EU-SPR Ljubjana, October 2015

Assessing and Changing Implicit Cognitive Processes in Addiction.

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Overview

1. Theory: dual process models and beyond
2. Data: assessment, individual differences
3. Clinical data: training
4. Prevention?
5. Discussion - Conclusions

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Dual Process Models

(Kahneman, 2003; thinking fast & slow)

System 1 ("thinking fast ")	System 2 ("thinking slow")
• Unconscious	• Conscious
• Evolved early	• Evolved late
• Shared with animals	• Uniquely human
• Non verbal	• Verbal
• Rapid, parallel	• Slow, sequential
• High capacity	• Low capacity
• Domain specific	• Logical, abstract
• Pragmatic	• Hypothetical
• Independent of working memory, IQ	• Related of working memory capacity, IQ

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Dual process models

- Broad appeal in psychology (Kahneman; Strack & Deutsch, 2004, etc.)
- Applied to addiction (e.g., Bechara, 2005; Wiers & Stacy, 2006)
- Health behaviors (e.g., Hofmann et al 2008)
- Anxiety (e.g., Ouimet et al, 2009)

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Dual Process Theories Addictions

Review

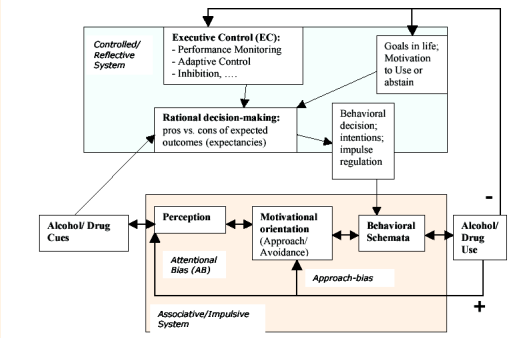
Automatic and controlled processes and the development of addictive behaviors in adolescents: A review and a model

Reinout W. Wiers [a,b,c,*], Bruce D. Bartholow [d], Esther van den Wildenberg [a], Carolien Thush [a], Rutger C.M.E. Engels [b], Kenneth J. Sher [d], Jerry Grenard [e], Susan L. Ames [e], Alan W. Stacy [e]

Detailed Review:
Pharmacology, Biochemistry, Behavior, 2007, 86, 263-283
(*Short version: Current Directions in Psychological Science*, 2006, *15,* 292-296)

Updated version model:
Wiers, Field & Stacy, (2014). In: K. J. **Sher (Ed).** ***Oxford Handbook of Substance Use Disorders.***

(Model Wiers et al., 2007 Pharm Bioch Behav)



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Metaphore: Impulse (horse) and Reflection (horseman)

Picture Courtesy Wilhelm Hofmann

Addiction: horse who easily runs wild…
Anxiety: fearful horse (both: weak Rider)

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Simplistic?

Cognitive neuroscience of self-regulation failure

Todd F. Heatherton and Dylan D. Wagner

Review

Trends in Cognitive Sciences March 2011, Vol. 15, No. 3

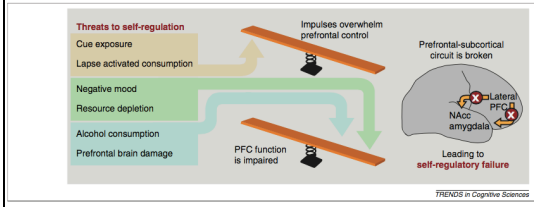

Figure 2. Schematic of a balance model of self-regulation and its failure, highlighting the four threats to self-regulation identified in the text and their putative impact on brain areas involved in self-regulation. This model suggests that self-regulatory failure occurs whenever the balance is tipped in favor of subcortical regions involved in reward and emotion, either due to the strength of an impulse or due to a failure to appropriately engage top-down control mechanisms.

