

Dark Flow and Reactivity to Rewards: Distinct Routes to Slot Machine Enjoyment for Problem and Recreational Slots Players

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Disclosure of Potential Conflict of Interest

Presenter Disclosure

- I have no potential conflicts of interest for my presentation.

“You go into that trance, that zone, that box. Nobody can touch you. You have escaped from reality. No one can ask you for anything”

Lose track of time

Effortless Concentration

Complete Absorption

Lose sense of the self

Forget everything else



“Dark Flow”

(Dixon, Stange, Larche, Graydon, Fugelsang and Harrigan (2017))

A Dark Path to Enjoying Slots

- 1) There is a reliable relation between “dark flow” and Problem Gambling
- 2) Since flow states are highly pleasurable we posit that PGs enjoy slots because they experience (dark) flow
- 3) Show in two separate studies that dark flow is related to PG and Depression



- 1) Majority of players are not PGs and do not experience dark flow - Report playing slots because it is exciting, arousing, fun...

A light(er) path to enjoying slots

- 3) I will show two in-game measures that quantify the degree to which players react to wins
- 4) I will show that this reactivity to rewards predicts how much they enjoyed a slots session
- 5) Show that neither measure is related to PG or depression



Propose an account of **why** Problem Gamblers tend to experience dark flow

Lose track of time

Effortless Concentration

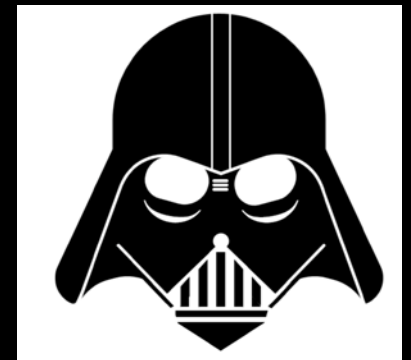
Lose sense of the self

Complete Absorption

Lose track of everything else

On game!!!

Dark Flow



PROBLEM GAMBLERS

Dark Flow

“You go into that trance, that zone, that box. Nobody can touch you. You have escaped from reality. No one can ask you for anything”



Early Study on Dark Flow in Multiline Games

Recorded the game play of 83 participants

Used standard cutoffs of the Problem Gambling Severity Index

29 Non-problem gamblers

25 Moderate Risk gamblers

29 Problem Gamblers

Played 2 actual slot machines for 250 spins each
told to play as they would in a casino

