Loss chasing in gambling disorder: clinical, behavioral, and data science perspectives

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Disclosures

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Objectives

• Part 1: the role of loss chasing in disordered gambling
  – Loss chasing as a ‘symptom’
  – Two perspectives on loss chasing: neurocognitive vs behavioral economics
  – Different behavioural expressions of loss chasing

• Part 2: recent data on the multi-faceted nature of chasing
  – Decision-making about gains vs losses in gambling disorder
  – Habit formation in slot machine gambling
  – Behavioural predictors of self exclusion in online gambling data
# Diagnosis of Gambling Disorder

**DSM-5: at least 4 from**

- Needs to gamble with increasing amounts
- Restless or irritable when attempting to stop gambling
- Repeated attempts to reduce or stop gambling
- Pre-occupation with gambling
- Gambles when feeling distressed
- After losing, often returns another day to get even
- Lying to conceal involvement
- Jeopardised / lost relationship or job due to gambling
- Forced to borrow money due to gambling debt

*(Illegal acts to support gambling – dropped from DSM-IV)*

Not better explained by manic episode
Loss chasing as the hallmark of disordered gambling

Lesieur 1977: a spiral of intensifying gambling, until all financial options are exhausted

Yucel et al 2018 Lancet Psychiatry

CENTRE for GAMBLING RESEARCH at UBC
Criteria for Pathological Gambling are not all equal

1. Loss chasing: too sensitive; too many non-problem gamblers endorse

2. Illegal acts: insensitive; only endorsed by gamblers who already meet the diagnosis anyway

Toce-Gerstein et al (2003 Addiction): data from 2 large household surveys $n > 2900$ (DSM-IV, so 10 symptoms = 100%)
Two lenses for thinking about loss chasing

- **Neurocognitive view**
  - Loss chasing as a lack of inhibitory control or self-regulation, or ‘compulsivity’
  - Urgency (emotionally-triggered impulsivity) as a key construct
  - Evidence from self-report, cognitive testing, brain imaging

- **Behavioral economics**
  - Prospect Theory (Kahneman & Tversky 1978) describes the subjective valuation of gains and losses
  - “losses loom larger than gains” (loss aversion) as well as other mechanisms that could shape gambling choices...
  - Inspires modern research on mental accounting & behavioral insights

See Zhang & Clark 2020 Curr Op Beh Sci
Imas (2016) the ‘realization effect’: the physical exchange of money between gambles forces the investor to re-reference & abolishes loss-chasing.

A. Person ‘re-references’ after each outcome; their choices are not influenced by past gains or losses, so no loss chasing.

B. Person does NOT re-reference between each decision; after 3 successive losses, flattening curve at $R_3$ makes gambler less sensitive to prospect of further losses (→ loss chasing).
Different expressions of chasing

- Between-session chasing (returning another day) vs within-session (Lesieur 1984, Walker 1992, O’Connor & Dickerson 2003)

- Within-session chasing in multiple forms!
  - Gambling for longer (persistence)
  - Increasing bet size through the session
  - Faster pace of play

- Is chasing restricted to losing?
  - O’Connor & Dickerson (2003 JoGS)
  - The house money effect & non-linearity

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Table 1
Chasing-Related Win and Loss Items Endorsed
(“Sometimes–Very Often”): EGM vs. TAB

<table>
<thead>
<tr>
<th></th>
<th>EGM</th>
<th>TAB</th>
<th>X²</th>
</tr>
</thead>
<tbody>
<tr>
<td>After Winning Heavily:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thought . . . continue betting</td>
<td>57.6</td>
<td>82.4</td>
<td>11.31***</td>
</tr>
<tr>
<td>Felt an urge to continue betting</td>
<td>54.5</td>
<td>76.5</td>
<td>8.36**</td>
</tr>
<tr>
<td>Actually continued betting</td>
<td>53.5</td>
<td>76.5</td>
<td>9.08***</td>
</tr>
<tr>
<td>Thought . . . increase the size of bets</td>
<td>34.3</td>
<td>41.2</td>
<td>.81</td>
</tr>
<tr>
<td>Felt an urge to increase the size of bets</td>
<td>39.4</td>
<td>55.9</td>
<td>4.41*</td>
</tr>
<tr>
<td>Actually increased the size of bets</td>
<td>27.3</td>
<td>47.1</td>
<td>6.91***</td>
</tr>
</tbody>
</table>

| After Losing Heavily: |     |     |     |
| Thought . . . continue betting | 50.4 | 49.3 | .02 |
| Felt an urge to continue betting | 58.0 | 56.7 | .03 |
| Actually continued betting | 35.3 | 40.3 | .46 |
| Thought . . . increase the size of bets | 18.3 | 31.3 | 4.08* |
| Felt an urge to increase the size of bets | 27.0 | 41.8 | 4.25* |
| Actually increased the size of bets | 14.7 | 20.9 | 1.17 |
| Continued after a near-miss | 43.1 | 50.0 | 5.27* |
| Increased the size of bets after a near-miss | 19.0 | 32.1 | 4.95* |