When you put in PFC for rider and Nacc, Amygdala for horse, it's neuroscience

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But: Dual Process Models criticized (e.g., Keren & Schul, '09 PPS)

System 1

- Unconscious
- Evolved early
- Shared with animals
- Non verbal
- Rapid, parallel
- High capacity
- Domain specific
- Pragmatic
- Independent of working memory, IQ

-These characteristics are not well correlated

-Many processes have some mixture of characteristics

-No isolatable systems

System 2

- Conscious
- Evolved late
- Uniquely human
- Verbal
- Slow, sequential
- Low capacity
- Logical, abstract
- Hypothetical
- Related of working memory capacity, IQ

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Theoretical work: decomposing horse-rider metaphore

Gladwin, Figner, Crone & Wiers, 2011, DCN
Wiers et al, 2013 Clinical Psychological Science
cf. Cunningham et al. 2007

Problem dual process Models:
Who is in control?
➢Motivational Homunculus (~Frijda)
➢Grounding in Cognitive Neuroscience may help

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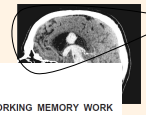
Help on the way!



Neuroscience 139 (2006) 105–118

BANISHING THE HOMUNCULUS: MAKING WORKING MEMORY WORK

T. E. HAZY, M. J. FRANK AND R. C. O'REILLY*

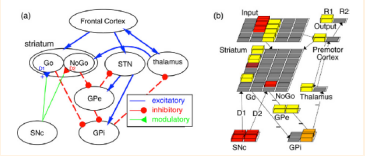
nisms for dealing with these functional demands collec-

2006 Special Issue

Hold your horses: A dynamic computational role for the subthalamic nucleus in decision making

Michael J. Frank *,1

M.J. Frank / Neural Networks 19 (2006) 1120–1136



Computational models Of interplay motivation And control learning

No more homunculus

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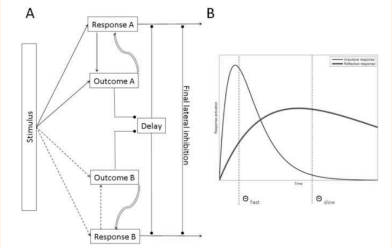
Levels of description

*Motivational processes and top-down biasing: intertwined, co-developing components of **reflective states** of processing (Gladwin et al, 2011)*



Impulsive vs. Reflective Processing re-defined as Re-processing in same system

Reflective Processing Buys you time (cf. Cunningham et al 2008)

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Impulsive and Reflective processes Assessment

- Reflective processes: questionnaire/interview. Consciously accessible Pros and Cons of drinking and ability to control (Ex Control)
- Impulsive processes: behavioral tests, spontaneous associations, attentional bias, approach-bias
- But not process-pure (Sherman et al 2008)

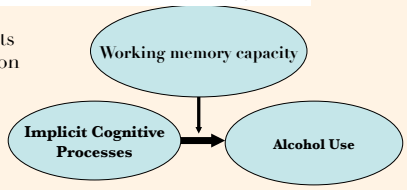
Example study: individual differences in EC

Drug and Alcohol Dependence 94 (2008) 116–124

Interactions between implicit and explicit cognition and working memory capacity in the prediction of alcohol use in at-risk adolescents

Carolien Thush[a,*], Reinout W. Wiers[a,1], Susan L. Ames[b], Jerry L. Grenard[b], Steve Sussman[b], Alan W. Stacy[b]

