



# IMPLICIT COGNITION IN PROBLEM GAMBLING: NEW HORIZONS FOR UNDERSTANDING AND INTERVENTION?

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# OUTLINE

- 1. Review methods used to assess several implicit cognitive processes in excessive/problem gambling
  - Attentional bias, automatic memory associations, automatic action tendency
  - Examples from my lab
- 2. Introduce audience how to intervene with implicit cognitive processes in addictive behaviors
  - Cognitive bias modification (CBM) procedures
  - Example of work ongoing in my lab
- 3. Discuss promises and limitations of implicit cognition as applied to problem gambling area
  - Potential for increasing understanding of problem gambling
  - Potential for novel intervention targets

## WHAT IS 'IMPLICIT COGNITION'?

- Dual-process models consider addiction the result of disrupted interaction between two cognitive processes, i.e. bottom-up cue-elicited impulsive processes ('implicit cognition') and top-down reflective processes ('explicit cognition') (Wiers et al., 2013)
- Implicit cognition - fast, effortless and automatic reactions towards stimuli in the environment
  - May occur without conscious awareness
- Explicit cognition – slower, deliberative, more effortful cognitive processes
- In addiction, the interplay between these two processes becomes maladaptive
  - Implicit impulsive processes gain strength
  - Explicit reflective processes are too late to efficiently modulate impulsive processes

# IMPLICIT COGNITION AND ADDICTIVE BEHAVIORS

- Implicit Cognition studies in the area of substance addictions have shown biases in the processing of substance cues in the environment
- For those with substance use disorders, substance-related cues:
  - (a) selectively recruit attentional resources (**attentional bias**),
  - (b) trigger affective, arousal and motivational implicit memory associations (**memory bias**)
  - (c) activate the behavioural schemata associated with the seeking out the rewarding outcome, bringing the individual into the proximity of drugs (**approach bias**)
- These automatic, impulsive motivational processes gain priority over goal-relevant alternative behaviours
- Moderating them becomes more difficult for slower reflective processes.



# PROBLEM GAMBLING AND ATTENTIONAL BIAS



# EYE ON THE PRIZE STUDY (HUDSON ET AL., 2016; JGI)

## BACKGROUND

- Stroop colour naming task with words or pictures [e.g., Baron et al., 1995]
  - Attentional interference for gambling-related cues in problem gamblers
- Dot probe task – stage of attentional bias (orienting vs. disengagement)
  - Facilitated performance in detecting dots following gambling cues in problem gamblers [Vizcaino et al., 2013]
  - Exposure times suggested attentional maintenance bias (problems disengaging)
- Flicker paradigm – report single difference (gambling vs. non-gambling item) between 2 pictures repeatedly flashed [Brevers et al., 2011a]
  - Speeded orienting and impaired disengagement for gambling cues in problem gamblers
- Rapid Serial Visual Presentation (RSVP) task – identify targets from rapid stream of distractors [Brevers et al., 2011b]
  - Problem gamblers more accurate in detecting gambling than neutral targets

# EYE ON THE PRIZE STUDY (HUDSON ET AL., 2016; JGI)

## PURPOSE

- Extend Brevers et al. (2011b) RSVP study with problem gamblers
- Make full use of the potential of the RSVP task to:
  - Assess the distracting value of gambling cues (use gambling cues as distractors vs. targets)
  - Distinguishing between types of attentional biases (orienting vs. disengagement)
  - Compare distracting value of gambling cues to other cues including emotional cues

# EYE ON THE PRIZE STUDY (HUDSON ET AL., 2016; JGI) DESIGN

- 2 x 2 x 4 Mixed Model Design using RSVP Task
  - Between-Subjects Factor – Gambler Type: High-risk gambler (n = 31) vs. Low-risk gambler (n = 26) based on PGSI scores
  - Within-Subjects Factor 1 – Distractor Type: Gambling vs. Neutral vs. Positive vs. Negative
  - Within-Subjects Factor 2 – Lag Duration: 200 msec (orienting) vs. 800 msec (disengagement)

# EYE ON THE PRIZE STUDY (HUDSON ET AL., 2016; JGI)

## RSVP TASK



Figure 1. Series of trial events for last elements of a 200-ms lag trial, beginning with a gambling distractor, followed by a filler image, a rotated target, and response prompts.

Did you see a rotated image?

Press 'Y' or 'N'

If 'Y', in what direction was it rotated?

If 'N', press spacebar to continue.

