

# Virtual reality: new avenues for research and therapy

- **Objective** (greater impact)
- **Current model** (bi-directional limitations)
- **New model** (VR = promising)
  - Success
  - Examples
- **Risks**
- **Payoffs**



# OBJECTIVE - impact

Basic

Classification

Diagnosis

Treatment

Outcomes

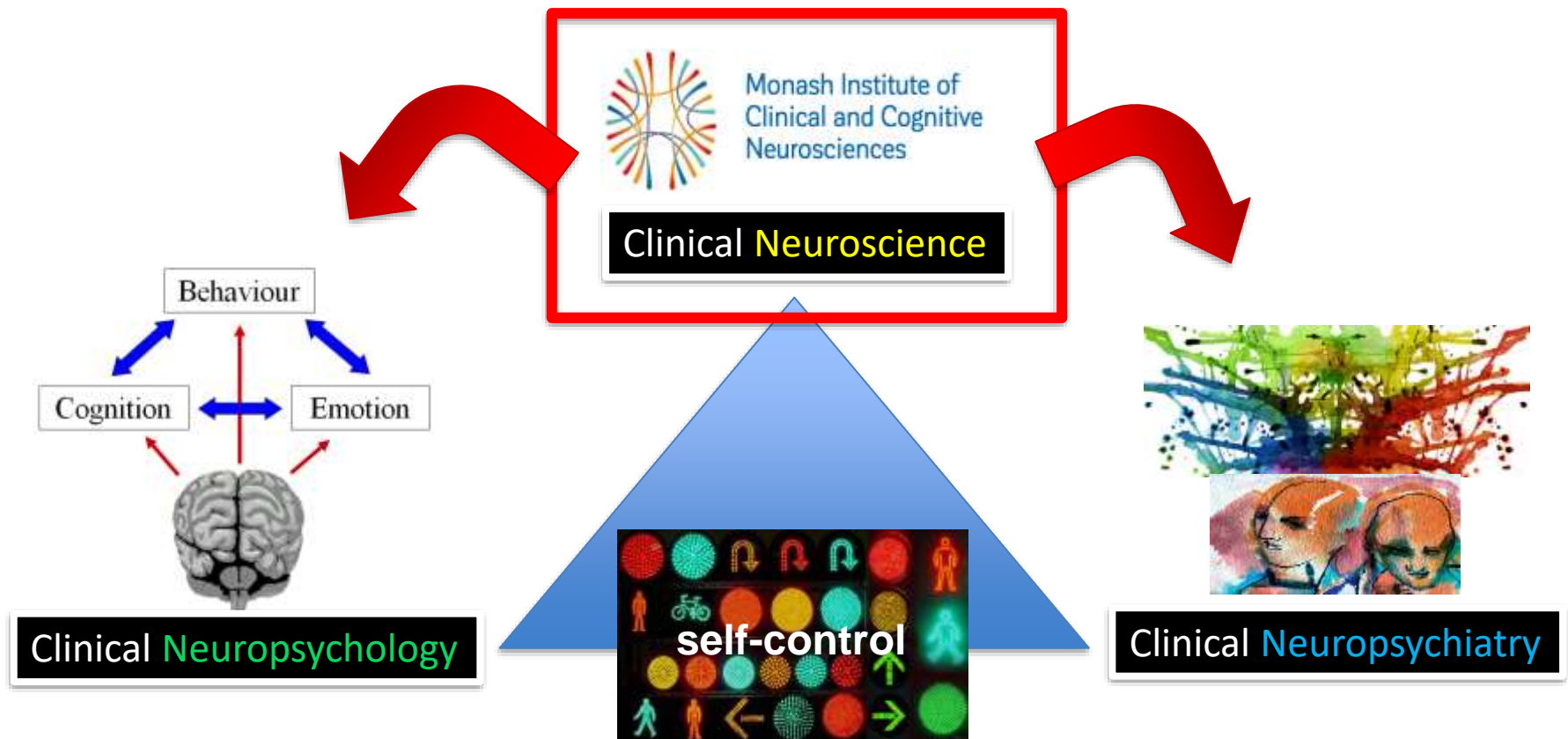


Tools

Studies

Frameworks

# OBJECTIVE – take advantage



# OBJECTIVE – self-control

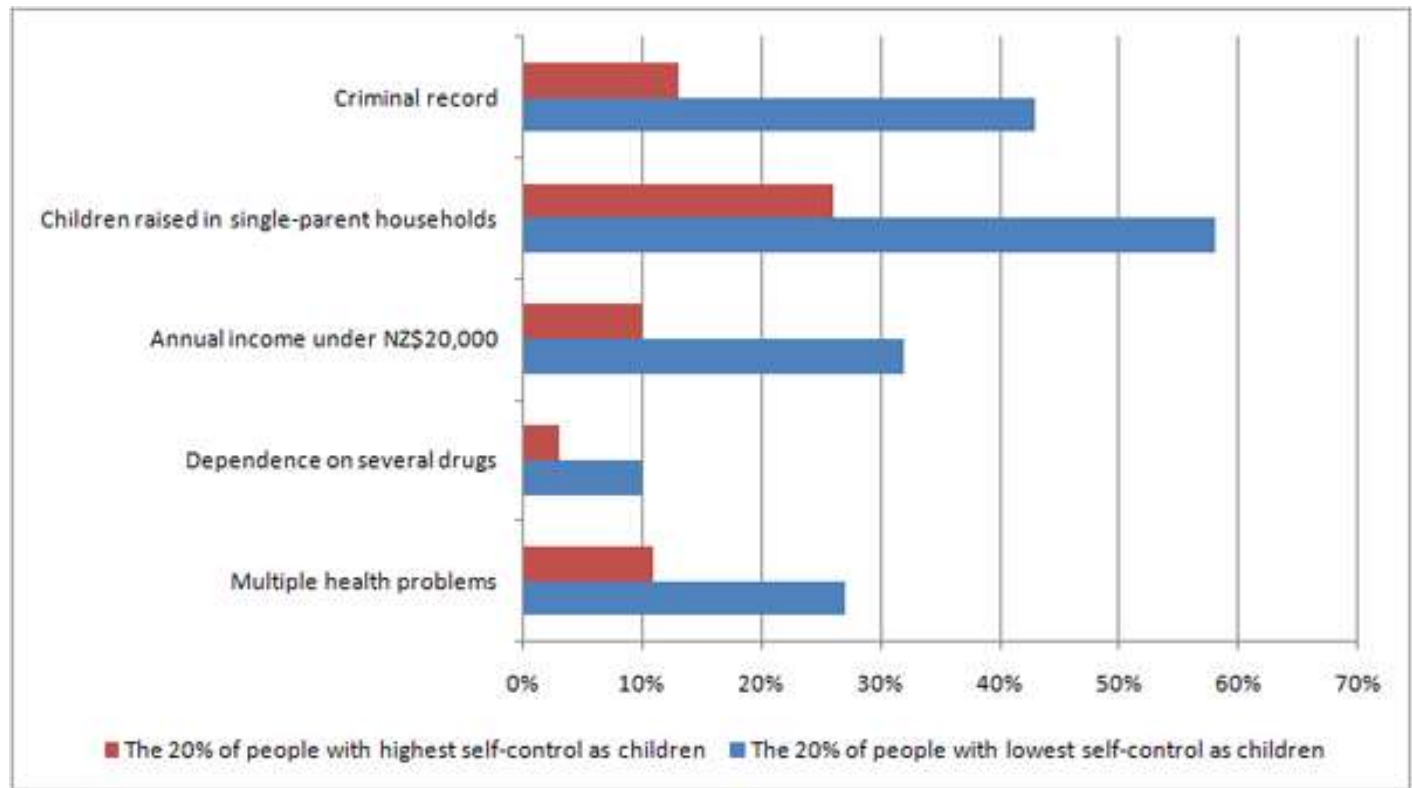




# OBJECTIVE – self-control

## A gradient of childhood self-control predicts health, wealth, and public safety

Terrie E. Moffitt<sup>a,b</sup>, Louise Arseneault<sup>b</sup>, Daniel Belsky<sup>a</sup>, Nigel Dickson<sup>c</sup>, Robert J. Hancox<sup>c</sup>, HonaLee Harrington<sup>a</sup>, Renate Houts<sup>a</sup>, Richie Poulton<sup>c</sup>, Brent W. Roberts<sup>d</sup>, Stephen Ross<sup>a</sup>, Malcolm R. Sears<sup>a,f</sup>, W. Murray Thomson<sup>a</sup>, and Avshalom Caspi<sup>a,b,1</sup>



**Self-Control is more important than intelligence and social class !!**

# OBJECTIVE – self-control

## Self-control

- dynamic
- individual
- context



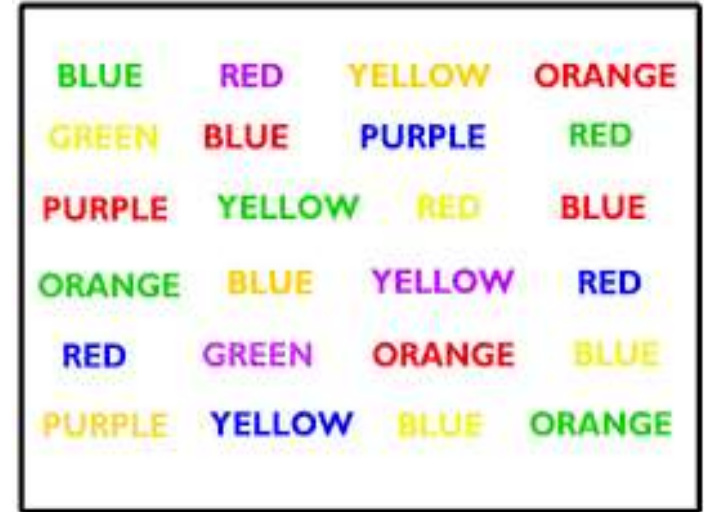
- **compelled to act** (video 1)
- **in the zone / excitement** (video 2)
- **intense cravings / pre-occupations**
- **withdrawal / negative affect**
- **cue-reactivity**

# CURRENT MODEL – clinical (NP<sub>psych</sub>)

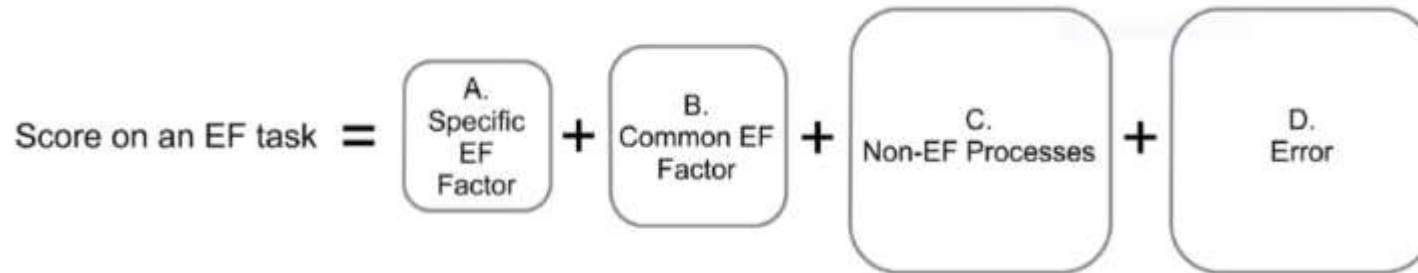
## Self-control

- dynamic
- individual
- context

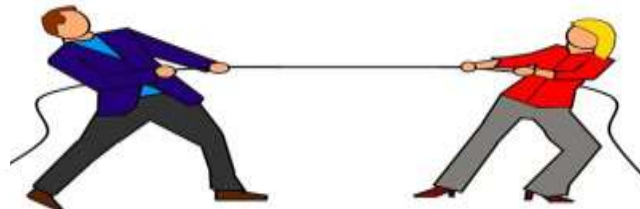
1929 !!