N = 88 adolescents
low level education



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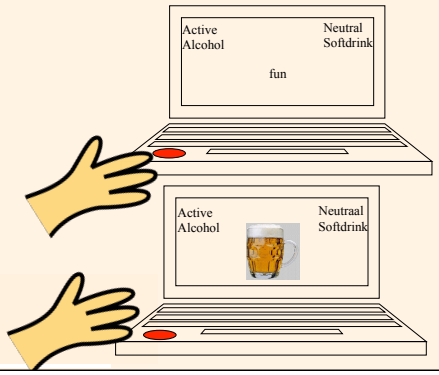
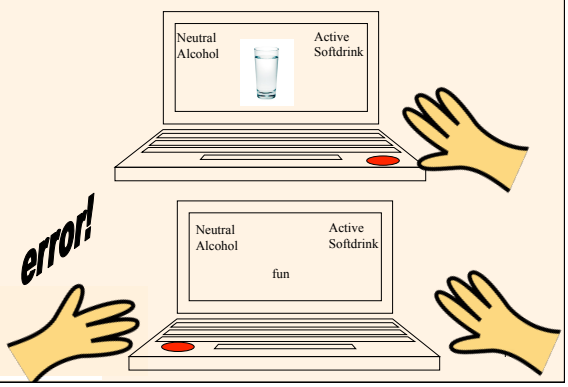
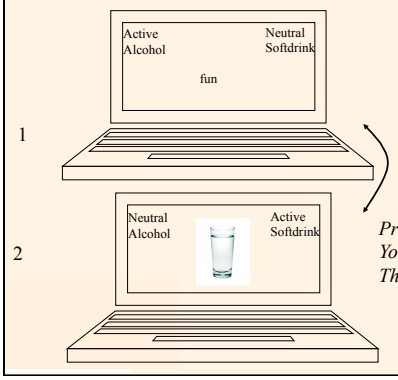
Assessment: for example with Implicit Association Test (IAT)



Assessment: many tests, e.g. IAT





Index automatic Associations alcohol en active
=
RT2 - RT1
(more elaborate scoring Algorithm: also errors)

Predicts alcohol use in Youth, one year later, e.g. Thush & Wiers, 2007)

Working Memory: SOPT

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Working Memory: SOPT

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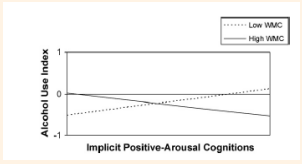
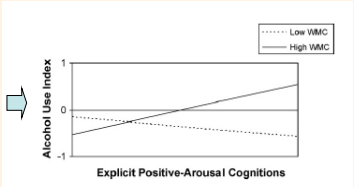
Prediction prospective Drinking



Low WM: Associations Predict alcohol Use/problems

high WM: Explicit expectancies Predict alcohol Use/problems



More Evidence: Many Recent Studies

Relatively automatic processes predict alcohol/drug use in individuals with relatively low executive control

Thush et al 2008; Grenard et al 2008; Houben & Wiers, 2009; Friese et al 2010; Peeters et al 2012; 2013

Also evidence for similar pattern in other behaviors where impulsive and reflective processes may clash: aggression, aggression after alcohol, eating, sex

Hofmann et al 2008 JPSP; Wiers et al (2009)

Reviews: Hofmann, Friese & Wiers, '08 Wiers et al 2013 Clinical Psychological Science; Wiers et al 2015 Current Addiction Reports

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2 types of drinkers…?

low wm: "impulsive drinkers" > associations predict behavior

high wm: "reflective drinkers" > expected positive vs. negative outcomes predict

Difference may only show when Next day's obligations request Restraint…

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Upshot

Models based on rational decision making (theory of reasoned action, planned behavior etc.) predict behavior pretty well in high WM(IQ) samples (e.g. students, the typical subjects), but…

Not well in low WM(IQ) samples, who are typically more at risk > Interventions?

(Wiers et al 2013 CPS; 2015 Curr Add Reports)

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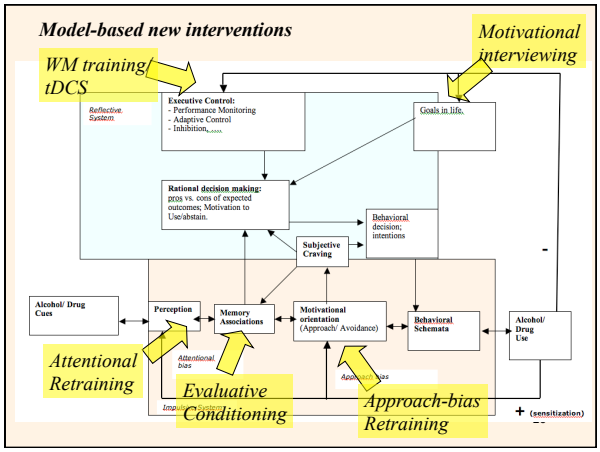
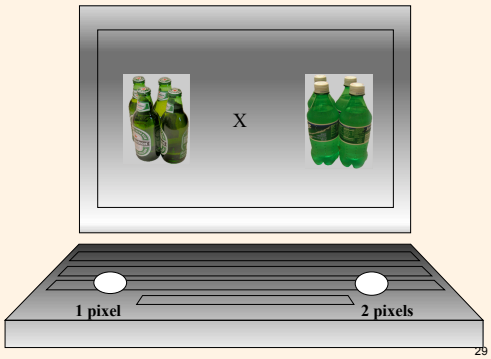


What is attentional-*bias*?

