Social interaction in cocaine users: altered response to joint attention and underlying functional changes of the reward system

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Introduction

- **Social interaction deficits** in drug users likely have consequences for treatment and contribute to the high costs for the society associated with addiction [1]
- The **neural basis** of altered social interaction in drug users is unknown
- Joint attention is a central element of social interaction (see Figure 1)
- Engagement in joint attention is considered to reflect our understanding of another person's point of view and has been shown to activate the **reward system** [2]

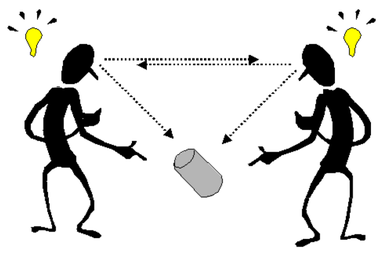

Fig 1. Joint attention is established when a person follows the direction of another person's gaze so that both attend to the same object

Objective

To investigate the nature of basic **social interaction deficits in cocaine users** by applying behavioral, psychophysiological and functional brain imaging methods

Methods

	Study I	Study II
Interactive task	• Gaze was recorded by an eye-tracking device and used to control the gaze of an avatar • Participants either looked in the same direction as the avatar (joint attention) or in another direction (nonjoint attention)	
Participants	• 80 regular cocaine users • 63 healthy controls	• 16 regular cocaine users • 16 healthy controls
Dependent variables	• pupil size • valence ratings • arousal ratings	• Functional magnetic resonance imaging: BOLD contrast • network size: Social Network Questionnaire
Statistics	mixed-effects analyses of variance: between-subjects factor: group; within-subjects factor: joint (joint vs. nonjoint attention)	GLM as implemented in SPM8

Results Study I

- **Valence ratings** revealed that cocaine users differentiated less between joint attention and nonjoint attention than controls: (interaction group*joint for valence ratings: ($F(1,141)=4.35$, $p<0.04$))
- **Arousal ratings** additionally reflect altered emotional engagement than controls (interaction group*joint for arousal ratings: ($F(1,141)=3.94$, $p<0.05$))
- Subjective ratings were in line with reduced **pupil responses** in cocaine users (interaction group*joint for pupil size: ($F(1,130)=4.91$, $p<0.03$)) (Figure 2a-c)