Snyder et al., 2015, *Frontiers in Psychology*



external  
validity



internal  
validity



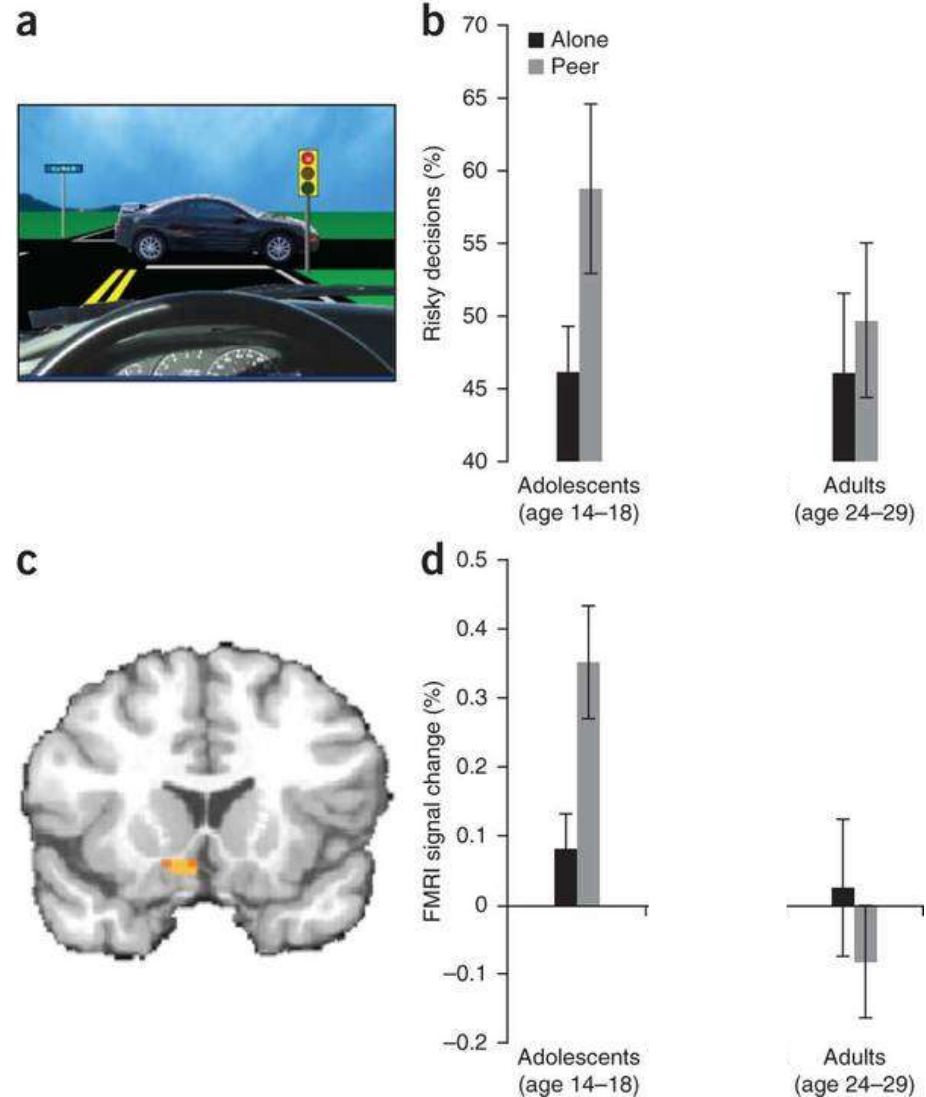
# CURRENT MODEL – neuroscience

## Self-control

- dynamic
- individual
- context

## Value-Based Choice

how people use different types of information (probability, reward, punishment) to guide decision-making (*no learning component*).



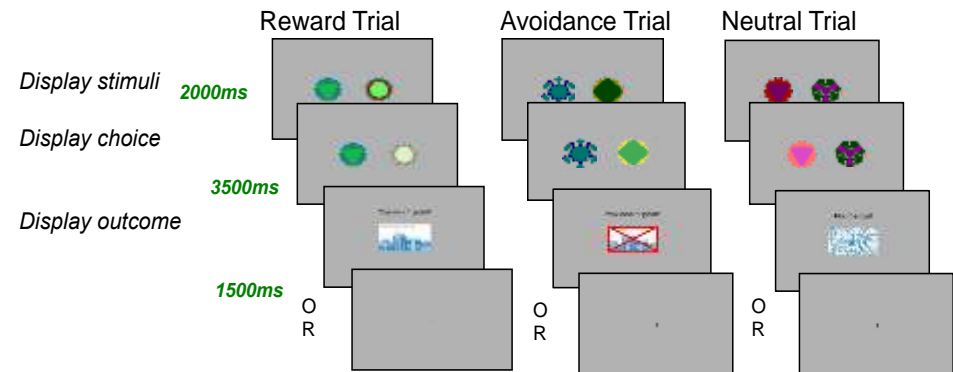
# CURRENT MODEL – neuroscience

## Self-control

- dynamic
- individual
- context

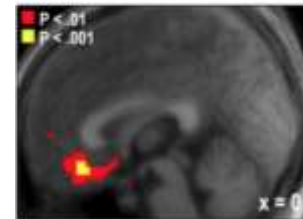
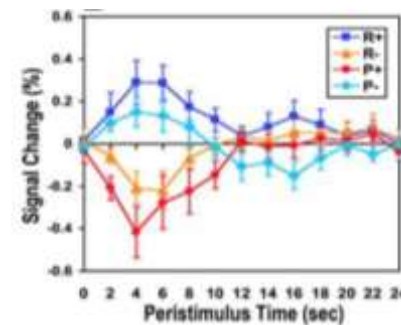
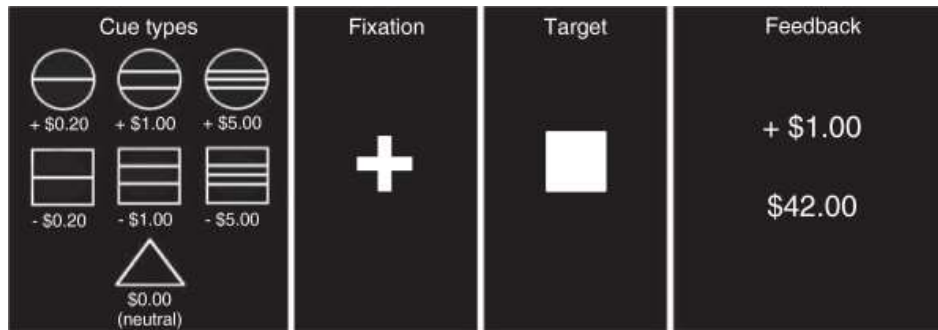
## Reinforcement Learning

typically involve learning which abstract stimuli predict winning or losing points or money.



## Incentive Motivation

how much effort an individual is prepared to exert to gain reward.



Kim et al (2006)

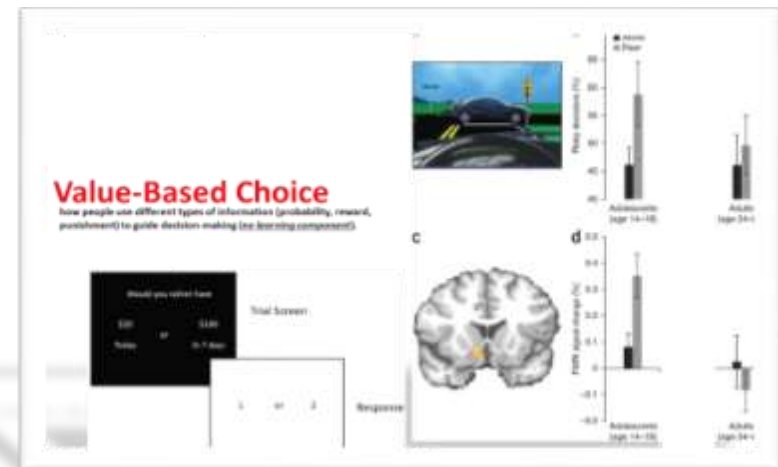
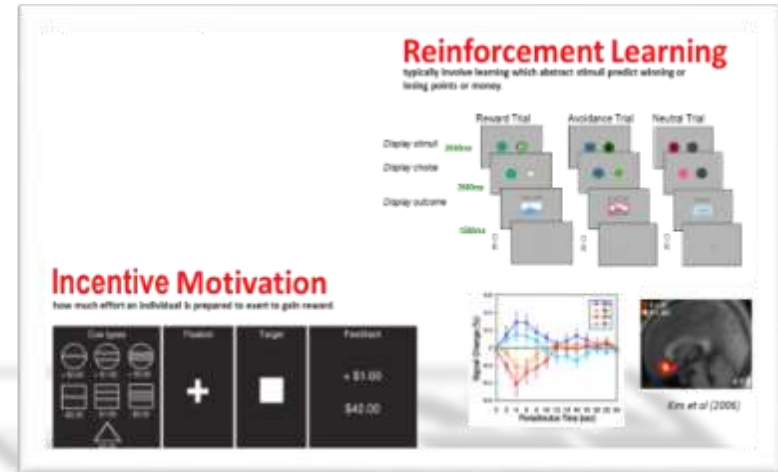
# CURRENT MODEL – neuroscience

## Self-control

- **dynamic**
- **individual**
- **context**



- **compelled to act** (video 1)
- **in the zone / excitement** (video 2)
- **intense cravings / pre-occupations**
- **withdrawal / negative affect**
- **cue-reactivity**