# EYE ON THE PRIZE STUDY (HUDSON ET AL., 2016; JGI) DISTRACTOR PICTURES

Positive



Neutral



Negative



Gambling

Figure 2. Examples of pictures from publicly accessible sources, which resemble International Affective Pictures System (IAPS) pictures used as distractors on RSVP.

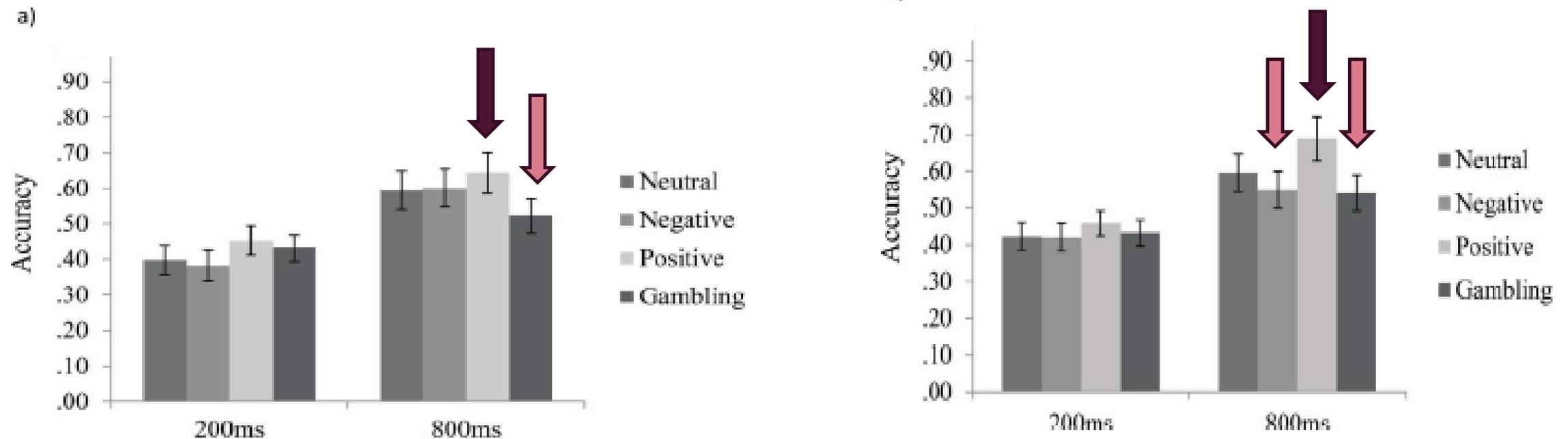
# EYE ON THE PRIZE STUDY (HUDSON ET AL., 2016; JGI)

## HYPOTHESES

- H1: High-risk gamblers - attentional biases for gambling cues, relative to all other cues including emotional cues
- H2: Low-risk gamblers – no attentional bias for gambling cues
- H3: Biases - most prominent at the level of attentional maintenance/disengagement (i.e., at the 800-ms lag)
- H4: In both groups - biases for emotional cues (negative in particular Vuilleumier, 2005) relative to neutral cues

# EYE ON THE PRIZE STUDY (HUDSON ET AL., 2016; JGI): MAIN RESULTS

Figure 1. Accuracy scores for targets appearing after neutral, negative, positive, and gambling distractors at 200-ms and 800-ms time lags for (a) high-risk and (b) low-risk gamblers.



