PRIFYSGOL BANGOR UNIVERSITY

Why don't (some) gamblers learn the value of gambling games? And What Can We Do About It?

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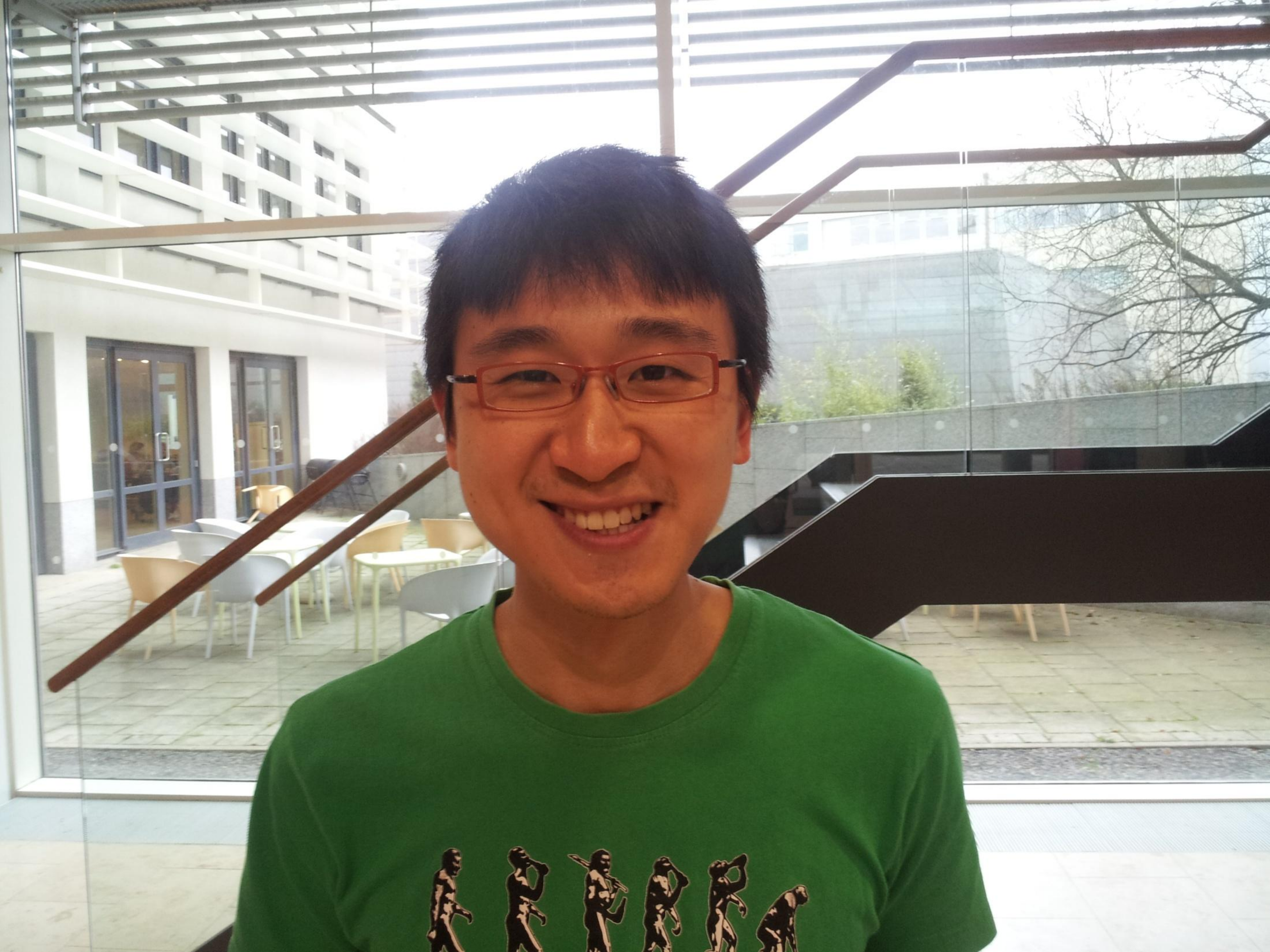
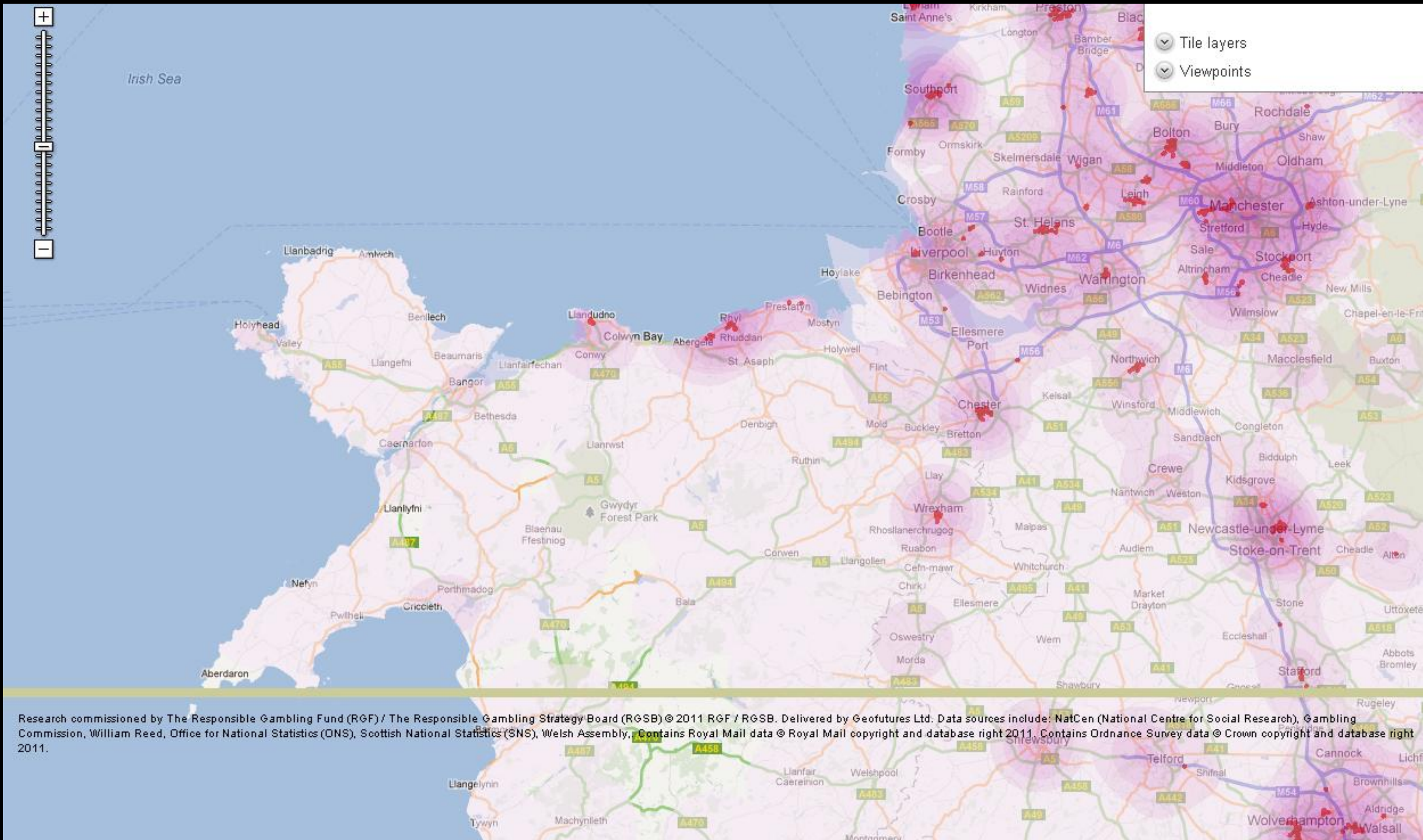
MRC Medical Research Council



- 48% of the UK population have gambled in the last 4 weeks
- 0.5% of people aged 16+ in England identify as problem gamblers (2012)
- 0.7% of people aged 16+ in Scotland identify as problem gamblers (2015)
- 1.1% of people aged 16+ in Wales identify as problem gamblers (2015)
- Opportunities to gamble are increasing → numbers seeking help?
- Casino and online revenues will go from $118billion in 2009 to $182billion in 2015
- Risk factors-> youth, male, familial gambling, low income and/or low education
- Social factors/supply-side factors ↔ individual factors
- Regulatory issues-> vulnerable groups (e.g. young people), crime and fairness
- 'Problem gambling' can be defined as gambling to a degree that compromises, disrupts or damages family, personal or recreational pursuits → harms
- Now included alongside the substance use/addictive disorders within DSM-V

Some gambling basics….


Tile layers
Viewpoints
Irish Sea
Holyhead
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Caernarfon
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Pwllheli
Criccieth
Porthmadog
Aberdaron
Llandudno
Colwyn Bay
Conwy
Abergele
Rhyl
Rhuddlan
Prestatyn
St. Asaph
Denbigh
Ruthin
Holywell
Flint
Mold
Buckley
Wrexham
Llangollen
Corwen
Bala
Oswestry
Gwydyr Forest Park
Blaenau Ffestiniog
Southport
Formby
Crosby
Bootle
Liverpool
Birkenhead
Hoylake
Bebington
Ellesmere Port
Widnes
Warrington
St. Helens
Wigan
Bolton
Bury
Rochdale
Oldham
Manchester
Stockport
Altrincham
Sale
Wilmslow
Macclesfield
Northwich
Winsford
Chester
Crewe
Nantwich
Kidsgrove
Newcastle-under-Lyme
Stoke-on-Trent
Stafford
Telford
Shrewsbury
Wolverhampton
Walsall
Cannock
Whitchurch
Market Drayton
Welshpool
Machynlleth
Tywyn

Total consumption theory: the prevalence of a condition, such as excessive alcohol use, depends upon the average level of behaviour in the population

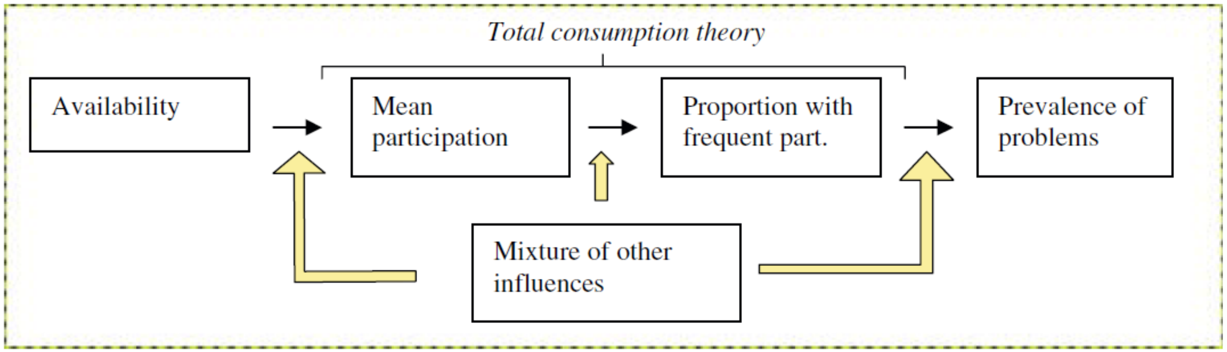


Fig. 5 A simplified model of the links between availability and problems

Household gambling expenditure in Family Expenditure Survey data collected before and after the introduction of a national lottery in November 1994

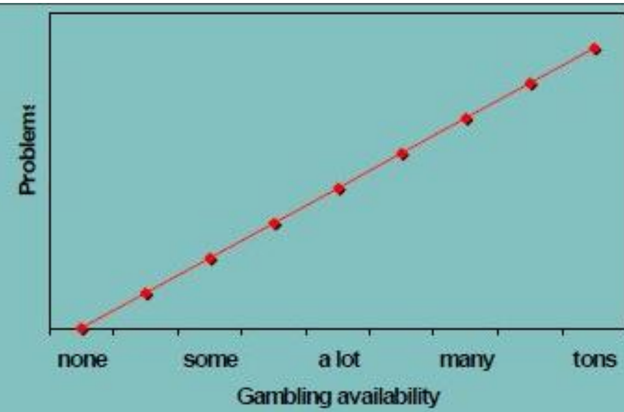
Table 2. *Relation of proportion of households gambling excessively to average gambling expenditure by region, 1993–94 and 1995–96*

		Slope of regression coefficient (95% CI)		
		Against mean gambling expenditure		Against median gambling expenditure
Percentage gambling > £20/week	1993–94	0.8 (0.5–1.0)		–
	1995–96	1.6 (1.1–2.1)		2.9 (0.5–5.3)
Percentage gambling > 10% of income	1993–94	0.5 (0.1–0.8)		–
	1995–96	1.2 (0.7–1.7)	*	1.8 (0.3–3.3)

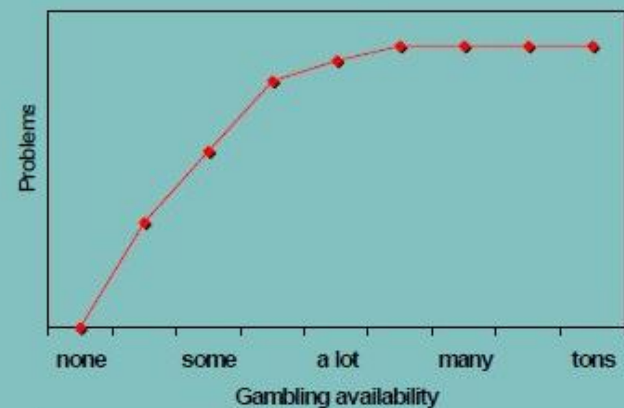
Grun & McKeigue, 1995

Public health effects of gambling: other better models are possible (Shaffer et al, 2004)

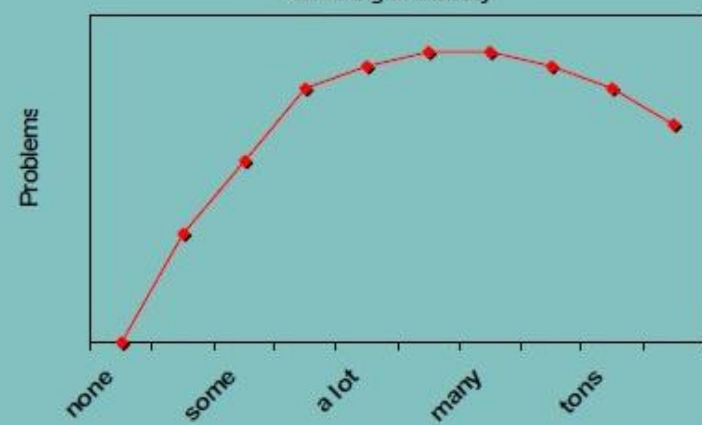
Exposure



Saturation



Social Adaptation



Social adaptation model (see Shaffer et al, 2004)

Exposure → environmental toxins (casinos) increase the likelihood of related disease (e.g., gambling-related disorders)

Adaptation → new toxins initially increase adverse reactions but subsequent symptoms diminish through adaptation/resistance.