# CURRENT MODEL

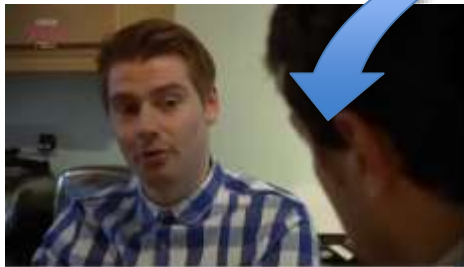
Clinical **Treatment**

Clinical **Neuroscience**

Clinical **Neuropsychology**

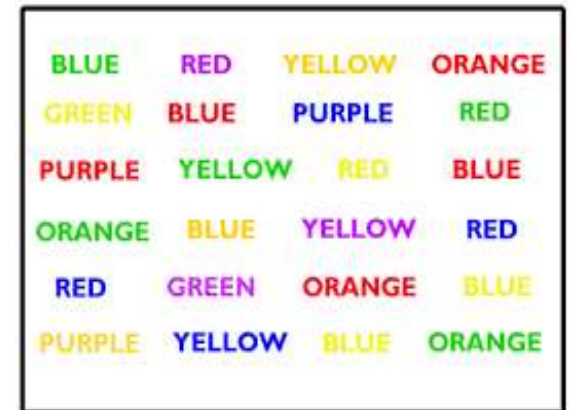
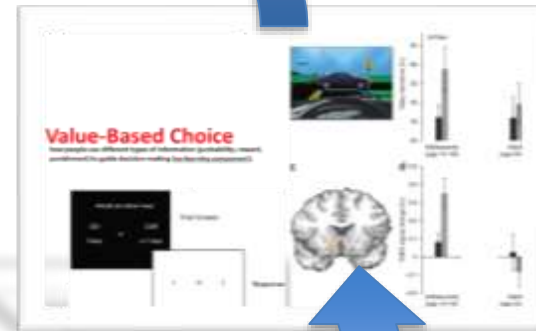
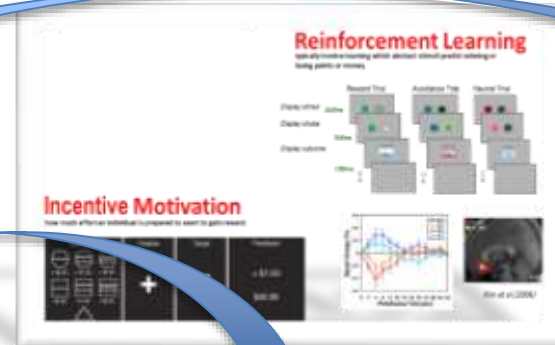
**Self-control**

- **dynamic**
- **individual**
- **context**

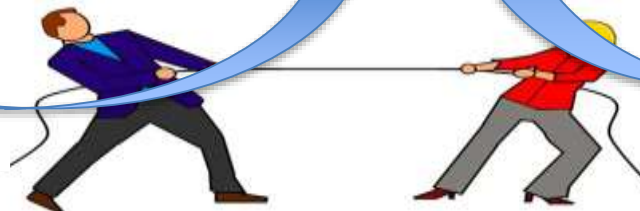


- **compelled to act** (video 1)
- **in the zone / excitement** (video 2)
- **intense cravings / pre-occupations**
- **withdrawal / negative affect**
- **cue-reactivity**

**external  
validity**



**internal  
validity**



# CURRENT MODEL - tension

## Lab/Clinic

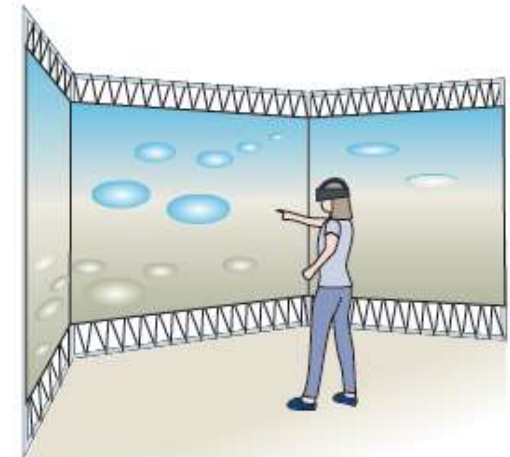
## Real life...

let off  
my hand  
or we  
both die

no, there's no  
way I gonna  
leave you

Get off my hand,  
bastard!!! Die for your  
own good!!

F\*\*k!!!  
Pull me up!!!





# NEW MODEL



# NEW MODEL

immersion

measurement

## Compatible Channels

### Sensor Data

- ✓ ECG/HRV
- ✓ Dual Band Respiratory Inductance Plethysmography
- ✓ EEG
- ✓ EMG
- ✓ Blood Pressure
- ✓ Temperature (Skin)
- ✓ Temperature (Core)
- ✓ E-Patient Diary
- ✓ Pulse Oximetry
- ✓ PPG Waveforms
- ✓ TriAxial Accelerometry
- ✓ GSR
- ✓ Event Marking (On Device and Remote)



# SUCCESS — emotions/motivations/physiology





# SUCCESS – huge investment

## Virtual reality will reach 11MM users by 2016E

Although few devices are ready for retail, VR will become commercially viable in 2016.

**\$2.6B**

Amount invested in virtual and augmented reality companies in 2014

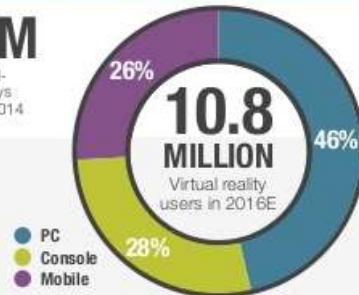
**286**

Currently available virtual reality applications\*

**1.3MM**

Number of head-mounted displays (HMD) sold in 2014

There are currently over 200 developers working on virtual reality projects and 15 different virtual reality HMDs at different stages of completion. A wave of PC devices will launch in mid 2015 while the first console device will launch in mid to late 2016.



### Types of virtual reality head-mounted displays (HMD)



**PC** devices like the Oculus Rift have the highest capabilities and track head and body movements. Retail versions will launch later this year.



**Light Mobile** devices are smartphone attachments that render a crude virtual reality experience using Google Cardboard VR software.



**Premium Mobile** devices, like Samsung Gear VR, use smartphones as screens but offer advanced features like positional tracking.



**Console** devices, like Sony's Morpheus, will have similar capabilities to PC head-mounted displays.



### Industry Players React to VR

### BDMI

HARDWARE	PLATFORMS	MEDIA	BRANDS
<b>SONY</b> developing the PlayStation VR (PS4 headset for PS4)	<b>facebook</b> purchased Oculus VR headset producer for reported \$2B	<b>Condé Nast</b> developing two original video series in VR	<b>VOLVO</b> launched a campaign for Google Cardboard with a VR app
<b>SAMSUNG</b> developed the Samsung Gear VR (a mobile VR headset)	<b>Google</b> created Cardboard (VR headset) and Jumping and software for VR video	<b>VICE</b> produced the VR documentary film Millions March	<b>Marrriott</b> developed VR experiences for four tropical destinations
<b>htc</b> developing the Vive (VR headset) in collaboration with Steam	<b>Microsoft</b> developing the HoloLens (AR headset)	<b>NBC</b> created VR experiences for the 40th Anniversary SNC Special	<b>The Peters</b> created a VR walk-through of their 150th

**BALANCE** – optimism/profit mongering !

Do not over-inflate claims

Rigorous neuroscience (controlled CTs)

# SUCCESS – early prototypes

## Personality Assessment in Ecological Settings by Means of Virtual Reality

Pietro Cipresso

*Istituto Auxologico Italiano, Milan, Italy*

Giuseppe Riva

*Istituto Auxologico Italiano, and Università Cattolica del Sacro Cuore, Milan, Italy*





# SUCCESS – MCI → Dementia

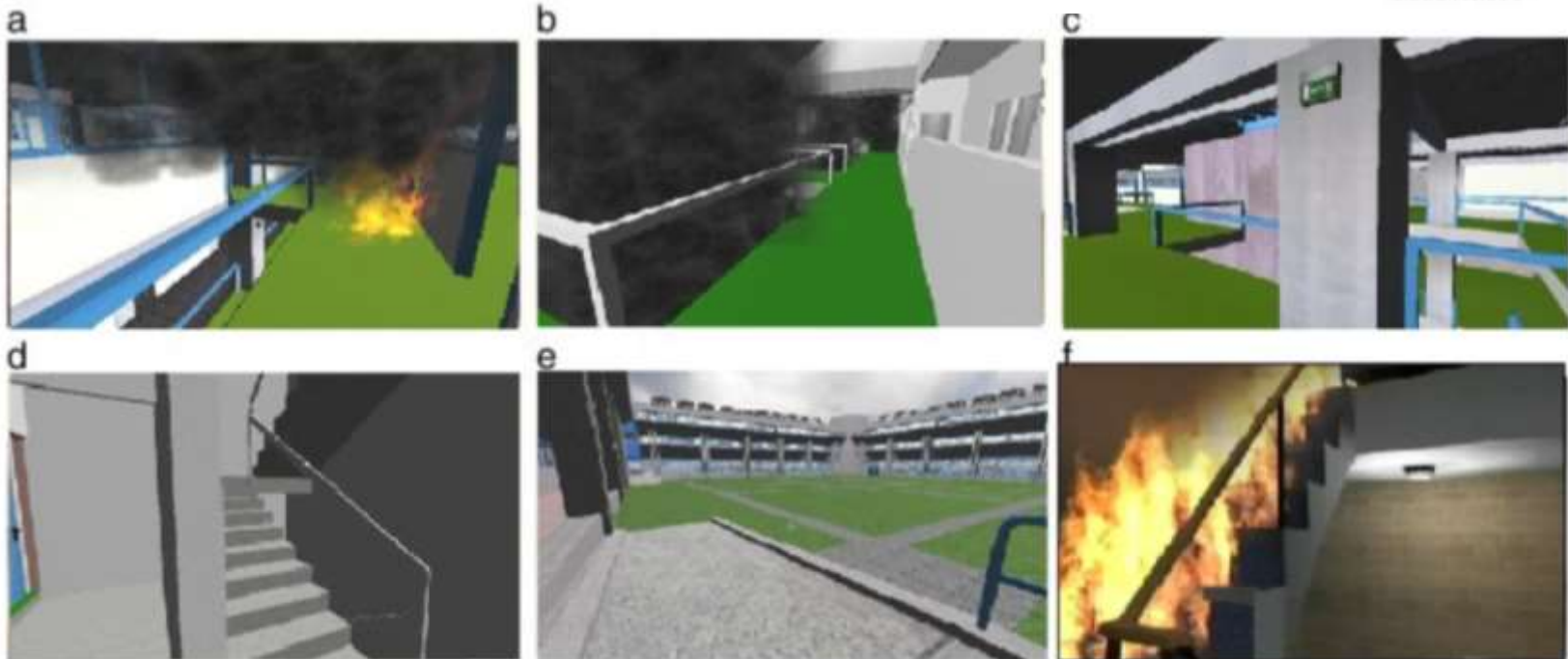
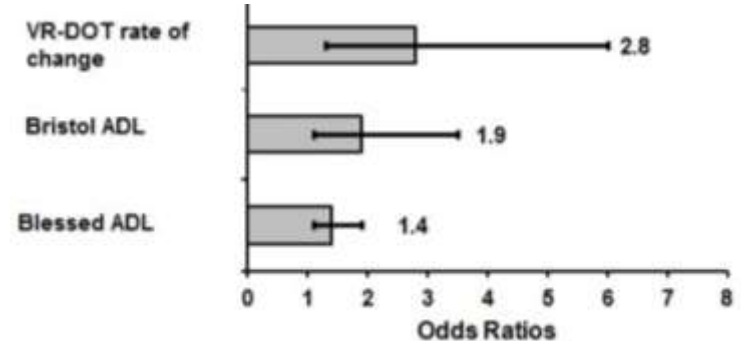
JMIR SERIOUS GAMES