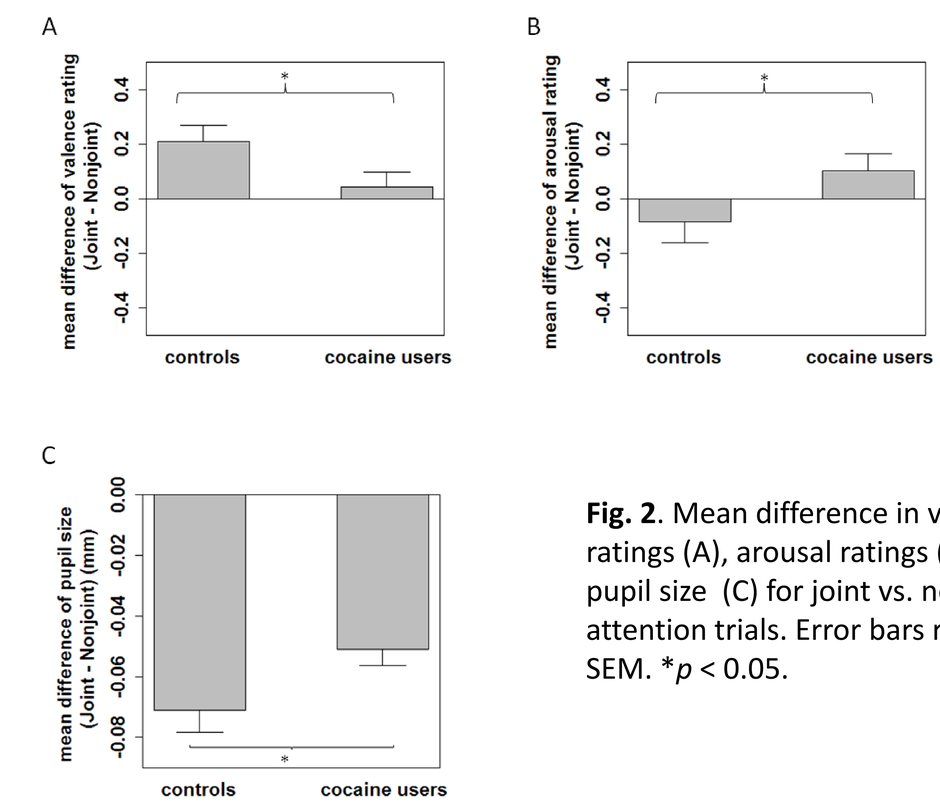

Fig. 2. Mean difference in valence ratings (A), arousal ratings (B) , and pupil size (C) for joint vs. nonjoint attention trials. Error bars refer to SEM. *$p < 0.05$.

Results Study II

- In response to social interaction cocaine users displayed decreased activation of **the medial orbitofrontal cortex (mOFC)** (peak: x=-6, y=56, z=-5, p<0.05, FWE) – a key region of reward processing
- Blunted activation of the mOFC was significantly correlated with a decreased **social network size** (r=0.35, p<0.05) (Figure 3a-c)

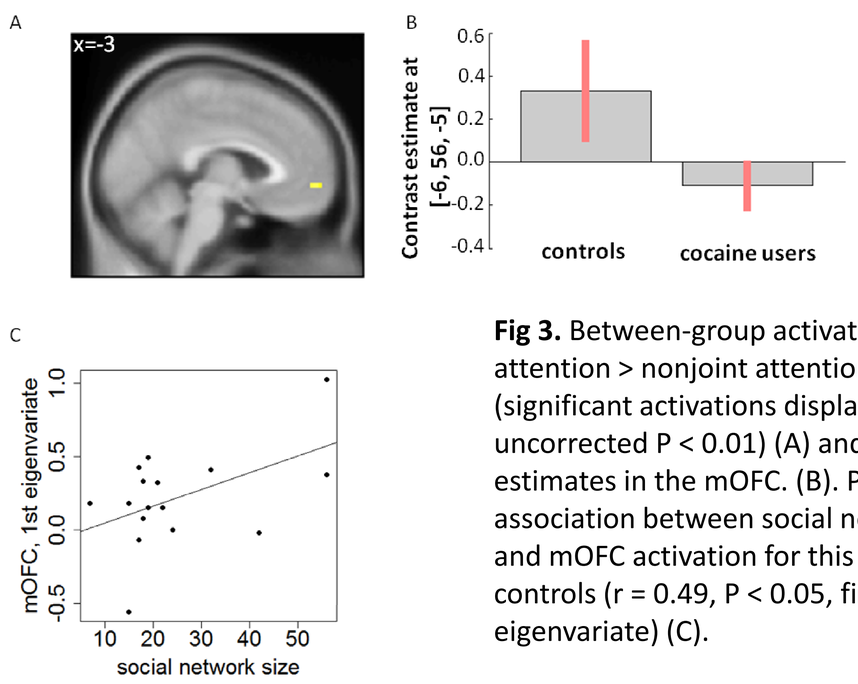

Fig 3. Between-group activation for joint attention > nonjoint attention contrast (significant activations displayed at uncorrected P < 0.01) (A) and contrast estimates in the mOFC. (B). Positive association between social network size and mOFC activation for this contrast in controls (r = 0.49, P < 0.05, first eigenvariate) (C).

Conclusion and implication

- Basic social interaction deficits in cocaine users may arise **from blunted social reward processing**
- Alterations in social gaze processing seem to be related to **impaired real-life social behavior** in cocaine users
- Altered reward sensitivity might reduce the motivation to engage in social interaction and **impair general social competence**
- This might explain why negative social consequences (e.g. family problems) do not lead the addicted person to give up drug use
- Since social reward processing is an important factor in the treatment of substance use disorders, **training of social reward processing** might be beneficial for therapy

References:

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