## EYE ON THE PRIZE STUDY (HUDSON ET AL., 2016; JGI) ADDITIONAL RESULTS

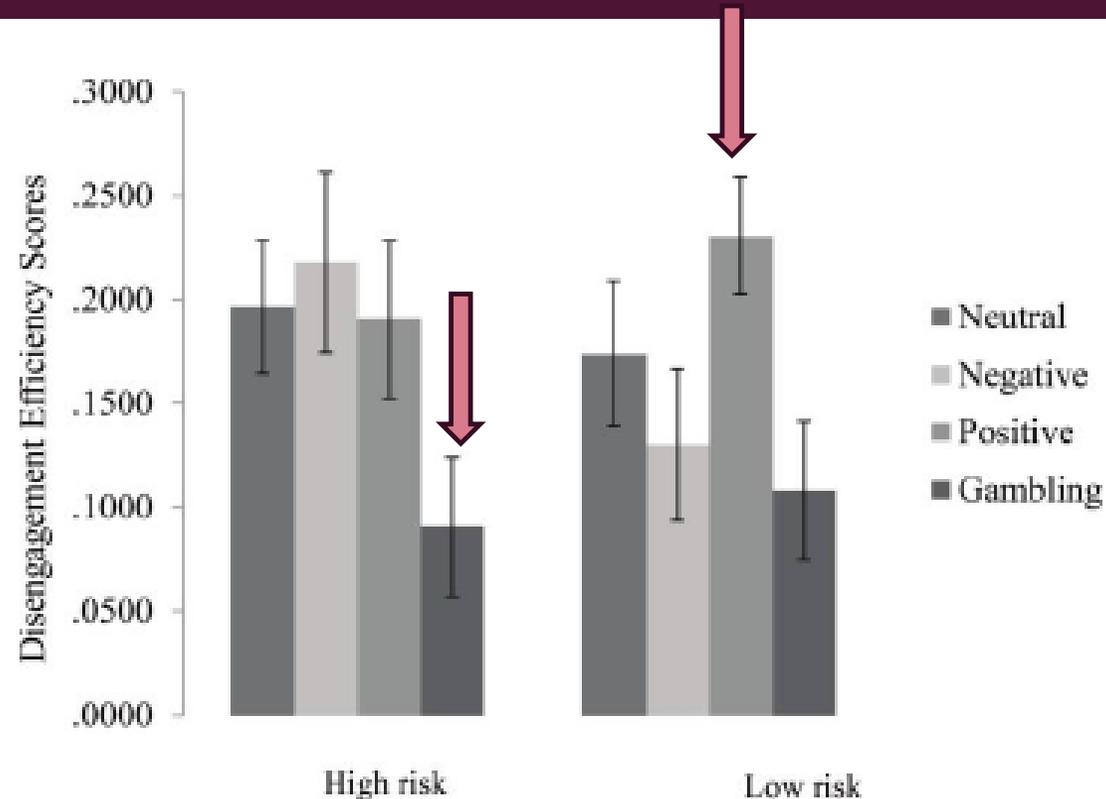


Figure 2. Disengagement efficiency scores (800ms lag accuracy subtract 200 ms lag accuracy) for high- and low-risk gamblers for all distractor types.

# EYE ON THE PRIZE STUDY (HUDSON ET AL., 2016; JGI)

## CONCLUSIONS

- High-risk gamblers exhibited a bias for maintaining attention on gambling stimuli that was specific (only for gambling distractors) and robust (detected across both measures of attentional disengagement)
- Low-risk gamblers showed some preferential maintenance of attention to both negative and gambling items, but this maintenance of attention disappeared when initial orienting responses were taken into account.
- Low-risk gamblers showed robust evidence of facilitated disengagement following positive pictures (positive mood effects?; Rowe, et al. 2007) that was not seen consistently in high-risk gamblers.
- Suggests selective attention to gambling at the expense of normal processing of affective stimuli in the high risk gamblers (due to disruptions to systems involved in processing threat and reward?; Koob et al., 2004)
- Highlights differences in attentional processes between high- and low-risk gamblers
- Sustained attentional biases toward gambling cues might be worthy targets for clinical interventions



# PROBLEM GAMBLING AND IMPLICIT MEMORY ASSOCIATIONS



# GAMBLING AD CUE EXPOSURE STUDY (STEWART ET AL., IN PREP)

## BACKGROUND

- Outcome expectancies = anticipated positive or negative effects of engaging in a behaviour.
- In the alcohol literature, outcome expectancies play an important role in the relation between exposure to alcohol-related cues and drinking (e.g., Goldman, 2002; Palfai & Ostafin, 2003).
- Stewart, Yi, and Stewart (2014) - exposure to a five-minute video of gambling scenes → activated implicit and explicit positive outcome expectancies in regular gamblers.
- What if cue exposure is of shorter duration? e.g., brief exposure to gambling advertisements.
- Gambling ads
  - Portrayed in various forms of media
  - Often highlight monetary gains without disclosing the risks (Fried et al., 2010)
  - Make it more difficult for problem gamblers to reduce or abstain from gambling (Binde, 2008)
  - May also influence the perceived outcomes individuals believe will occur from gambling???