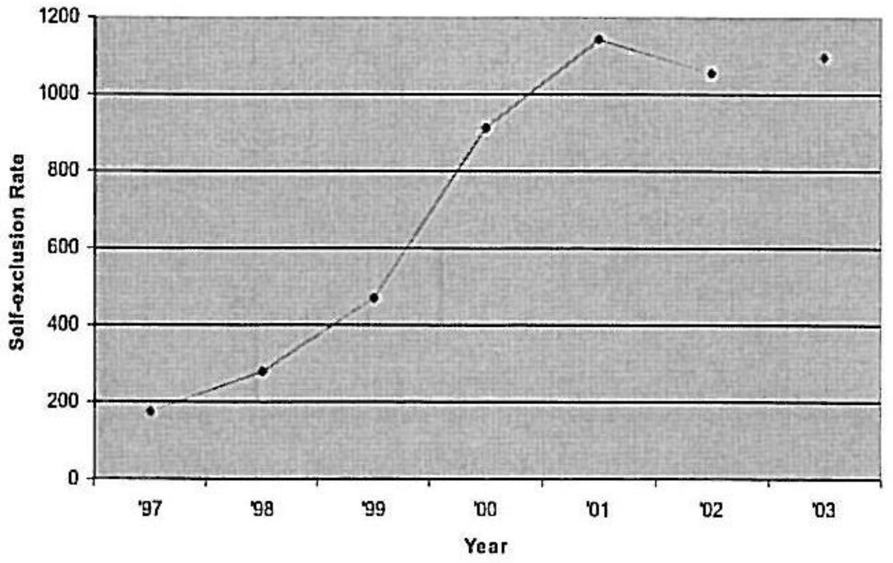


Figure 2. Missouri self-exclusion rates over time. (Adapted from "Missouri Casino Self-Excluders: Distributions Across Time and Space," by R. A. LaBrie et al., 2007, *Journal of Gambling Studies, 23*, p. 236.

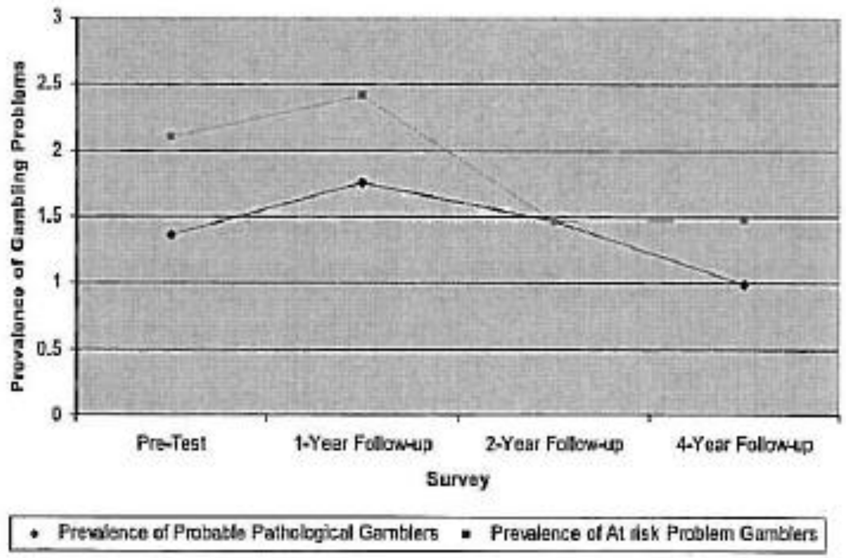


Figure 3. Gambling-related problems over time following a casino opening. (Adapted from "A Prospective Study of the Impact of Opening a Casino on Gambling Behaviours: 2- and 4-year follow-ups," by C. Jacques and R. Ladouceur, 2006, *Canadian Journal of Psychiatry, 51*, p. 770.

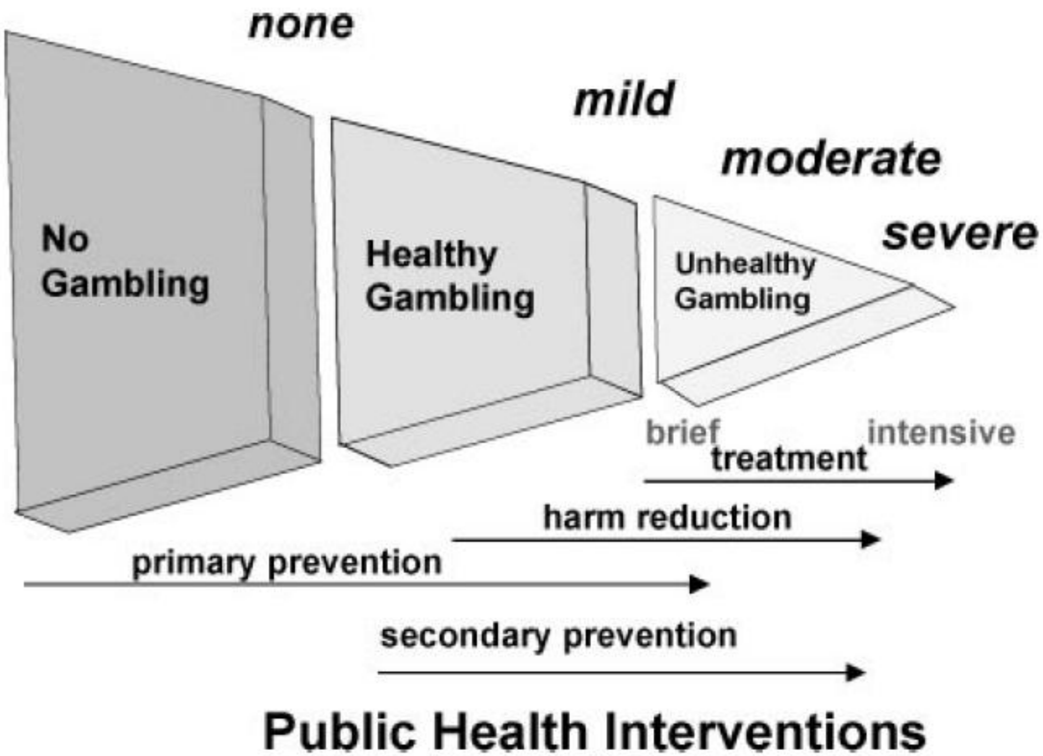
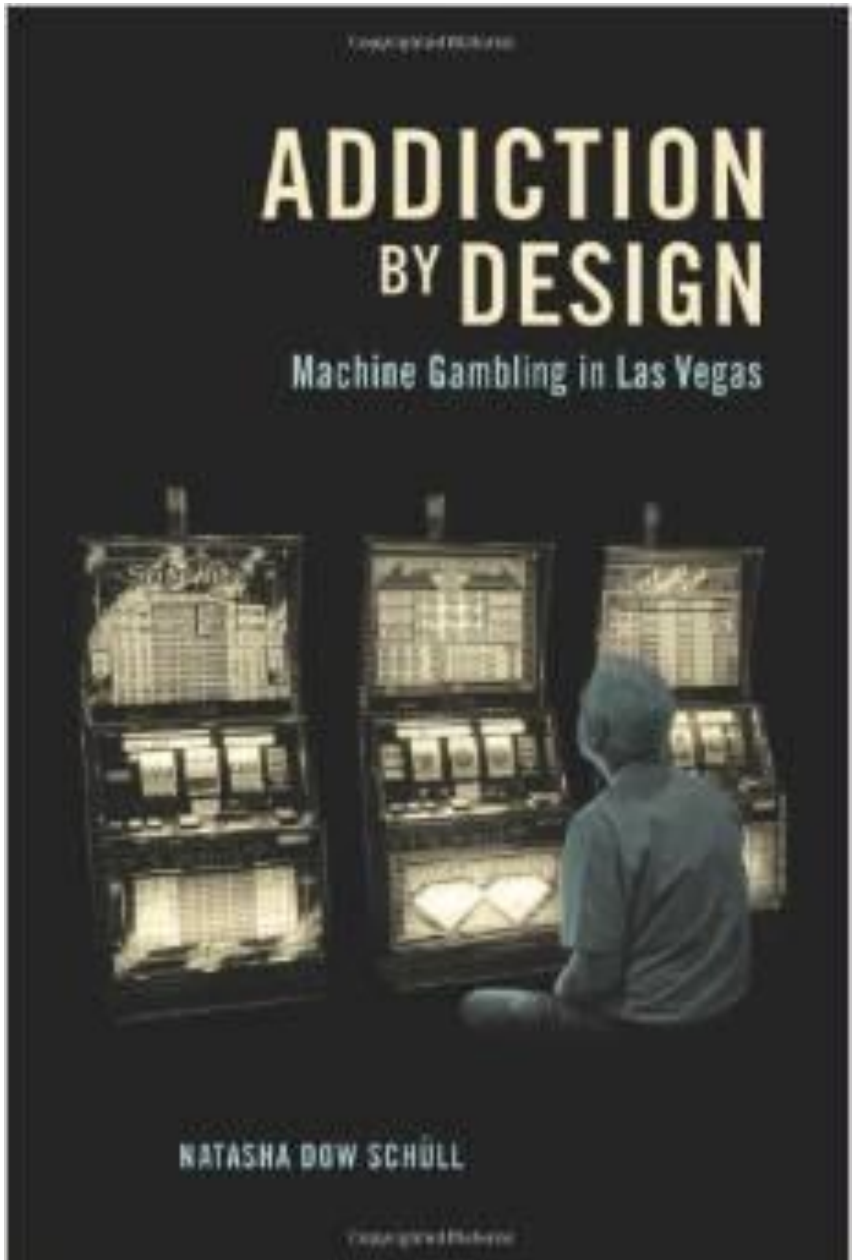
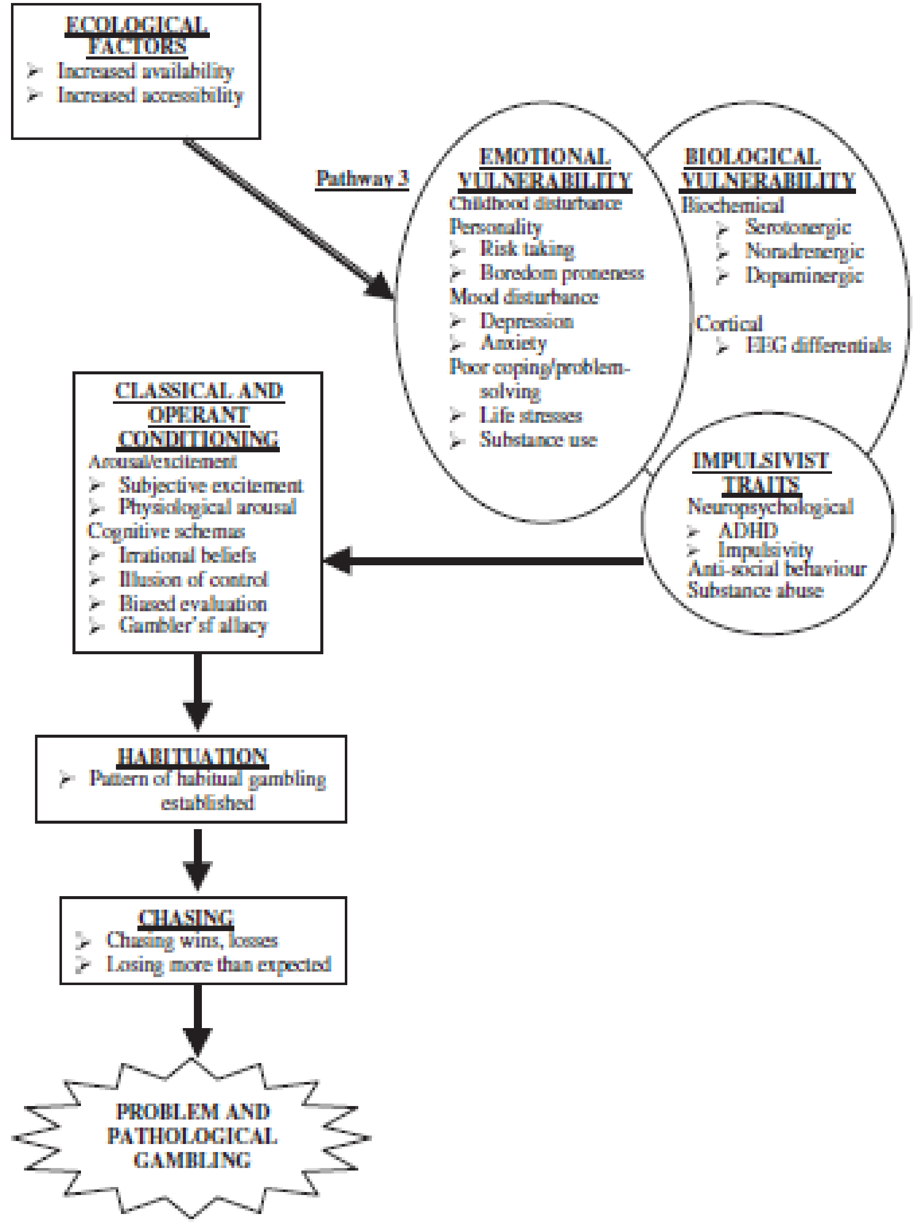


