Chess as an intervention against addictive disorders?
- Potential neurobiological underpinnings

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6th December 2015
London, UK
Chess against Addiction?

Same neural networks?  

Cognitive Impairments  

Cognitive Enhancement  

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I. Chess Therapy

II. What is addiction? - Pathways to Relapse

III. Cognitive Impairments in Addiction

IV. Cognitive Remediation Treatment

V. Chess and the Brain

VI. Chess as treatment “cognitive enhancer”? 

VII. Discussion
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VII. Discussion
Chess Therapy

Chess Therapy as a form of Psychotherapy

- Muhammad ibn Zakariyā Rāzī (*854, † 925)
  - Persian physician, alchemist and chemist, philosopher
  - Chief physician of Baghdad hospital
- Chess games between the therapist and patient or between patients
- Tactics and strategies in board games ➔ metaphors for real life situations

(Fadul & Canals “Chess Therapy” 2010)
Psychotherapy Approaches and Chess

- **Psychoanalytic**: verbalization of patient’s thoughts
- **Cognitive behavioral**: identification of understanding of chess games, chess problems
  - real life problems
- **Systemic**: analyze patient’s attitude and behavior when playing chess with others
  - determine dynamics in group
- **Other approaches** (e.g. behavior therapy, narrative therapy,…)

(Fadul & Canals “Chess Therapy” 2010)
Chess Therapy

Classical Chess Training

**Efficacy in ADHD**
- Decrease in severity (Blasco-Fontecilla et al. Rev Psiquiatr Salud Ment 2015)
- Improvement of concentration skills and period (Nour ElDaou & El-Shamieh Procedia - Social and Behavioral Sciences 2015)

**Efficacy in Schizophrenia**: Improvement of
- voluntary processing
- inhibitory capacity
- planning abilities
(Demily et al Schizophr Res 2009)

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What is addiction?

Giving up smoking is the easiest thing to do, I know because I've done it several times

-Mark Twain
What is addiction?

**Key feature of substance misuse:**
- Maladaptive pattern of substance use
- Recurrent and significant adverse consequences related to repeated substance use

**Relapse:**
- Resumption of substance use after one or more periods of abstinence
- Return to their former behavior

WHO [http://www.who.int](http://www.who.int)
[http://www.dsm5.org](http://www.dsm5.org)
What is addiction?

Addiction:

- Chronic relapsing disorder
- Compulsion to take a drug
- Loss of control over drug intake

- Initial use: hedonic effects
- Continued use ➔ drug intake to escape from drug-withdrawal states

Koob Neuron 1996
Burden of addiction

Example: alcohol misuse / alcohol addiction

• Harmful use of alcohol
  – causes 5.9 % of all deaths
  – causal factor in more than 200 disease and injury conditions

• Age group 20 – 39 years: approximately 25 % of the total deaths are alcohol-attributable

• Beyond health consequences, harmful use of alcohol brings significant social and economic losses to individuals and society, $235 billion in the United States (Rehm et al. Lancet 2009)

WHO http://www.who.int

Photo credit: http://www.eichbaum.de
Pathways to relapse

- **Relapse associated with**
  - States of craving
  - Protracted abstinence (depressed mood and elevated anxiety over 3-6 weeks of abstinence)
  - Stress sensitivity

- **Why relapse after long-term abstinence?**
  - Return to former behavior, overestimation of skills
  - “Addiction memory”
  - Confrontation with drug-associated cues/situations

Von der Goltz & Kiefer Eur Arch Psychiatry Clin Neurosci 2009
Heilig Addict Biol 2010
Remission / Relapse Rates

Example: alcohol misuse / alcohol addiction

- Treated individuals achieve higher short-term remission rates than do untreated individuals

- In treated samples, estimated long-term relapse rates have varied between 20 and 80%
Remission / Relapse Rates

Example: alcohol misuse / alcohol addiction

• Short-term remission between 20 and 50%
Chess against Addiction?

How could it work?

• Cognitive functioning impaired in addiction
• Can chess „normalize“ cognition?
• Can chess be a treatment add-on?

