CENTRE for GAMBLING RESEARCH at UBC

Understanding the Risk Profile of Slot Machine Gambling

Dr Luke Clark

Bochum Conference on Gambling and Society (GLUG)
21 Sept 2023

a place of mind
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Department of Psychology

Centre for Gambling Research

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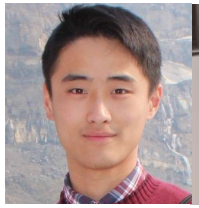
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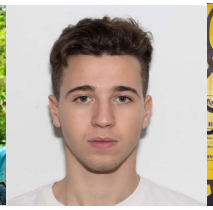
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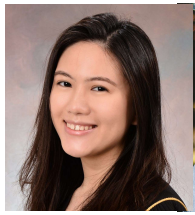
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Disclosures

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Roadmap

- Background:
- Slot machines continue to be one of the most high-risk gambling products
- Gambling harm as the interaction of Person, Product & Environment
- Addictive forms rely on neural mechanisms of reward uncertainty

- New Research:
- Research Program 1: studying individual ingredients of slot machines (aka 'structural characteristics')
  - Revisiting the slot machine near-misses
  - Changing the payment format
- Research Program 2: the whole is greater than the sum of the parts – immersion as the driver of harm

Slot Machines – a Century of Evolution

1895 Charles Fey invents the 'Liberty Bell'

1938 Bally's 'Double Bell'

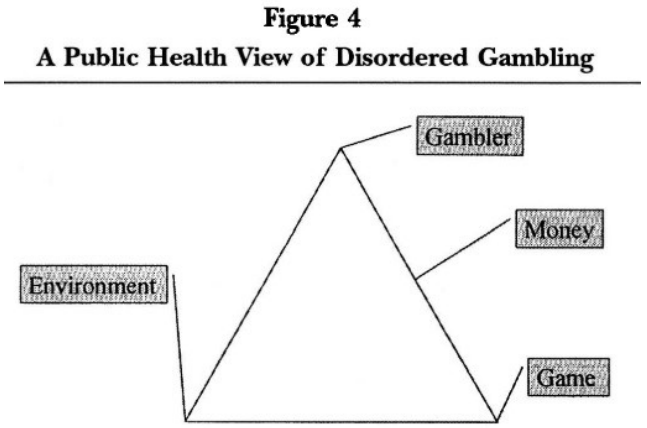
A modern game: Buffalo Spirit (WMS / Scientific Games), a fully digital EGM ***and*** online game

Modern slot machines are a relatively harmful form of gambling

- In Canada, slot machines and VLTs account for ~2/3 gambling revenue (Maclaren 2015)
- The relationship between gambling spending and PG symptoms is strongest & most consistent for slots (e.g. Markham et al 2016)
- In treatment services, slot machines are the most common preferred form of gambling (23 of 48 in Vancouver; Limbrick-Oldfield et al 2020)
- More rapid progression from initial use to gambling problems (1.1y vs 3.6y) (Breen & Zimmerman 2002)

Person x Product x Environment

- Gambling problems arise from a combination of factors at the level of the **person**, the **product**, and the gambling **environment**:
  - Most research on gambling (esp. addiction science, psychology) has emphasized personal risk factors
  - In past 5 years, research on environmental determinants has expanded
  - Gambling products lie at the interface between the gambler and their environment, but for methodological reasons, gambling products may be the most challenging part of the triad to study.



Korn & Shaffer 1999

Product features

- Gambling products can be analyzed as a number of distinct design ingredients ('structural characteristics' after Griffiths 1993)
- Modern EGMs have evolved into complex products that are characterized by *many* notable features, e.g.
  - Speed of play
  - Pay-out features
  - Audio-visual feedback
  - Near-misses & Losses Disguised as Wins
  - Opportunities for illusory control
  - Ease of payment

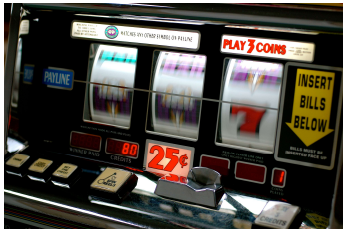
Scoring ingredients to estimate product risk

Event frequency (over 6 days – under 15 seconds)	Multi-game / stake opportunities	Prize-back ratio	Light and sound effects (none; light or sound; both)	Variable stake size
Availability	Jackpot size	Cashout interval	Near misses (intentionally generated: Y/N)	Continuity

ASTERIG tool, redrawn from Meyer G et al (2011) International Gambling Studies, see also Blanco et al 2013

A Common Process? Amplification of Reward Uncertainty

- Reward uncertainty is the core feature of gambling that recruits – and then amplifies - brain reward circuitry:
  - Variable Ratio schedules yield high rates of responding and persistence (Skinner)
  - Dopamine cells display both cue-related activity AND anticipatory firing (Fiorillo et al 2003)
  - Neural activity shows sensitization under reward uncertainty (Singer et al 2012, Zack et al 2014)
  - Engineered products and online environment insert new sources of reward uncertainty and compress the timescale



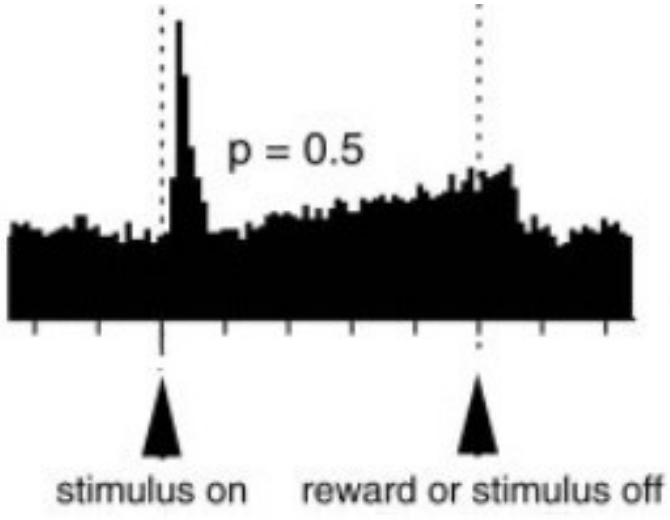


Figure adapted from: Fiorillo, Tobler & Schultz 2003 *Science*

Near misses (intentionally generated: Y/N)