Players could select 1, 5, 9 or 15 lines

Dark Flow

- Game Experiences Questionnaire
 - Brief version

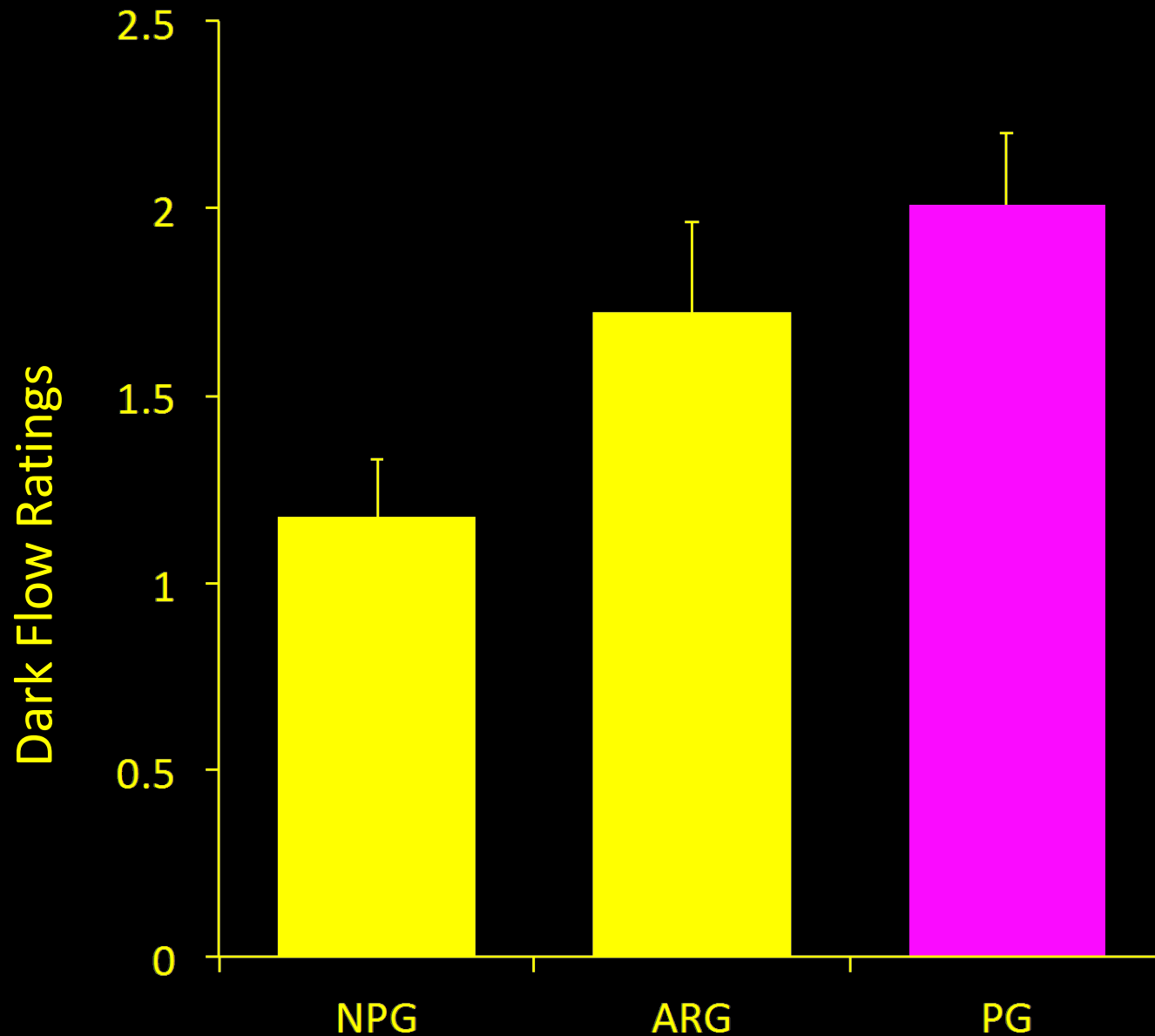
I forgot everything around me.

- Not at all
- Slightly
- Moderately
- Fairly
- Extremely

I felt completely absorbed.

- Not at all
- Slightly
- Moderately
- Fairly
- Extremely

PGs give higher ratings of Dark Flow



PGs give higher ratings of Dark Flow

Correlations of PGSI scores and Dark Flow ratings

within session replications

$r(132) = .419, p < .001$ (20 lines, 37 LDWs)

$r(131) = .408, p < .001$ (20 lines, 74 LDWs)

$r(125) = .237, p = .008$ (9 lines, 65 LDWs, stop button)

$r(125) = .291, p = .001$ (9 lines, 65 LDWs)

I forgot everything around me.

- Not at all
- Slightly
- Moderately
- Fairly
- Extremely

I was deeply concentrated in the game.

- Not at all
- Slightly
- Moderately
- Fairly
- Extremely

I lost track of time.

- Not at all
- Slightly
- Moderately
- Fairly
- Extremely

I was fully occupied with the game.

- Not at all
- Slightly
- Moderately
- Fairly
- Extremely

I lost connection with the outside world.

- Not at all
- Slightly
- Moderately
- Fairly
- Extremely

PGs give higher ratings of Dark Flow

Correlations of PGSI scores and Dark Flow ratings

$r(98) = .301, p < .005$

$r(104) = .315, p < .001$

$r(134) = .572, p < .001$

$r(127) = .250, p < .01$

- 1) There is a reliable relation between “dark flow” and Problem Gambling Status
- 2) Since flow states are highly pleasurable we posit that PGs enjoy slots because they experience (dark) flow