Tammanas et al

[Original Paper](#)

## Ecological Validity of Virtual Reality Daily Living Activities Screening for Early Dementia: Longitudinal Study

Ioannis Tammanas<sup>1,2,3</sup>, Winfried Schlee<sup>2</sup>, PhD(Psych); Magda Tzolaki<sup>3</sup>, PhD; René Müttr<sup>1,4</sup>, MD; Urs Mosimann<sup>1,5</sup>, MD, PhD; Tobias Nef<sup>4,6</sup>, PhD



# SUCCESS

## Substances



## Behaviour



## OCD

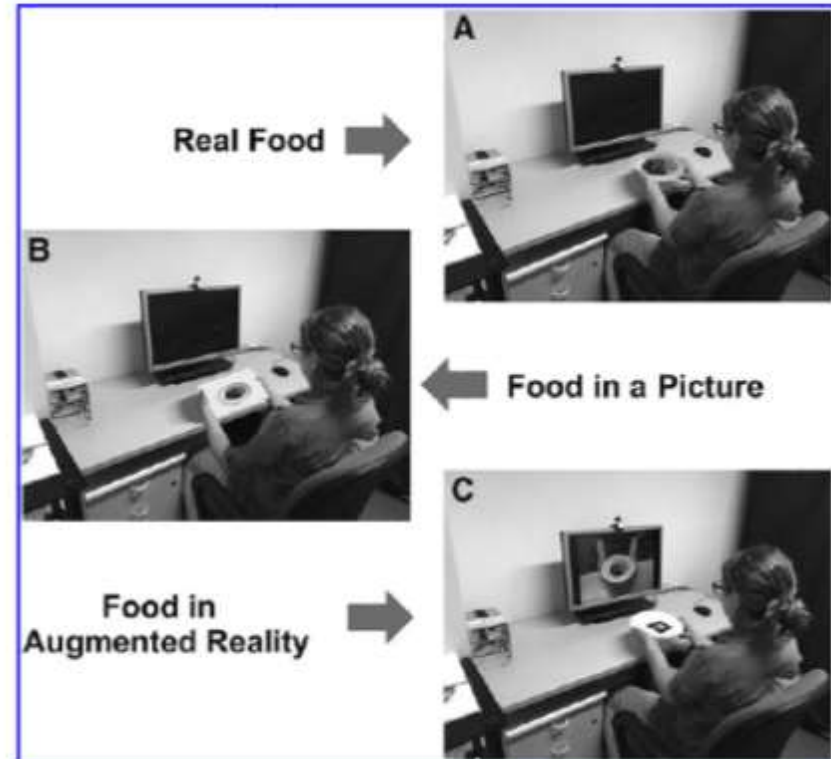
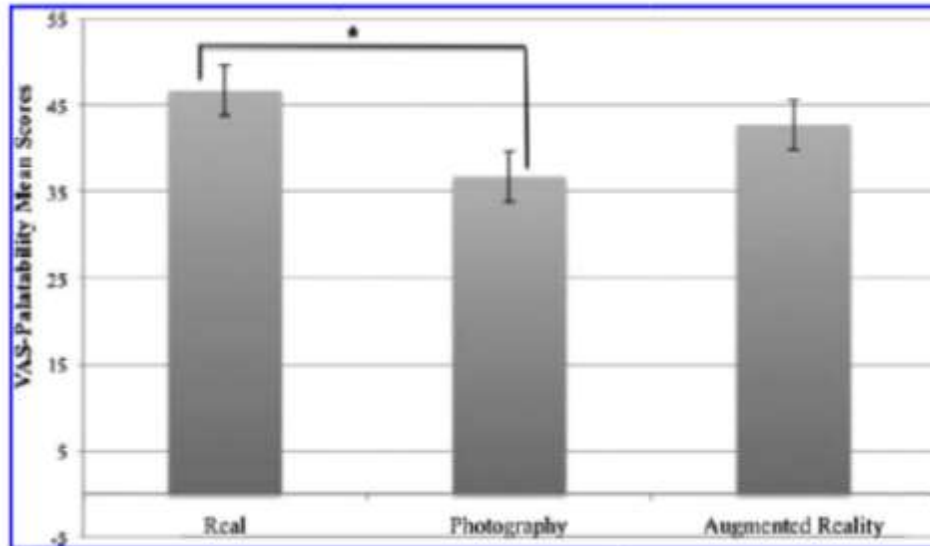


# SUCCESS – more palatable

CYBERPSYCHOLOGY, BEHAVIOR, AND SOCIAL NETWORKING  
Volume 19, Number 2, 2016  
© Mary Ann Liebert, Inc.  
DOI: 10.1089/cyber.2015.0235

## Testing Augmented Reality for Cue Exposure in Obese Patients: An Exploratory Study

Federica Pallavicini, PhD,<sup>1</sup> Silvia Serino, PhD,<sup>1</sup> Pietro Cipresso, PhD,<sup>1</sup> Elisa Pedrotti, PSYD,<sup>1</sup>  
Irene Alice Chicchi Giglioli, MA,<sup>1</sup> Alice Chirico, MA,<sup>1</sup> Gian Mauro Manzoni, PhD,<sup>2,3,\*</sup>  
Gianluca Castelnuovo, PhD,<sup>2,3</sup> Enrico Molinari, PhD,<sup>2,3</sup> and Giuseppe Riva, PhD<sup>1,3</sup>



# SUCCESS – feasible

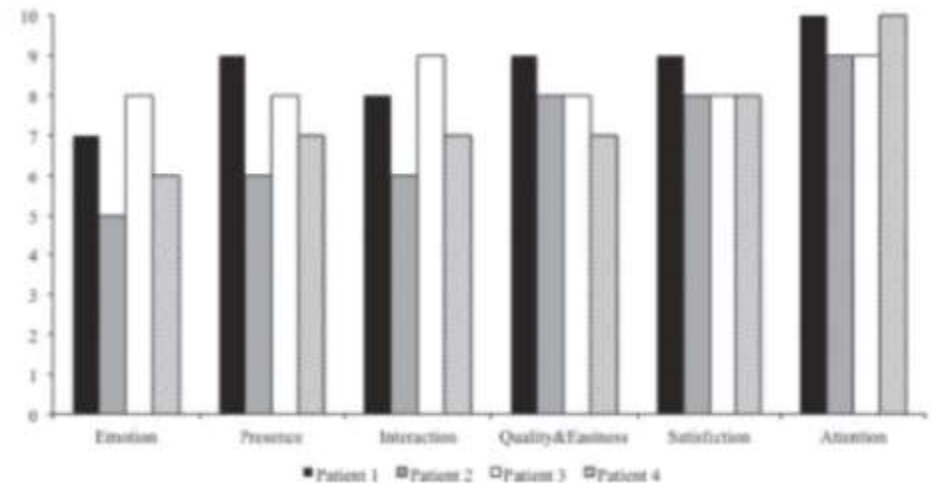
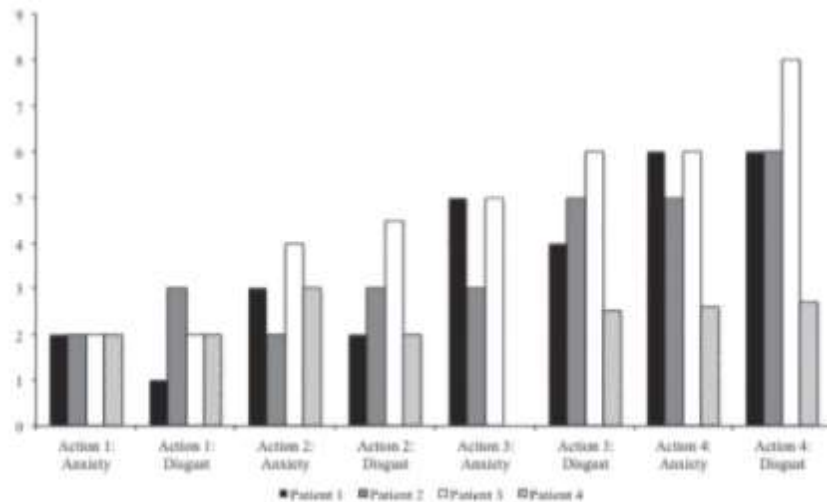


Asociación Española  
de Psicología Clínica  
y Psicopatología

*Revista de Psicopatología y Psicología Clínica* Vol. 19, N.º 1, pp. 37-44, 2014  
www.aepp.net ISSN 1136-5420/14

## VIRTUAL REALITY EXPOSURE FOR OCD: IS IT FEASIBLE?

AMPARO BELLOCH<sup>1</sup>, ELENA CABEDO<sup>2</sup>, CARMEN CARRIÓ<sup>3</sup>, JOSE A. LOZANO-QUILIS<sup>4</sup>, JOSE A. GIL-GÓMEZ<sup>4</sup>, AND HERMENEGILDO GIL-GÓMEZ<sup>4</sup>





# SUCCESS ? – efficacious

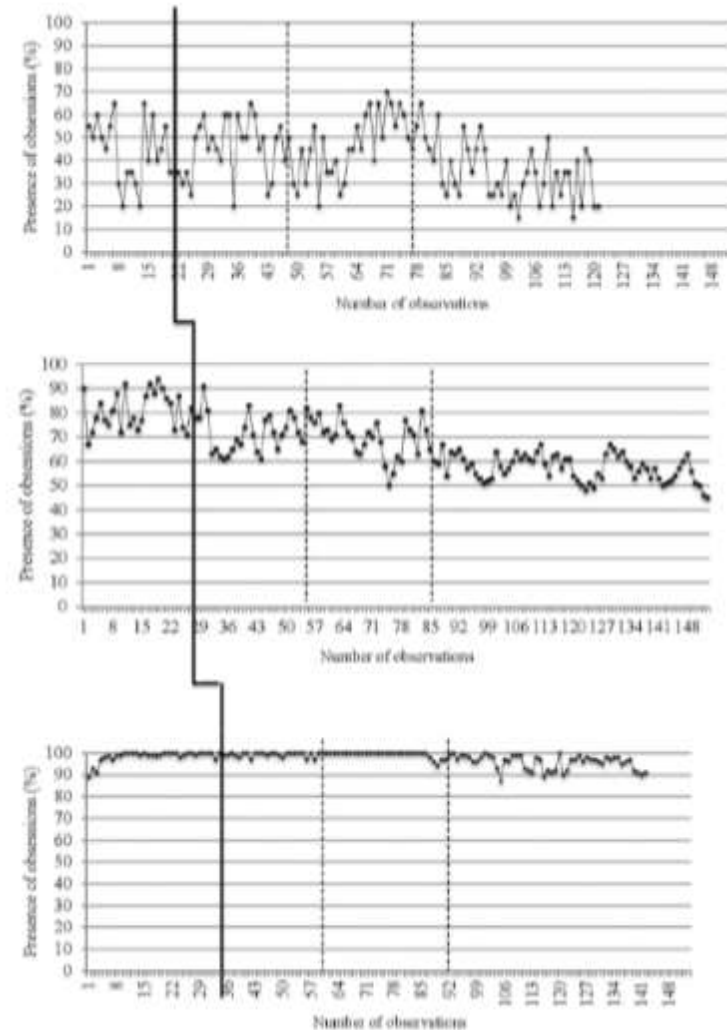


## Effectiveness of *In Virtuo* Exposure and Response Prevention Treatment Using Cognitive–Behavioral Therapy for Obsessive–Compulsive Disorder: A Study Based on a Single-Case Study Protocol

Myéline Laforest<sup>1</sup>, Stéphanie Bouchard<sup>1,2\*</sup>, Jessie Bosse<sup>2</sup> and Olivier Mosy<sup>1,2</sup>



| Screenshots of the virtual environment used for exposure and response prevention in a “contaminated” public toilet.