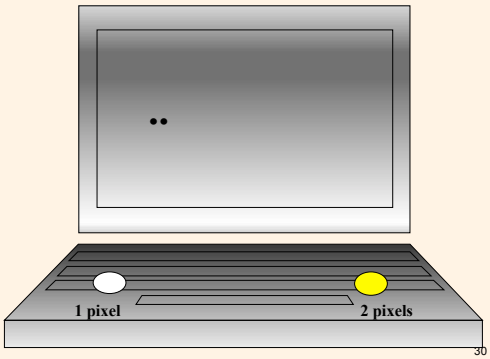
- Eye movements
- Motivationally relevant stimuli attract and capture attention
- Normal function evolutionary adaptive
- Not only in addicts, here normal attentional bias "in the wild"

Drugs "hijack" motivational system (mesolimbic DA) and place themselves in top of motivational hierarchy > attentional bias, memory associations, approach bias

Attentional Bias, Dot probe test



Alcohol latency trial



Assessment

- Probe replaces problem category (alcohol, cannabis, anxiety) and control category equally often

Training

- Experimental group: Probe replaces control category most (or all) of the time (cf. Macleod et al 2002).
- Control group: continued assessment / nothing/ different task

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Conclusions single session Attention re-training alcohol

- It is possible to train heavy drinking students toward alcohol (Field & Eastwood, 05; Field et al. 07)
- It is possible to train heavy drinking students away from alcohol, but:
  - no generalization to new stimuli
  - no effects on behavior (Field et al. 07; Schoenmakers et al 07)
- Multiple training-sessions?

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Schoenmakers, Wiers et al clinical study (2010, Drug Alc Dep)

- Experimental groups

* AR group (21 alcohol dependent patients):

Instruction:

- AR: "The probe never replaces the alcohol picture".
- VP Test: "Probe can replace any picture".

* Controls (22 alcohol dependent patients):

Irrelevant IAT-like categorization task

Same stimuli & feedback

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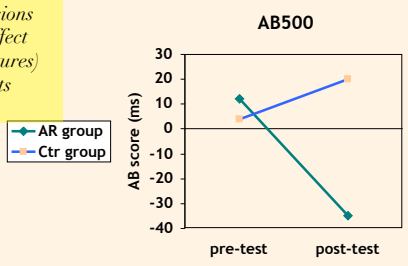
Schoenmakers, Wiers et al 2010 DAD

*Time * Group = sign.*

- After five sessions
Generalized effect
(untrained pictures)
- Clinical effects
(later relapse)



Note: No effect on 200 ms > early detection process unchanged but Increased (early) control over impulse.

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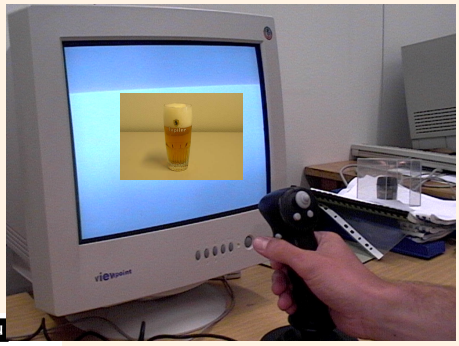
Assessing and re-training automatic action tendencies to approach alcohol



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Irrelevant Feature Version

Format determines action

landscape picture: push portrait: pull

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Pull: approach

push: avoid (withdraw)