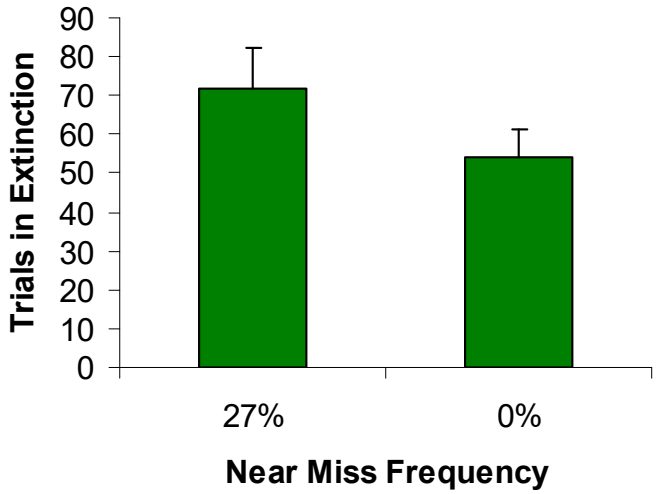
Research Program 1: Design Features

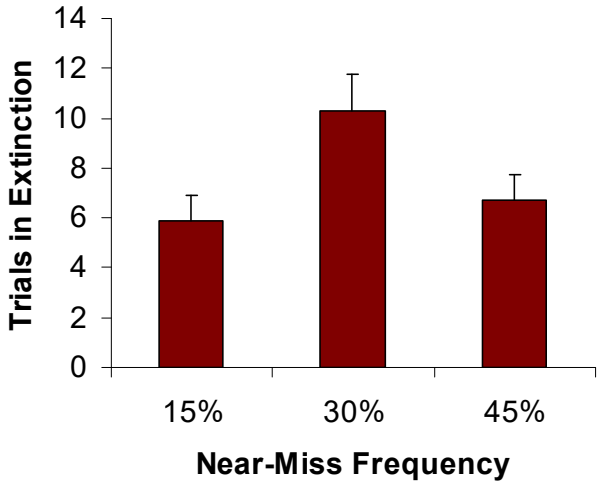
- Near Misses
- Payment Format

The classic 'near-miss effect'

"A special kind of failure to reach a goal, one that comes close to being successful" (Reid 1986)

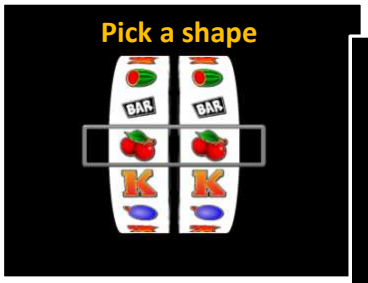
"The gambler is not constantly losing, but constantly nearly winning" (Griffiths 1990)