# GAMBLING AD CUE EXPOSURE STUDY (STEWART ET AL., IN PREP)

## PURPOSE

- Drawing upon the affective priming RT paradigm (Fazio et al., 1995), the current study examined:
  - (a) whether brief exposure to gambling advertisements facilitates the activation of gambling outcome expectancies
  - (b) whether positive expectancies would be evident using both implicit (i.e., reaction time) and explicit (i.e., self-report) assessment modes

# GAMBLING AD CUE EXPOSURE STUDY (STEWART ET AL., IN PREP)

## DESIGN

- 96 regular gamblers recruited from community; majority (>60%) were moderate to high risk on PGSI
- 2 x 2 x 2 Mixed Model Design for Implicit Task (Affective outcome expectancy RT task)
  - Between-Subjects Factor - Ad Exposure Condition: Gambling Ad (n = 51) vs. Control Ad (n = 45)
  - Within-Subjects Factor 1 – Prime Type: Gambling Pictures vs. Control Pictures
  - Within-Subjects Factor 2 – Gambling Outcome Expectancy Target Type: Positive (“fun”) vs. Negative (“tension”)
- 2 x 2 Mixed Model Design for Explicit Task (23-item Gambling Expectancy Questionnaire)
  - Between-Subjects Factor – Ad Cue Exposure Condition: Gambling Ad vs. Control Ad
  - Within-Subjects Factor - Expectancy Type: Positive (e.g., “I will win money”) vs. Negative (e.g., “I will feel guilty”) (Gillespie et al., 2007)

# GAMBLING AD CUE EXPOSURE STUDY (STEWART ET AL., IN PREP)

## SAMPLE GAMBLING AND NON-GAMBLING PRIMES



# GAMBLING AD CUE EXPOSURE STUDY (STEWART ET AL., IN PREP)

## HYPOTHESES

- Brief exposure to gambling advertisements would facilitate the activation of positive but not negative gambling outcome expectancies, and such a facilitation of positive gambling outcome expectancies would be observed implicitly but not explicitly.
  - H1: Implicit Positive Gambling Outcome Expectancies:
    - Compared to control advertisement cue condition, participants in gambling advertisement cue condition would be significantly faster in responding to positive gambling expectancy targets when preceded by gambling relative to non-gambling picture primes.
  - H2: Explicit Positive Gambling Outcome Expectancies:
    - Participants in the gambling and control advertisement cue conditions would not significantly differ in their self-reported positive gambling outcome expectancies following cue exposure.
  - H3: Implicit & Explicit Negative Gambling Outcome Expectancies:
    - Drawing upon findings from the alcohol (Jones et al., 2001) and gambling literature (Stewart et al., 2014), exposure to gambling advertisements would not activate implicit or explicit negative gambling outcome expectancies.

# GAMBLING AD CUE EXPOSURE STUDY (STEWART ET AL., IN PREP)

## RESULTS

### IMPLICIT TASK RESULTS

|                         | Gambling Primes |               | Non-Gambling Primes |               |
|-------------------------|-----------------|---------------|---------------------|---------------|
|                         | <i>M</i>        | <i>SD</i>     | <i>M</i>            | <i>SD</i>     |
| Control Ad Cue          |                 |               |                     |               |
| Positive targets        | 790.55          | 157.41        | 778.43              | 220.60        |
| Negative targets        | 764.11          | 173.42        | 767.32              | 158.79        |
| Gambling Ad Cue         |                 |               |                     |               |
| <b>Positive targets</b> | <b>779.47*</b>  | <b>180.64</b> | <b>815.83*</b>      | <b>188.90</b> |
| Negative targets        | 812.36          | 235.31        | 819.26              | 239.68        |

### EXPLICIT TASK RESULTS

- On the self-report GEQ:
- No significant differences in self-reported positive  $t(94) = 1.33, p = .19$  or negative  $t(92) = 1.67, p = .10$  gambling outcome expectancies between gambling advertisement and control advertisement cue condition after cue exposure

Table I. Affective Outcome Expectancy RT Task Performance (Implicit Measure of Gambling Outcome Expectancies); \* $p = .04$

# GAMBLING AD CUE EXPOSURE STUDY (STEWART ET AL., IN PREP)

## CONCLUSIONS

- As expected, brief exposure to gambling advertisements immediately prior to the assessment of outcome expectancies activates implicit positive gambling outcome expectancies in memory among regular gamblers.
- Does not activate positive expectancies on an explicit self-report task suggesting the effects on the RT task occur without the individual's awareness.
- Findings extend previous research examining the role of gambling-related cues on the activation of implicit and explicit gambling outcome expectancies (Stewart et al., 2014).
- Results suggest that the relatively brief duration of exposure to gambling advertisements activates implicit positive gambling outcome expectancies but does not allow individuals the time or cognitive resources to engage in the conscious, deliberative processing that is captured by explicit, self-report modes of assessment.
- Might explain help explain how gambling ad exposure makes it more difficult for problem gamblers to reduce or abstain from gambling (Binde, 2008)
- Possibility of cognitive bias modification of automatic memory associations; might be best conducted when bias is activated through cue exposure.