*p < .05; **p < .01; ***p < .001.
Part 2

- Understanding chasing in disordered gambling
  - Decision-making about gains vs losses in gambling disorder (Limbrick-Oldfield et al 2020 J Behavioral Addictions)
  - Habit formation in slot machine gambling (Ferrari et al, under review)
  - Behavioural predictors of self exclusion in online gambling data (Finkenwirth et al 2021 Int Gambling Studies)
Decision-making in Gambling Disorder

- Many studies show poor/risky choices on the Iowa Gambling Task in disordered gambling (Kovacs et al 2017 meta) – but hard to interpret given complexity and learning demands of task


- Behavioural economics: choices maximize expected value as the combination of magnitude (gain / loss) × probability information (see also Ligneul et al 2013, Ring et al 2018)
Sensitivity to expected value: task

a.

Decision (unlimited) Anticipation (1000ms) Outcome (3500ms) OR Outcome (2500ms) ITI (500ms)

GAIN

No win...

You won!

No loss!

You lost...

LOSS

b. EV ratio = -.909 (negative)

Gain version:
Left: EV = .6 * 1 = 0.6
Right EV = .4 * 4 = 1.6 (optimal)

Loss version
Left EV = .6 * -1 = -0.6 (optimal)
Right EV = .4 * 4 = -1.6

c. EV ratio = .909 (positive)

Gain version:
Left: EV = .8 * 2 = 1.6 (optimal)
Right EV = .2 * 3 = 0.6

Loss version
Left EV = .8 * -2 = -1.6
Right EV = .2 * 3 = -0.6 (optimal)

### Methods: Participants

<table>
<thead>
<tr>
<th></th>
<th>Gambling Disorder</th>
<th>Healthy Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number</strong></td>
<td>48</td>
<td>35</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td>24M : 23F : 1 other</td>
<td>17M : 17F : 1 other</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>41.5 (22-65)</td>
<td>32.0 (21-65)</td>
</tr>
<tr>
<td><strong>PGSI</strong></td>
<td>16.5 (8-27)</td>
<td>0 (0-2)</td>
</tr>
<tr>
<td><strong>NART</strong></td>
<td>93.0 (1.7)</td>
<td>93.1 (1.2)</td>
</tr>
<tr>
<td><strong>GRCS</strong></td>
<td>78.3 (26-142)</td>
<td>29 (23-161)</td>
</tr>
</tbody>
</table>

- GD recruited via advertising and BC treatment program
- Diagnosis by SCID-IV interview + PGSI > 7
- Preferred form of gambling was slots in 48%
- Controls mostly non-gamblers (9 with PGSI 1-2)
- See also Kennedy et al (2019 *Psychophys*, interoception & HRV), Wu et al (2021 *Addictive Bhvs*, on regret)
Reduced sensitivity to Expected Value in both gain and loss decisions

- Separating probability and magnitude parameters, GD less sensitive to both

Limbrick-Oldfield et al (2020 J Behavioral Addictions)
Highly sensitive to both GD severity and cognitive distortions

**Gain Choices**

- **Gambling Severity (PGSI)**
- **Gambling Related Cognitions**

**Loss Choices**

- **Gambling Severity (PGSI)**
- **Gambling Related Cognitions**

Limbrick-Oldfield et al (2020) *J Behavioral Addictions*
Effects of prior feedback -- between independent trials

Gain model: GD (but not controls) are less sensitive to EV after a zero-point outcome

Loss model: GD (but not controls) are less sensitive to EV after a loss

Across both conditions, the group with Gambling Disorder appear to be less sensitive to EV because they continue to be influenced by the emotional (and irrelevant) consequences of the previous trial.
Behavourial expressions of habit formation in slot machine gambling

- How does behaviour change within and across sessions?
- 56 Ps with no prior slot machine experience
- Two markers: 1) speed of play, 2) changing bet

Mario Ferrari
Within- and between-session behaviour

1. Speed of play (‘spin initiation latency’)

2. Bet changes

→ Participants become faster and more rigid in betting style both within a session, and across successive sessions of play

Mario Ferrari et al, under review
How are habits shaped by wins and losses?

- Modelling behaviour following wins, including win size as a predictor
  - ‘Post reinforcement pauses’ are sensitive to win size
  - This *slowing* also increases across sessions (session × win size, p = .011)

- Modelling behaviour following losses, with loss streak length as a predictor
  - Losing streaks predict a faster speed of gambling

Mario Ferrari et al, under review
Study 2: habit formation in slot machine gambling

- The behavioural repertoire during slot machine gambling is limited, but this ‘micro-analysis’ of behavior can still identify markers relevant to loss chasing.
- Behavioural effects of practice can be observed both within and between sessions of gambling:
  - Consistent with psychological theories of habit formation.
- These effects are influenced, and in different ways, by gains and losses:
  - Including a cumulative effect of losing streaks on speed of play.
Online Gambling

- BC has a single, state-run online gambling platform called PlayNow.com (since 2004)
- Public concern over e.g. 24/7 access
- Evidence that online gamblers have high rates of gambling problems
- Unlike most land-based gambling, the logging of all transactions against the user’s account creates a unique opportunities for detection and intervention
# Tracking Disordered Gambling?