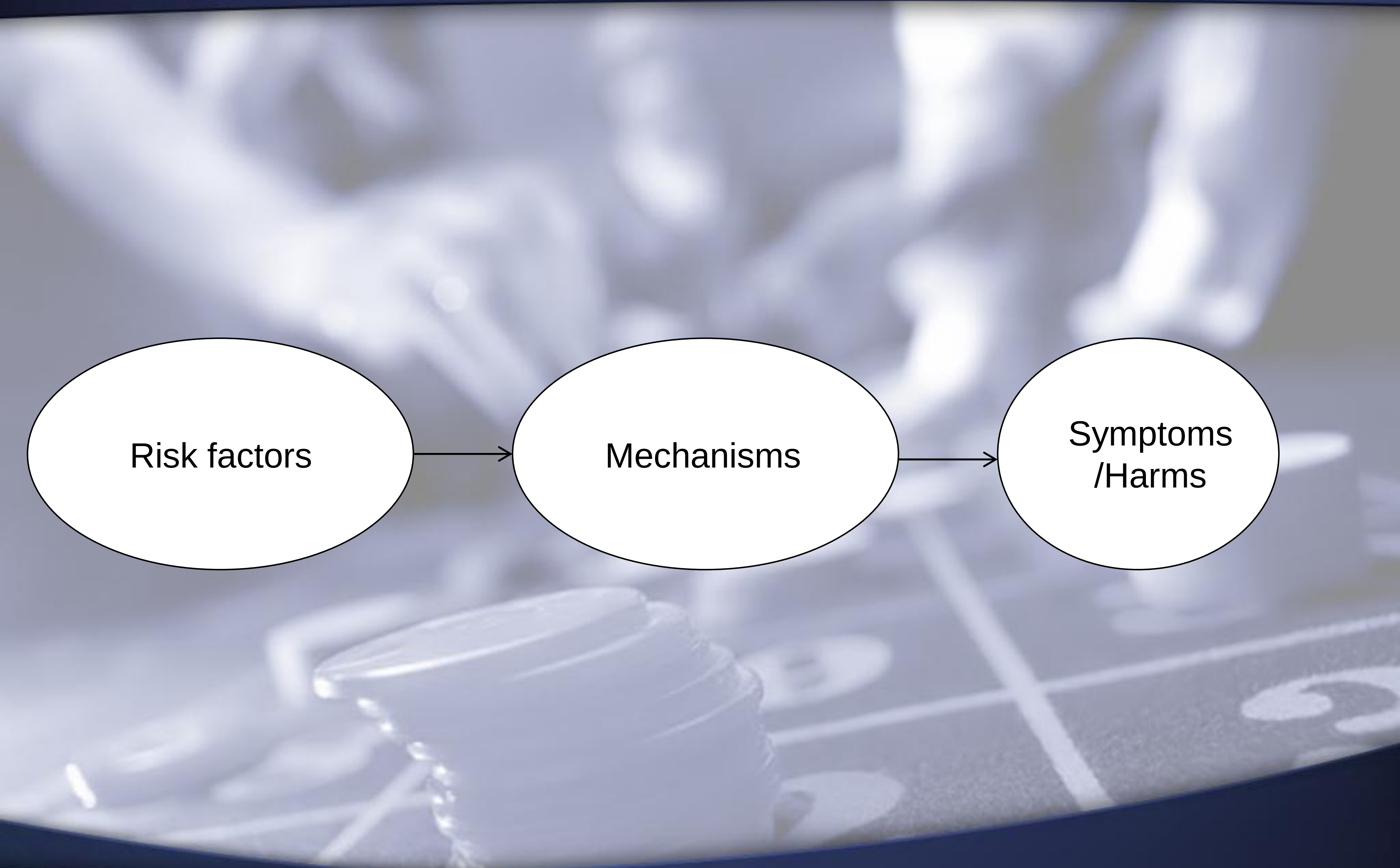
Figure 1 Public health perspective on gambling and gambling-related problems (87).

Shaffer & Korn (2002) Annual Review of Public Health 23: 171- 212





Blasczczynski & Nower (2002)


Risk factors
Mechanisms
Symptoms
/Harms

Some risk factors for gambling problems are specific......

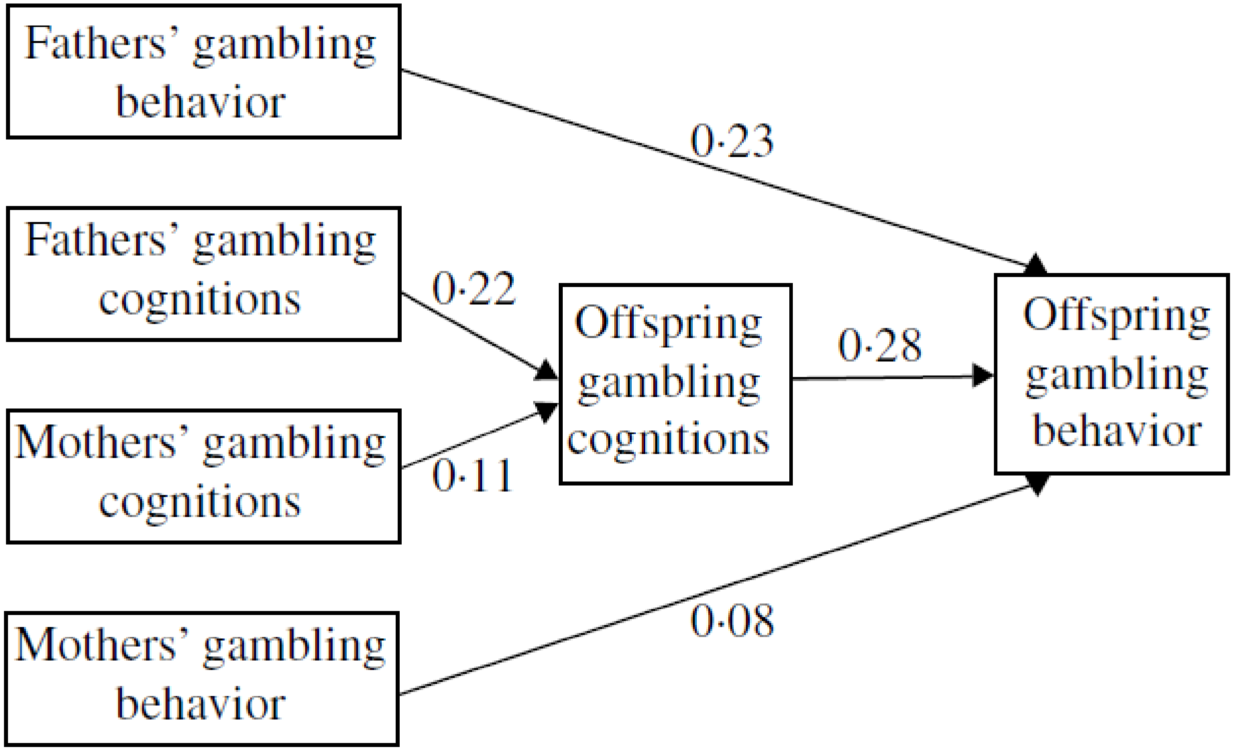


FIG. 4. Resulting model (including standardized regression pathways >0·0) depicting familial influence on offspring gambling-related cognitive errors and gambling behavior. This model best fitted the data.

Oei et al, 2004

- *Gambling expectancies*
  - *'Gambling makes the future brighter'*
  - *'Having a gamble helps reduce tension and stress'*
- *Inability to stop*
  - *'I can’t function without gambling'*
  - *'My desire to gamble is so overpowering'*
- *Illusions of control*
  - *'Specific numbers and colours can help increase my chances of winning'*
  - *'I have specific rituals and behaviours that increase my chances of winning'*
- *Interpretive bias*
  - *'Relating my losses to bad luck and bad circumstances makes me continue gambling'*
  - *'Remembering how much money I won last time makes me continue gambling'*
- *Predictive control*
  - *'Losses when gambling,are bound to be followed by a series of wins'*
  - *'If I keep changing my numbers, I have less chances of winning than if I keep the same numbers every time'*
  - *'A series of losses will provide me with a learning experience that will help me win later‘*
  - *'There are times that I feel lucky and thus, gamble those times only'*

Raylu & Oei, 2004

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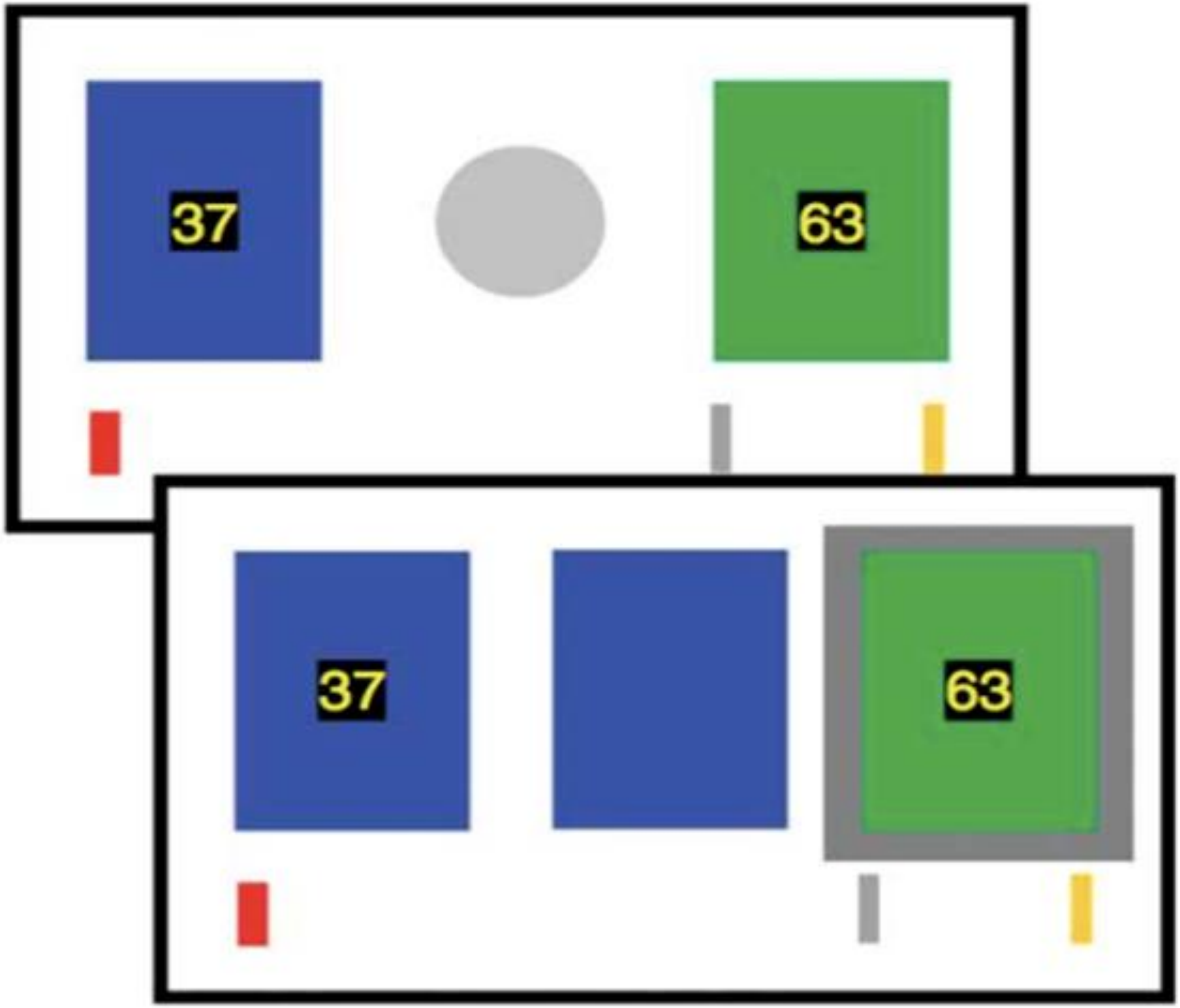
Raylu & Oei, 2004

23,000 slot-machines situated in the state of Ontario generated approximately $3,135,660,000 during 2004, amounting to over $130,000 per machine



