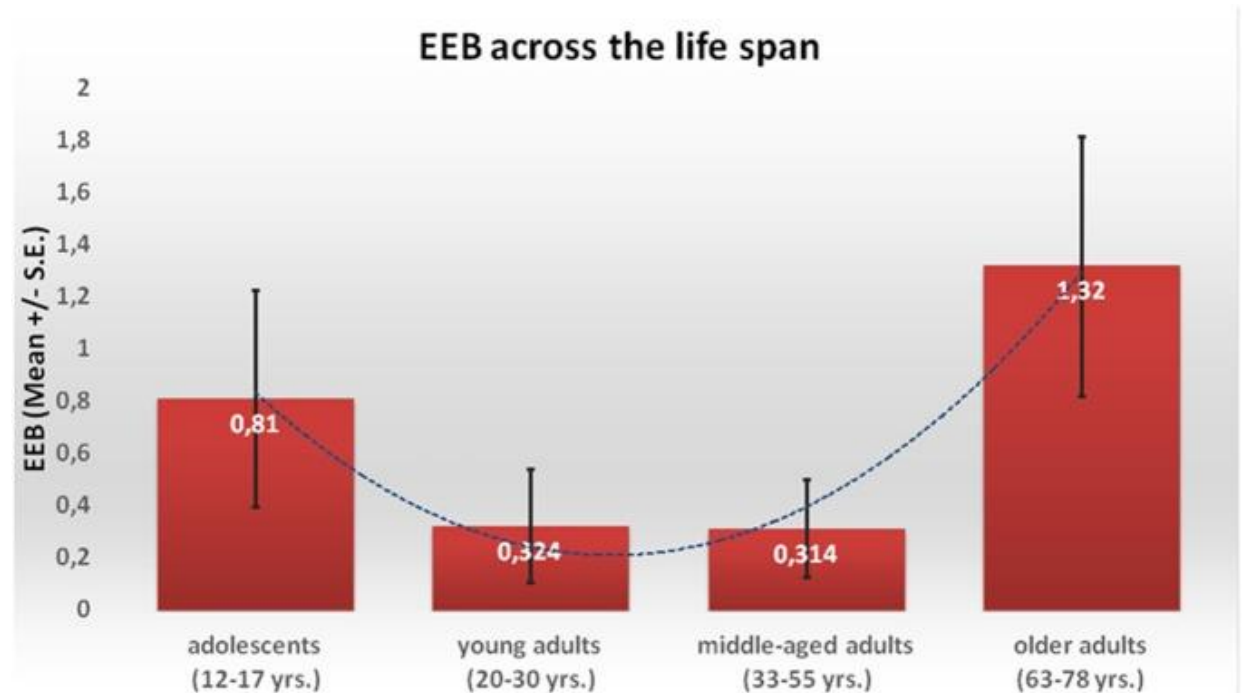


- Perceptual decision making
- Negativity bias (ambiguous seen as sad) associated with bilateral ACC activation

- Increased connectivity – correlated with hopelessness

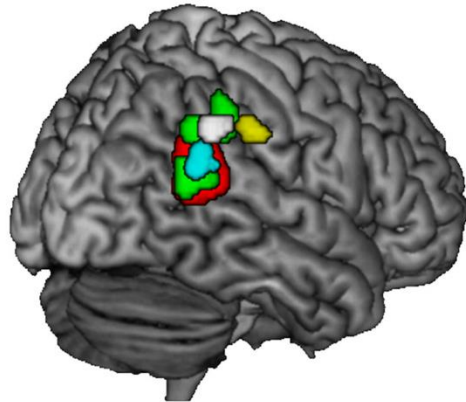
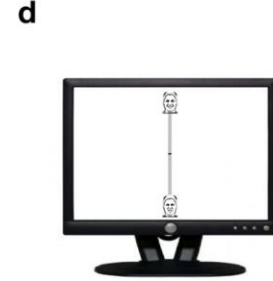
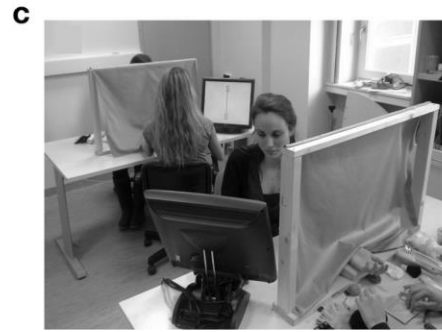
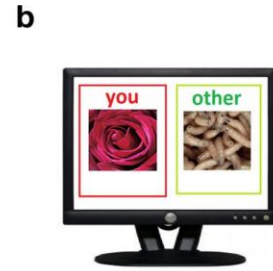
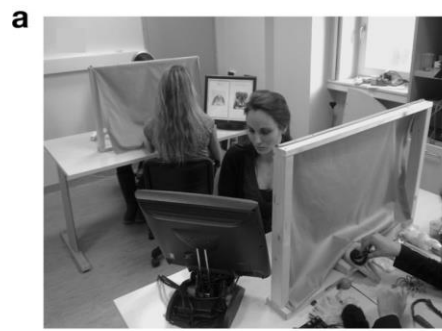
Emotional Egocentricity Bias (EEB)

- Humans often project their own beliefs, desires and emotions onto others, indicating an inherent egocentrism
- Can result in interpersonal misunderstandings
- In case of incongruent emotional states between ourselves and the others, our judgments can be biased



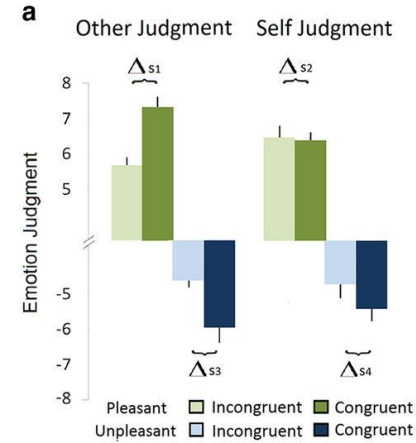
(Riva et al., 2016)