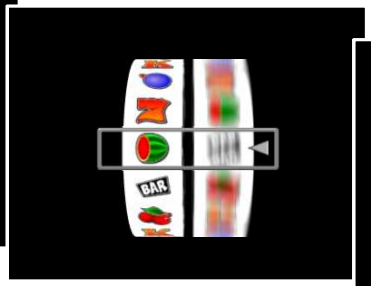


Cote et al 2003, Kassinove & Schare 2001

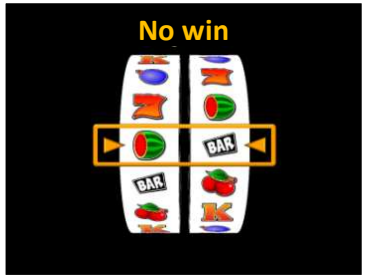
Slot Machine Simulations



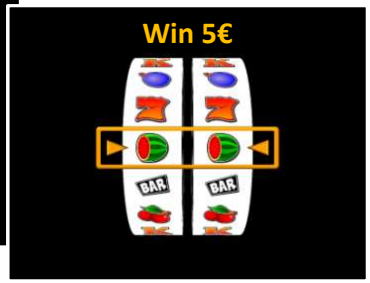
Selection



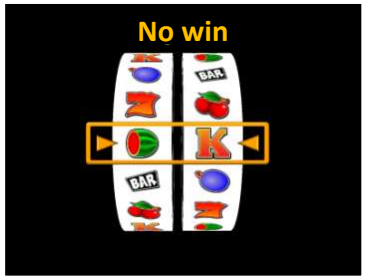
Anticipation



Near-miss outcome



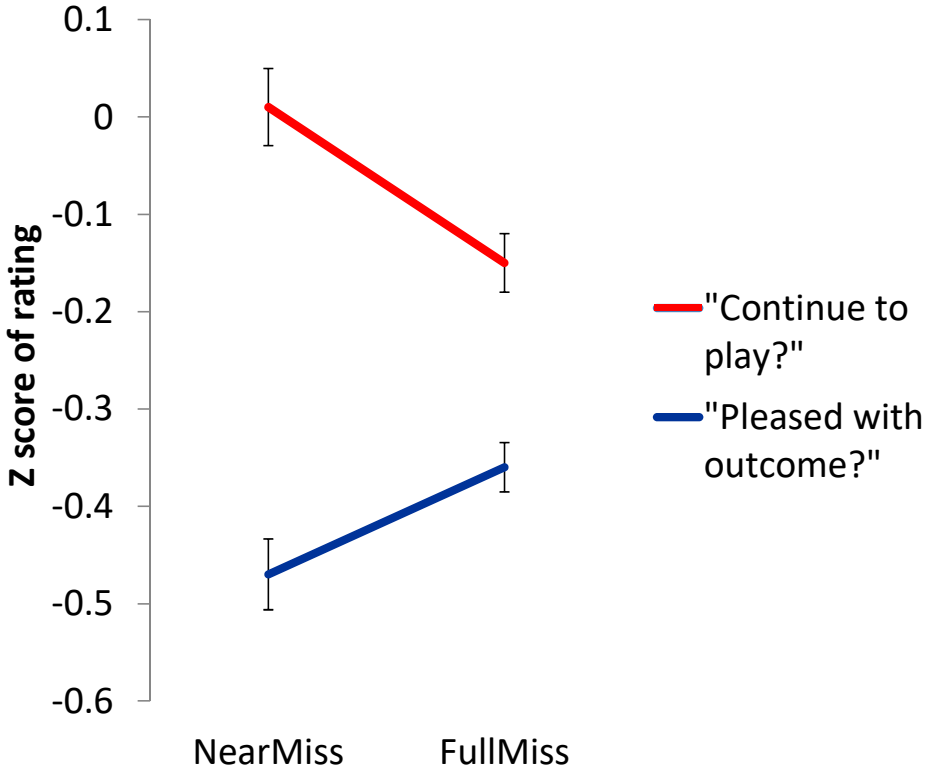
Win outcome



Full-miss outcome

Rating

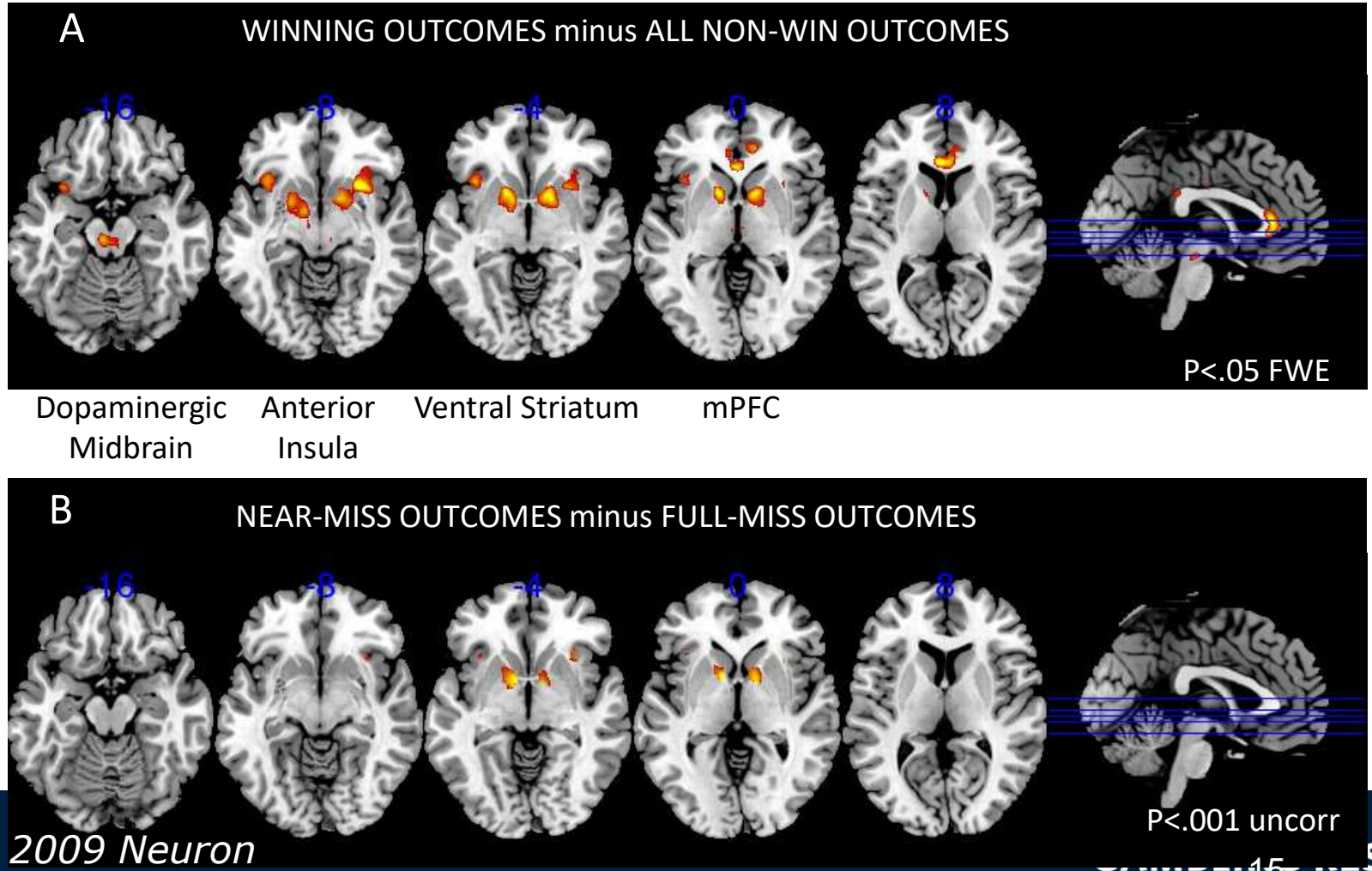
Near Misses: Aversive, but Enhance Motivation to Play



NB. Participant-chosen trials only; near-misses only effective when you chose…

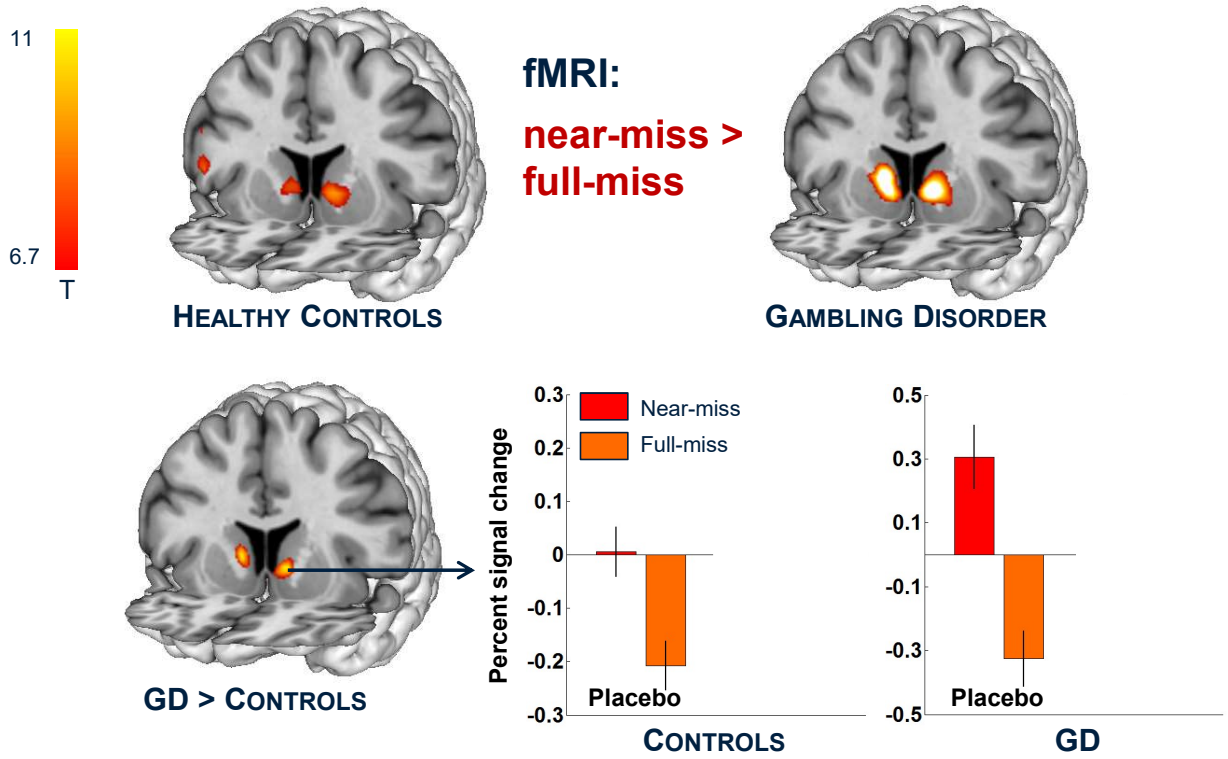
Clark et al 2009 Neuron

fMRI Responses to Wins & Near-Misses



Clark et al 2009 Neuron

Increased Striatal Reactivity to Near-Misses in Gambling Disorder



Sescousse et al 2016 Neuropsychopharm

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Critique of near-miss studies