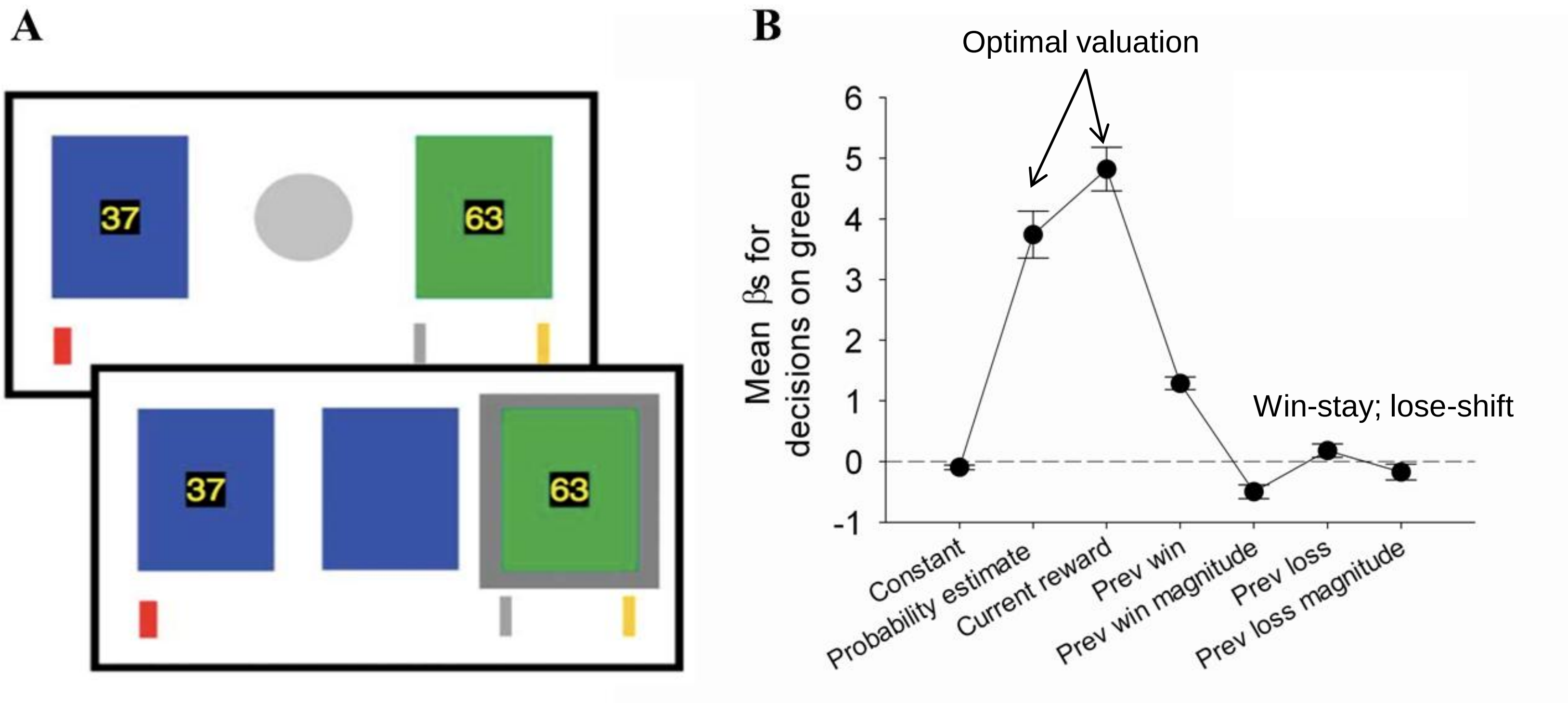
Optimal valuation = (Probability estimate * Current reward)

Table S1. Descriptive statistics of 104 gamblers

	N (%), Mean (*SD*)		Mean (*SD*)
Male	89 (85.60)	***Chasing questionnaire***	
Age	31.39 (11.13)	*Big wins*	13.67 (6.48)
Years of education	14.63 (2.96)	*Big losses*	10.50 (5.73)
		Near-miss	4.45 (2.09)
Gambling problems		*Total*	28.63 (13.14)
Past year	0.87 (1.42)		
Lifetime	1.67 (2.35)	***Gambling Cognition***	
		Gambling expectancies	12.27 (5.27)
Gambling losses (past year)		*Illusions of control*	7.69 (4.91)
£0	14 (13.50)	*Predictive control*	16.32 (7.00)
< £100	62 (59.60)	*Perceived inability to stop*	8.92 (5.45)
£100 - £500	22 (21.20)	*Interpretive control/bias*	12.14 (5.61)
> £500	6 (5.80)	*Total score*	57.64 (22.43)
Gambling frequency (past year)		***Impulsivity***	
Once or less	19 (18.30)	*attentional*	12.69 (3.19)
Few times a year	18 (17.30)	*Motor*	23.19 (3.78)
1-3 times a month	11 (10.60)	*Non-planning*	23.69 (4.81)
1-3 times a week	45 (43.30)	*Total score*	59.87 (9.99)
Daily	11 (10.60)		
		Affect	
Mood questionnaire	5.04 (3.89)	*State positive*	33.13 (6.59)
		State negative	12.51 (4.21)

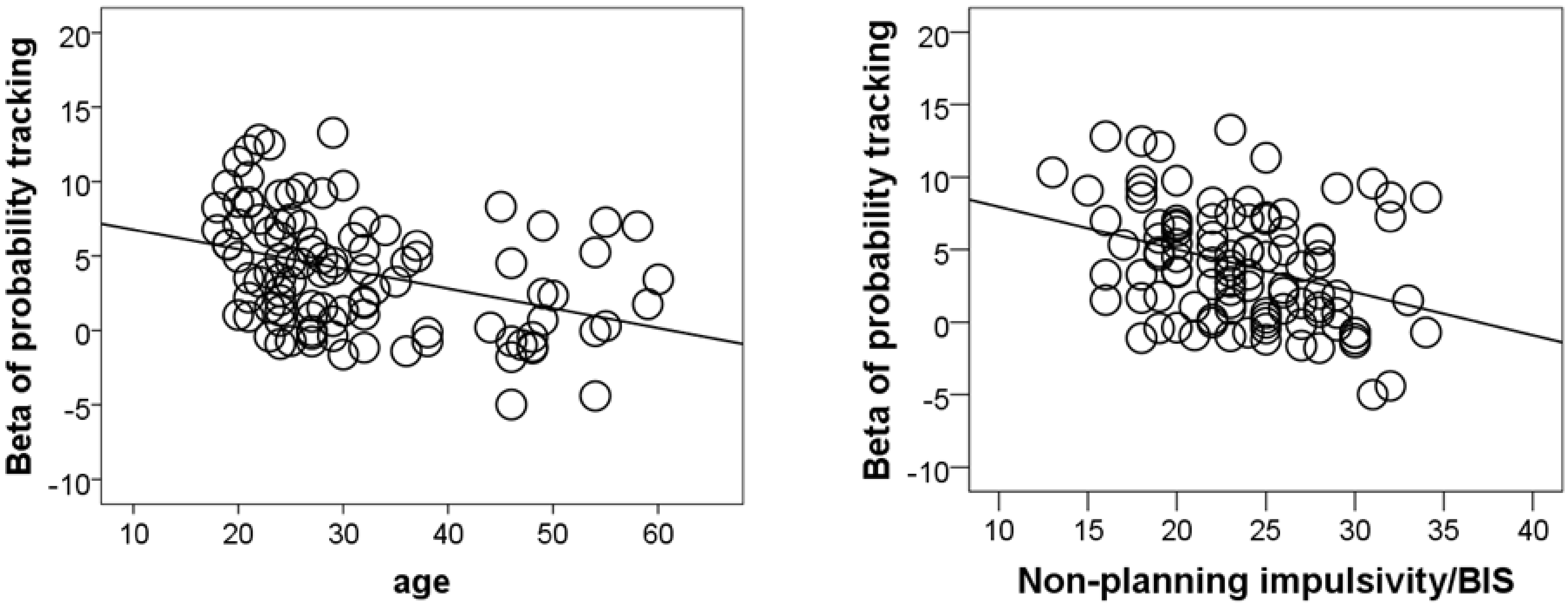
Note: Gambling problems - National Opinion Research Centre DSM IV Screen; Mood questionnaire – Mood Disorder Questionnaire (MDQ; *26*); Chasing Questionnaire (CHQ; *22*); Gambling cognitions – Gambling Related Cognitions Scale (GRCS; *11*); Impulsivity – Barratt's Impulsivity Scale (BIS-11; *12*); Affect – Positive and Negative Affective Scales (PANAS; *25*).

Action selection:- (non-problematic) gamblers tend to use estimated probability and reward value to select optimal actions and to a lesser extent, other cues in the recent reinforcement history



Optimal valuation = (Probability estimate * Current reward)

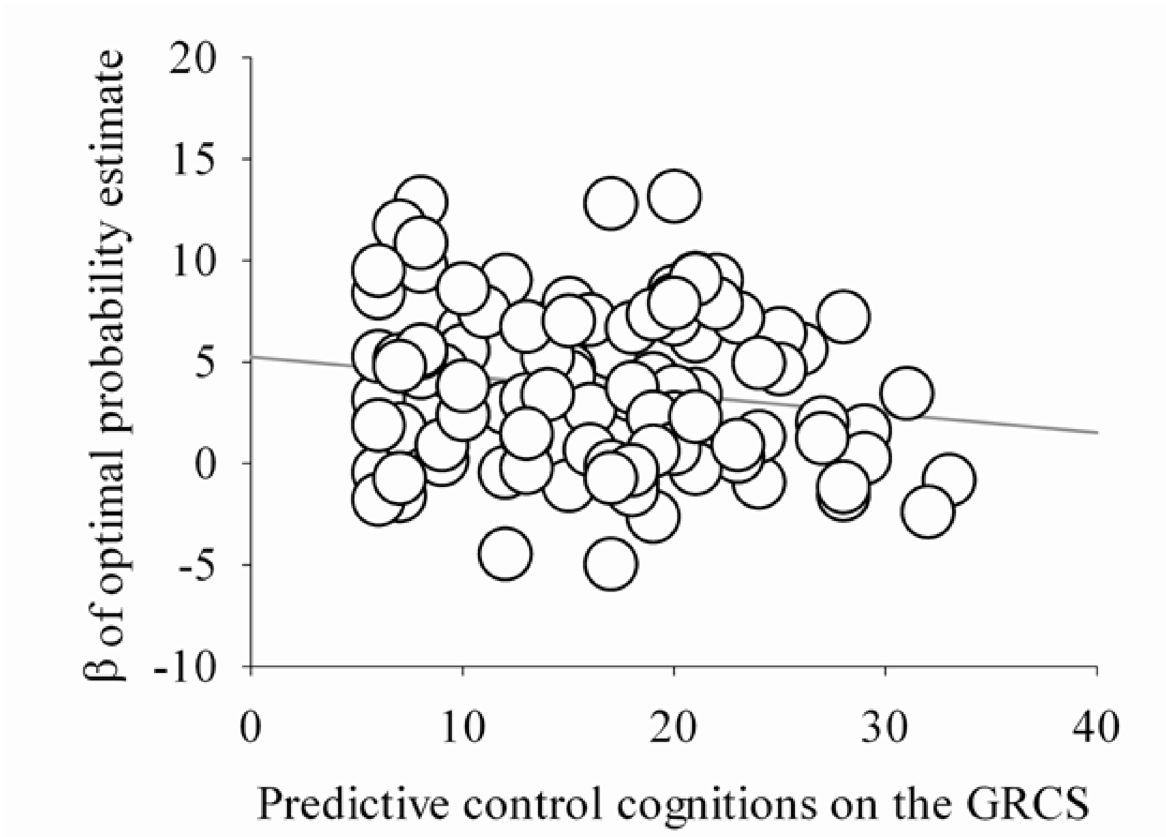
Age and impulsivity in (non-problematic) gamblers, is associated with reduced use of reinforcement history to estimate probability when selecting actions



Predictive control, in non-problematic) gamblers, is associated with reduced use of reinforcement history (i.e. probability tracking when selecting actions

'A series of losses will provide me with a learning experience that will help me win later'

'There are times that I feel lucky and thus, gamble those times only'



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	B	SE B	β
Constant	9.905	3.229	
Education	.231	.127	.174^{+}
Age	-.102	.032	-.287**
Past year gambling losses	.274	.534	.051
Non-planned impulsivity/BIS-11	-.209	.078	-.256**
Predictive control/GRCS	-.106	.051	-.188*

Note: R^2 = .26 (p< .001); ^{+}p < .10; *p < .05; **p < .01; BIS-11 - Barratt's Impulsivity Scale (12); GRCS - Gambling-related cognitions scale (11).

- Generic and specific risk factors for gambling problems have significant impacts on optimal action selection and reinforcement learning in a simulated gambling game
- Impulsivity and gambling-related cognitive biases are associated with reduced use of tracked/estimated probability information and reward magnitude when selecting actions
- Impulsivity, but not cognitive biases, is associated with low learning rates and overweighting of low probabilities and underweighting of high probable outcomes
- Predictive control blocks the use of estimated probability

'They think they know better!'

Why can't (some) gamblers learn the real value of gambling games?

Mindfulness → 'a moment-by-moment awareness of our thoughts, feelings, bodily sensations, and surrounding environment'

And what can we do about it?