EEB neurocognitive mechanisms

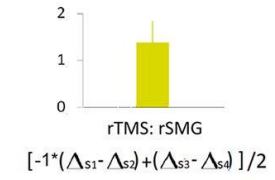


- fMRI EEB
- fMRI attention reorienting
- Imitation-inhibition tasks
- Agency tasks
- Theory of Mind tasks

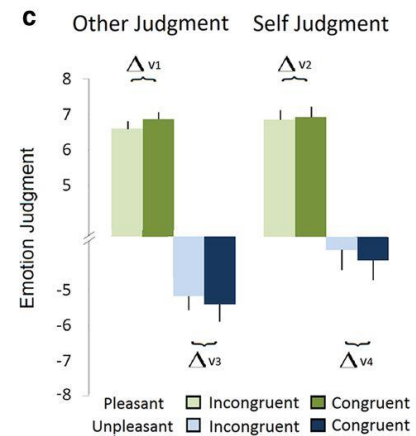
rTMS: right SMG (N=22)



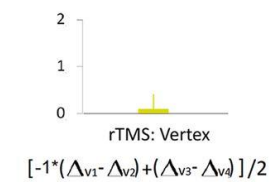
b Emotional Egocentricity Bias



rTMS: Vertex (N=23)



d Emotional Egocentricity Bias



(Silani et al., 2013)

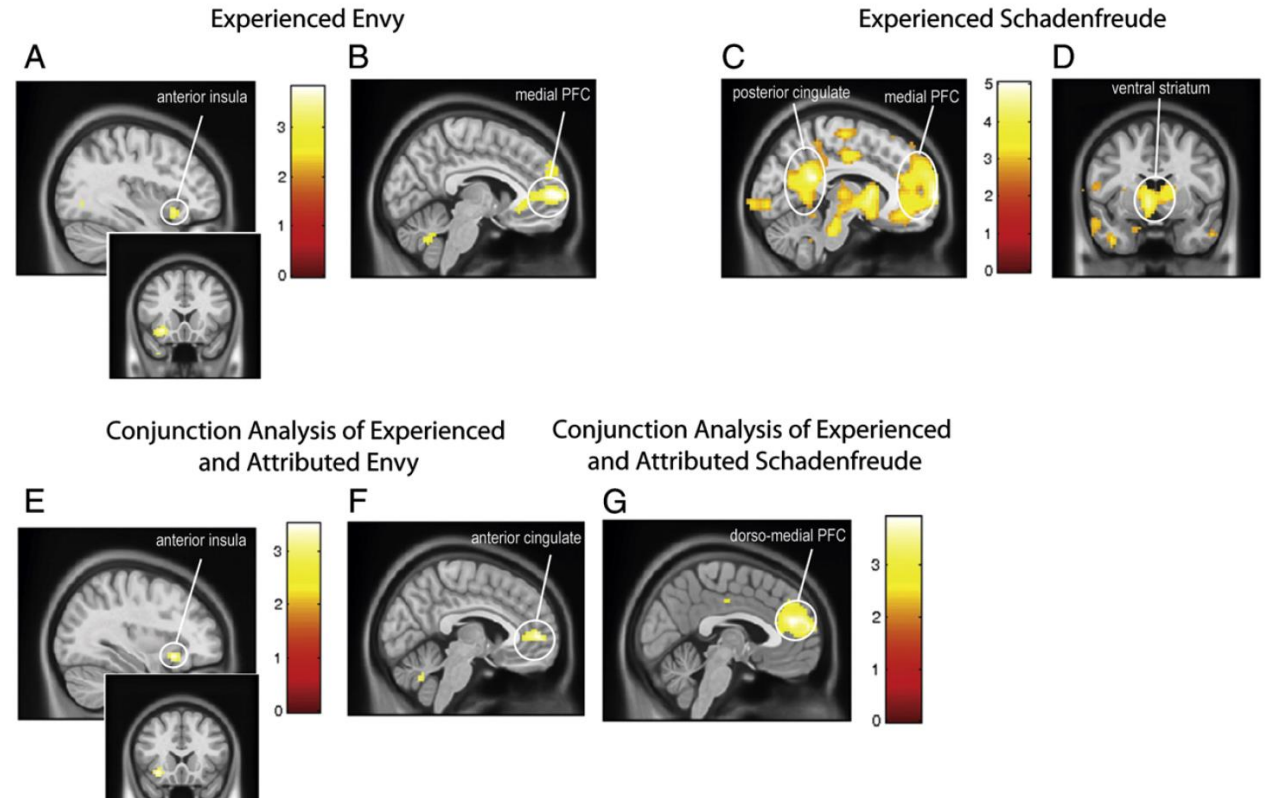
- rSMG crucial to overcome EEB

EEB neurocognitive mechanisms

- What mechanisms give rise to the EEB?

Rewards		Emotions when rating Self		Rating Other Online Bias	
Self	Other				
		-	+	-	+
		-	+	-	+
		-	+	-	+
		-	+	-	+

Experienced Schadenfreude (rows 1-2) leads to Negative Bias.
 Experienced Envy (rows 3-4) leads to Positive Bias.



- EEB – strong correlation between first hand experience and the attribution of such emotions to others
- When time pressure is high we are more egocentric

- We use the same neural representations for others feelings like for our own experience (aInsula, mPFC)

(Steinbeis and Singer, 2014)

Social-cognitive bias in mental disorders

An overly exaggerated or extremely low demonstration of cognitive bias could be an indicator of mental illness

- Major depression (MD)
- Anxiety disorder (AD)
- Eating disorders (ED)



Major depression and cognitive bias

- MD characterized by presence of negative schemas, defined as mental representations of past experiences, containing dysfunctional attitudes about the self (Beck theory)
- important influence on the way information is processed, guiding one's attention, memory and interpretation for personally relevant negative experiences (Koster et al., 2011)
- CB contributes to the development and maintenance of the symptoms (Feng et al., 2015)



MD and neural basis of cognitive bias

- In normal individuals, the **anterior cingulate** regulates the attention–emotion balance by **signaling** to the **dorsolateral prefrontal cortex**
- **pgACC** – depressive affect, hopelessness
- depressed individuals show **less activation** in these regions, which might relate to their inability to gain attentional control over emotional interference (Feng et al., 2015)
- deficient inhibition for attention to negative stimuli, needs further exploration