Journal of Gambling Studies
https://doi.org/10.1007/s10899-019-09891-8

ORIGINAL PAPER

The Near-Miss Effect in Slot Machines: A Review and Experimental Analysis Over Half a Century Later

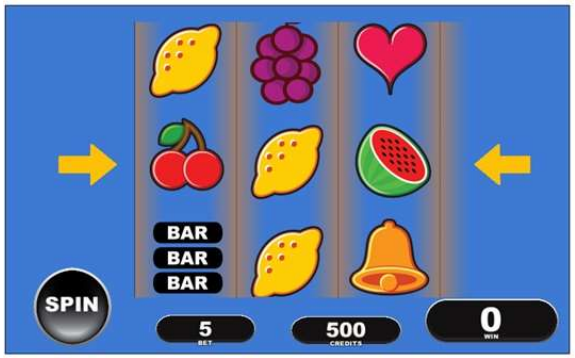
Jeffrey M. Pisklak[1] · Joshua J. H. Yong[1] · Marcia L. Spetch[1]

Given that the near-miss effect on gambling persistence was founded on an early and imprecise account of conditional reinforcement (Fantino 1977; Skinner 1953), near-miss research may have been misguided from the start. Furthermore, some studies—including the present work—seem to do more to challenge the belief that near misses prolong gambling. If near misses do lead to prolonged gambling, the effect appears to be limited or idiosyncratic (Witts et al. 2015). Nevertheless, 66 years after B.F. Skinner first proposed the idea, adherence to the belief that near-miss outcomes reinforce gambling persistence has remained strong. Our research questions the underlying premise that conditional reinforcement by near-miss stimuli should increase persistence of gambling behavior during extinction.

Revisiting the near-miss effect: a series of pre-registered replications

Lucas Palmer

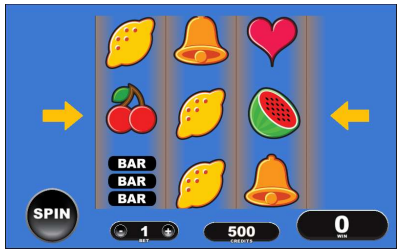
Study	d.v.s	Online N	Hypothesis
1a	Self-report: motivation, valence	169	NMs will increase motivation, but aversive (Clark et al 2009, 2012)
1b	Self-report: motivation, valence	148	(Direct replication of 1a)
2	Behavioural: spin initiation latency	170	NMs elicit faster response times (Dixon et al 2013)
3	Behavioural: bet size	172	NMs elicit higher bets on next spin (Alicart et al 2015)



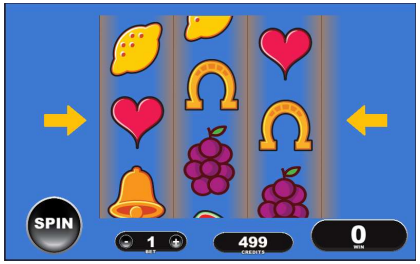
Palmer, Ferrari & Clark (under review; preprint on PsyArxiv)

Slot Machine Task

Initiation
(spin button)



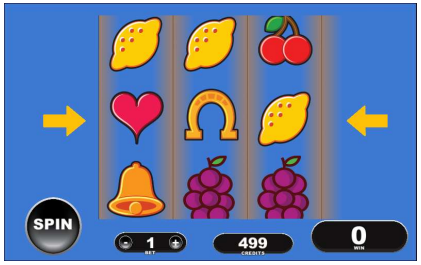
Anticipation



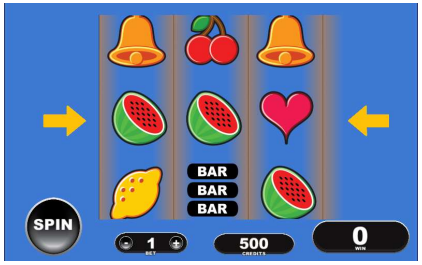
(reel spin ~2.8 s, followed by sequential stop)