# PROBLEM GAMBLING AND AUTOMATIC APPROACH BIAS



# LUCK COME HERE STUDY (BOFFO ET AL., 2017; ADDICTION)

## BACKGROUND

- The Approach-Avoidance Task - RT task developed to study automatic avoidance tendency in spider phobia
- React to stimuli with 'pushing' and 'pulling' responses, based on a feature of the stimulus unrelated to its content (e.g., picture orientation).
- Faster pull than push to substance cue → automatic approach bias for that substance
- On AAT, substance abusers show approach bias towards their substance of abuse
- Strength of the approach bias predicts consumption escalation across substances
  - Alcohol [e.g., Martin Braunstein et al., 2016]
  - Tobacco [e.g., Watson et al., 2013]
  - Heroin [Zhou et al., 2012]
  - Cannabis [Cousijn et al., 2011]

# LUCK COME HERE STUDY (BOFFO ET AL., 2017; ADDICTION)

## PURPOSES

- To evaluate the gambling-related approach tendencies in non-treatment-seeking higher-risk gamblers, compared to lower-risk gamblers, by adapting the Approach Avoidance Task (AAT) to the gambling context.
- To examine the utility of gambling-related approach bias to predict escalations in gambling behaviour across 6 months

# LUCK COME HERE STUDY (BOFFO ET AL., 2017; ADDICTION) DESIGN

- 2 x 2 x 4 Mixed Model Design using Gambling Approach-Avoidance Task (G-AAT)
- Between-Subjects Factor – Gambler Type: High-risk gambler (n = 26) vs. Low-risk gambler (n = 26); all Dutch and recruited online
- Within-Subjects Factor 1 – Picture Type: Gambling vs. Neutral
- Within-Subjects Factor 2 – Response Type: Push (avoidance) vs. Pull (approach)

# LUCK COME HERE STUDY (BOFFO ET AL., 2017; ADDICTION) G-AAT TRIAL ILLUSTRATION



LUCK COME HERE STUDY (BOFFO ET AL., 2017; ADDICTION)  
G-AAT TRIAL ILLUSTRATION



LUCK COME HERE STUDY (BOFFO ET AL., 2017; ADDICTION)  
G-AAT TRIAL ILLUSTRATION



# LUCK COME HERE STUDY (BOFFO ET AL., 2017; ADDICTION)

## HYPOTHESES

- H1: At baseline, higher-risk gamblers would show a greater approach bias towards gambling cues (vs. neutral cues) in comparison to non-problem gamblers on the G-AAT
- H2: Baseline gambling approach bias would prospectively predict gambling behaviour (duration, time, expenditure) on the G-TLFB 6 months later.

# LUCK COME HERE STUDY (BOFFO ET AL., 2017; ADDICTION)

## MAIN RESULTS

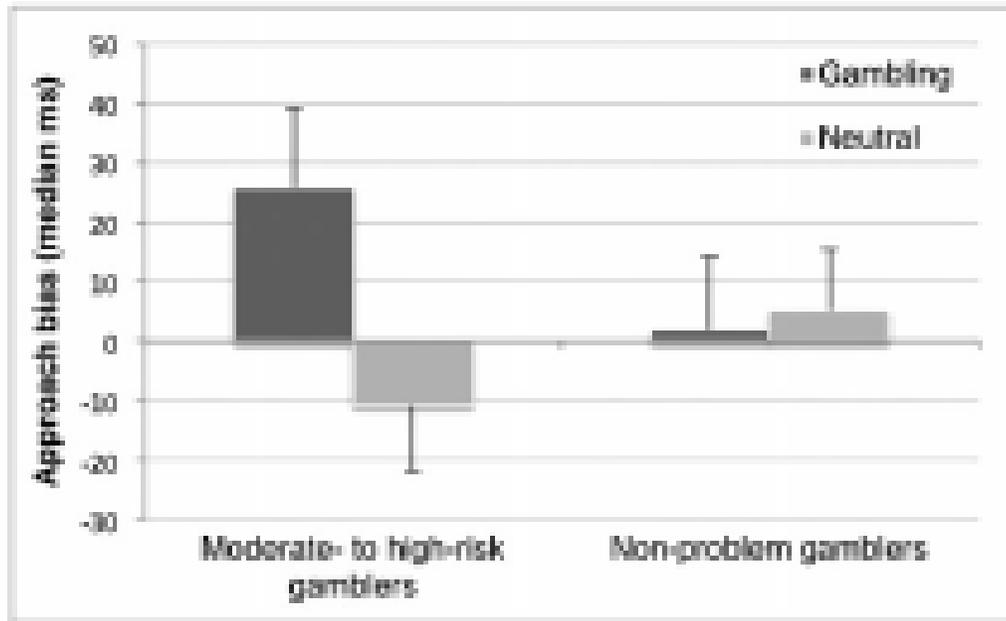


Figure 1 Mean (+SE) approach bias scores (median RT<sub>push</sub> – median RT<sub>pull</sub>) for gambling and neutral stimuli in moderate-to-high-risk and non-problem gamblers.