# SUCCESS ? – efficacious

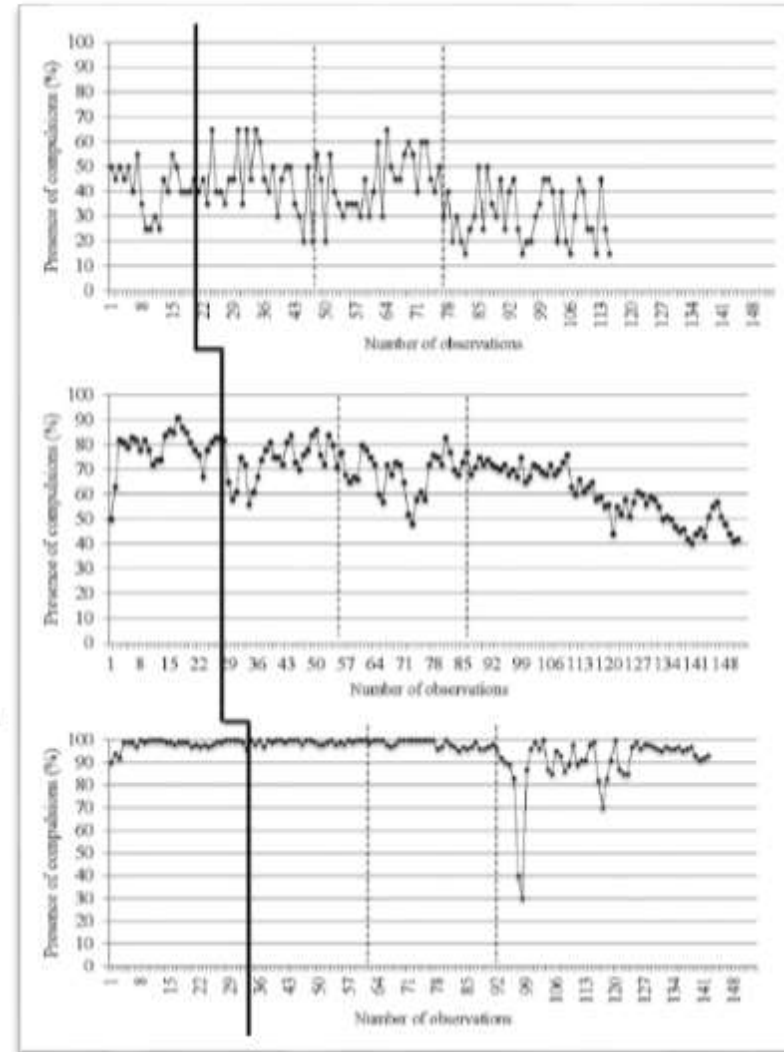


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| Screenshots of the virtual environment used for exposure and response prevention in a “contaminated” public toilet.



# SUCCESS – urge to gamble

Addictive Behaviors 41 (2015) 61–64



Contents lists available at ScienceDirect

Addictive Behaviors



Short Communication

The effect of repeated exposure to virtual gambling cues on the urge to gamble



Chan-Bin Park<sup>a,e</sup>, Su Mi Park<sup>a</sup>, Ah Reum Gwak<sup>a</sup>, Bo Kyung Sohn<sup>a,b</sup>, Jun-Young Lee<sup>a,b</sup>, Hee Yeon Jung<sup>a,b</sup>,  
Sam-Wook Choi<sup>c</sup>, Dai Jin Kim<sup>d</sup>, Jung-Seok Choi<sup>a,b,\*</sup>



Monash Institute of  
Clinical and Cognitive  
Neurosciences

# VR EXPOSURE – OCD & GAMBLING



# VR CASINO



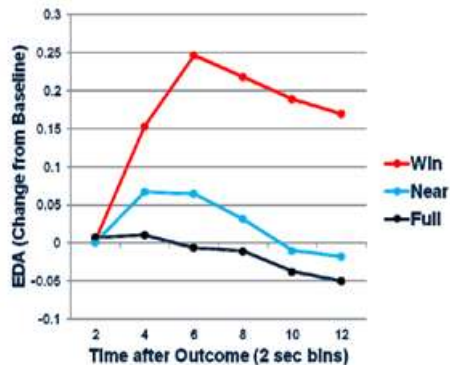
made with **unity**



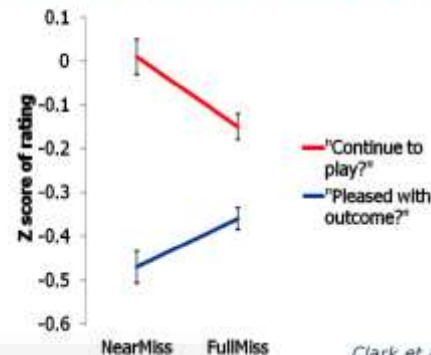
# Near Miss



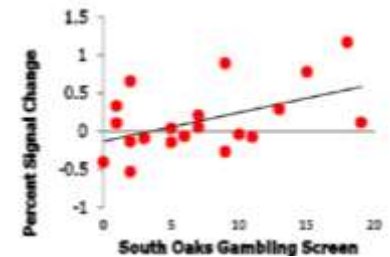
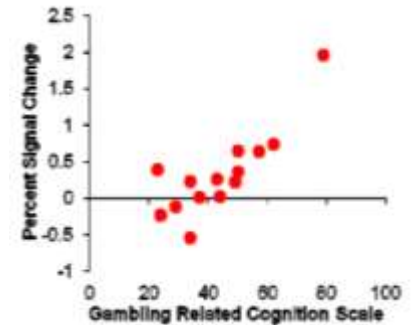
## Skin Conductance Responses to Near-Misses



## Near Misses are Aversive but Enhance Motivation to Play

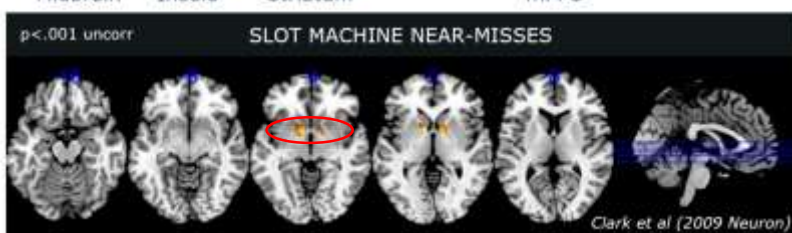
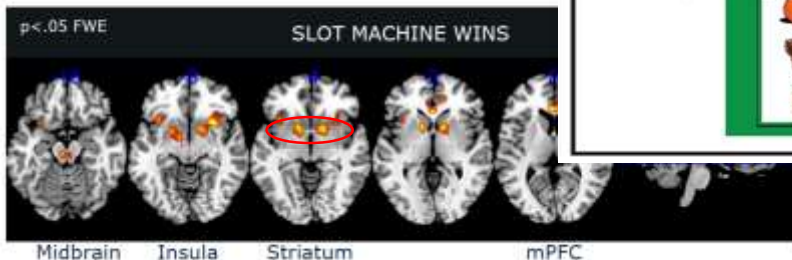


## Gambling outcomes

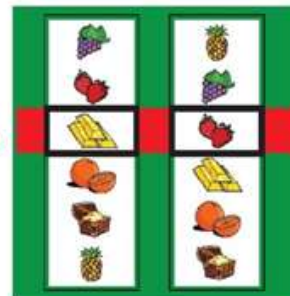


Clark et al (2009 Neuron)

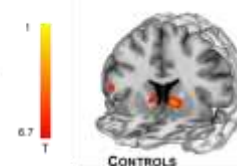
## Brain Responses (fMRI)



No win  
Total \$2



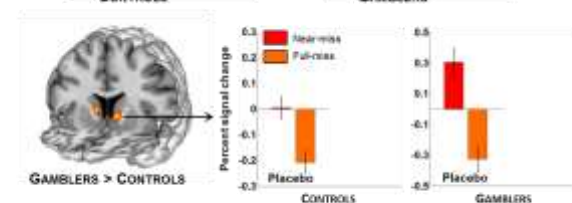
fMRI: near-miss > full-miss



CENTRE FOR GAMBLING RESEARCH AT UBC



Sescousse et al, under review



Increased Striatal Reactivity to Near-Misses in Problem Gamblers

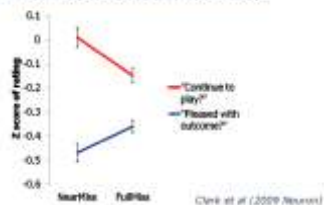


# Near Miss

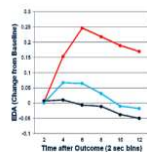


- **compelled to act** (video 1) → **value-based choice**
- **in the zone / excitement** (video 2) → **incentive motivation**
- **intense cravings / pre-occupations** → **reinforcement learning**
- **withdrawal / negative affect** → **physiological reactions**
- **cue-reactivity** → **attentional bias**

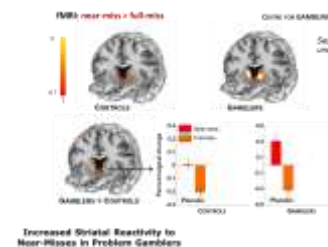
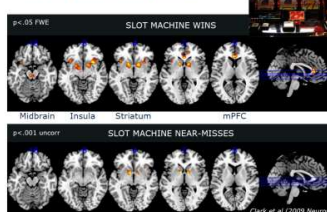
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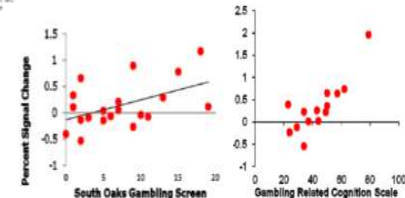
## Skin Conductance Responses to Near-Misses