• Which cognitive functions / brain regions are altered in addiction?
• How does chess act on these cognitive functions / brain regions?
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Central nervous system two types of tissue:

Gray matter:
- carries sensory information from grey matter cells and sensory organs

White matter:
- connects different parts of grey matter to each other
Cognitive impairments in Addiction

- **Impulsive system**
  - Immediate reward
  - Brain regions: striatum (putamen, caudate nucleus), amygdala

- **Reflective system**
  - Long-term consequences
  - Brain regions: ventromedial prefrontal cortex (VMPC), dorsolateral prefrontal cortex (DLPFC), anterior cingulate, insula, hippocampus

Bechara Nat Neurosci 2005

Photo credit: http://www.eichbaum.de
Cognitive impairments in Addiction

Impulsive system vs. reflective system in Addiction

Imbalance between the two systems
- Hypersensitivity to reward
- Preference of smaller, sooner rewards over larger, later rewards

Executive functions:
- Impairments in inhibition
- Poor decision making, risky behavior

Bechara Nat Neurosci 2005

Photo credit: http://www.eichbaum.de
Cognitive impairments in Addiction

Further deficits in executive functioning:
• Problem-solving
• Mental flexibility
• Judgement
• Working memory

Deficits in other domains:
• Attention
• Visuospatial abilities

How could chess increase cognitive functioning?

- think about it individually (1 min)
- discuss your ideas with your neighbor (3 min)
- share ideas with whole audience

Cognitive domains:

- Cognitive control / inhibition
- Decision-making
- Problem-solving skills
- Mental flexibility
- Judgement
- Working memory
- Attention
- Visuospatial abilities
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Cognitive Remediation Treatment

Cognitive remediation therapy (CRT) = cognitive enhancement therapy (CET) = cognitive rehabilitation (CR)

Behavioral treatment to improve cognitive impairments in
  • executive functioning (inhibition, decision-making, cognitive flexibility, working memory)
  • attention
  – Exercises to improve neuropsychological skills
  – Often computer-based

Goal:
  – Improve effects of other interventions
  – Better social functioning
  – Durability and generalization

Chess as cognitive enhancer?

Cella et al. Curr Opin Behav Sci 2015
Cognitive Remediation Treatment

Improvement of effects of other interventions

Motivation

Cognition

Age

Coping skills

Functioning

Taken from: Wykes & Spaulding Schizophr Bull 2011

Photo credits
Cognitive Remediation Treatment

Example: Cognitive Behavioral Therapy

- Psychotherapeutic treatment
- Identify thoughts and feelings that influence behaviors
- Learn healthier skills and habits

The CBT triangle: Core principles of CBT

- Improvement of CBT through improvements in
  - attention / concentration
  - memory (remembering appointments, learning of skills)
  - cognitive flexibility (change way of thinking about things)
  - ….

Beck 1976

Photo credits
http://www.clipartpanda.com
http://www.minddisorders.com
Cognitive Remediation Treatment

CRT efficacious in
- Schizophrenia
- Eating disorders
(Dunner et al. Curr Opin Psychiatry 2015)

Photo credits
http://www.markersoftware.com (COGPACK software)
CRT in addiction

Review by Bernardin et al.: Front Psychiatry 2014
Cognitive impairments in alcohol-dependent subjects

• CRT improved
  – divided attention, alert capacities, working memory, and episodic memory
  – non-cognitive domains, especially psychological aspects (well-being, self-esteem) and craving
• Training working memory and inhibition can lessen the impact of implicit processes on drinking behavior

Limitations:
• Methodological problems (CRT requirements, transfer to clinical practice, … )
• Modification of drinking behavior: really improvement in inhibition?

Photo credits
CRT and CBT in addiction

CBT in patients with greater cognitive impairment ➔ limitations (Kadden et al., 2001)

Why? (Sofuoglu et al. 2013):
• CBT requires a high cognitive workload
• Learning, practicing, and implementation of new cognitive skills is complex
• Patients have to be able to understand the therapist’s instructions and to remember and execute these new skills in difficult situations

How can treatment outcome be improved? (Kiluk et al. 2010)
• Executive functioning mediates long term-outcomes of CBT

Photo credits
Which strategies are learnt in CBT? (Sofuoglu et al. 2013)

(1) **exert cognitive control** over over-learned patterns of substance use via functional analysis of behavior

(2) **reduce impulsive responding** in response to drug cues via implementing strategies to control craving

(3) improve general **decision-making and problem-solving skills**

(4) and **recognize, challenge, and exert control** over cognitions associated with drug use

→ CRT might strengthen these cognitive skills

Chess as cognitive enhancer?
Example 1: Medical Neuroenhancement in addiction

Cue-exposure treatment
• 9 sessions
• over 3 weeks

Functional Magnetic Resonance Imaging (fMRI)

FMRI cue-reactivity task
(Vollstädt-Klein et al. 2010)

Vollstädt-Klein et al.,
Biol Psychiatry 2011

Photo credits
http://www.theworkoutblog.de
http://www.adhs.org
http://www.healthcare.siemens.com
Example 1: Medical Neuroenhancement in addiction

Further decrease of cue-reactivity by D-cycloserine (DCS)?
⇒ Medical Neuroenhancement of treatment?