In hierarchical multiple regressions, controlling baseline gambling behaviour on TLFB, baseline gambling approach bias positively predicted monthly gambling frequency ( $p = 0.03$ ) and total duration of gambling episodes ( $p = 0.01$ ) on the TLFB 6 months later.

# LUCK COME HERE STUDY (BOFFO ET AL., 2017; ADDICTION)

## CONCLUSIONS

- Relative to Dutch lower-risk gamblers, Dutch higher-risk gamblers have stronger automatic tendency to approach rather than to avoid gambling-related cues compared with neutral cues.
- This automatic gambling approach bias is predictive of persistence in gambling behaviour over time
- Could be useful novel treatment target for problem gambling given successes in altering automatic approach bias in alcohol field (e.g., Eberl et al., 2013)

# BASIC IMPLICIT COGNITION STUDIES

## OVERALL CONCLUSIONS

- For higher-risk gamblers, gambling cues are:
  - Selectively **attention-maintaining** (Hudson et al., 2016)
  - Triggers of positive **automatic memory associations** (Stewart et al., in preparation)
  - Automatically eliciting of a motor response of **approach** towards them (Boffo et al., 2018)
- All three could be novel intervention targets

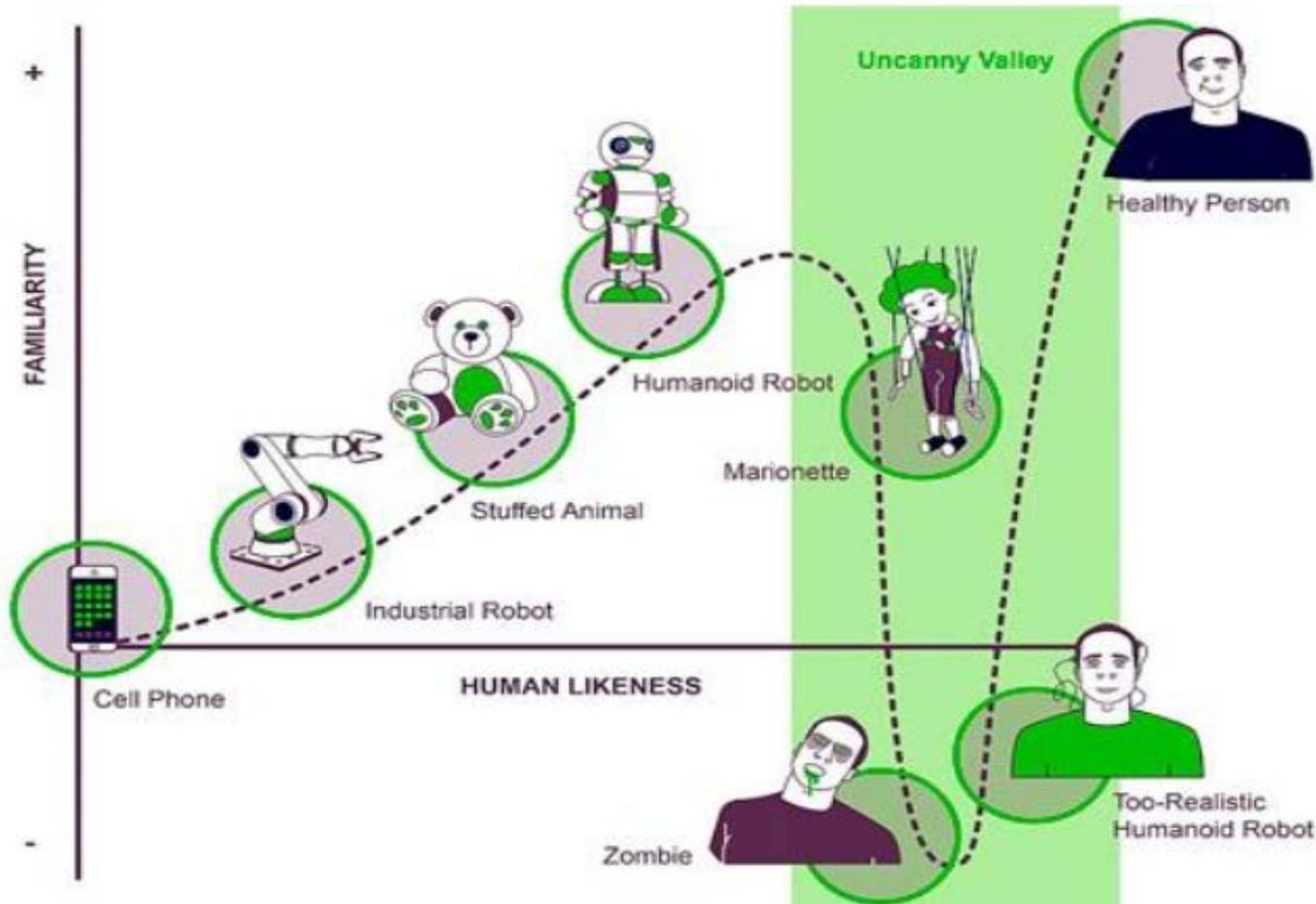
## IMPLICIT COGNITION RESEARCH IN PROBLEM GAMBLING: CAUTIONS