Mindfulness and gambling

- Dispositional mindfulness is associated with less severe gambling problems (Lakey et al, 2007)
- Experiential avoidance mediates thought suppression → gambling problems (Riley, 2014)
- 8-week mindfulness-based group treatment in 17 problem gamblers reported to improve sense of control, anxiety symptoms and ability to 'stay in the now' (Chen et al, 2014)

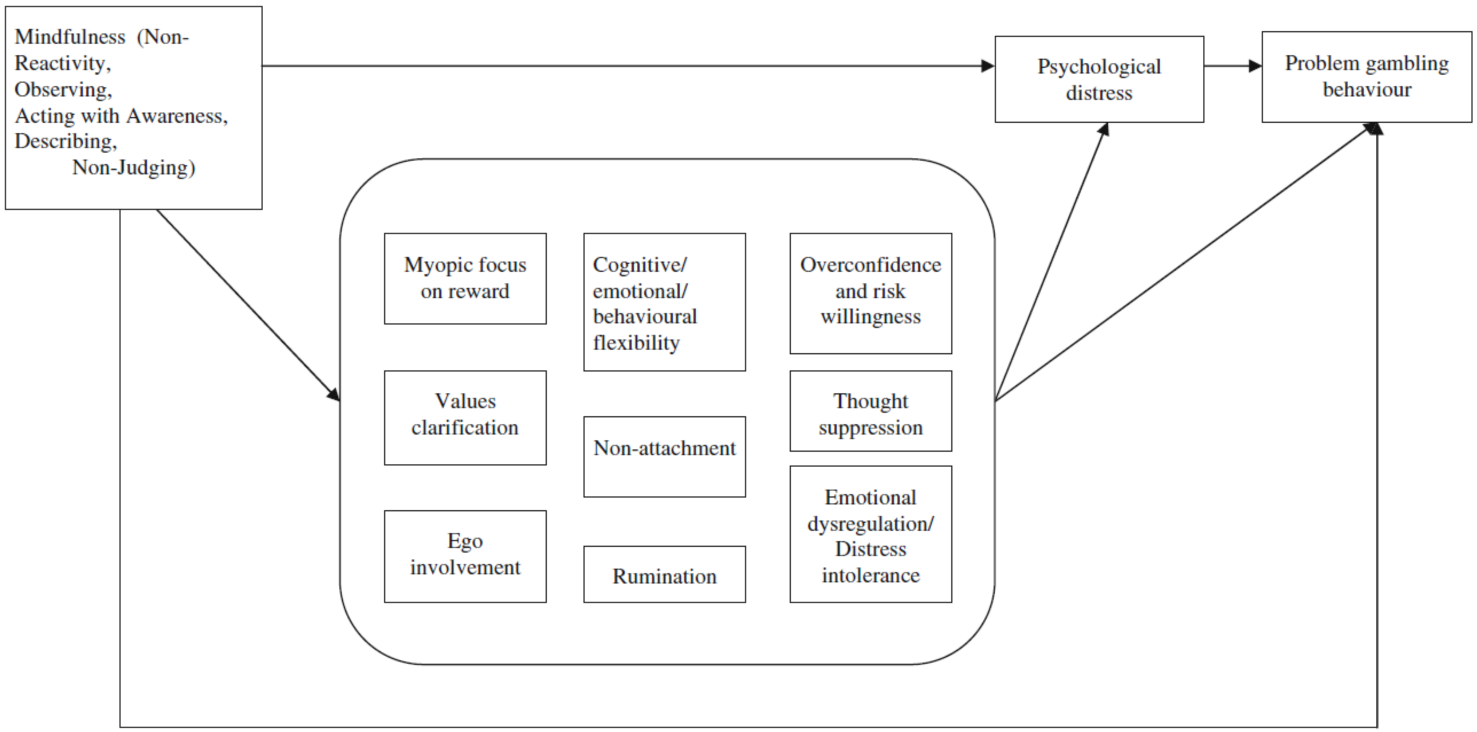
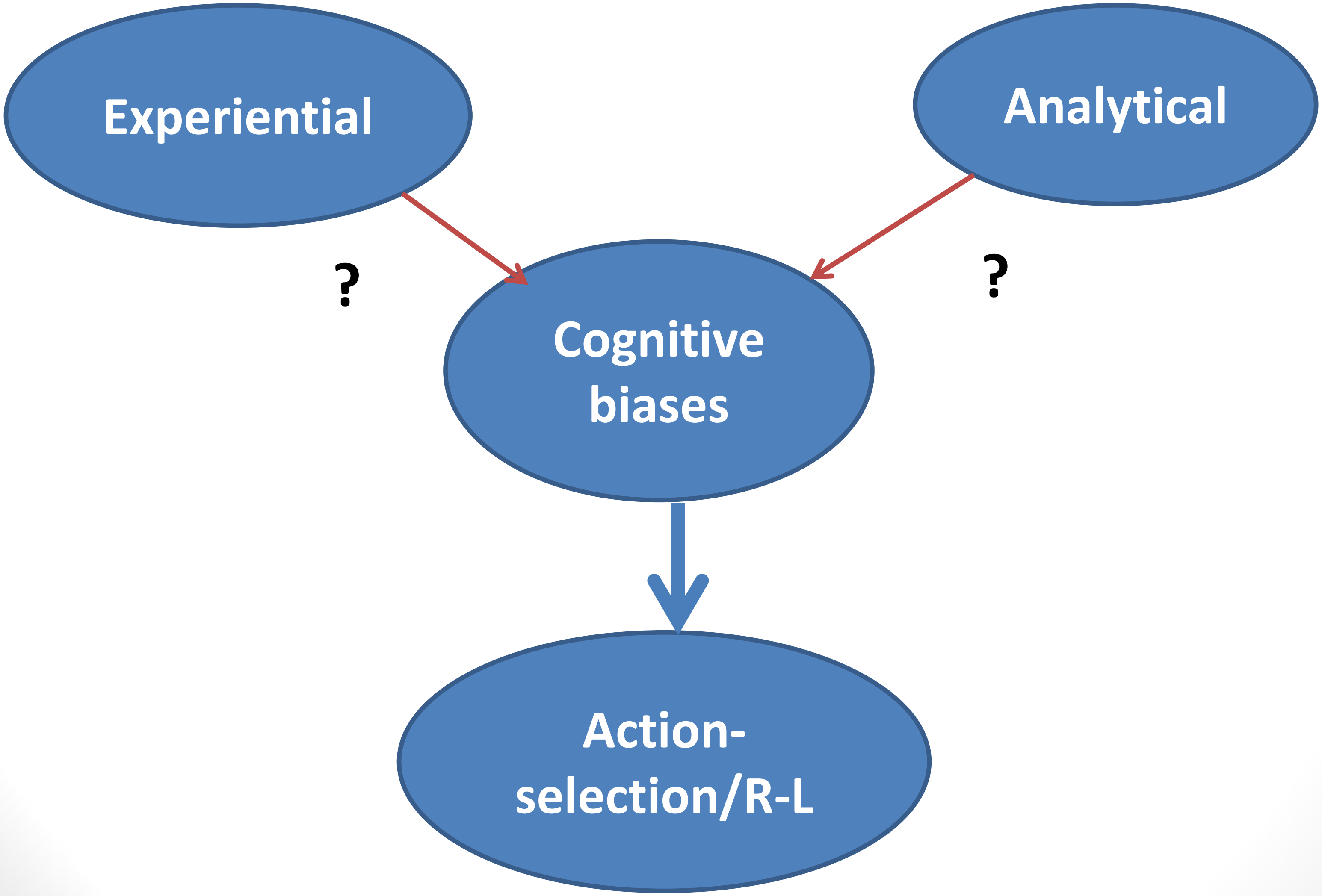


Fig. 1 Proposed model of relationships between mindfulness, mechanisms of action, and problem gambling behaviour

de Lisle et al (2014)

Experiential vs. Analytic Modes



Induction: ……the physical sensations in your body…… the way you feel inside…….the amount of certainty you feel…… how sad or happy you are feeling…… ……how weak or strong your body feels right now……….

Analytic Vs. ***Experiential***

Think about the *causes*, *meanings* and *consequences* of the items. Spend a few moments visualising and concentrating on each item, attempting to *make sense of* and *understand the issues raised.*

Focus your mind on each experience. Spend a few moments visualizing and concentrating on *your experience*, attempting to find a phrase, image or set of words that best describes the quality of what you sense.

Demographics: 40 (regular) gamblers

	Analytic (n=20), Mean (SEM)	Experiential (n=20), Mean (SEM)	Total (n=40), Mean (SEM)	*p*-value
Age	27.55 (2.025)	24.75 (1.395)	26.15 (1.234)	*p*= .262
Raven’s	9.85 (.425)	10.55 (.276)	10.20 (.256)	*p*=.175
BDI	5.40 (1.027)	4.10 (.743)	4.75 (.634)	*p*=.312
State PANAS +	29.70 (1.357)	26.65 (1.580)	28.17 (1.057)	*p*= .151
State PANAS -	11.60 (.554)	11.00 (.377)	11.30 (.334)	*p*= .376

Gambling questionnaires/cognitive biases

	Analytic (n=20), Mean (SEM)	Experiential (n=20), Mean (SEM)	Total (n=40), Mean (SEM)	*p*-value
Gambling Cognitions / GRCS	60.30 (4.042)	59.40 (4.398)	59.85 (2.949)	*p*=.881
Predictive Control / GRCS	3.15 (.280)	2.775 (.253)	2.963 (.189)	*p*=.327
Gambling Beliefs / GBQ	72.05 (3.943)	74.35 (4.055)	73.20 (2.797)	*p*=.687
Chasing / CHQ	29.85 (3.119)	27.85 (2.041)	28.85 (1.847)	*p*= .595
Gambling Frequency	3.40 (.134)	3.55 (.114)	3.48 (.088)	*p*=.399
Past Year Problems / NODS	1.20 (.296)	.80 (.213)	1.00 (.183)	*p*=.279