Task coded in Unity, delivered online via Qualtrics

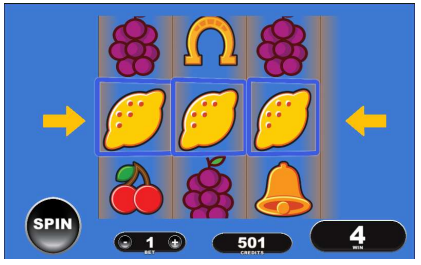
Outcome



Full-miss 3/6

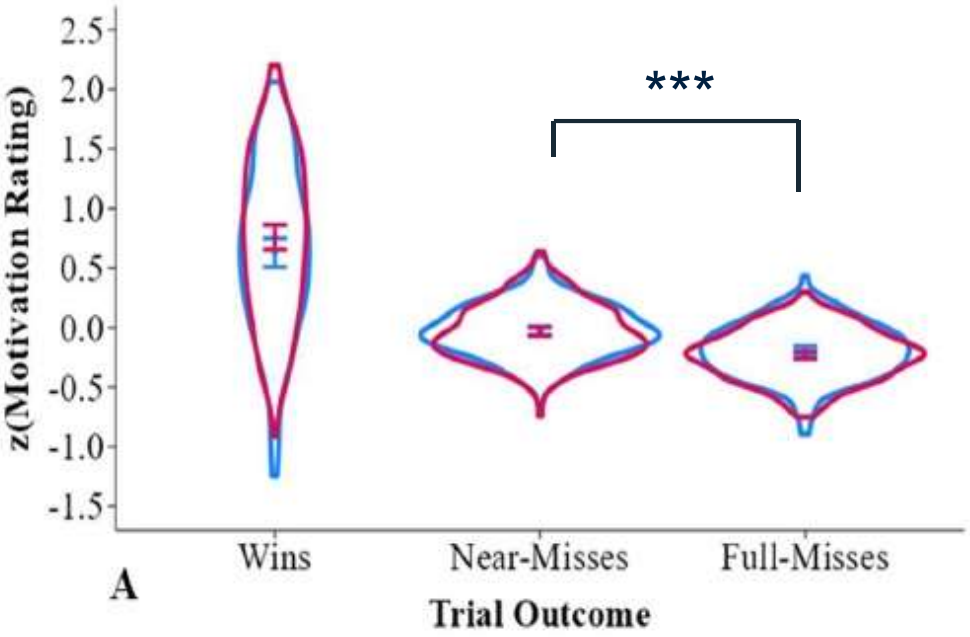


Near-miss 2/6

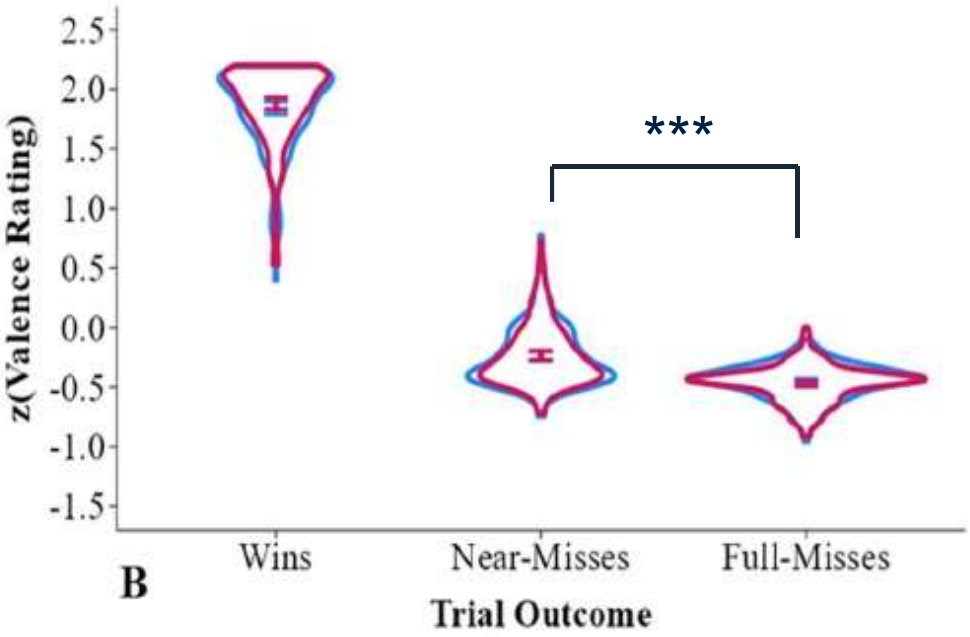


Win (1/6)

Study 1: motivation ratings
NM > FM p<.001 in 1a and 1b

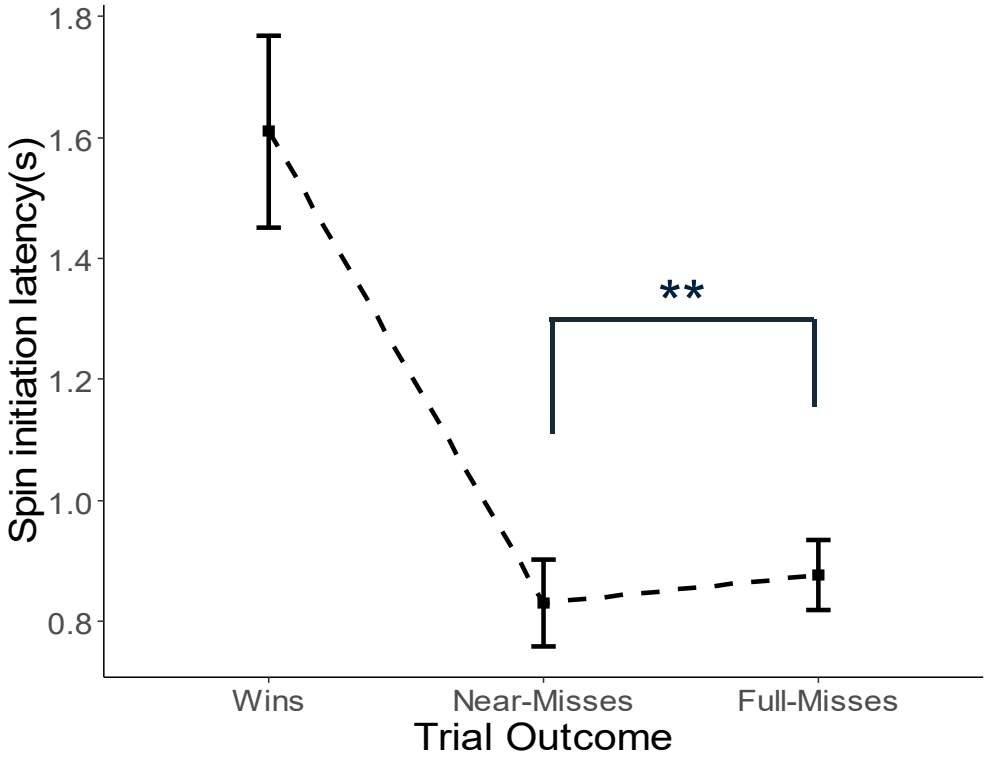


Study 1: valence ratings
NM > FM p<.001 in 1a and 1b

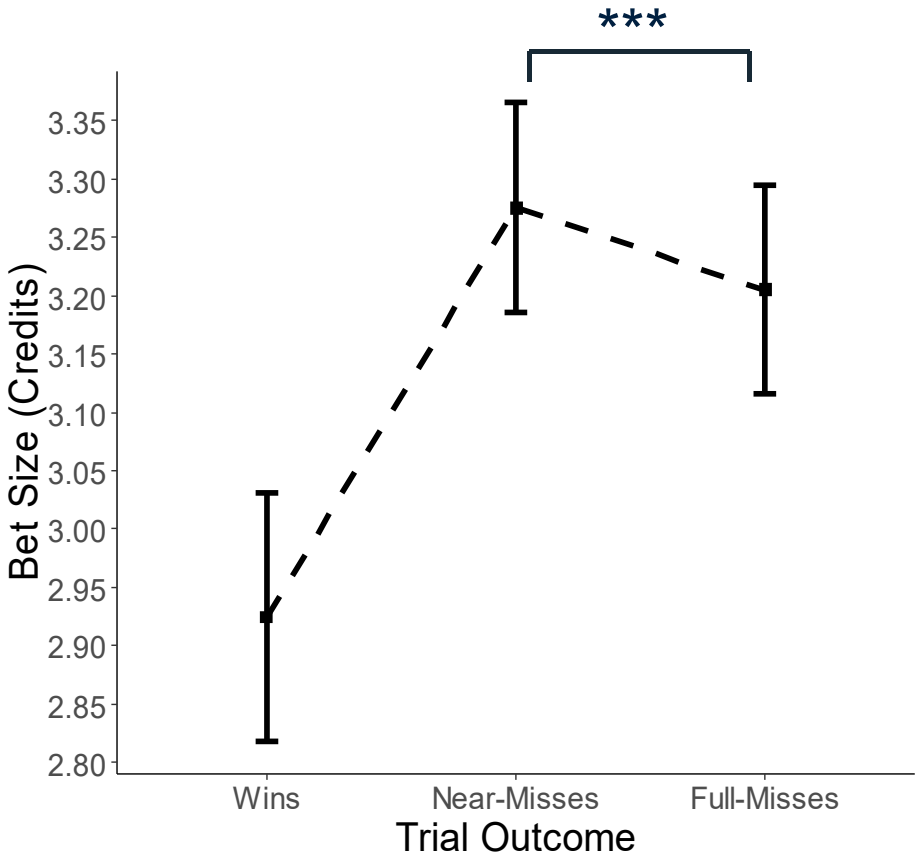


Compared to full-misses, near-misses increase motivation and rated more positively