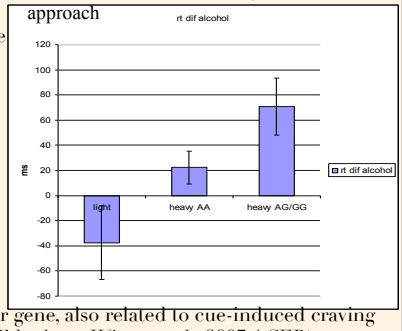
Assessment Results

(Wiers, Rinck et al. Genes, Brain, Behav, 2009)

Significant difference Light vs. Heavy Drinkers

Heavy drinkers Faster to approach alcohol

especially those with risk allele OPRM1



mu-opioid receptor gene, also related to cue-induced craving (van den Wildenberg, Wiers, et al., 2007 ACER)

Retraining: 1st clinical study

Research Article

Psychological Science
22(4) 490–497
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DOI: 10.1177/0956797611400615
http://pss.sagepub.com

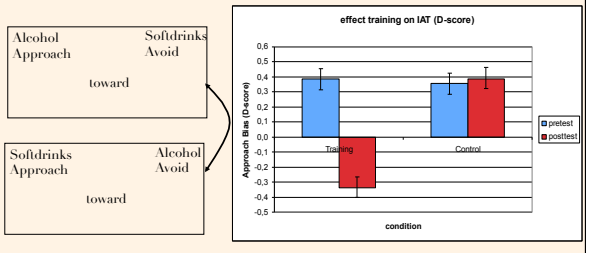
Retraining Automatic Action Tendencies Changes Alcoholic Patients' Approach Bias for Alcohol and Improves Treatment Outcome

Reinout W. Wiers[1], Carolin Eberl[2], Mike Rinck[3], Eni S. Becker[3], and Johannes Lindenmeyer[2]
[1]Department of Psychology, University of Amsterdam; [2]Salus Klinik, Lindow, Germany; and [3]Behavioural Science Institute, Radboud University

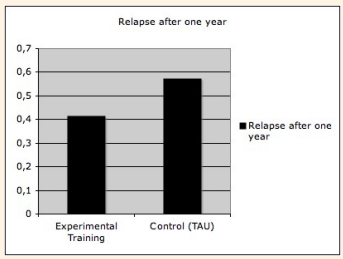
214 alcohol-dependent patients in clinic in 4 conditions:
- relevant training (push alcohol away) ⇄ *training*
- irrelevant training (portrait-landscape)
- assessment control (50-50) ⇄ *control*
- no training

Results: Strong Generalization

Significant generalizations to untrained pictures and to IAT (verbal memory association task):



Effect on relapse 1 year later



Adding CBM to CBT results in 13% less relapse a year later

Developmental Cognitive Neuroscience 4 (2013) 38–51

Contents lists available at SciVerse ScienceDirect

Developmental Cognitive Neuroscience

journal homepage: http://www.elsevier.com/locate/dcn

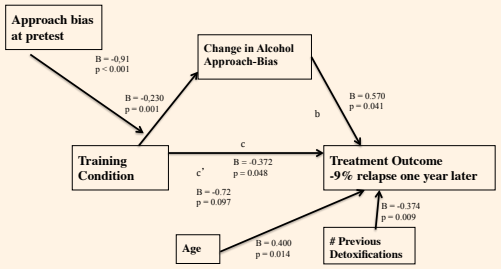
Approach bias modification in alcohol dependence: Do clinical effects replicate and for whom does it work best?

Carolin Eberl[a,c,*], Reinout W. Wiers[b], Steffen Pawelczack[a,c], Mike Rinck[c], Eni S. Becker[c], Johannes Lindenmeyer[a]

[a] Salus Clinic, Lindow, Germany
[b] ADAPT-Lab, Department of Psychology, University of Amsterdam, The Netherlands
[c] Behavioural Science Institute, Radboud University Nijmegen, The Netherlands

Results Replication study (Eberl, Wiers, Pawelczack, Rinck, Becker & Lindenmeyer, 2013, DCN)
N = 509, training / no training
Replication outcome & mediation & moderation

Replication: Approach bias re-training



What does this mean?