VAS 1

↓

Induction

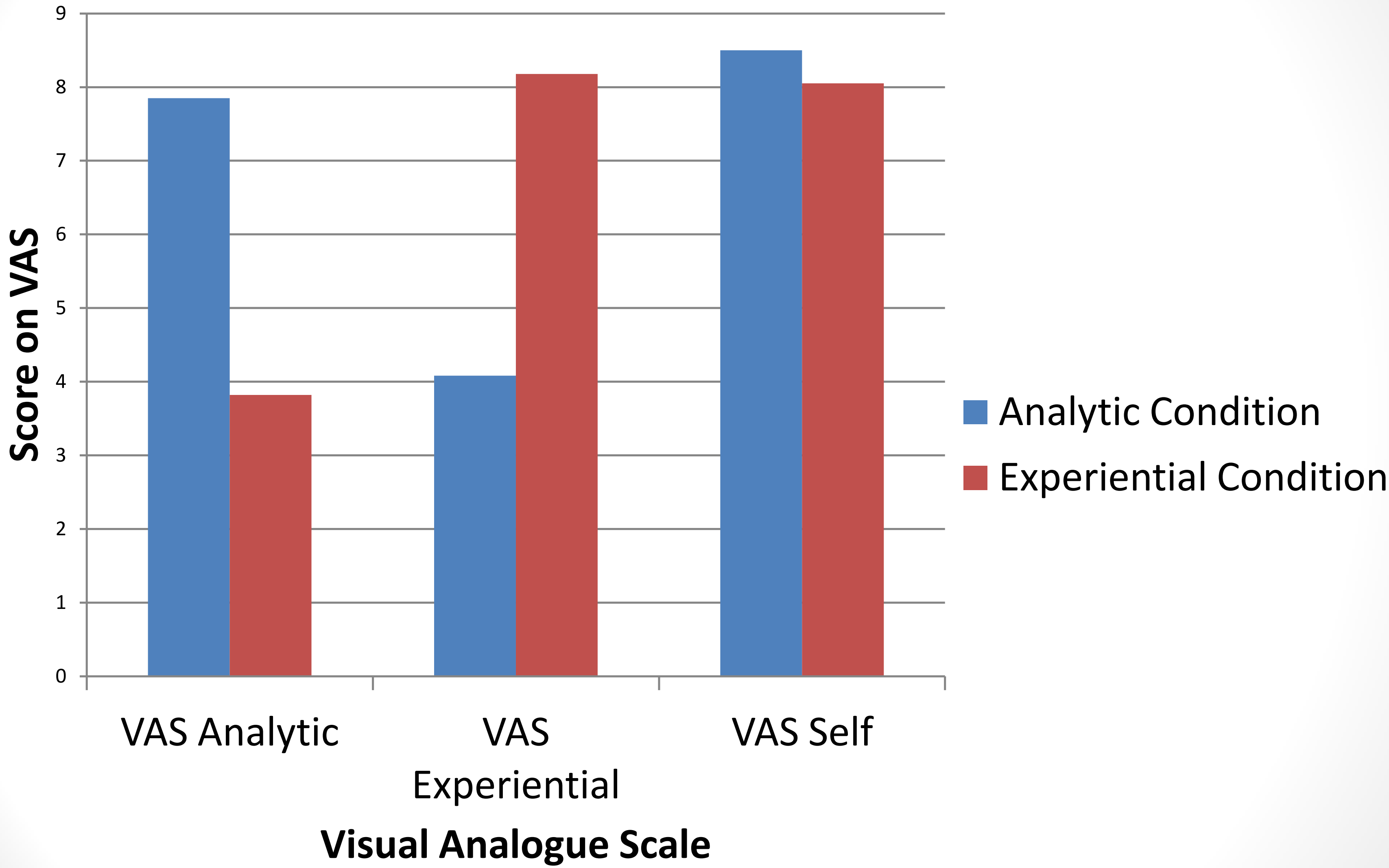
↓

VAS 2

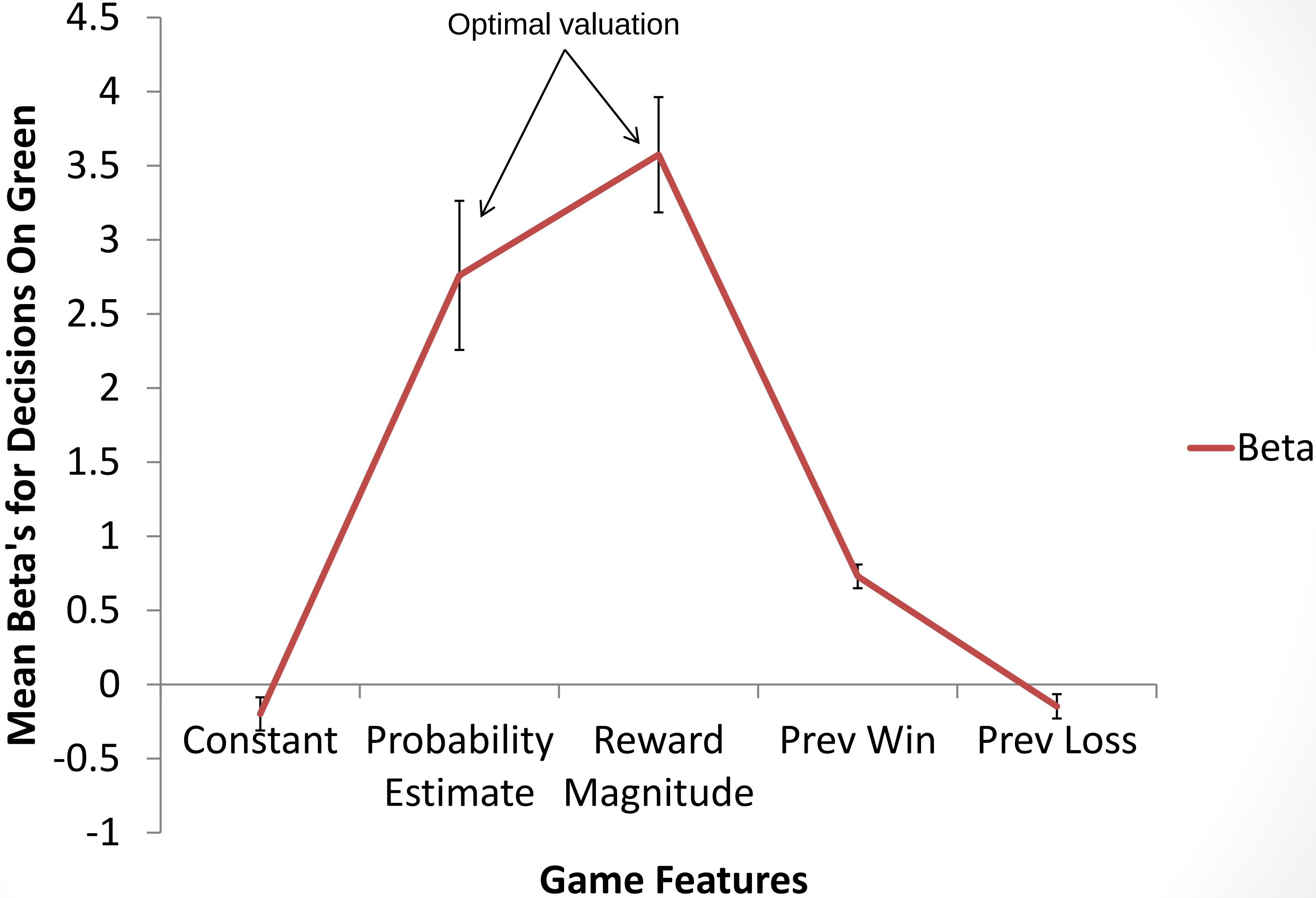
↓

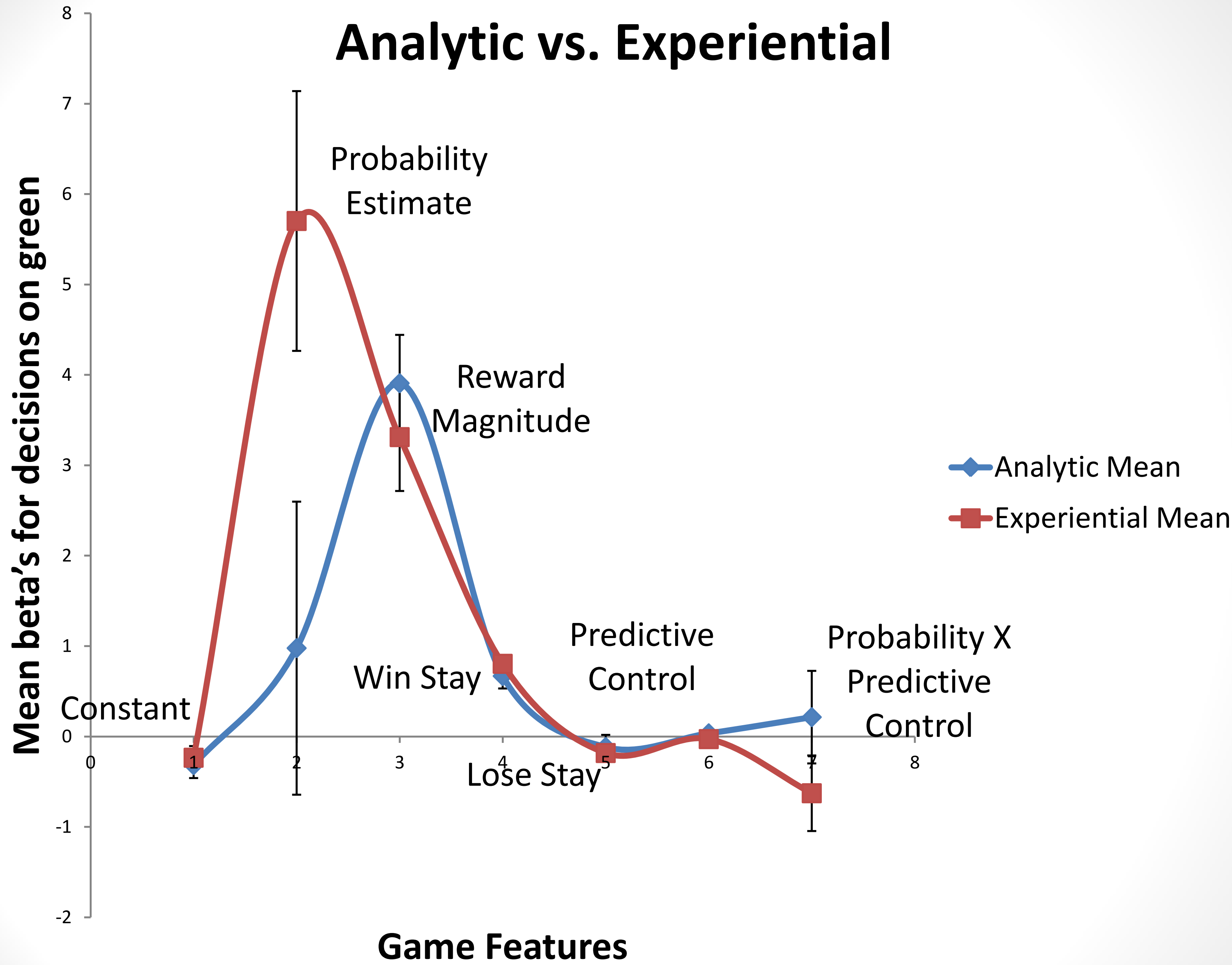
Action-selection/R-L task

Manipulation check

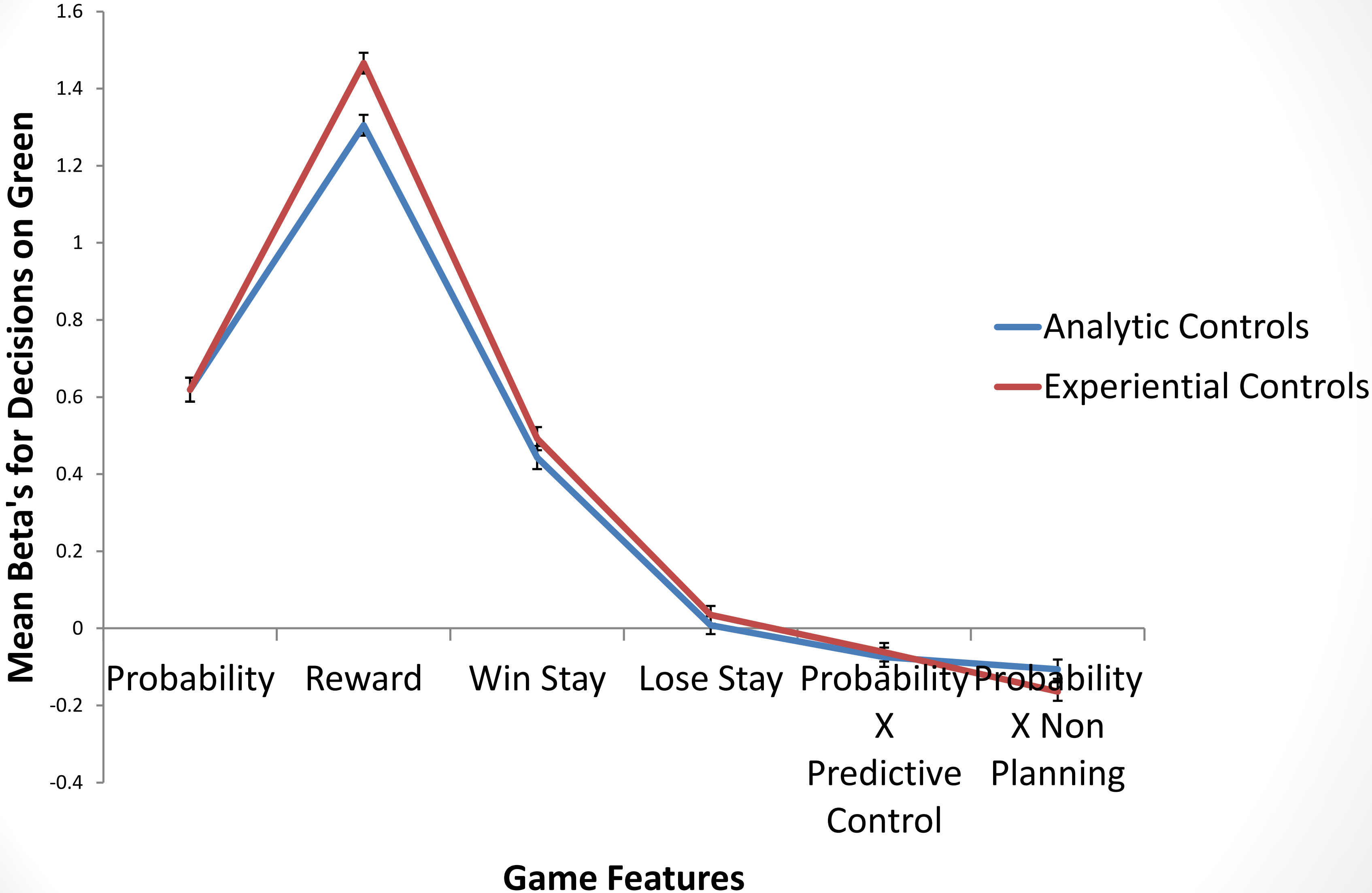


Action-selection model: (regular) gamblers




Analytic vs. Experiential
Mean beta's for decisions on green
Game Features
8
7
6
5
4
3
2
1
0
-1
-2
0
1
2
3
4
5
6
7
8
Probability Estimate
Reward Magnitude
Win Stay
Constant
Lose Stay
Predictive Control
Probability X Predictive Control
Analytic Mean
Experiential Mean

Controls: Experiential vs analytic

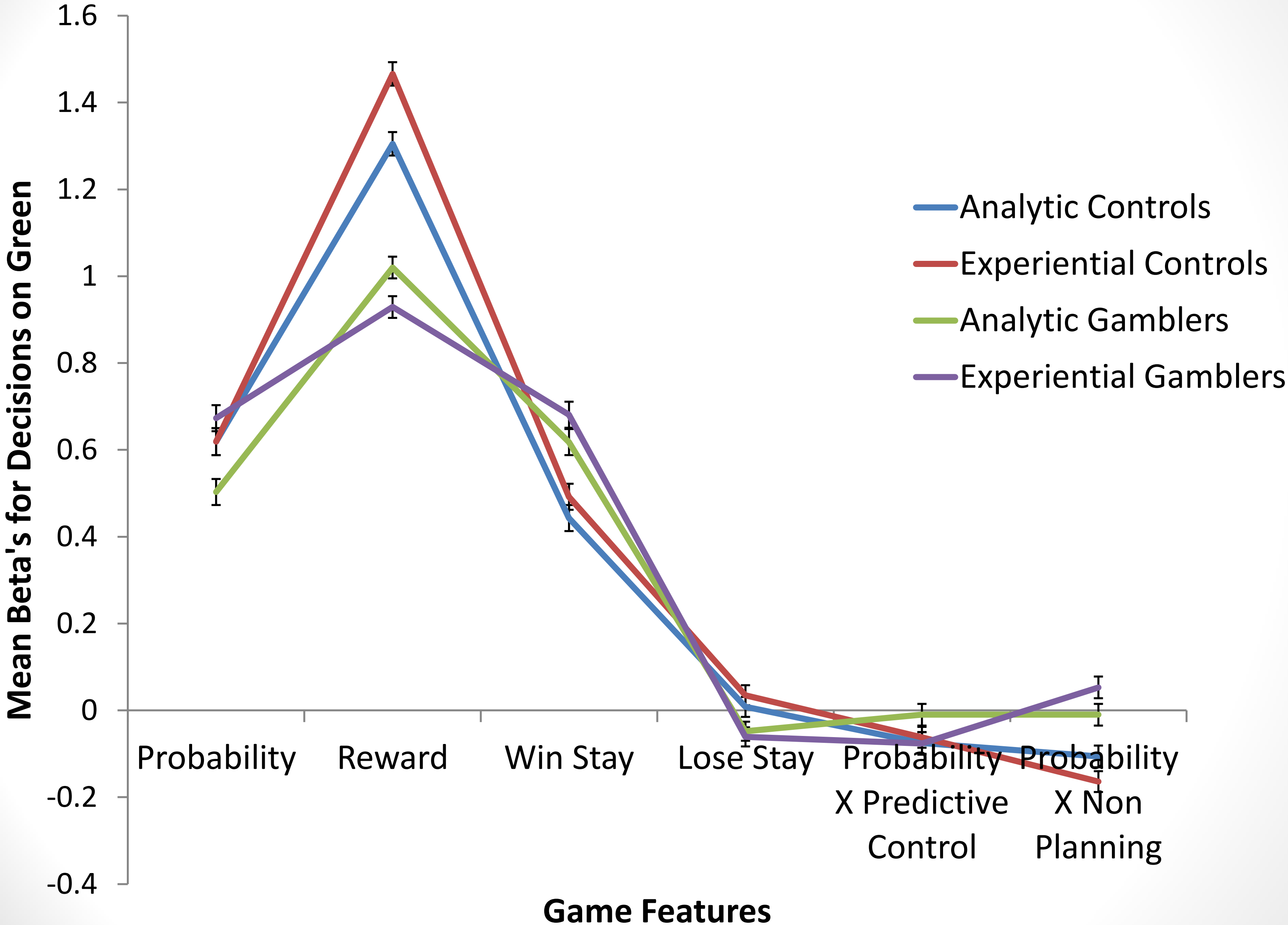


- A brief self-focus intervention – only an ''analog mindfulness' – can help read the reinforcement histories of gambling-like games in regular gamblers but not controls

‘Mindfulness needs a cognitive substrate to work on'

And what can we do about it?

Gamblers vs. Controls



Some risk factors for gambling problems are generic......