Negativity social bias and MD

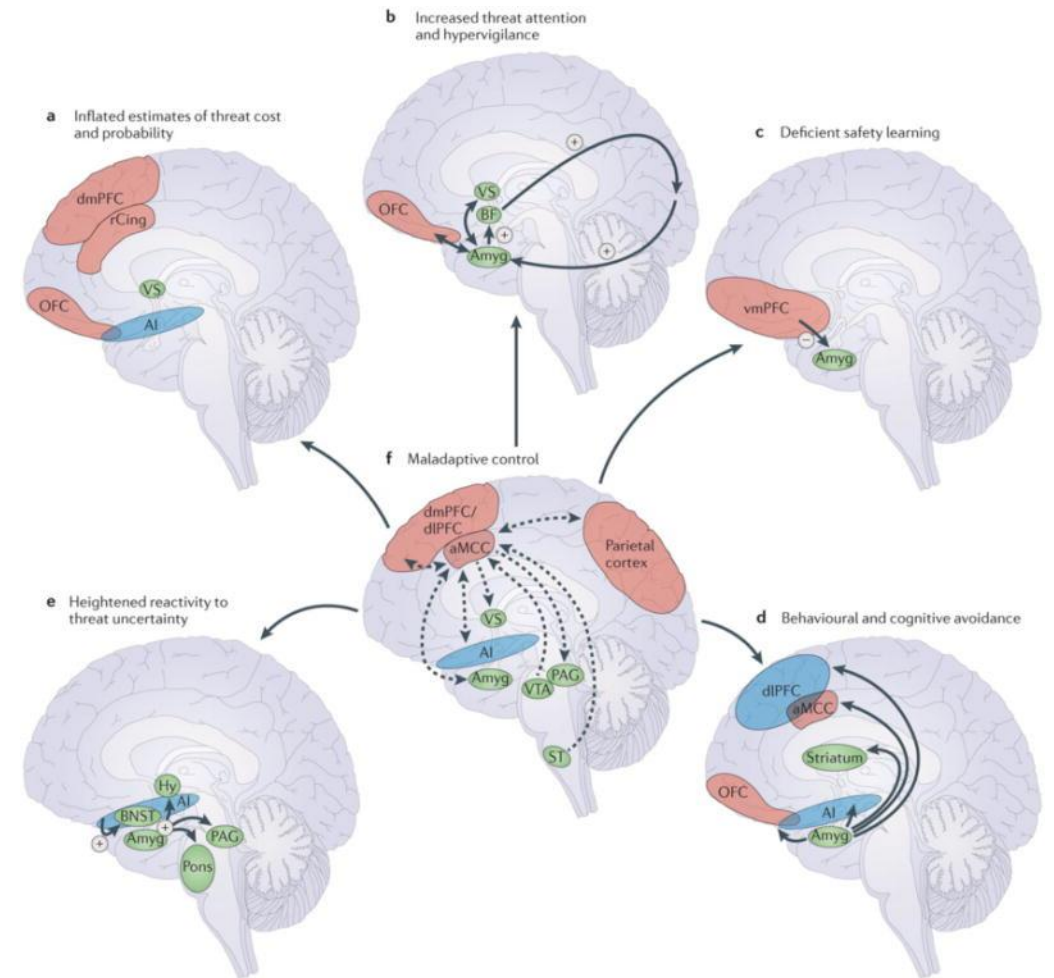
- Depressed individuals display a negative bias in the perception of others' facial emotional expressions, linked with poor outcome in depression.
- Self-focused depressive rumination as a possibly important causal mechanism (Raes et al., 2006)
- High negativity bias evokes a distinctive pattern of brain activation in the frontal cortex of depressed participants, specifically increased activation in the **left IFG**, associated with language and semantic processing, response inhibition, and cognitive reappraisal, ambiguous social stimuli processing (Gollan et al., 2015).

Anxiety disorder

- associated functional impairment in social or occupational area
- ADs are characterized by processing selectivity such as attentional or interpretation bias
 - Misinterpreting neutral signals as negative or threatening
 - impact on person's emotional state, may lead to maladaptive behavior (e.g. social withdrawal)
 - evidence that the uncertainty accompanying anxiety can increase reliance on egocentric self-knowledge when trying to understand others' – EEB (Todd et al., 2015)

Neural basis of cognitive bias in AD – Uncertainty and anticipation

- Research on orienting in anxiety strongly implicates **biased processing of threats** in the maintenance of anxiety - these biases arise from perturbations in underlying neural circuitry
- Research less strongly implicates biased **orienting away from rewards** in anxiety, though brain imaging studies suggest that some form of reward-attention perturbation likely occurs in anxiety
- UAMA - propose aMCC to have an adaptive control



(Grupe and Nitschke, 2013)

Intervention for AD and MD: Modification of attentional bias

- Computerized procedures aim to implicitly retrain biased attentional patterns
- ABM was associated with reduced amygdala and anterior cingulate cortex (ACC) activation
- Response within the insular cortex was associated with the induction of positive affective bias following ABM and with improvement in symptoms
- ABM methods which encourage active **goal-focused attention-search for positive/nonthreat information** and **flexible cognitive control** across multiple processes may prove more effective in reducing anxiety than ABM-threat-avoidance training which targets a specific bias in spatial orienting to threat (Mogg et al., 2016)