Study 2: Spin initiation latencies



Study 3: bet size



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Interim summary: new near-miss data

- Across 4 separate datasets collected online, near-misses differed significantly from (objectively equivalent) full-miss outcomes on ALL dependent variables → their effects are reliable

- Nevertheless, our effects on valence ran contra to our hypothesis: near-misses were rated more positively. Boundary conditions?

- Overall pattern of data do not categorically support one theory of near-misses (frustration, regret, skill acquisition), e.g. near-misses were rated positively but have opposing effects to win on speed & bet size

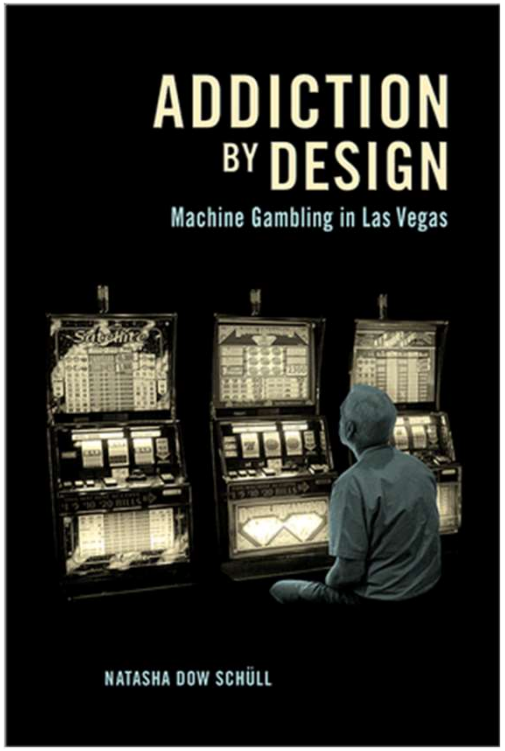
Research Program 2: Immersion

- ‘zoned in’ or ‘zoned out’

- The value of eye tracking on modern EGMs

Slot machine gamblers get lost in the game

- During gambling, many gamblers enter a state of immersion (‘trance-like’ state, dark flow, dissociation)
- Reliably correlated with gambling problems (Rogier et al 2021 meta)
- Mostly researched in context of (land-based) slot machines but unlikely to be specific (e.g. online: Remond & Romo 2018)
- Immersion may provide a means of escape from depression, financial anxiety, boredom, setting up negative reinforcement

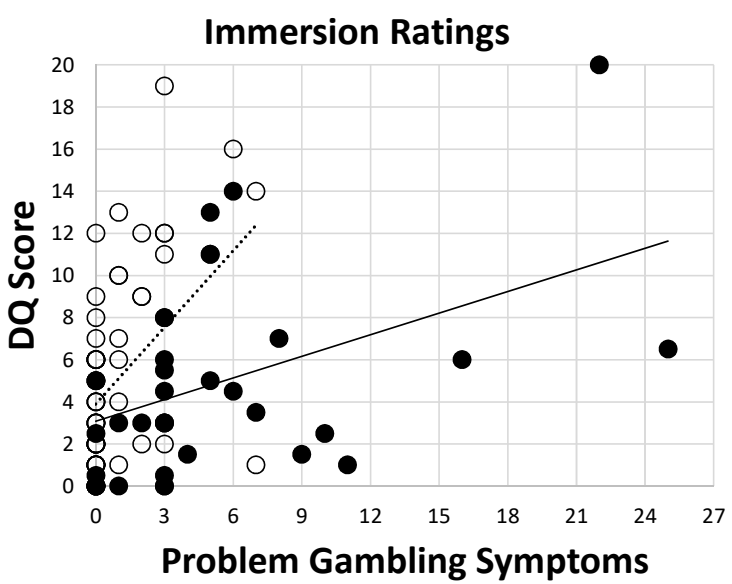


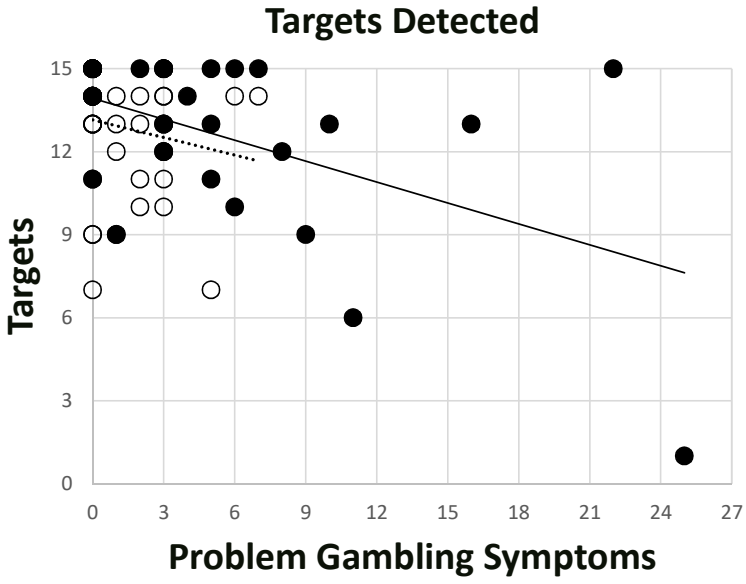
Spencer Murch

Measuring Immersion

Undergrads (some gambling involvement)

Community slot machine gamblers





In both groups, gambling severity predicted higher self-reported immersion

In community sample, gambling severity predicted fewer peripheral targets

Are immersed gamblers ‘zoned out’ or ‘zoned in’?