- Replicability issues
- We ran the Boffo et al. (2017) study with the G-AAT in sample of Canadian gamblers
- Significant site differences and failure to replicate (Salmon et al., 2016; NCRG)
- In fact, Canadian results in opposite direction to Dutch
  - Correlation of PGSI with selective gambling approach bias:  $r = +.304$  (NL) vs.  $-.309$  (CAN)
- Could be due to stimuli
- Another example is failure to replicate gambling ad study (Hudson et al., 2017)
- Findings speak to fragility of the effects
- Must have a robust effect before attempting to intervene

# STIMULUS ADAPTATION FOR CANADIAN CONTEXT



# THE 'UNCANNY VALLEY'



Uncanny valley (Mori, 1970) may have potentially caused aversion towards adapted gambling stimuli; close but something's not quite right

## IMPLICIT COGNITION RESEARCH IN PROBLEM GAMBLING: CAUTIONS

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- Another example is failure to replicate gambling ad study (Hudson et al., 2017)
- Findings speak to fragility of the effects
- Must have a robust effect before attempting to intervene; basic research needed



# COGNITIVE BIAS MODIFICATION IN PROBLEM GAMBLING



# COGNITIVE BIAS MODIFICATION IN ADDICTION

- Clinical studies with alcohol-dependent patients - addiction-related attentional biases can be modified
  - Attentional bias modification affects alcohol treatment success (Schoenmakers et al., 2010).
- Cognitive retraining methods have been developed that alter implicit memory associations with alcohol from positive to negative (i.e., evaluative conditioning procedures; Houben et al. 2010)
  - Retraining associated with reduced drinking (Houben et al. 2010; Wiers et al. 2005)
- In the area of alcohol use disorder, problem drinkers' automatic action-tendency to approach alcohol has been successfully altered using a cognitive bias modification (CBM) procedure: adaptation of the Alcohol Approach-Avoidance Task
  - Retraining led to reductions in drinking behavior (Eberl et al., 2013; Wiers et al, 2010; 2011).

# IN PROGRESS CBM STUDY IN PROBLEM GAMBLING: PURPOSES

- To test:
  1. Whether problem gamblers' automatic action-tendencies to approach gambling can be altered using a cognitive bias modification (CBM) procedure involving adaptation of the G-AAT to retraining
  2. Whether the retraining actually impacts gambling behavior

# IN PROGRESS CBM STUDY IN PROBLEM GAMBLING: DESIGN

- Participants:  $N = 176$  higher-risk gamblers; internet recruited; identified with PGSI
- 2 x 2 x 2 mixed model design with approach bias scores on G-AAT as the DV
  - Between-subjects factor: Intervention Condition: Active Retraining ( $n = 88$ ) vs. Sham Training ( $n = 88$ )
  - Within-subjects factor 1: Stimulus Type: Gambling vs. Control
  - Within-subjects factor 2: Time: Pre- vs. Post-Training