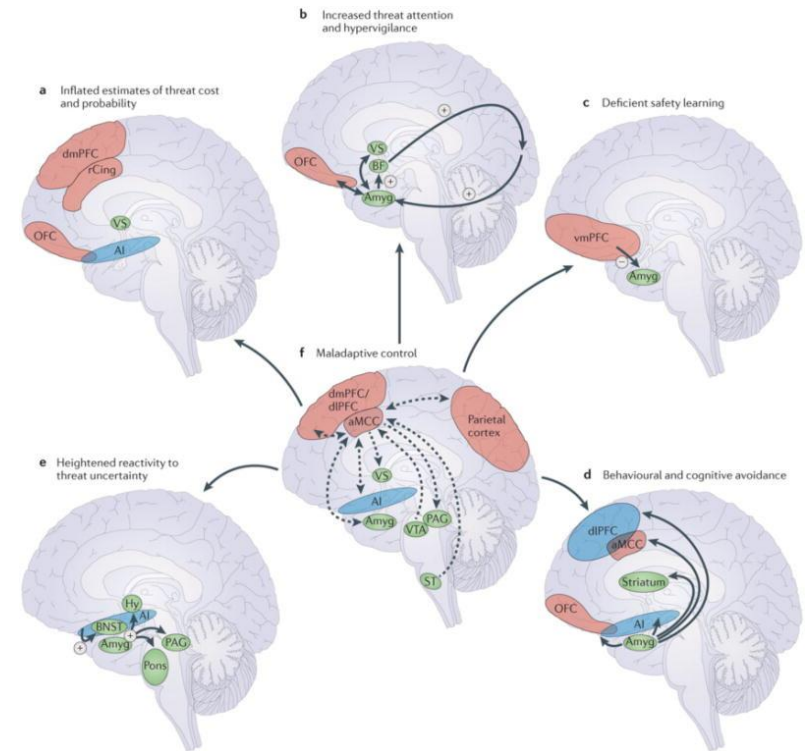
Eating disorders (ED) and social cognition

- Abnormalities in emotional functioning belongs to key features in ED (anorexia nervosa, bulimia nervosa)
- Increased levels of **anxiety**
- Increased levels of **alexithymia**
- Decreased activation of regions related to mentalization (Grynberg et al., 2012)



Is anxiety gender specific?

- Both AD and ED significantly more prevalent in women and have more disabling consequences
- Gender differences in emotion processing (e.g. women more sensitive to negative stimuli)
- UAMA model doesn't consider gender differences, neither treatment approaches



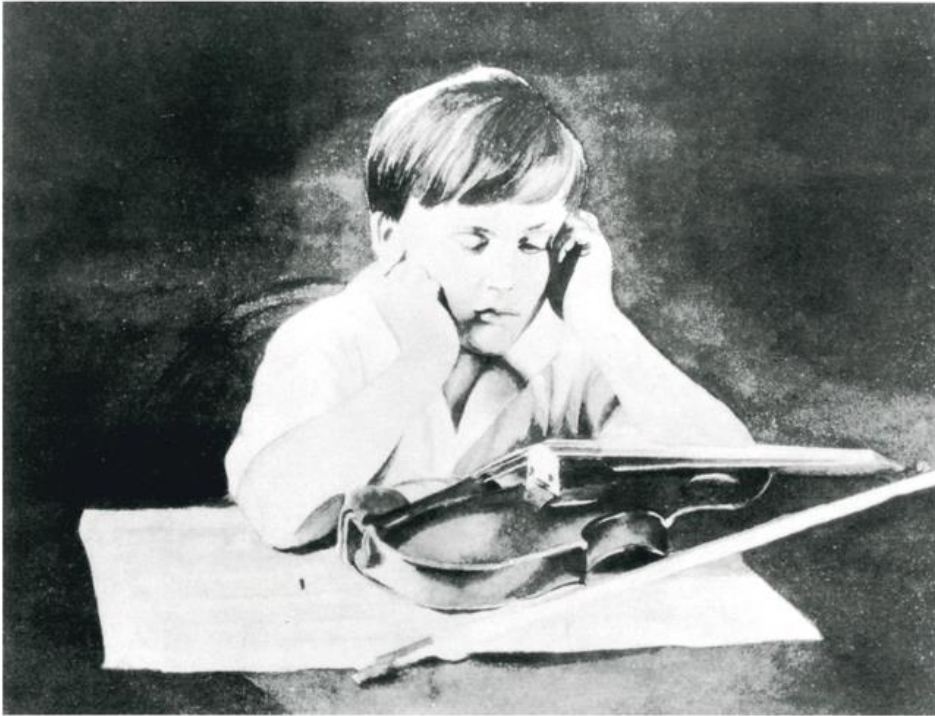
(Grupe and Nitschke, 2013)

ED and attentional bias

- Poorer performance with respect to angry faces for both AN and BN patients compared to healthy controls (Harrison, Sullivan, Tchanturia, & Treasure, 2010)
- Social stimuli often ambiguous - **Intolerance towards uncertainty** has been proposed to be a vulnerability factors across various mental disorders including anxiety and depressive disorders
- Lack of studies on ED population - evidence supporting it might be a vulnerability factor even for ED pathology, especially for the emotional symptoms (Renjakn et al. 2016; Kesby et al. 2017)

We are the first to investigate the underlying mechanisms and neural correlates of emotionally ambiguous social stimuli processing in ED patients

- Using **Thematic Apperception Test (TAT)** pictures as a visual stimuli



TAT

- projective psychological test – complex ambiguous stimuli
- subjects' responses, in the narratives they make up about ambiguous pictures of people, reveal their underlying motives, concerns, and the way they see the social world (Schacter et al., 2009)
- Widely used method in research and clinical settings
- Criticized over its reliability and validity
- No neuroimaging study published yet