- Moderation: CBM is a useful addition to CBT for those patients who show a strong cognitive bias (similar findings in anxiety: Kuckertz et al 2014 BRAT).
- Clinical implication would be to preselect patients with strong bias for additional CBM. But… measurement issues (not reliable for individual diagnostics)
- Mediation: the effect on relapse is indeed related to the change in the bias

The Economist

Psychiatry

Therapist-free therapy

Cognitive-bias modification may put the psychiatrist's couch out of business

Mar 3rd 2011 | from the print edition

Do we need therapy or can CBM be effective without?

Addictive Behaviors 40 (2015) 21–26

Contents lists available at ScienceDirect

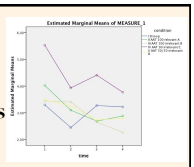
Addictive Behaviors

Alcohol Cognitive Bias Modification training for problem drinkers over the web

Reinout W. Wiers[a,*], Katrijn Houben[b], Javad S. Fadardi[c,d], Paul van Beek[b,e], Mijke Rhemtulla[f], W. Miles Cox[d]

- 314 problem drinkers recruited through web
- Online training (attentional re-training; varieties of approach-bias re-training; placebo control)
- Main outcome: reduction in alcohol use

Outcomes



- Alcohol Use
- Significant Reduction **in all groups** (including placebo-training)

- Apparently many people can successfully reduce problematic drinking, also with placebo (cf. recent findings with new medication nalmefene)

- Two differences with previous clinical studies
  - No additional CBT
  - Goal was reduction, not abstinence

Online CBM Smoking

(Elfeddali, De Vries, Bolman, Pronk, Wiers, submitted)

- Online recruitment (e.g., links on smoking info sites)
- Participants (18+, Wanting to quit smoking)
  - Randomly assigned to one of two conditions:
    - Visual-probe based training 90% trained away from smoking (5 sessions, cf. Schoenmakers et al 2010)
    - Control Condition: Visual-probe based training 50%-50% (5 sessions)
- Main outcome: successful quit attempt (maintained abstinence)

Outcomes

- No effects in light-moderate smokers (<15 cig/day)
- **Effects in heavy smokers only** (15+ cig/day):
- Attentional Bias:
  - Experimental group tended to have a less strong attentional bias for cigarettes at post test (p = .08)
- Success in quit-attempt, significant effect:
  - Controls: 23% still abstinent, CBM group 50%

Neural effects of cbm?

Effects of Cognitive Bias Modification Training on Neural Alcohol Cue Reactivity in Alcohol Dependence

Corinde E. Wiers, Ph.D., Christine Stelzel, Ph.D., Thomas E. Gladwin, Ph.D., Soyoung Q. Park, Ph.D., Steffen Pawelczack, M.Sc., Christiane K. Gawron, Cand.med., Heiner Stuke, M.D., Andreas Heinz, M.D., Ph.D., Reinout W. Wiers, Ph.D., Mike Rinck, Ph.D., Johannes Lindenmeyer, Ph.D., Henrik Walter, M.D., Ph.D., Felix Bermpohl, M.D., Ph.D.

Objective: In alcohol-dependent patients, alcohol cues evoke increased activation in mesolimbic brain areas, such as the nucleus accumbens and the amygdala. Moreover, patients show an alcohol approach bias, a tendency to more quickly approach than avoid alcohol cues. Cognitive bias modification training, which aims to retrain approach biases, has been shown to reduce alcohol craving and relapse rates. The authors investigated effects of this training on cue reactivity in alcohol-dependent patients.

Method: In a double-blind randomized design, 32 abstinent alcohol-dependent patients received either bias modification training or sham training. Both trainings consisted of six sessions of the joystick approach-avoidance task; the bias modification training entailed pushing away 90% of alcohol cues and 10% of soft drink cues, whereas this ratio was 50/50 in the sham training. Alcohol cue reactivity was measured with functional MRI before and after training.