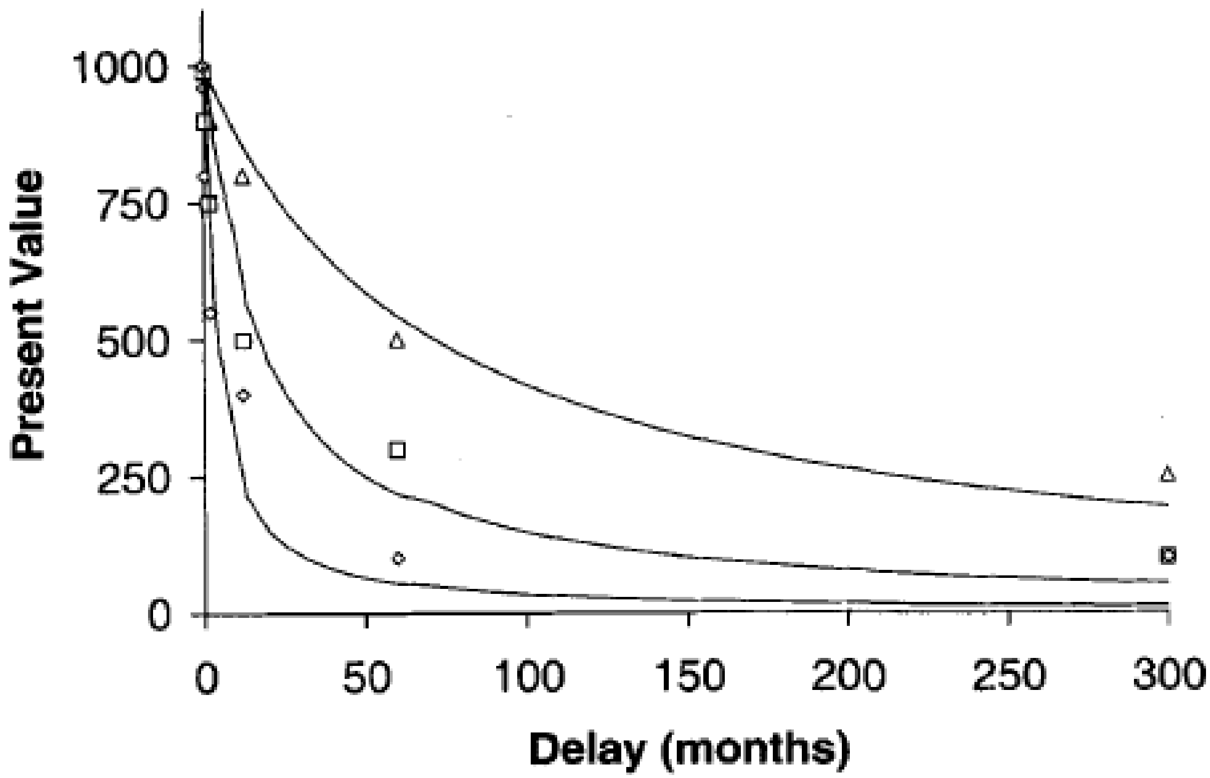
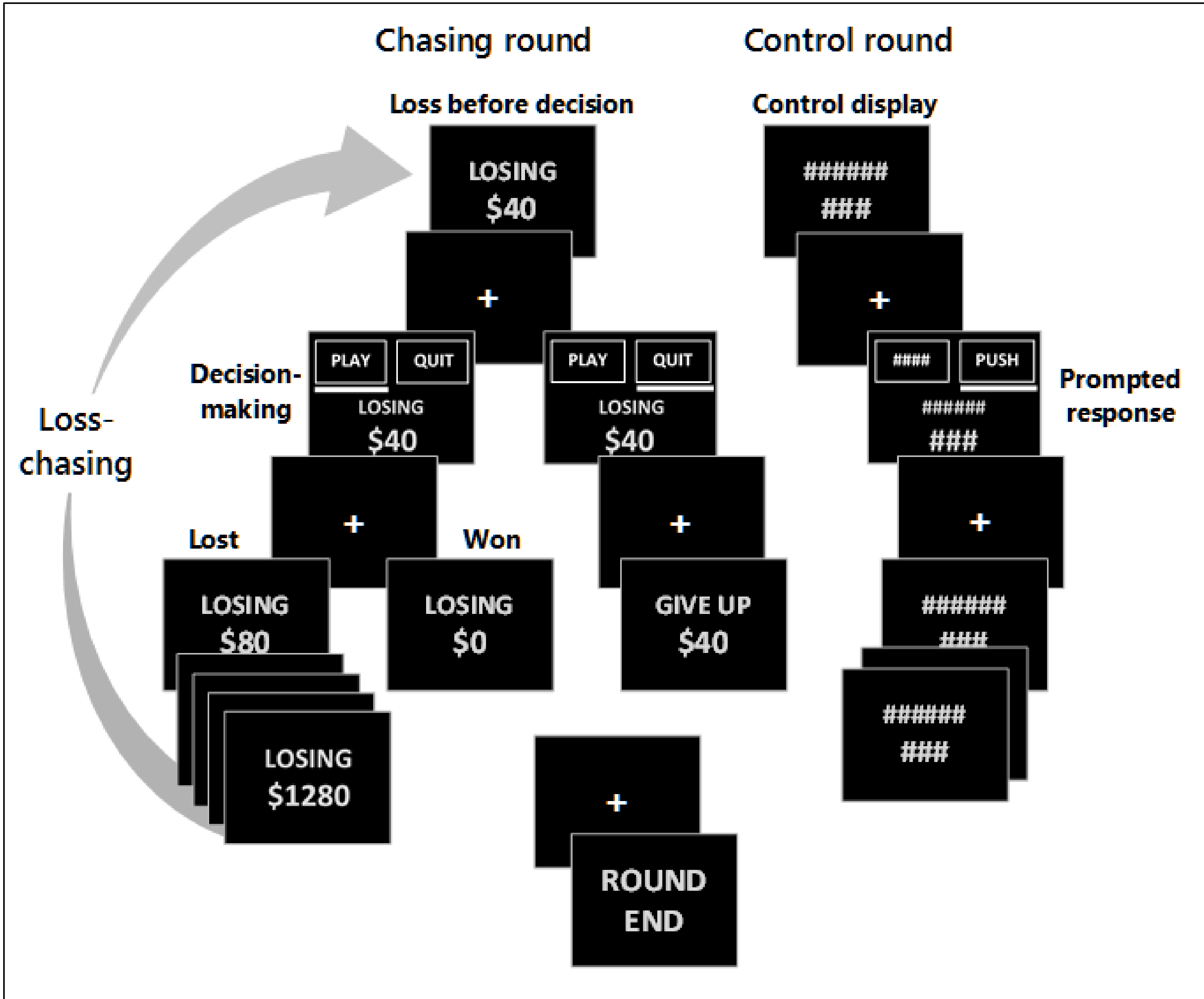


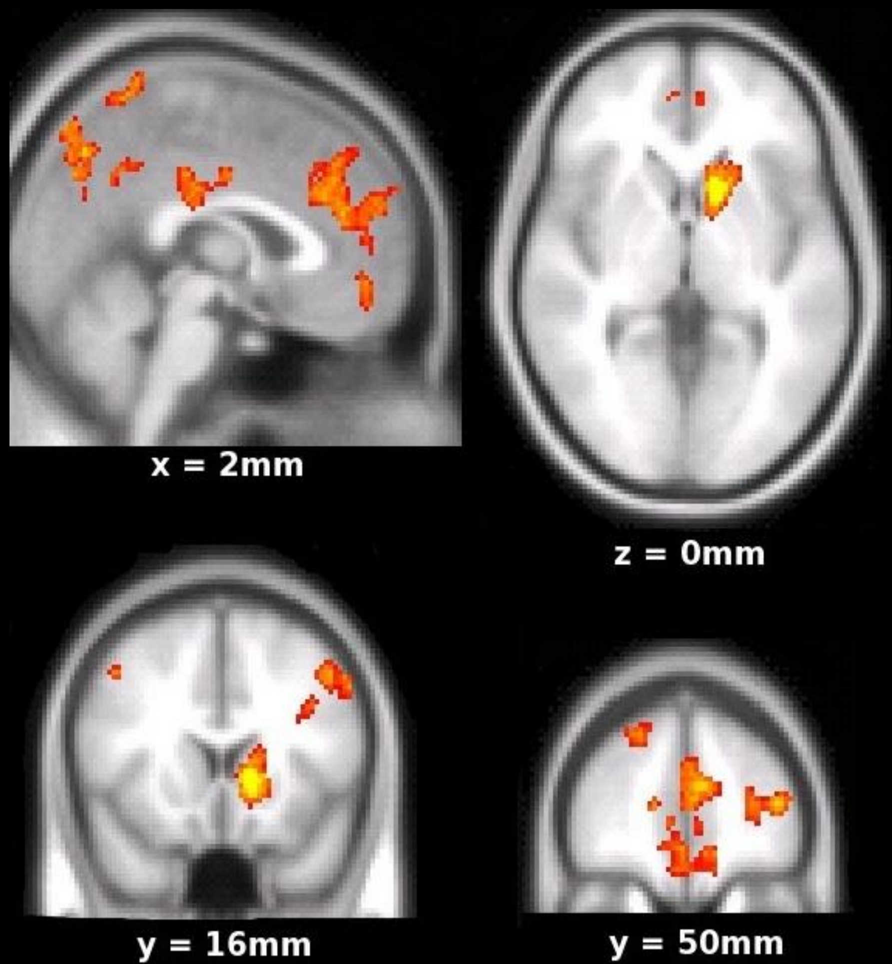
Figure 1. Subjective values of $1,000 rewards delayed in time from 6 hr to 25 years. The median indifferent points for each of the three participant groups are presented for control participants (open triangles), for non-substance-abusing pathological gamblers (open squares), and for substance-abusing pathological gamblers (open diamonds). The lines represent Equation 1 when fit to these group median indifference points.

Petry, 2001



Chasing round
Control round
Loss before decision
Control display
LOSING
$40
######
###
+
+
Decision-
making
PLAY
QUIT
LOSING
$40
PLAY
QUIT
LOSING
$40
####
PUSH
######
###
Prompted
response
Loss-
chasing
+
+
+
Lost
Won
LOSING
$80
LOSING
$0
GIVE UP
$40
######
####
LOSING
$1280
######
####
+
ROUND
END

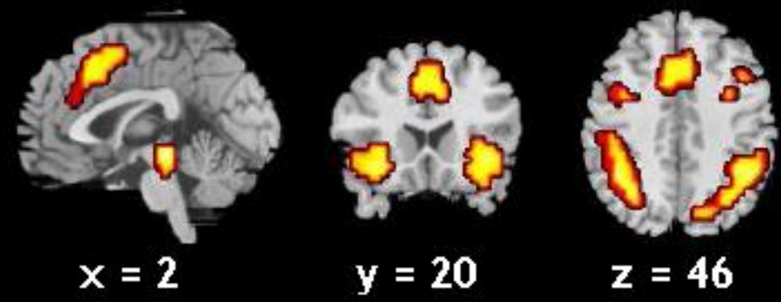
Individuals who reinterpret their losses in a way that encourages further gambling (interpretive bias) show reduced neural activity in anterior and posterior ACC region when deciding to quit

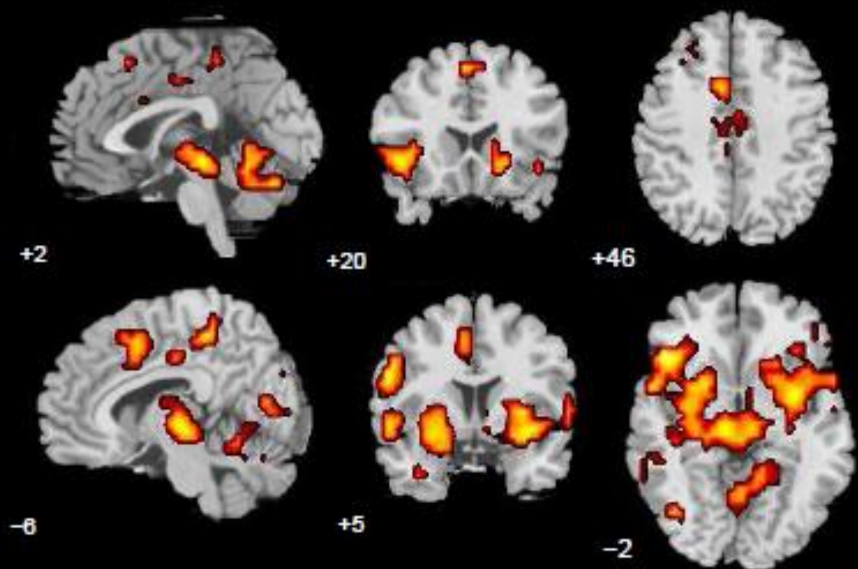


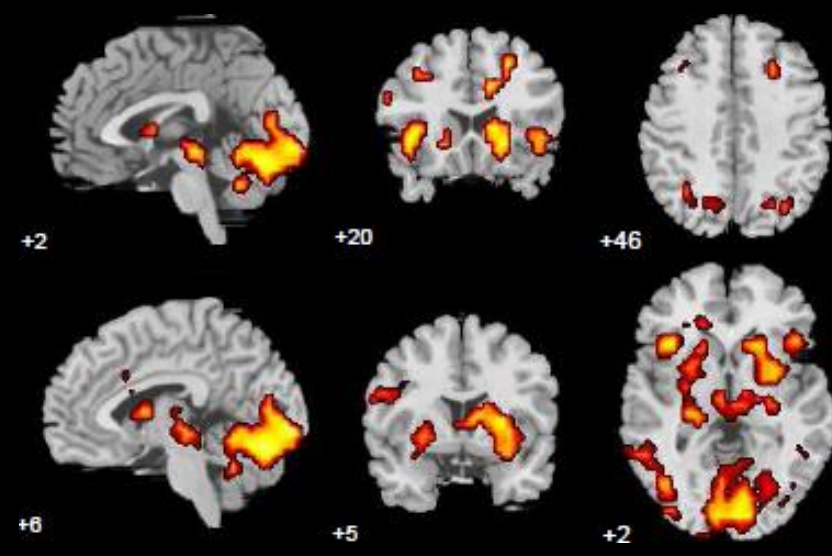
'Relating my losses to bad luck and bad circumstances makes me continue gambling'
'Remembering how much money I won last time makes me continue gambling'