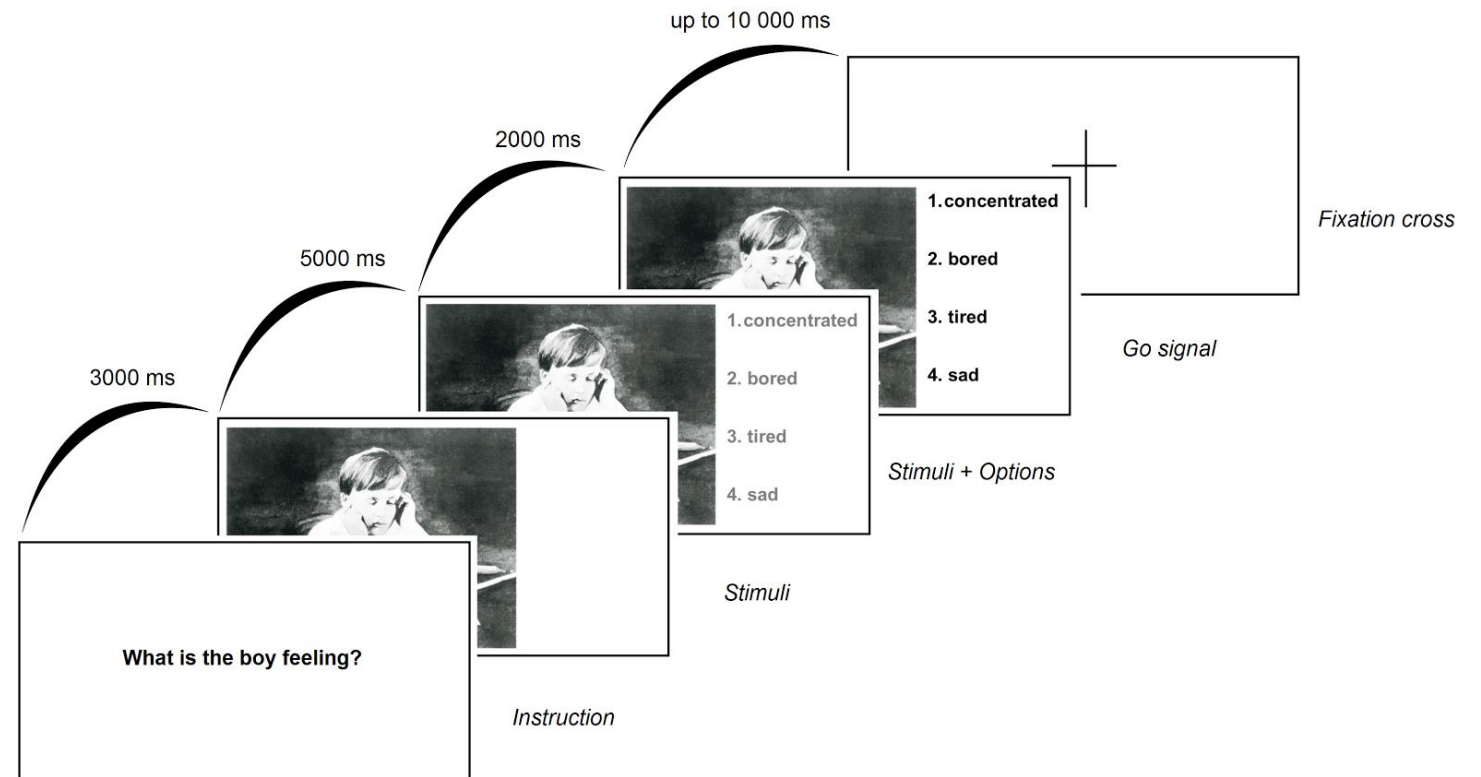
Challenge accepted!

TAT fMRI study

- 40 healthy participants:

Experimental conditions:

- 1) Mental state judgement
- 2) Self-refferential judgement
- 3) Age judgement

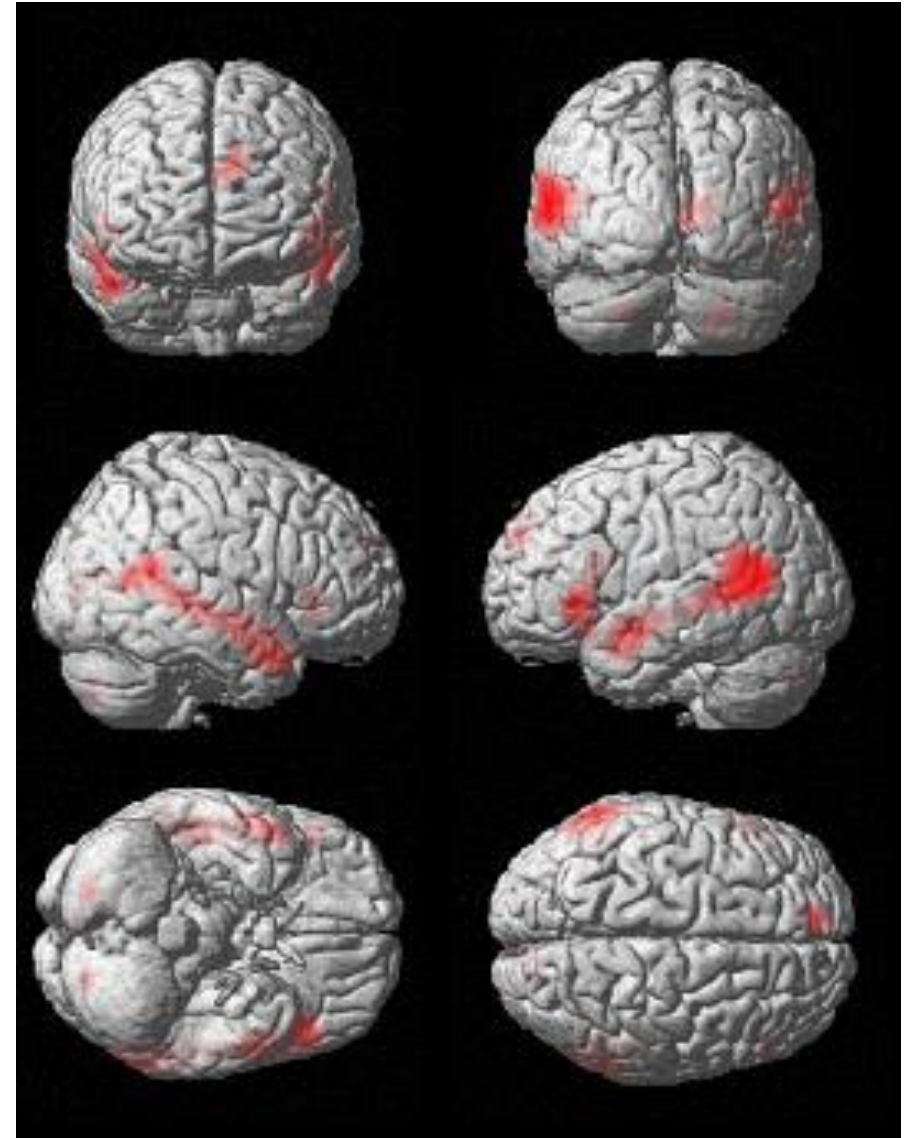


Task effect

N=40

Contrast: **emotion judgement** > **age judgement**

$p < 0.05$, FWE correction

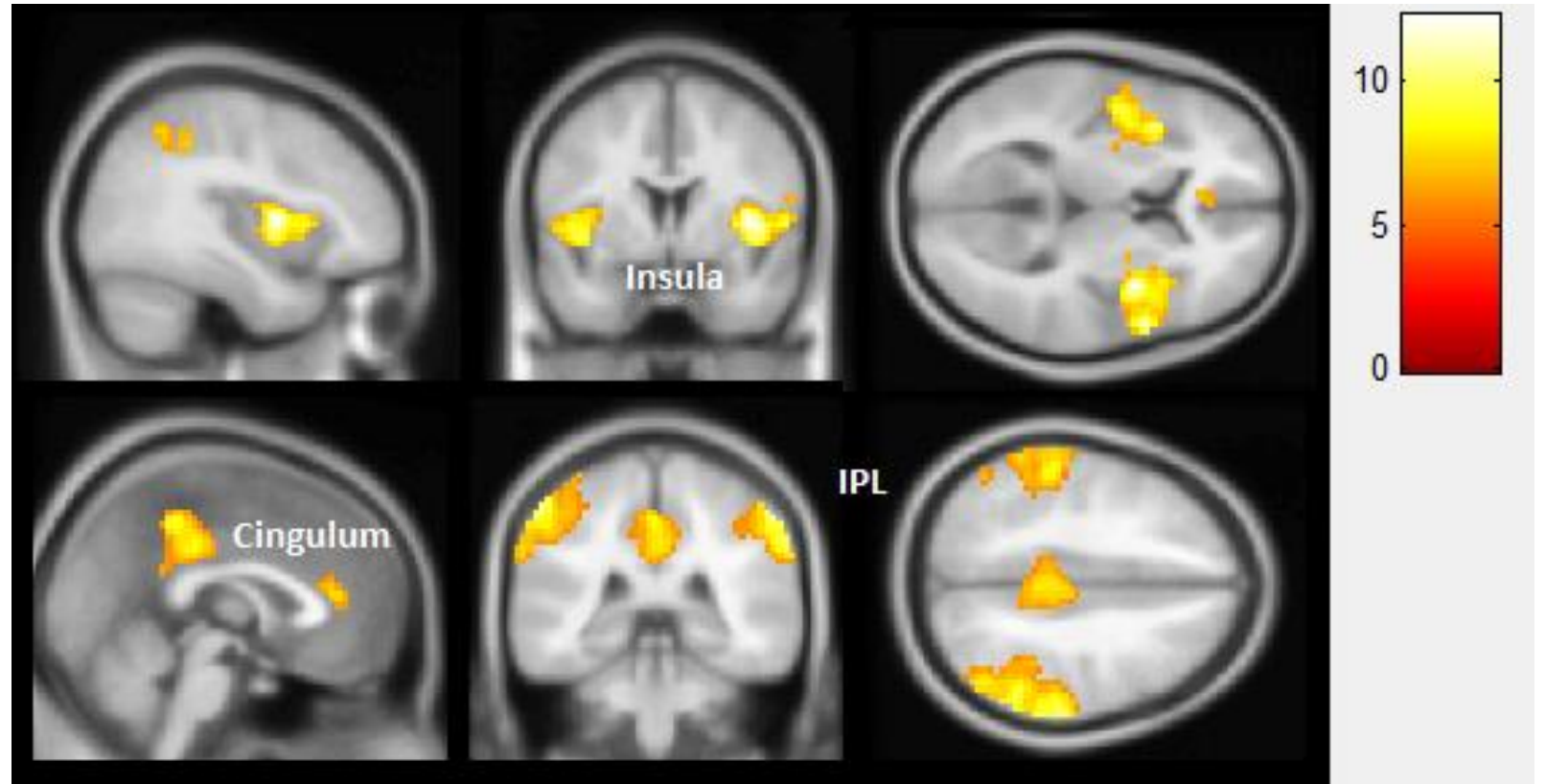


Task effect

N=40

Contrast:
my emotions > others emotions

$p < 0.01$, FWE corrected



ED - Pilot fMRI study

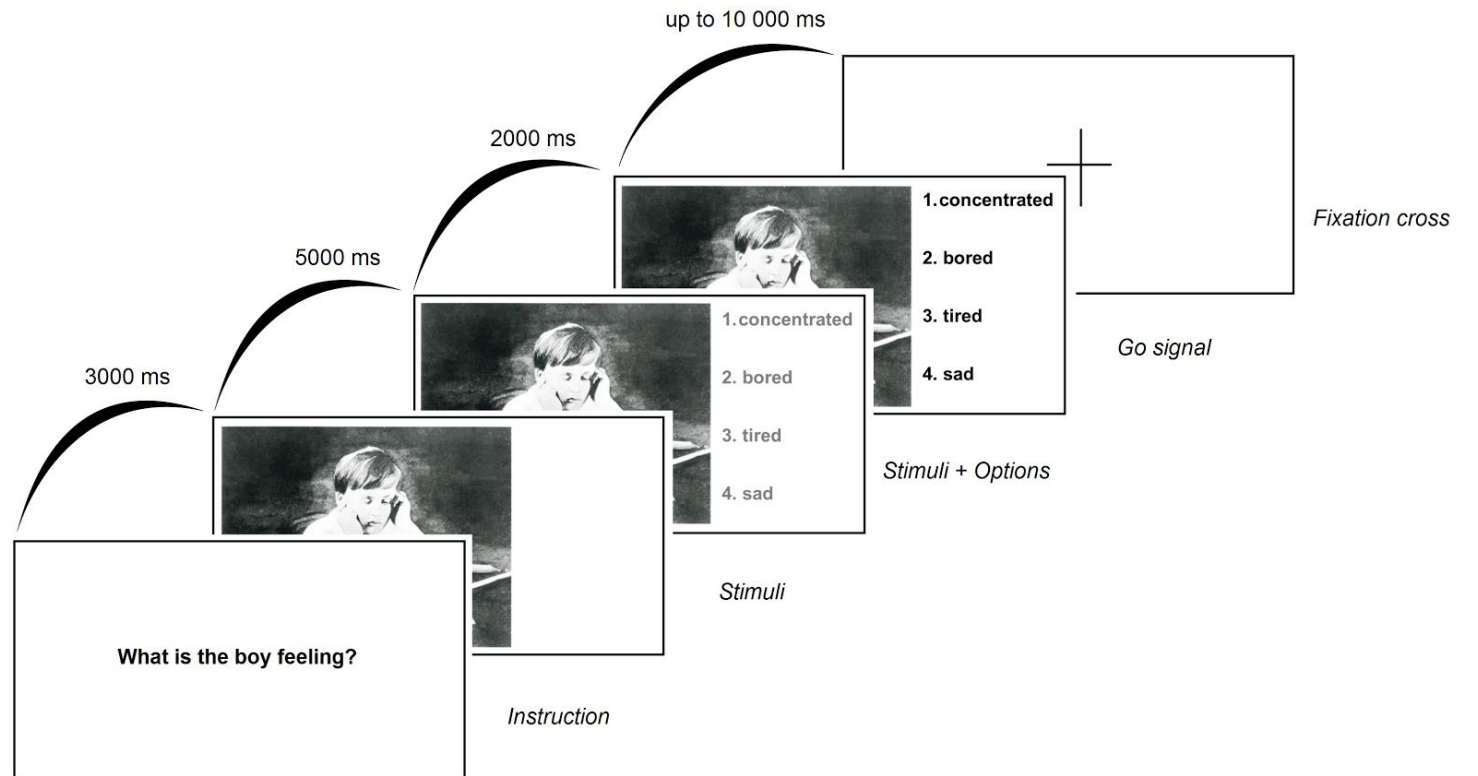
- 28 subjects:

ED (n=14), **HC** (n=14)

Age, sex, education - matched

- Siemens Prisma, 3T
- Modified TAT

Are there differences in the behavioral responses or brain activation during TAT task between the two groups?



Results

Group differences

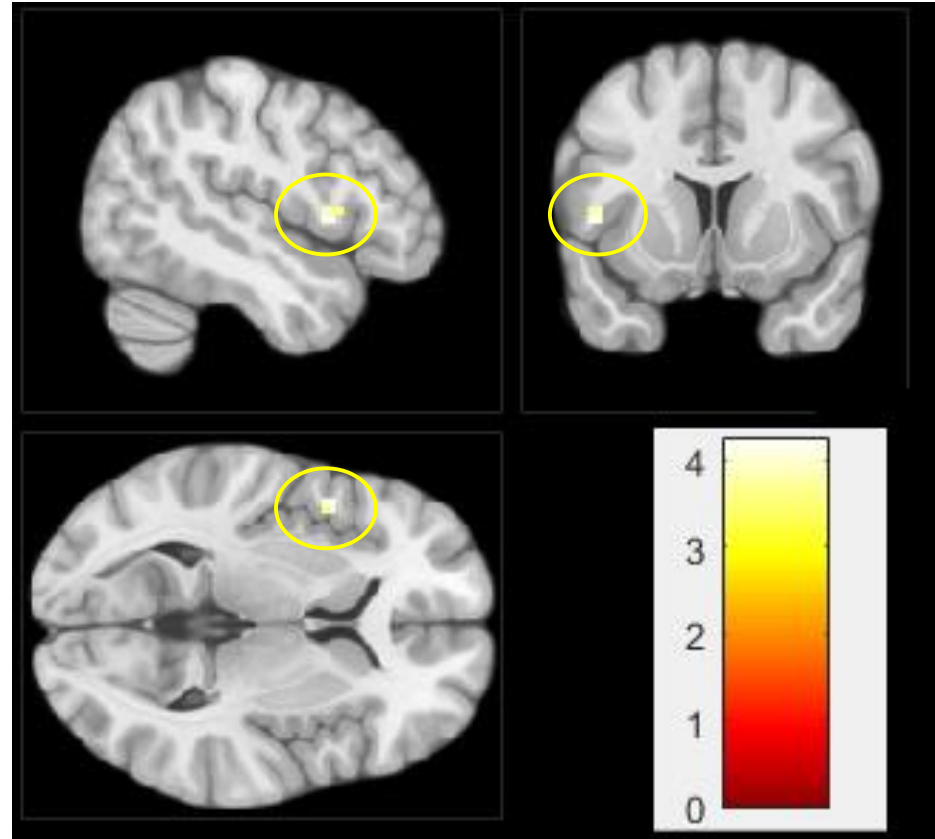
HC > ED

contrast:

emotions vs. age

$p < 0.001$, uncorr.