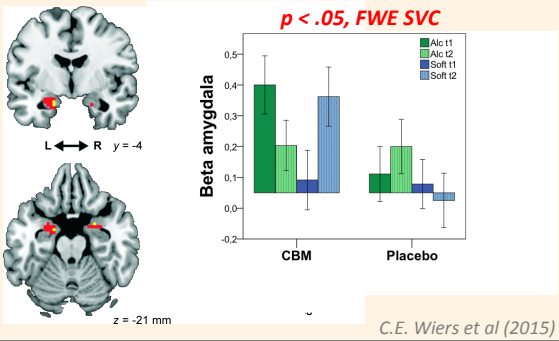
Results: Before training, alcohol cue-evoked activation was observed in the amygdala bilaterally, as well as in the right nucleus accumbens, although here it fell short of significance. Activation in the amygdala correlated with craving and arousal ratings of alcohol stimuli; correlations in the nucleus accumbens again fell short of significance. After training, the bias modification group showed greater reductions in cue-evoked activation in the amygdala bilaterally and in behavioral arousal ratings of alcohol pictures, compared with the sham training group. Decreases in right amygdala activity correlated with decreases in craving in the bias modification but not the sham training group.

Conclusions: These findings provide evidence that cognitive bias modification affects alcohol cue-induced mesolimbic brain activity. Reductions in neural reactivity may be a key underlying mechanism of the therapeutic effectiveness of this training.

Am J Psychiatry 2014; AiA:1–9; doi: 10.1176/appi.ajp.2014.13111495

Cue Reactivity pre-post training:(Alcohol>Softdrink)

CBM > Placebo



C.E. Wiers et al (2015)

Interim Conclusions

- CBM can help a subgroup of patients who are motivated to change, but don't succeed because of cue-reactivity (bottom-up triggered motivational processes; "strong horse")
- Effective in those with strong bias (but hard to determine at individual level)
- *Prevention?*

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Prevention?

- Universal Prevention? > No evidence for bias prior to use, better use other proven-effective programs
- Targeted Prevention? > Could help problem users who want to change but don't succeed, but… often not motivated to change, motivation to change necessary

Prevention?

- In people who are not motivated to change, CBM might change a bias, but does not result in behavior change (smoking: Kerst & Waters, 2014; alcohol Lindgren et al., 2015 PlosOne).
- Possible solution: add CBM to CBT/MI (smoking adolescents: Kong, Larsen et al., 2015)
- Or make training more fun (gamification)?

Training boring?

ELSEVIER

Journal of Behavior Therapy and Experimental Psychiatry

journal homepage: www.elsevier.com/locate/jbtep

Cognitive Bias Modification for adolescents with substance use problems – Can serious games help?

Wouter J. Boendermaker*, Pier J.M. Prins, Reinout W. Wiers

Department of Developmental Psychology, University of Amsterdam, The Netherlands

… more fun to train, but not more motivated to change. Motivation to train is not the same as motivation to change! (still needs to be incorporated)

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New developments

➢ Training on smartphones/tablets

➢ Note that angle is smaller, so important to establish that bias can be changed. Two initial studies showed this is possible:

- Anxiety: Enock, Hofmann & McNally (2014)
- Smoking: Kerst & Waters (2014)

Both found changes in attentional bias on mobile device, but no change in behavior.

What was missing?

CBT/MI! (long-term goals)

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New developments

> new opportunities: combine with unique features of smartphone: might "know" when you need training better than you!

Nicotine & Tobacco Research, Volume 15, Number 10 (October 2013) *1651–1654*

COMMENTARY

I Am Your Smartphone, and I Know You Are About to Smoke: The Application of Mobile Sensing and Computing Approaches to Smoking Research and Treatment

F. Joseph McClernon PhD[1], Romit Roy Choudhury PhD[2]

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Praktical Consequence: Training Website

New website (www.impliciet.eu)

Also international Project (in FP7 AliceRap)

First NL, Eng, Ita

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Conclusions

- Interplay motivation and control processes can be influenced through training
- Training can reduce bottom-up reactivity (& perhaps also control over temptations)
- Important new tools (only selection shown), especially in high-risk populations motivated but unable to change
- CBM can also be added to CBT/MI (first increase motivation to change and teach skills), which can also be done online

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