Cue exposure treatment reduced cue-reactivity

DCS further reduced cue-reactivity

Vollstädt-Klein et al., Biol Psychiatry 2011

Kiefer, ..., Vollstädt-Klein, Psychopharmacology 2015
Example 2: Cognitive-bias modification (CBM) in addiction

Does CBM “training” have an effect on treatment outcome?

- 4 brief CBM sessions
- preceding regular inpatient treatment

Better treatment outcome (measured as relapse after 1 year)

Wiers et al. 2011
Wiers et al. 2014
Chess as CRT?

Chess playing is a model task in research on

- Basic cognitive processes: perception, memory, problem solving
- Individual differences in playing ability (chess expertise) \( \rightarrow \) ELO ratings
- Artificial intelligence

Chess playing requires

- Attention
- Perceptual grouping
- Various memory functions
- Problem-solving
- Executive functioning

Charness Psychol Rev 1992

Hänggi et al. Neuropsychologica 2014

Photo credits
Chess as CRT?

Chess as CRT to improve neuropsychological skills?

- Easy to implement, can be applied computer-based
- Can be applied after discharge / at home
- Low-cost treatment add-on

➤ Does it really improve cognition?
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Brain regions activated by chess playing

**Dorsolateral prefrontal cortex** ➔ reflective system

Finding best move: parietal and occipital regions (e.g. occipito-parietal junction), premotor areas, **dorsolateral prefrontal cortex** (Atherton et al. Cogn Brain Res 2003)


Photo credit: http://www.clipartpanda.com
Brain regions activated by chess playing

Checkmate-judgement: Occipito-parietal junction, prefrontal / orbitofrontal cortex (Nichelli et al. Nature 1994) ➔ reflective system

Playing against computer: Novices activate medial temporal cortex, e.g. hippocampus ➔ learning and retrieving of new information (Amidzic et al. Nature 2001) ➔ reflective system

Photo credit
http://www.clipartpanda.com
Gray matter volume of **Caudate nuclei** decreased with increasing chess playing experience (Hänggi et al. Neuropsychologica 2014)

⇒ impulsive system
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How could chess help to improve treatment effects?

Which improvements are needed?

- Cognitive control / inhibition
- Decision-making
- Learn and practice problem-solving skills
- General cognitive functioning to understand therapist’s instruction
- Remember and execute skills in difficult situations

- Chess might enhance executive function by
  - thinking ahead (anticipating the opponent’s moves)
  - analyzing the positions
  - basing future decisions on the predicted moves of the opponent
Chess as cognitive enhancer

Chess players vs. non chess players
- Children: better cognitive capacities
  - attention and resistance to distraction
  - planning
  - problem-solving

Positive influence on sociopersonal development
(Aciego et al. Span J Psychol 2012)
Chess as cognitive enhancer

Addiction Treatment (Gonçalves et al. Drug and Alcohol Dependence 2014):

- Abstinent (1 month) cocaine-dependents
- Motivational interviewing: psychologically based method in addiction treatment (Steine et al., 2009; Miller and Rollnick, 2002)
- “Motivational Chess”: combination of Motivational Interviewing with the game of chess
  - improvement in various attentional and executive domains; Chess especially improved working memory compared to recreational therapy

Photo credits
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Summary

• Chess playing activates / alters brain area related to addiction
  – Neural basis of improvement in cognitive functioning
  – Might adjust the imbalance between the impulsive and the reflective system

• Chess enhances cognitive functioning in domains impaired in addiction
  – Might „normalize“ cognition in addicted patients ➔ better social functioning, better performance at work, reduces impulsive behavior, …
  – Might improve effects of other interventions

Photo credits
Additional benefits

Chess as recreational therapy

• Structuring of free time
• Meaningful leisure activity ➔ reward from chess instead of substance consumption
• Newfound friendships
• Decrease in social anxiety: experience in social situations without drugs or alcohol
• Stress relief
• Improvement of self-efficacy

Improvement of general cognitive ability
Potential “risks”

- Chess played in pubs $\rightarrow$ risk of relapse (alcohol, tobacco, ...)
- Frustration after losses $\rightarrow$ risk of relapse
- „Chess addiction“ $\rightarrow$ shift to behavioral addiction
- Not suitable for all patients
Thank you for your attention!

photo credit: http://www.keepcalm-o-matic.co.uk