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*Not better explained by manic episode*
Study 3: Predicting Self-Exclusion in Online Data

- ~75% of VSE enrollees screen positive for problem gambling (McCormick et al 2018, Hayer & Meyer 2011)

- 1 year dataset from PlayNow.com ‘eCasino’: 30,902 users, from Oct 2014 – Sept 2015, 575 million bets

- De-identified data from PlayNow.com provided by BCLC, only accessible to BC residents

- 2,157 gamblers with self-exclusion status, 17,526 gamblers without previous self-exclusion, all placed >200 bets

- 20 input variables, of bet-by-bet gambling behaviour (e.g. active days, total sessions, variance in bet size)

Input Variables

Days Gambled  
Total Sessions  
Total Bets  
Bets per Session  
Variance (Bets per Session)  
Games per Session  
Variance (Games per Session)  
Total Money Bet  
Money Bet per Session  
Variance (Money Bet per Session)  
Sessions per Day  
Bets per Day  
Average Session Length  
Variance (Average Session Length)  
Total Money Bet from Promotional Offers  
Promotional Bets per Session  
Total Net Loss  
Net Loss per Session  
Total Net Win  
Net Win per Session
Machine Learning: Analysis Plan

- Primary model: Random Forest with 10-fold nested cross-validation
- Use simple Logistic Regression as baseline
- Sensitivity checks:
  - Balanced dataset: 2,157 with VSE vs 2,157 non-VSE randomly-chosen controls
  - Variable reduction to attain set of sufficiently uncorrelated inputs (corr. coef. < 0.3)
  - User threshold: all gamblers with >10 sessions (1,776 with VSE vs 13,470 controls)
Predicting Self-Exclusion in Online Gambling Data

Table 2. Random forest classification modeling results.

<table>
<thead>
<tr>
<th></th>
<th>Unbalanced data</th>
<th>Balanced data</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2,157 vs. 17,526</td>
<td>1,776 vs. 13,470</td>
</tr>
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<td></td>
<td>2,157 vs. 2,157</td>
<td>1,776 vs. 1,776</td>
</tr>
<tr>
<td></td>
<td>&gt;200 bets</td>
<td>&gt;10 sessions</td>
</tr>
<tr>
<td></td>
<td>&gt;200 bets</td>
<td>&gt;10 sessions</td>
</tr>
<tr>
<td>All variables (20)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AUROC</td>
<td>0.75 (0.01)</td>
<td>0.73 (0.02)</td>
</tr>
<tr>
<td>sensitivity</td>
<td>0.69</td>
<td>0.67</td>
</tr>
<tr>
<td>specificity</td>
<td>0.65</td>
<td>0.69</td>
</tr>
<tr>
<td>Selected variables (6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AUROC</td>
<td>0.70 (0.01)</td>
<td>0.65 (0.01)</td>
</tr>
<tr>
<td>sensitivity</td>
<td>0.63</td>
<td>0.60</td>
</tr>
<tr>
<td>specificity</td>
<td>0.59</td>
<td>0.70</td>
</tr>
</tbody>
</table>

Baseline performance with Logistic Regression: AUROC 39%

Finkenwirth et al 2021
Int Gambling Studies
Which variables are most predictive?

- Variance in Money Bet per Session accounts for 32% of discriminatory power in reduced variable set – likely to indicate episodic loss chasing (also Adami et al 2013)
Take-home messages I

• “Fundamentally, it is widely accepted that chasing of losses when gambling is the most significant step towards developing a gambling disorder” (A Parke et al 2015 JoGS)

• “Chasing losses ... a common feature in regular gamblers, is clearly a constellation of cognitive, emotive/arousal ("urges") and behavioral components associated with continuing to bet and increasing the size of bets” (O’Connor & Dickerson 2003 JoGS)
Take-home messages II

• People with gambling disorder are less sensitive to payoff structure in their gambling choices ... this appears to be due to a susceptibility or stickiness of prior outcomes – and it is primarily driven by loss outcomes

• In slot machine play, behavioural effects of practice can be observed both within and between sessions of gambling – even in novice gamblers playing for the first time. These effects are also influenced by gains and losses

• In online gambling, chasing is important as one of the few features of disordered gambling that we could expect to identify in tracked data. High variability in session spending was a key predictor of self exclusion
With thanks!

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Online gambling: Tilman Lesch, Kent Macdonld
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