Dysfunctions of cognitive control in addiction: Advances and needs in current research

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1. Background

Speaker’s background

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Declaration of interest statement
The authors have no competing interests.
Impaired cognitive control functions

... like inhibition of habitual or impulsive responses, goal maintenance, or cognitive flexibility

... have emerged to be a core characteristic of Substance-Related and Addictive Disorders (SAD)

Bühringer et al., 2008; Goschke, 2014
2. Current Research

Hypersensitivity to addiction cues

- **Automatic attentional capture by addiction-related cues**
  - **Attentional bias**
    for an overview see Field & Cox, 2008
  - **Approach bias**
    e.g., Robinson & Berridge, 2008; Wiers et al., 2009
  - **Cue reactivity**
    for an overview see Bühringer et al., 2012
2. Current Research

Reduced sensitivity to long-term outcomes

- E.g., greater discounting of delayed rewards in SAD
  for an overview see MacKillop et al., 2011

Kräplin et al., 2015
Impaired inhibitory control, goal maintenance and cognitive flexibility

- **Impaired response inhibition**
  e.g.; Ersche et al., 2011; Kräplin et al., 2014; Nestor et al., 2011
  for an overview see Smith et al., 2014; Verdejo-Garcia, et al., 2008

- **Impaired goal maintenance and reduced cognitive flexibility**
  e.g. Lane et al., 2005; Ornstein et al., 2000; Verdejo-Garcia, et al., 2015; van Holst et al., 2010

(for a general overview see Bühringer et al., 2008; George and Koob, 2010; Goldstein and Volkow, 2011; Perry et al., 2011; van Holst et al., 2010)
2. Current Research

Impaired inhibitory control, goal maintenance and cognitive flexibility

• Cognitive control may play an important role in cessation of SAD
  Krönke, Wolff, Benz & Goschke, 2015
2. Current Research

Impaired conflict monitoring

• Impaired error- and conflict-monitoring in substance use disorders
  e.g., Bolla et al., 2004; Franken et al., 2007; Hester et al., 2009; Salo et al., 2009

• Hyposensitivity for conflicting information may underlie the insufficient recruitment of cognitive control
  Bühringer et al., 2008; Goldstein and Volkow, 2011
Heuristic model modified according to Bühringer et al., 2008; Goschke, 2014

1. Background
2. Current Research
3. Conclusions
4. Future needs

- **Hyposensitivity for conflicting information**
  - Insufficient mobilization of cognitive control
  - Cognitive control network (lateral PFC, PPC)
    - Impairments in inhibition, goal maintenance, cognitive flexibility
  - Impaired modulation of value signals
  - Valuation and motivation network (vmPFC, OFC, VS)
    - Changes in reward learning
    - Increased incentive salience for addiction-related stimuli
    - Decreased value of other activities and future consequences

- Symptoms of Substance-Related and Addictive Disorders
  - Impaired behavioral control
  - E.g. loss of control over time and amount of substance intake

- Hypersensitivity to addiction cues
  - Hyposensitivity to non-addiction cues and future outcomes

Modified according to Bühringer et al., 2008; Goschke, 2014
Implications

- **Development of mechanism-targeting trainings aiming to improve cognitive control facets**
  
  - Attentional or approach bias retraining
    for an overview see Wiers et al., 2013
  
  - *(Content-specific)* inhibition training
    e.g., Houben et al., 2011, 2012
  
  - Working memory training or cognitive flexibility training
    e.g., Kray et al., 2011; Morrison & Chein, 2011
    for an overview see Wiers et al., 2013
Psychometric properties

- Studies on the reliability and validity of the behavioural tasks, comparing healthy controls and mental disorder groups

Longitudinal studies

- Prospective-longitudinal studies integrating different assessment levels: behavioural tasks, neuroimaging and real-life measures
Project „Volitional dysfunction in self-control failures and addictive behaviours“ (CRC 940)

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Cognitive Level
- Baseline clinical assessment $T_1$

Real-Life Behavioral Level
- Experience sampling $T_3$
- Basic CRC assessment of cognitive control $T_2$

Neural Level
- fMRI study $T_4$
- 1 y follow-up clinical assessment $T_5$

Sample
- A Behavioral addiction group
- B Substance use disorder group
- C Control group
Commonalities and differences across mental disorders

- Studies assessing a comprehensive range of cognitive control functions across different SAD

Competence impairment or performance failure

- Studies investigating cognitive control functions with and without addiction-related cues
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Krönke, K.-M., Wolff, M., Benz, A., & Goschke, T. Successful smoking cessation is associated with prefrontal cortical function during a Stroop task: A preliminary study. *Psychiatry Research: Neuroimaging. doi: http://dx.doi.org/10.1016/j.pscychresns.2015.08.005*