Trance-like, loses track of time, unaware of peripheral events

c.f. dissociative states

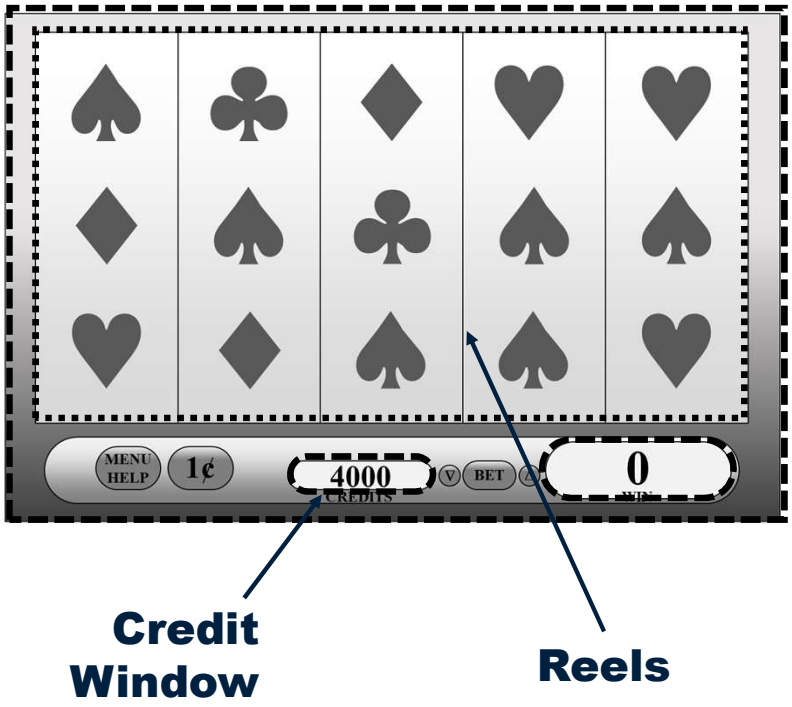
“Zoned out”

Intense focus on the activity and one’s performance

c.f. flow theory (Csikszentmihalyi)

“Zoned in”

Separating these accounts with mobile eye tracking during slot machine use



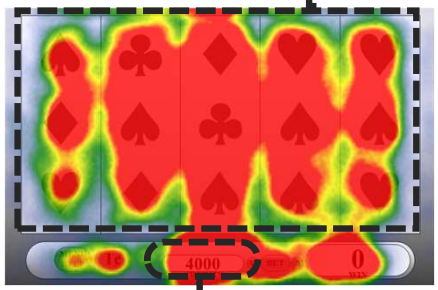
"Zoned out": eye movements to the reels as the primary source of stimulation

"Zoned in": distributed eye movements, including the credit and win information at the foot of the screen

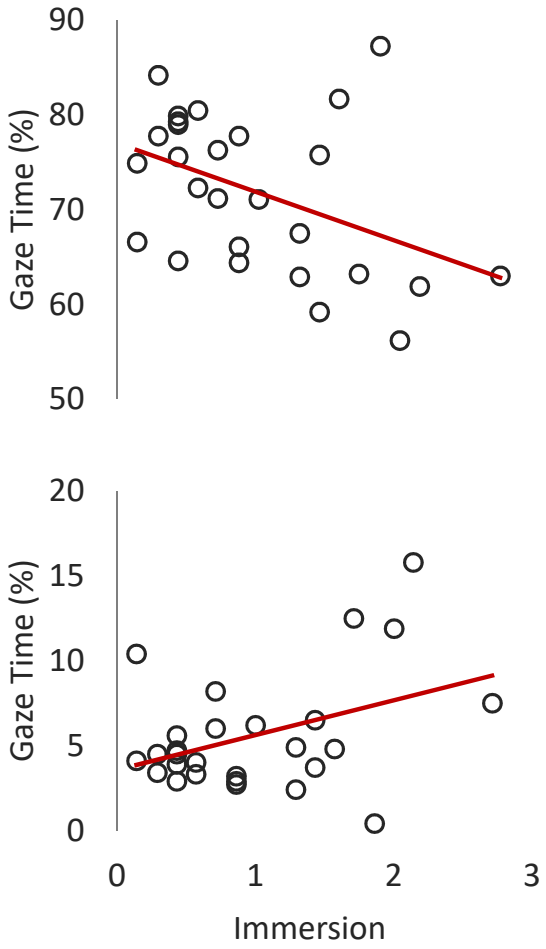
Design

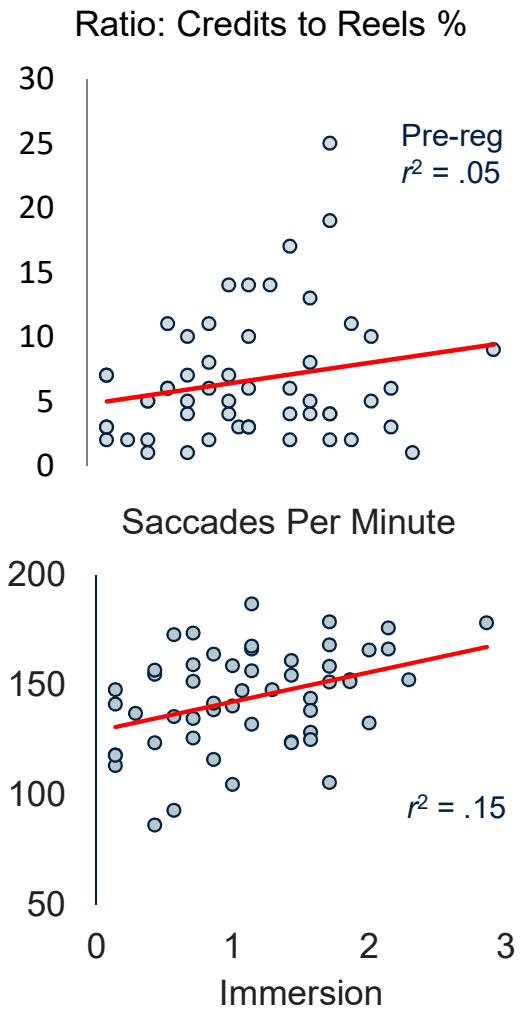
- SMI mobile eye tracking during 20 mins authentic slot machine use, followed by 7-item immersion scale (scored 0-4)
- Pilot in 27 subjects for pre-registering of hypotheses; main experiment in 53 regular slots gamblers from community

Reels AOI
111.0 fix/min
71.9% gaze time



Credit Window AOI
10.4 fix/min
5.6% gaze time





Murch et al (2020 *Addiction*)