Group data thresholded at Z= 2.3, with cluster correction at $p< .05$

Pathological gamblers show <u>increased</u> BOLD signal within dorsomedial prefrontal cortex, and striatum when deciding to quit





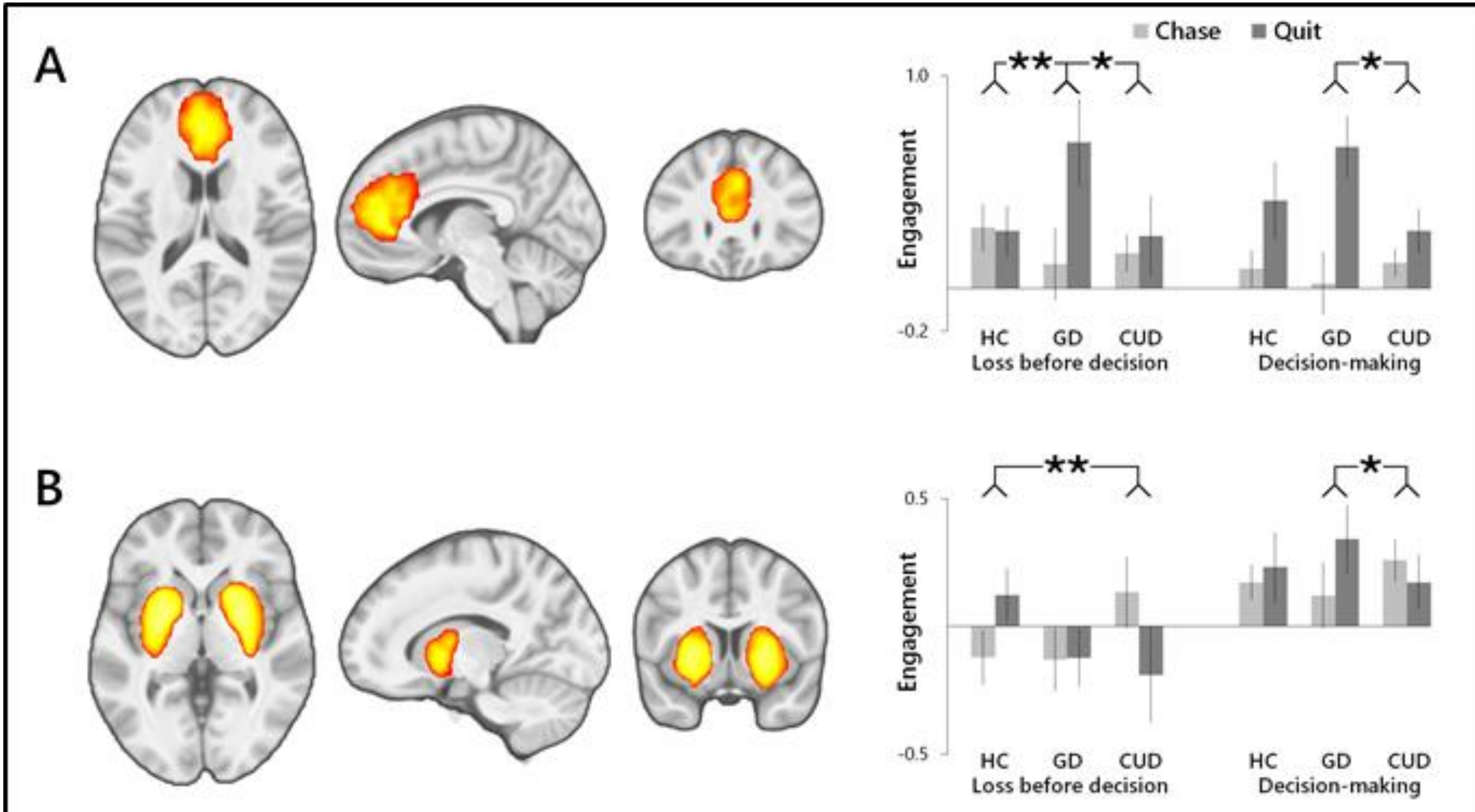


11 pathological gamblers,
vs
9 healthy controls
($p<0.01$, $k > 10$)

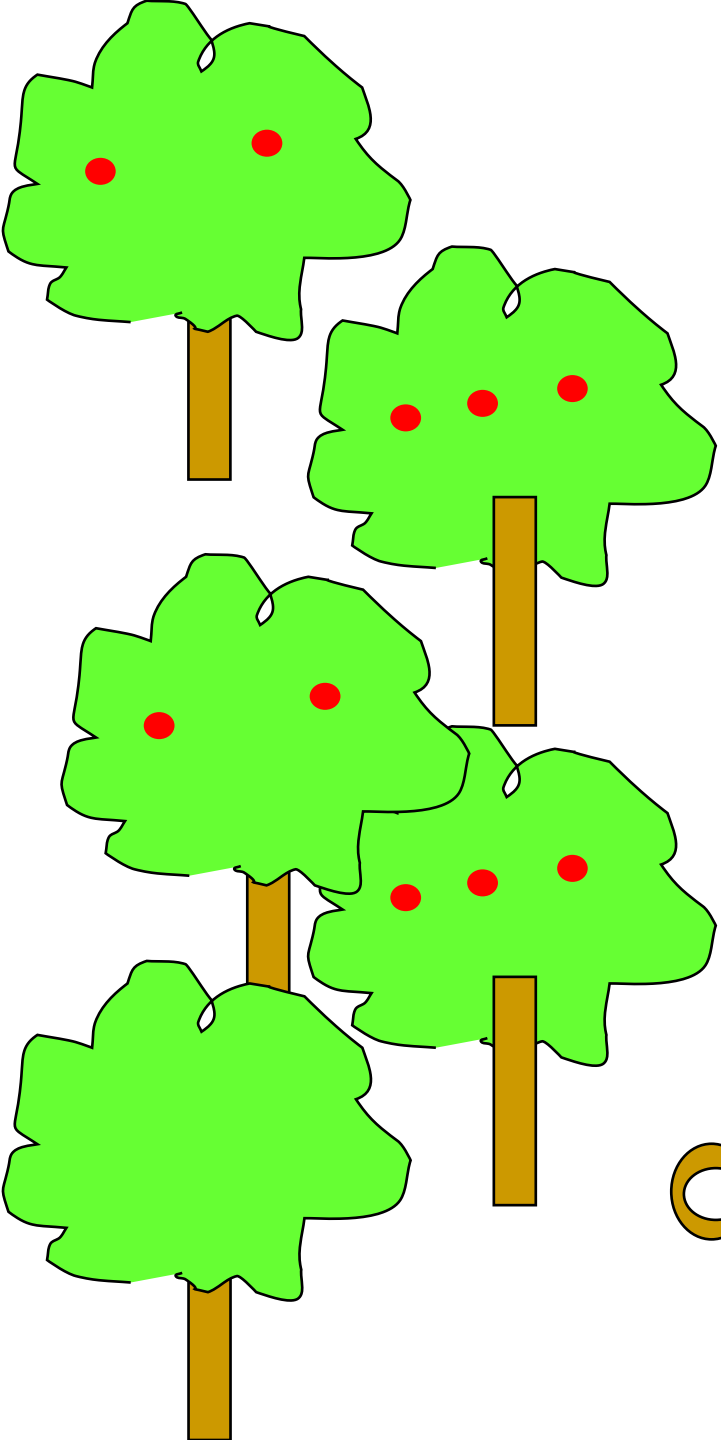
11 pathological gamblers,
vs
10 cocaine dependents
($p<0.01$, $k > 10$)

Patrick Worhunsky, Potenza & Rogers, DPhil research

ICA/full sample: Pathological gamblers (n= 25) show increased BOLD signal within dorsomedial prefrontal and striatal network when processing losing outcomes (and deciding to quit) compared to HCs (n=27) and cocaine-dependents (n= 18)

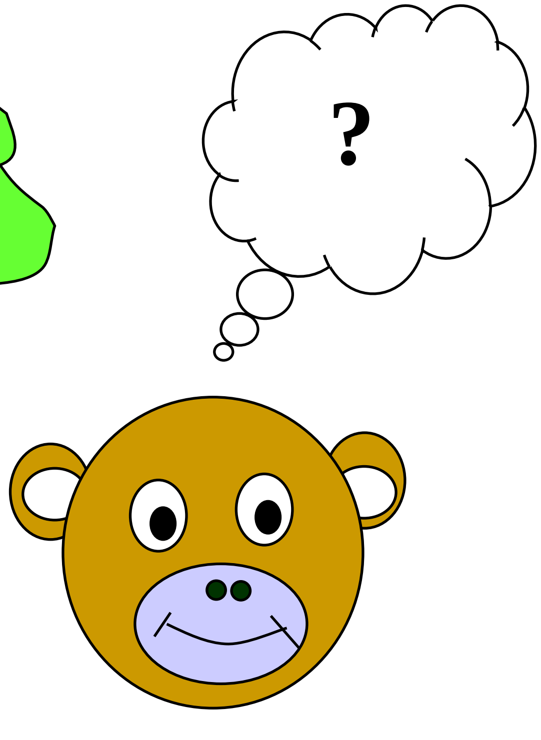


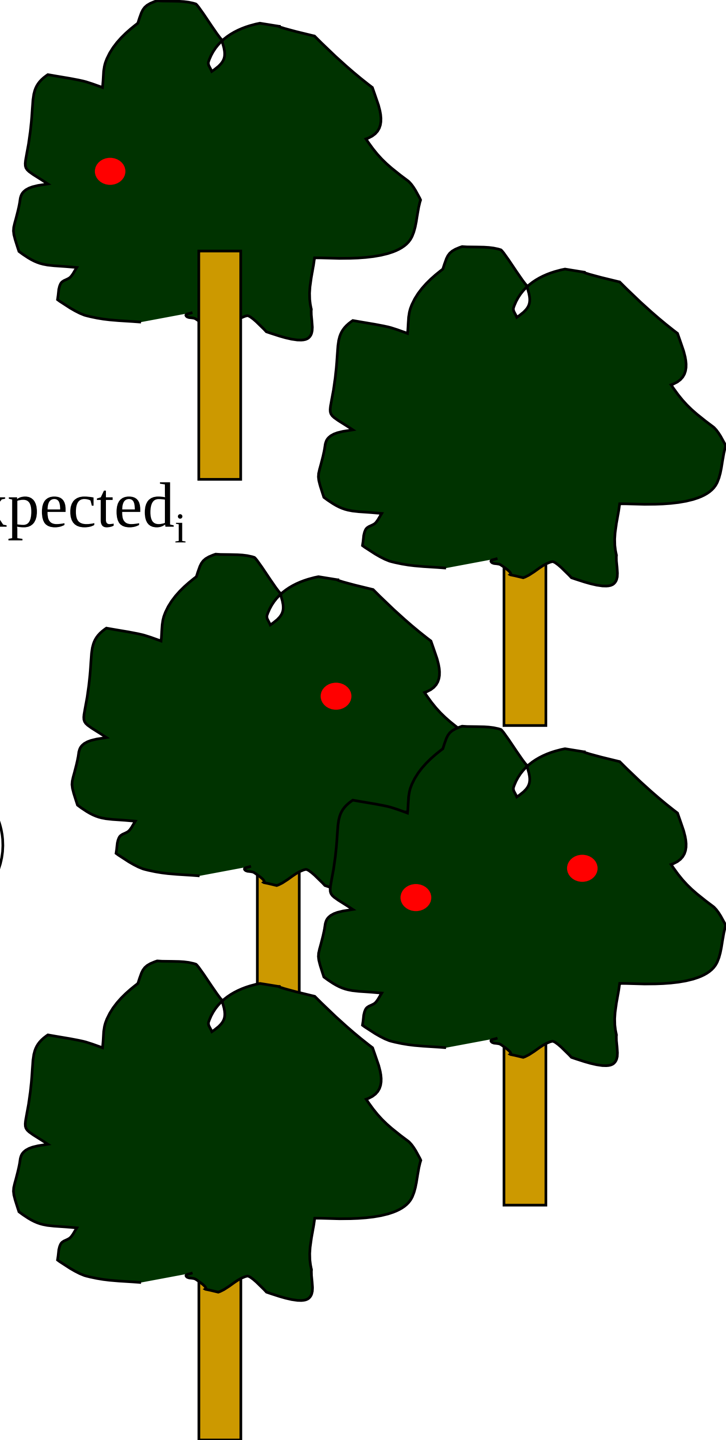
Worhunsky, Potenza & Rogers, submitted



$$\nu_{i+1} = \nu_i + \alpha\varepsilon_I$$

$$\varepsilon_i = \text{Outcome}_i - \text{Expected}_i$$





Action selection
Estimated probability (as if a Bayesian learner)
Reward value (magnitude)
Prior outcomes (previous winning outcome; previous winning value)
Reinforcement learning/simple delta rule
Learning rate
Probability distortion (Prospect Theory)
Underweighting of reward magnitude (Prospect Theory)
Randomness (inverse temperature in softmax function)

βs ← Demographics, gambling, impulsivity, gambling cognitions

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Reinforcement learning:- impulsivity in (non-problematic) gamblers linked to low learning rates and overweighting of low and underweighting of high probabilities

	B	SE B	β
Constant	-.754	.495	
Non-planned impulsivity/BIS-11	-.045	.020	-.212*

Note: $R^2 = .05$ ($p < .05$); *$p < .05$; BIS-11 - Barratt's Impulsivity Scale (12).

	B	SE B	β
Constant	.556	.413	
Non-planned impulsivity/BIS-11	-.049	.017	-.273**

Note: $R^2 = .08$ ($p < .01$); **$p < .01$; BIS-11 - Barratt's Impulsivity Scale (12).