Left Insula



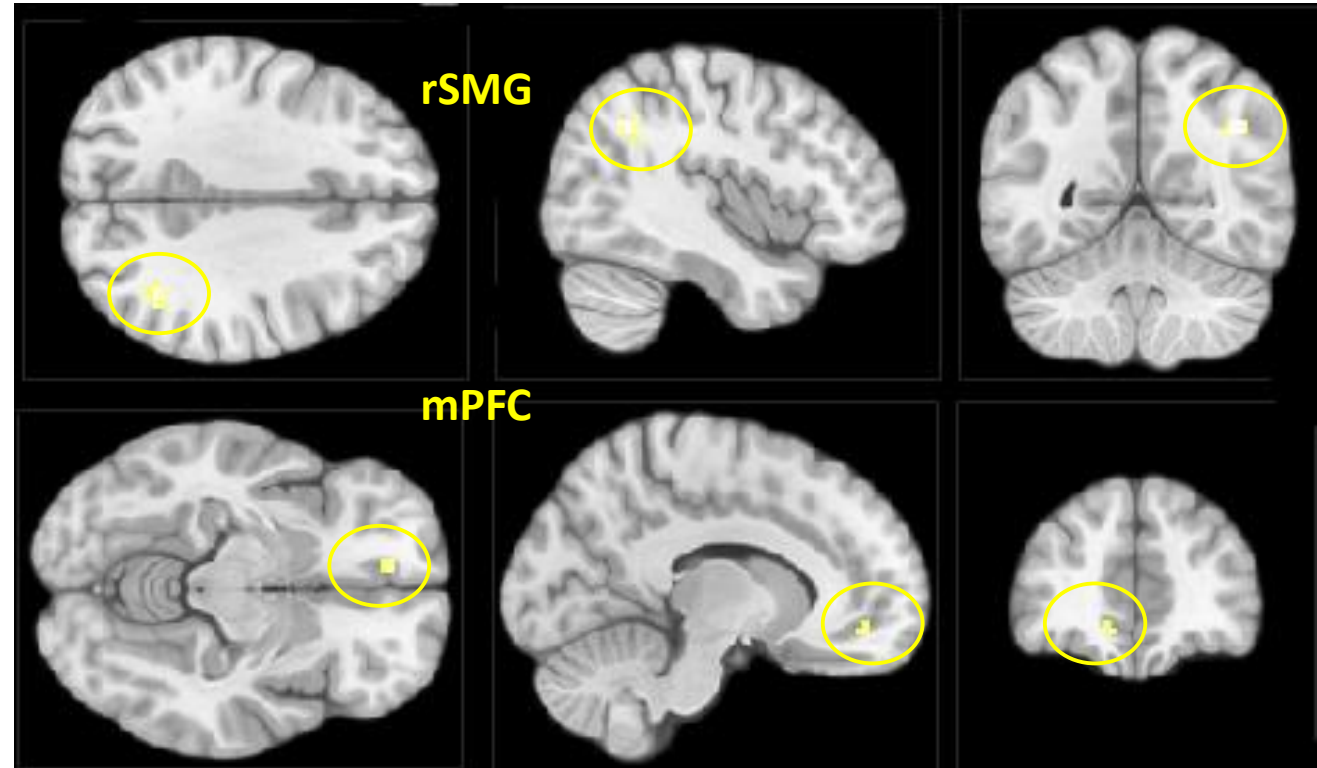
Results

Group differences **ED > HC**

Contrast:

emotions vs. age

$p < 0.001$, uncorr.



Discussion

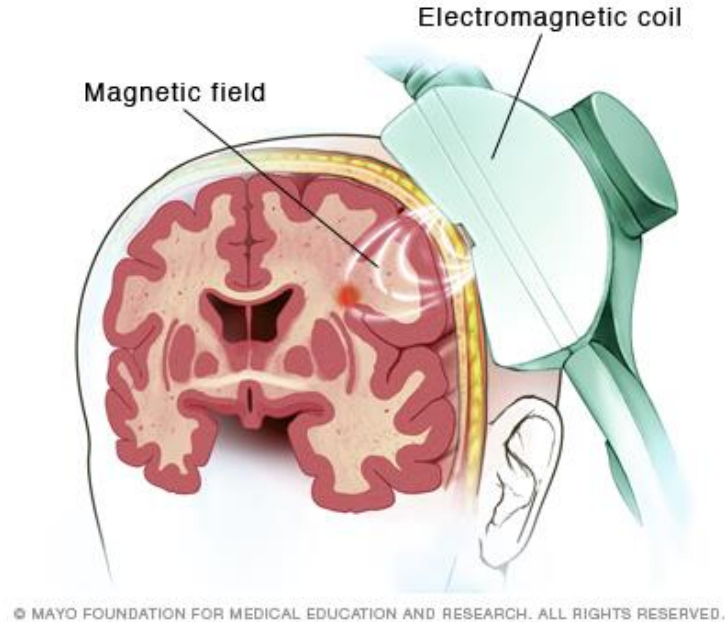
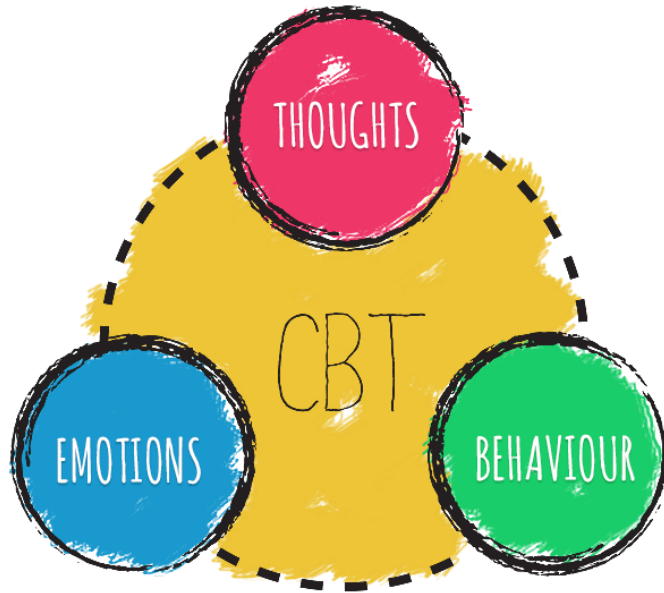
- Task activated regions which has been consistently associated in literature with social cognition (Overwalle, 2009).
- Group differences analysis revealed that HC group showed greater activations in insula, region involved in emotion formation and processing (Phillips et al., 2003).
- In contrast ED patients group showed higher activations in rSMG, compared to HC group. This structure is critical to overcome egocentricity bias in social judgement (Silani et al., 2013).
- We hypothesize that ED patients tend to suppress their own perspective while thinking about emotional states of others more strongly than HC, probably due to alexithymia and the lack of awareness of their mental states.

Discussion

- HC recruit rather affective paralimbic insular cortex (bottom-up processing), while EDs rely rather on functionally cognitive structures, such as MPFC and rSMG, involved for instance in regulatory processes and cognitive control (top-down processing)
- Anterior insula function goes beyond emotion processing related to self, it can serve as reference for other-related affective states as well, especially in decision making in complex and ambiguous environments (Lamm & Singer, 2010). Smaller engagement of anterior insular cortex in EDs during emotion processing could be a sign of alexithymic features often present in this clinical population and simultaneously would explain the preference of cognitive strategy over affective one.
- At this moment we have no behavioural or self-report evidence confirming our inferences

Take home message

- Biased decision making plays important role in the dynamics of number of mental disorders
- Cognitive bias manipulation training might help in treatment, targeting individual biases independently



Thank you for your attention!

Time for questions...