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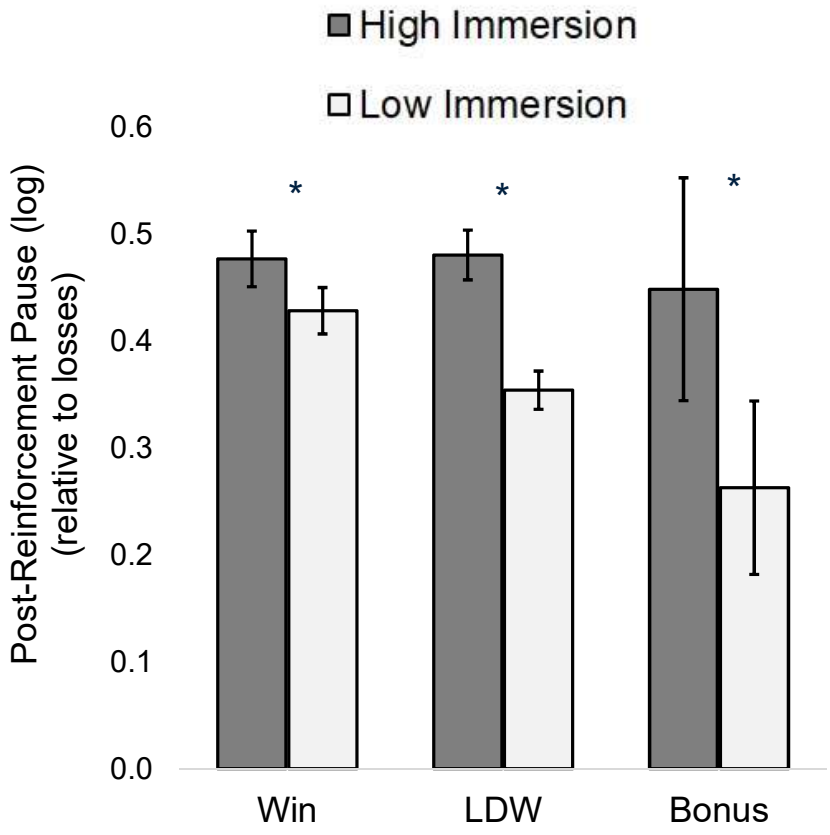
Eye tracking study: additional behavioral data

- Post-reinforcement pauses: after rewarding outcomes, gamblers (and pigeons) take longer to initiate their next response

- Event-related analysis:
  - Losses (baseline)
  - Wins
  - Losses disguised as wins
  - 'Free spin' bonuses

- Greater PRPs to rewarding events in more immersed participants



Murch et al (under review)

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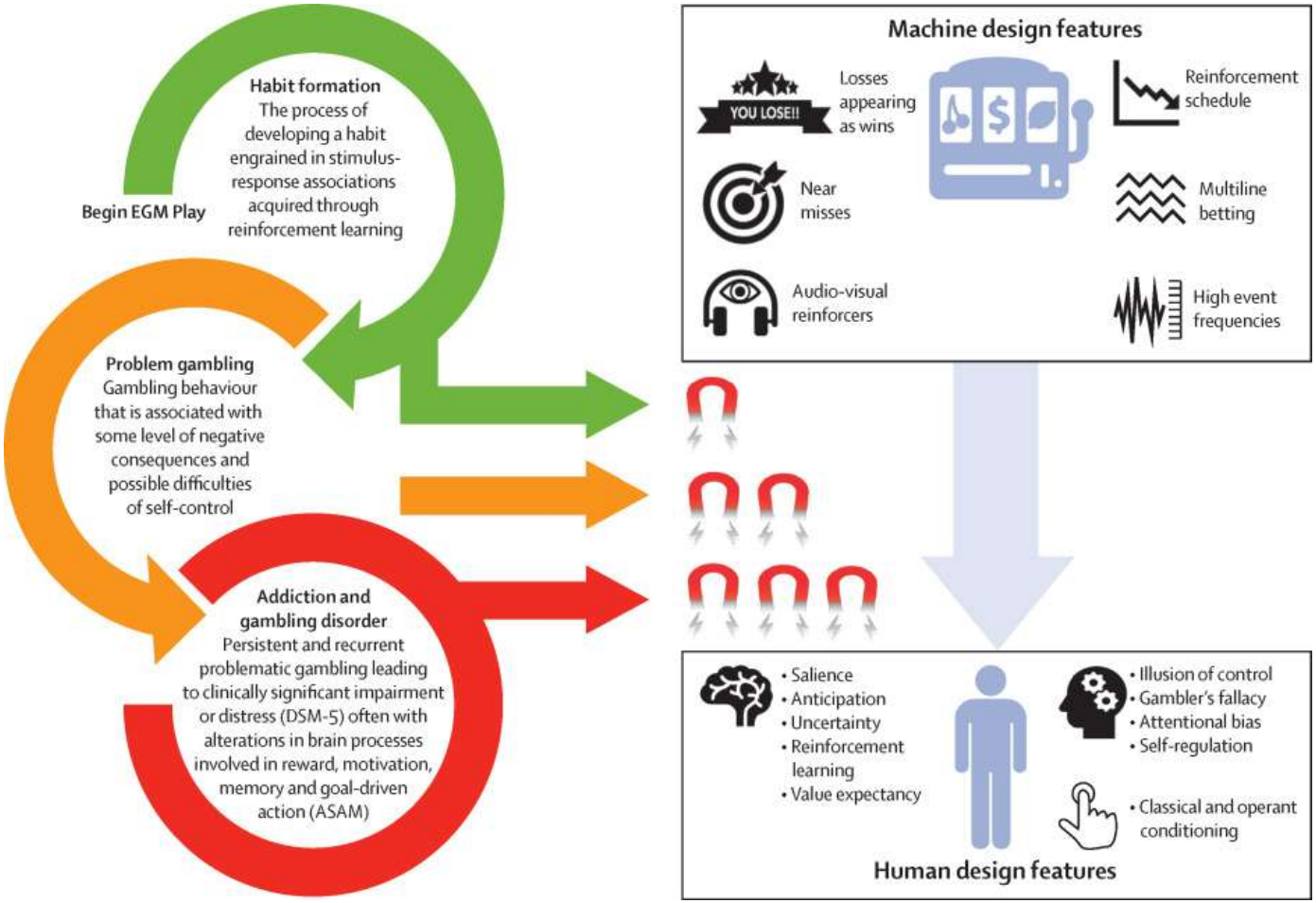
Implications for treatment & policy

- Gamblers, clinicians, & casino venue staff should consider that immersion is a state of *intense concentration* (akin to other healthy activities)
  - Implications for stigma

- In-game messaging needs to actively capture attention in immersed gamblers
  - Peripheral and static messages likely to be ineffective
  - Eye tracking can inform the dynamics of how messages should be presented



Yucel et al (2018 *Lancet Psychiatry*)

Take-home messages

- Gambling harms arise through an interplay of processes at the level of the Person, gambling Product, and wider Environment
- Within this framework, gambling Products represent the point of contact between the person and the wider environment
- Gambling products can be broken down into a number of discrete features (ingredients).
- It remains unclear whether the harm profile of any form of gambling is driven by specific features, or if many features create an immersive experience.
- We need to better understand the linkages between the 3 sets of factors: Person – Product, Person – Environment, Product – Environment.

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