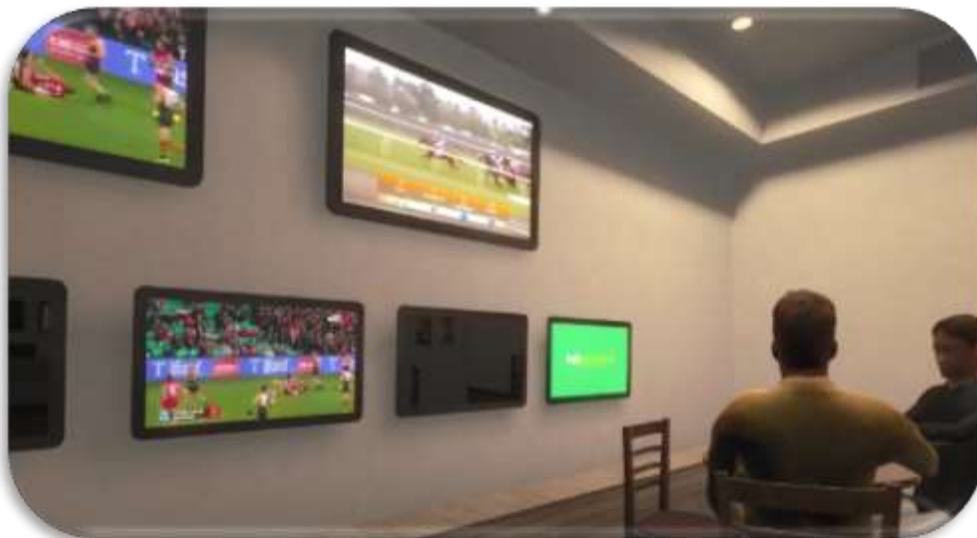
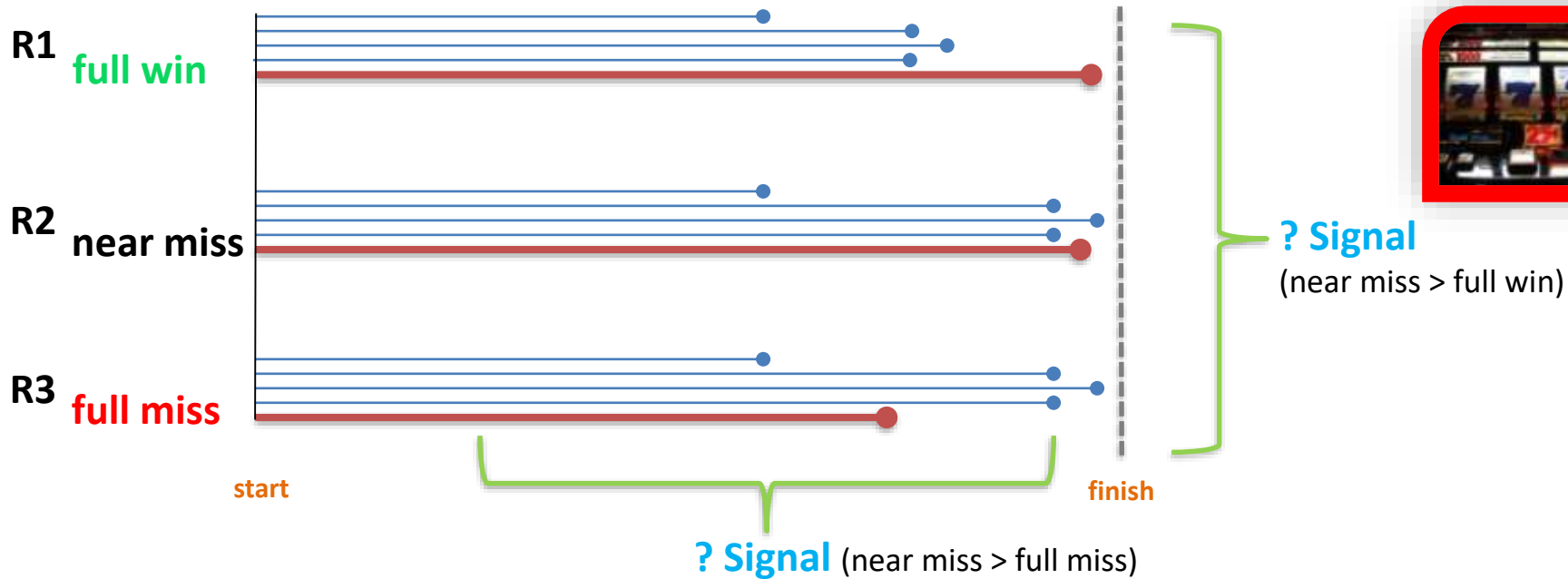
## Brain Responses (fMRI)



## Gambling outcomes



# Near Miss



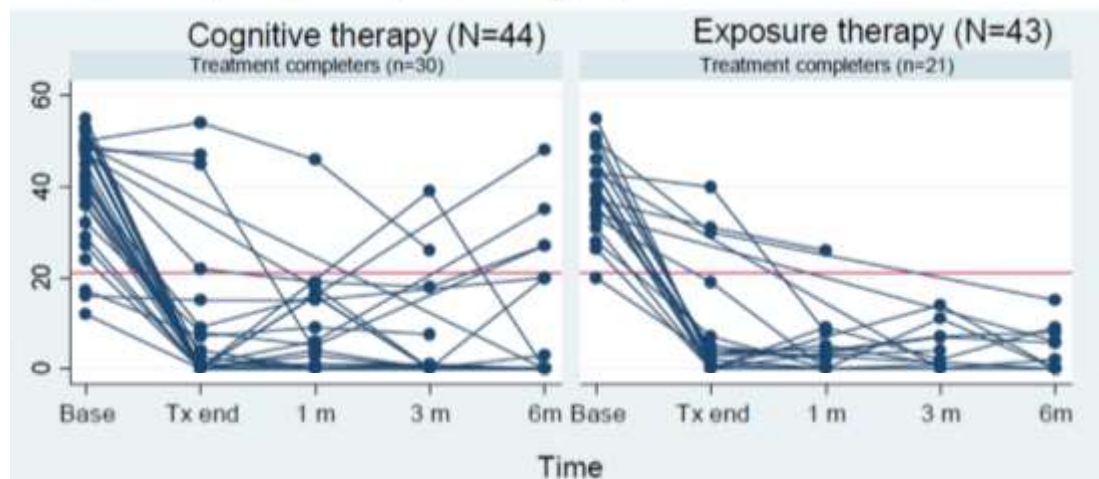
# VR-Enhanced Exposure

J Gambl Stud. 2015 Dec 26. [Epub ahead of print]

## Experiences and Perceptions of Problem Gamblers on Cognitive and Exposure Therapies When Taking Part in a Randomised Controlled Trial: A Qualitative Study.

Smith D<sup>1</sup>, Pols R<sup>2</sup>, Lavis T<sup>3</sup>, Battersby M<sup>4</sup>, Harvey P<sup>5</sup>.

**Figure 4. Individual response profiles for Victorian Gambling Screen (VGS) scores treatment completion status, treatment group and time.<sup>a</sup>**



Weekly Sessions	Exposure Therapy (ET)
Session 1:	Pre-treatment assessment to identify problem gambling and any co-morbid conditions. Rationale and protocol of exposure therapy explained.
Session 2:	Development of participant's measurable problems and goals. Establish cash restrictions to ensure participant has no cash. First exposure task set using images. Commence daily self-monitoring diary.
Session 3:	Review participant's attempt at first exposure task. Finalise cash restriction strategies if not already in place. In-session imagery exposure task with therapist guidance.
Session 4:	Review imagery exposure task. Finalise cash restriction strategies if not already in place. Imagery exposure task with therapist guidance.
Session 5:	Review imagery exposure task. Introduction of next exposure task involving image and sounds of gambling-related cues.
Session 6:	Introduction to first of the in-vivo exposure tasks. This task to take place outside of participant's usual gambling venue(s). The participant utilises principles of exposure therapy from imaginal tasks to assist in identifying what is happening to them at the time of the in-vivo task.
Session 7:	Fine tuning of in-vivo exposure task outside of venue. Introduction to in-vivo exposure task to take place inside venue without cash.
Session 8:	Fine tuning of in-vivo exposure task inside venue without cash. Introduction to next in-vivo task taking place inside a gambling venue with a small amount of cash.
Session 9:	Fine tuning of in-vivo exposure task inside venue with a small amount of cash. Introduction to next in-vivo task taking place inside a gambling venue changing a small amount of cash for Poker machine coins.
Session 10:	Review in-vivo exposure tasks. Introduction to next in-vivo task taking place inside a gambling venue changing a small amount of cash for coins and placing in Poker machine.
Sessions 11- 12	Explore gambling relapse and develop relapse prevention strategies.





# VR-Enhanced – Awareness/Policy

J.Gambl Stud, 2016 Mar 31. [Epub ahead of print]

## Exposure to Gambling Advertisements and Gambling Behavior in Young People.

Clemens F<sup>1</sup>, Hanewinkel R<sup>1</sup>, Morgenstern M<sup>2</sup>.

### ⊕ Author information

#### Abstract

A cross-sectional survey of 4617 adolescents and young adults from 38 schools in two German states was conducted in 2014 to assess the association between gambling advertisements and gambling behavior. Exposure to ten gambling advertisements was measured with masked ad images; students indicated contact frequency and brand recall. Main outcomes were several gambling behaviors including probable pathological gambling assessed with the South Oaks Gambling Screen (SOGS  $\geq 5$ ). A total of 65.4 % of the students reported gambling at least once in their life; 42.2 % gambled in the last 12 months; 6.9 % gambled in the last week, and 2.8 % reported probable pathological gambling. The average frequency that one of the selected ads had been seen at least once was 29.5 %, the average brand recall rate was 9.4 %. After adjustment for confounding, multilevel mixed-effects logistic regressions revealed that high gambling ad exposure was positively related to all assessed gambling outcomes, with the strongest association for weekly gambling. Future studies need to clarify the temporal sequence and specificity of these associations.





# VR-Enhanced – Awareness/Policy

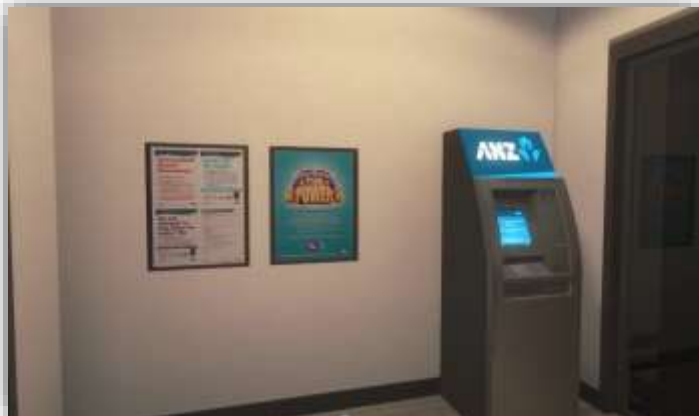


Optimal content for warning messages to enhance consumer decision making and reduce problem gambling

Sally M. Gainsbury<sup>a,\*</sup>, David Aro<sup>b</sup>, Dianne Ball<sup>b</sup>, Christian Tobar<sup>b</sup>, Alex Russell<sup>a</sup>

The eight messages used in this trial.