# IN PROGRESS CBM STUDY IN PROBLEM GAMBLING: TASK

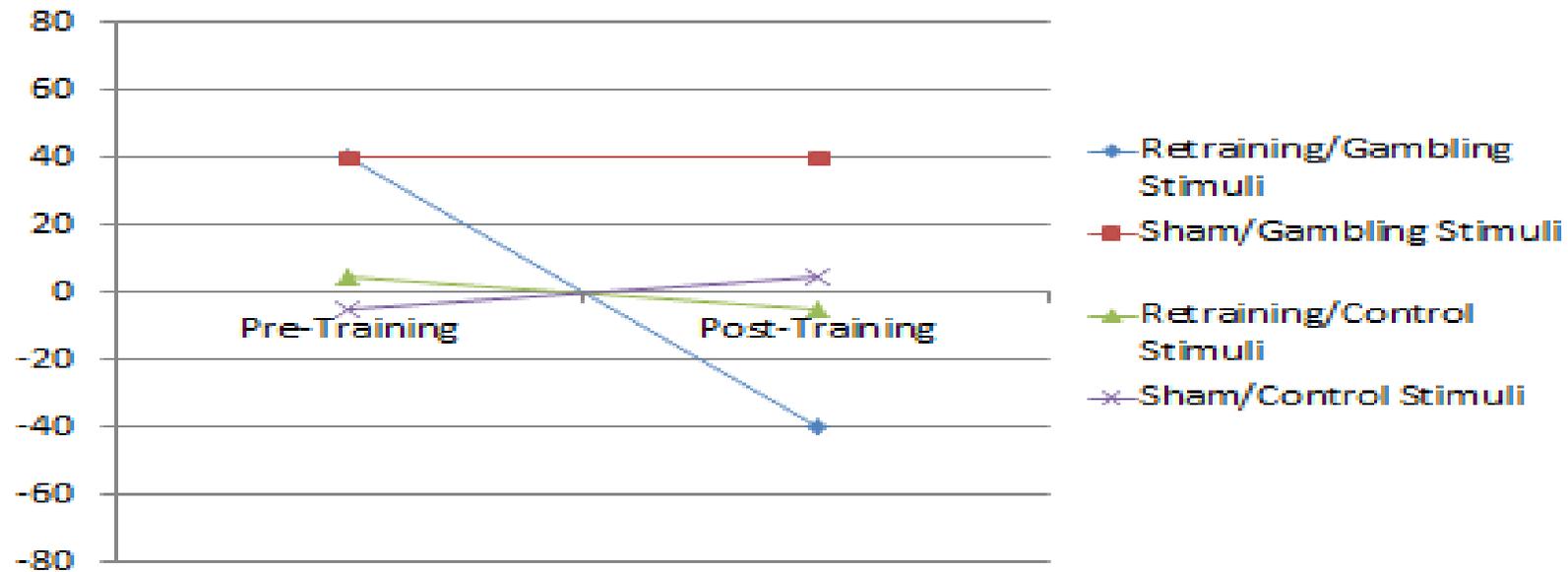
- CBM occurs via retraining version of G-AAT
- Pre-test as in Boffo et al. (2017)
- Moves immediately into retraining: 4 sessions of 240 trials each
  - Active condition: push to gambling, pull to control
  - Sham condition: push/pull equally to gambling and control
- Post-test as in Boffo et al. (2017) – two weeks after retraining

# IN PROGRESS CBM STUDY IN PROBLEM GAMBLING: HYPOTHESES

- H1. Participants trained to implicitly associate gambling with avoidance on the cognitive bias modification procedure will show a shift from gambling-approach associations to gambling-avoidance associations on the Gambling AAT from pre- to follow-up;
  - Those who receive sham training will not show this shift on the Gambling AAT from pre- to follow-up
  - The shift for those receiving the retraining will occur only for gambling approach bias but not for approach bias to control stimuli
- H2: Effects of CBM will be found on gambling behavior (Card cutting Task and G-TLFB) at 2-week follow-up
  - Participants in the avoid-gambling training condition will show less gambling behavior than those in the sham training condition.

# IN PROGRESS CBM STUDY IN PROBLEM GAMBLING: EXPECTED RESULTS

Approach  
Bias  
Score



# CBM RESEARCH IN PROBLEM GAMBLING: ISSUES & POTENTIAL

- As a first study in the area, we are examining the CBM procedure as supplemental treatment
  - All receive their training condition on top of a motivational enhancement intervention
  - Effective clinical studies with CBM have used it as supplemental rather than stand-alone (e.g., Eberl et al., 2013)
- How important is readiness to change?
- How to make the retraining more engaging to ensure retention/compliance?
  - Gamification
- Potential for the work to lead to development of novel supplemental (or even stand-alone) treatments for problem gambling to increase the armamentarium of treatment options available for problem gamblers.

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