Label	Message	Theme
A	Have you spent more than you can afford?	Self-appraisal
B	Is money all you are losing?	Self-appraisal
C	Set your limit. Play within it.	Informative
D	Only spend what you can afford to lose.	Informative
E	Do you need a break? Gamble responsibly.	Self-appraisal
F	Are you playing longer than planned?	Self-appraisal
G	A winner knows when to stop gambling.	Informative
H	You are responsible for your gambling.	Informative



## Pokie-Leaks: Australians urged to leak gambling industry secrets to politicians

By the National Reporting Team's [James Thomas](#)

Posted Tue at 12:05am

**Three federal politicians are calling on Australians to leak secret information relating to the poker machine industry.**

The "Pokie-Leaks" campaign will see independent MP Andrew Wilkie, Greens Senator Larissa Waters and the NXT's Nick Xenophon using parliamentary privilege to protect whistleblowers who come to them with secret information about industry tactics, poker machine design and payments to politicians.

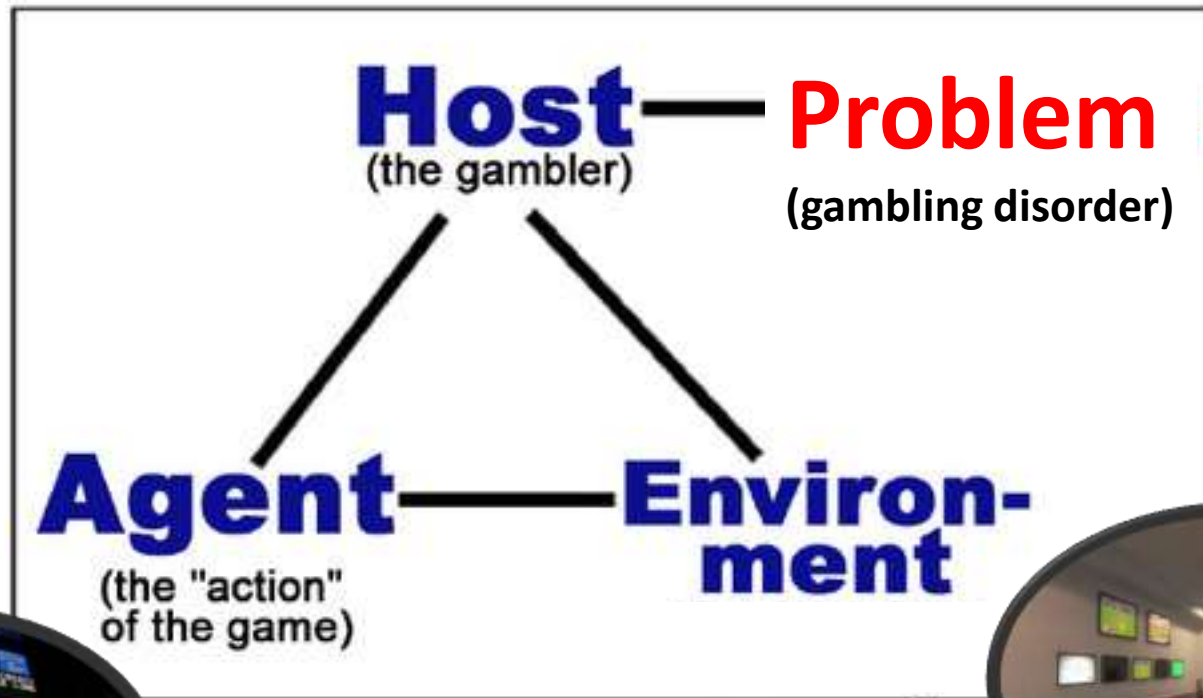
The campaign is being conducted with the support of the Alliance for Gambling Reform — a group of business people, academics and politicians who want greater restrictions on Australia's multi-billion dollar gambling industry.

Already, the leaks have begun, with Senator Xenophon's Adelaide office receiving a USB containing information from inside a pokie machine, which could reveal allegedly addictive features currently programmed into modern poker machines.



**PHOTO:** People with information are being encouraged to get in touch with politicians. (Flickr: Michael Coghlan)

# VR: new avenues for research and therapy



# RISKS

- ✗ \$\$
- ✗ programming tools / coding
- ✗ nausea
- ✗ hands
- ✗ just don't like it ! (client OR clinician)

- ✗ norms
- ✗ psychometrics
- ✗ targeted neuro-cognitive endpoints
- ✗ computational modelling

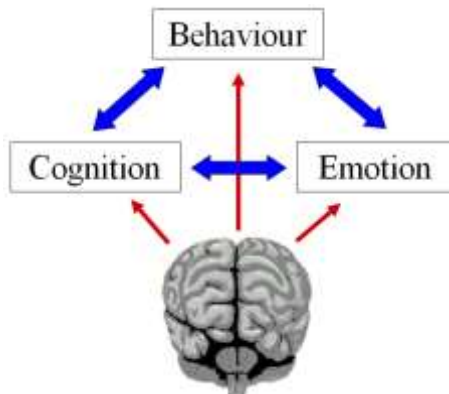


# RISKS

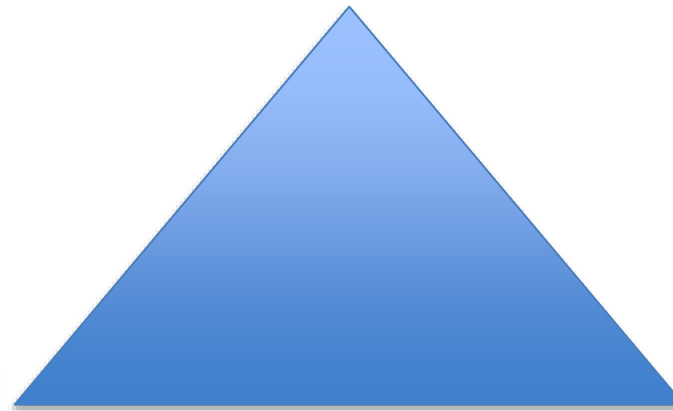


Monash Institute of  
Clinical and Cognitive  
Neurosciences

Clinical **Neuroscience**



Clinical **Neuropsychology**



Clinical **Neuropsychiatry**

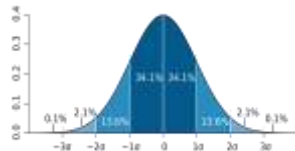
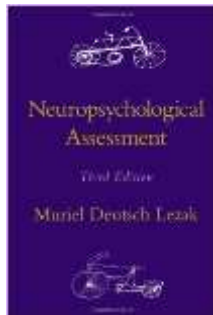


# PAYOFFS – truly interdisciplinary



## Clinical Neuroscience

Fundamentals & Modelling



## Clinical Neuropsychology

Psychometric & Psychosocial Treatment



## Clinical Neuropsychiatry

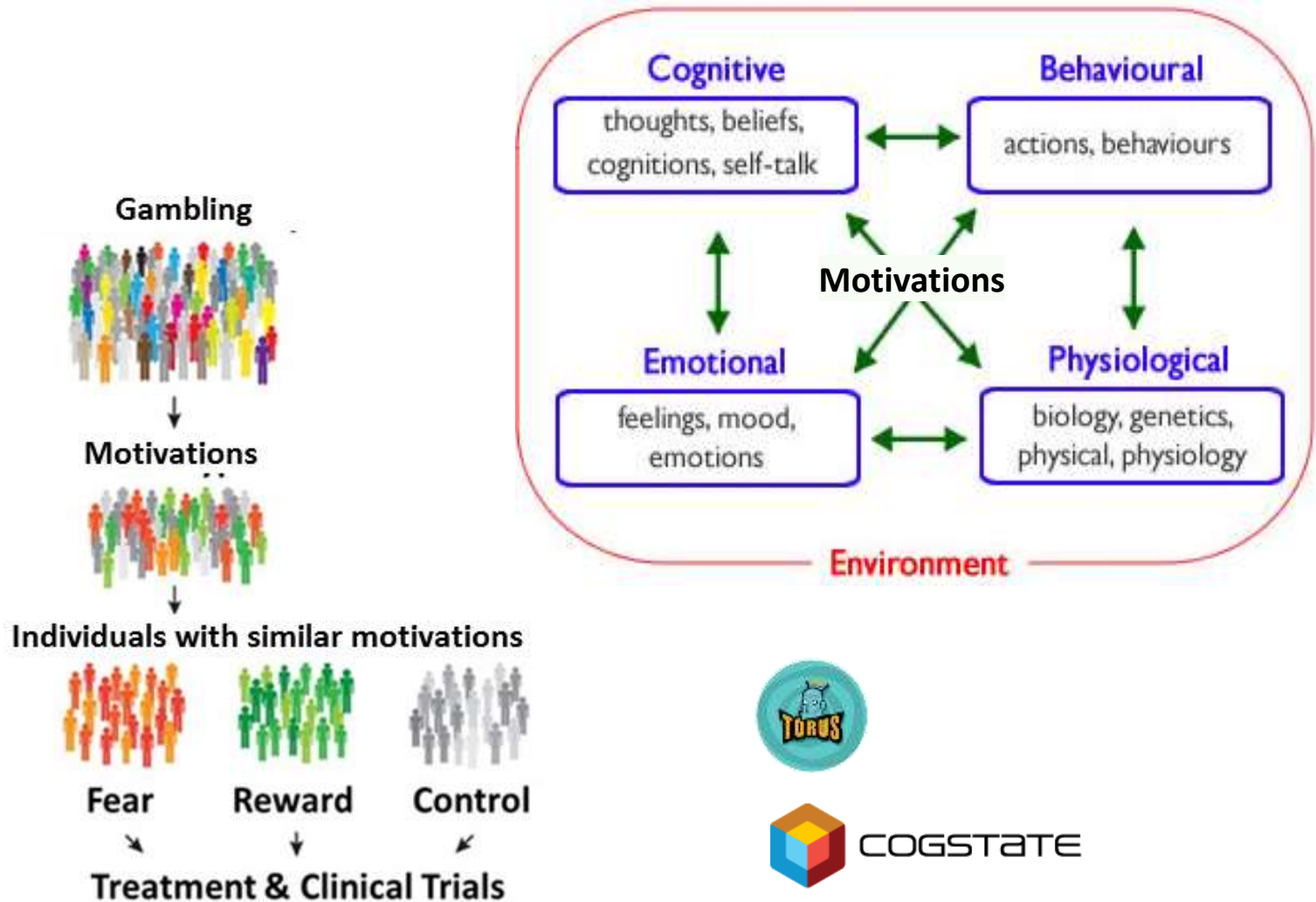
Phenomenology & Drug Treatment



## OUTCOMES !!

Assessment, Classification, Diagnosis, Prediction, Treatments

# Comprehensive Phenotyping



# Treatment Approaches & Mechanisms

lifestyle & technology – physical & mental

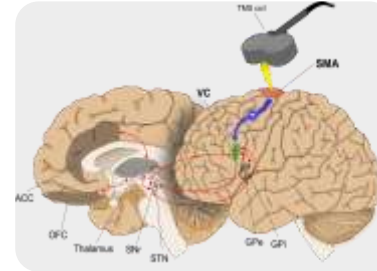
## Lifestyle



## Virtual Reality



## Brain Stimulation



## Cognitive Training





# Mindfulness-Based Approaches in the Treatment of Disordered Gambling: A Systematic Review and Meta-Analysis

Brandy R. Maynard<sup>1</sup>, Alyssa N. Wilson<sup>1</sup>, Elizabeth Labuzienski<sup>1</sup>,  
and Seth W. Whiting<sup>2,3</sup>



Technological



Mental

Immersion & Exposure to  
Gambling Cues

Regulation of  
Cravings & Urges

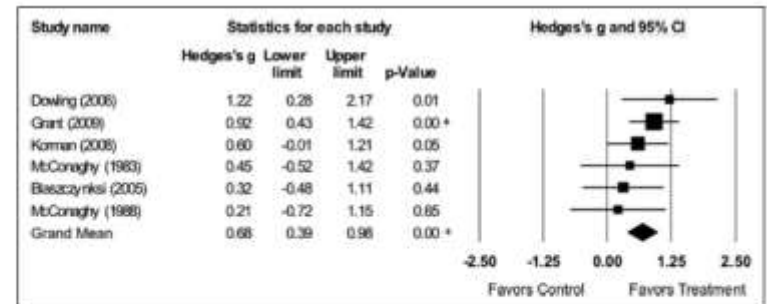


Figure 2. Effects of mindfulness-based interventions on gambling behaviors/symptoms. \* $p < .01$ .

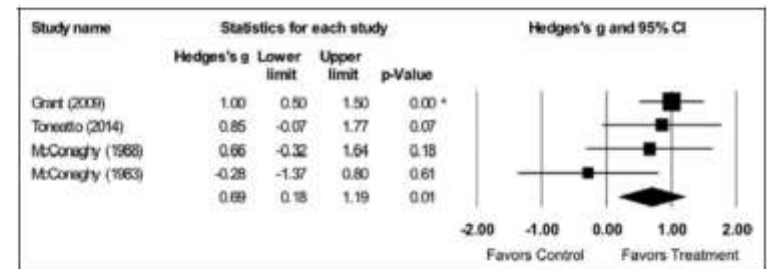


Figure 3. Effects of mindfulness-based interventions on gambling urges. \* $p < .01$ .

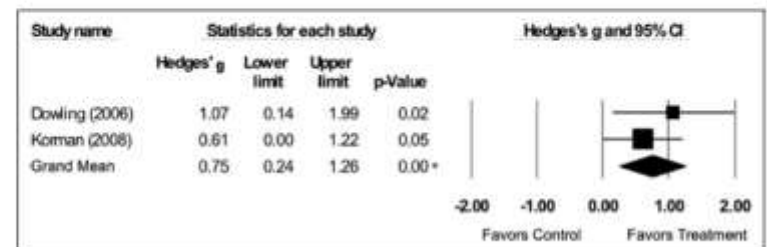


Figure 4. Effects of mindfulness-based interventions versus control on financial outcomes. \* $p < .01$ .

# Aerobic Exercise as a Tool to Improve Hippocampal Plasticity and Function in Humans: Practical Implications for Mental Health Treatment

Aaron Kandola<sup>1,2\*</sup>, Joshua Hendrikse<sup>1</sup>, Paul J. Lucassen<sup>3</sup> and Murat Yücel<sup>1\*</sup>



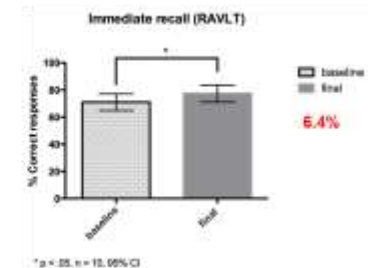
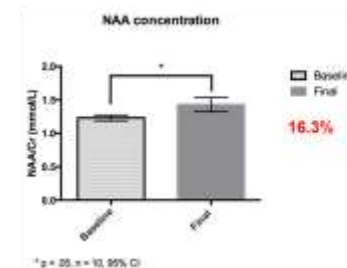
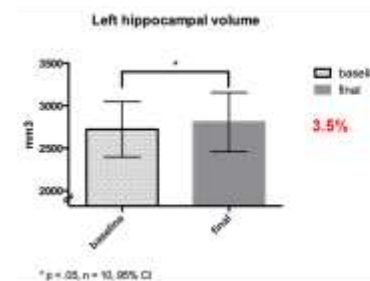
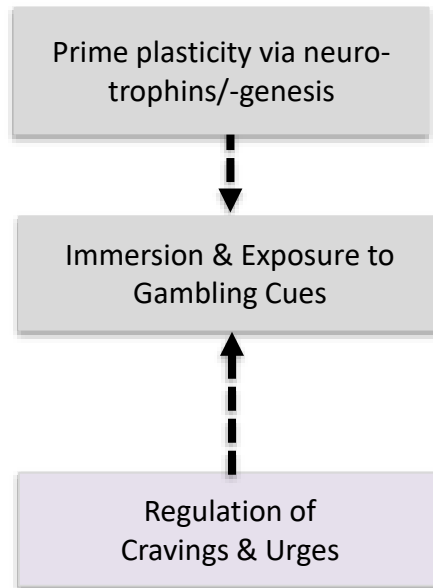
Physical



Technological



Mental





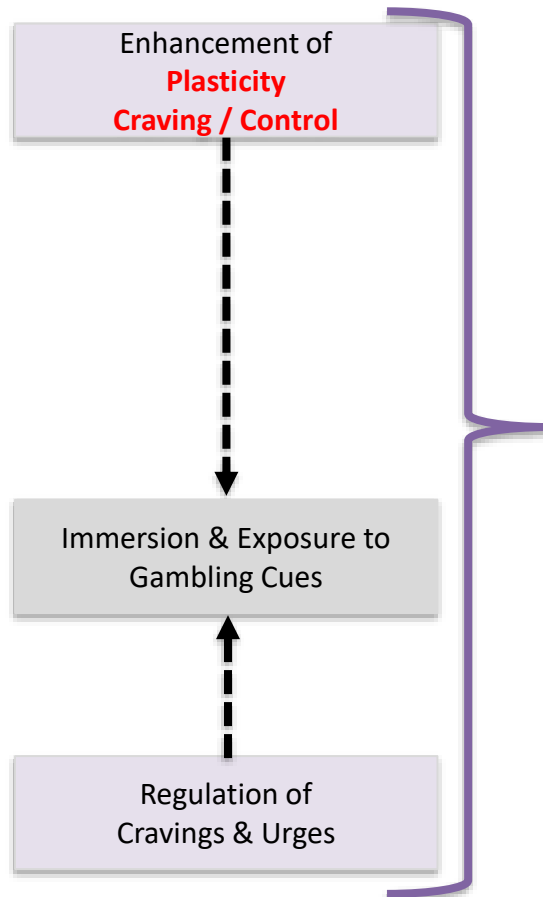
Biological



Technological



Mental



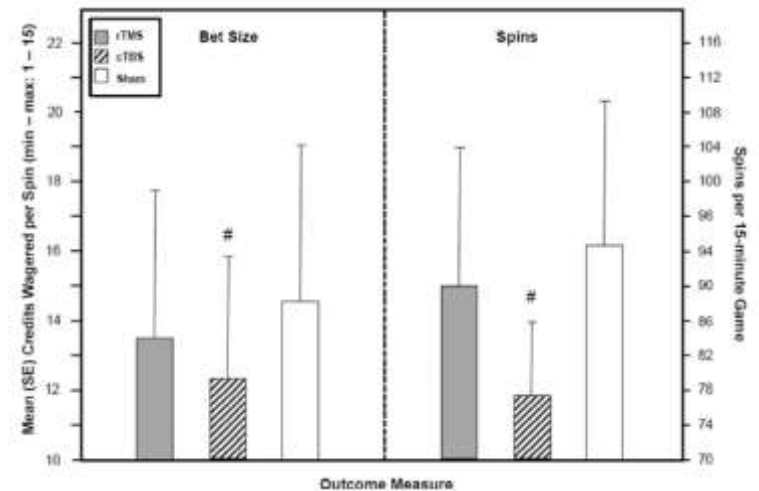
Contents lists available at ScienceDirect

Brain Stimulation

journal homepage: [www.brainstimjrn.com](http://www.brainstimjrn.com)

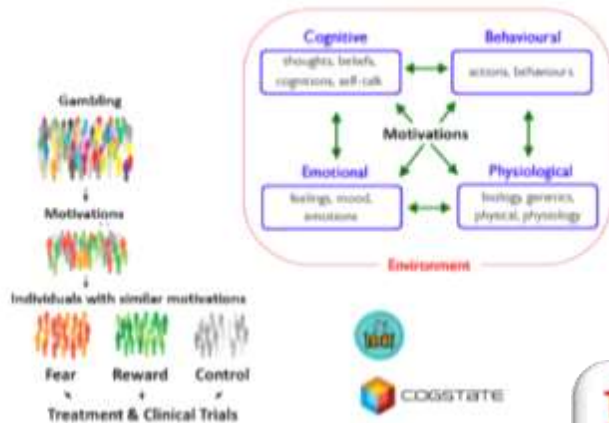
## Effects of High Frequency Repeated Transcranial Magnetic Stimulation and Continuous Theta Burst Stimulation on Gambling Reinforcement, Delay Discounting, and Stroop Interference in Men with Pathological Gambling

Martin Zack <sup>a,\*</sup>, Sang Soo Cho <sup>b</sup>, Jennifer Parlee <sup>a</sup>, Mark Jacobs <sup>b</sup>, Crystal Li <sup>b</sup>, Isabelle Boileau <sup>b</sup>, Antonio Strafella <sup>b</sup>



# Treatment: lifestyle & technology – physical & mental

## Comprehensive Phenotyping



Basic Classification Diagnosis Treatment Outcomes



ETHICS  
AND  
PUBLIC  
POLICY

## Treatment Approaches & Mechanisms

lifestyle & technology – physical & mental

Lifestyle



Virtual Reality



Brain Stimulation



Cognitive Training



## Dynamic measurement & feedback

Smart phones, wearables & MRI







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Cognitive and Clinical  
Neurosciences



**BMH**

Brain &  
Mental Health  
Laboratory

The David W Turner  
Endowment Fund