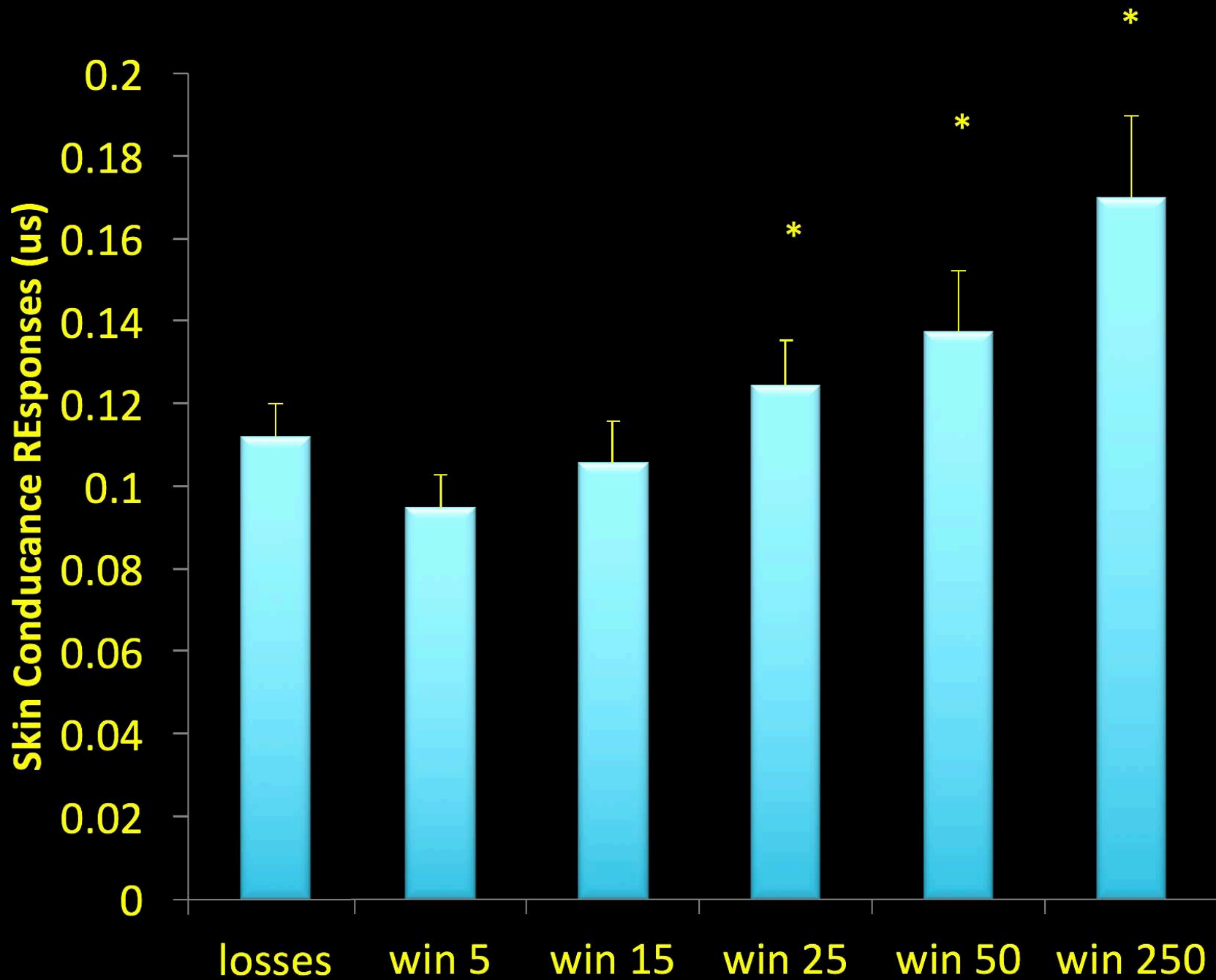
REACTIVITY TO REWARD

- Players enjoy playing due to the **rewarding property** of the wins
- Players describe how wins are exciting and subjectively arousing
- What we sought was a measure that captures the **degree** to which players react to wins of different sizes
- Show that there is a relation between the degree of reactivity to reward and slot enjoyment

MEASURING REACTIVITY TO REWARD

- BUT....
- We also wanted a measure that would not interfere with people experiencing dark flow

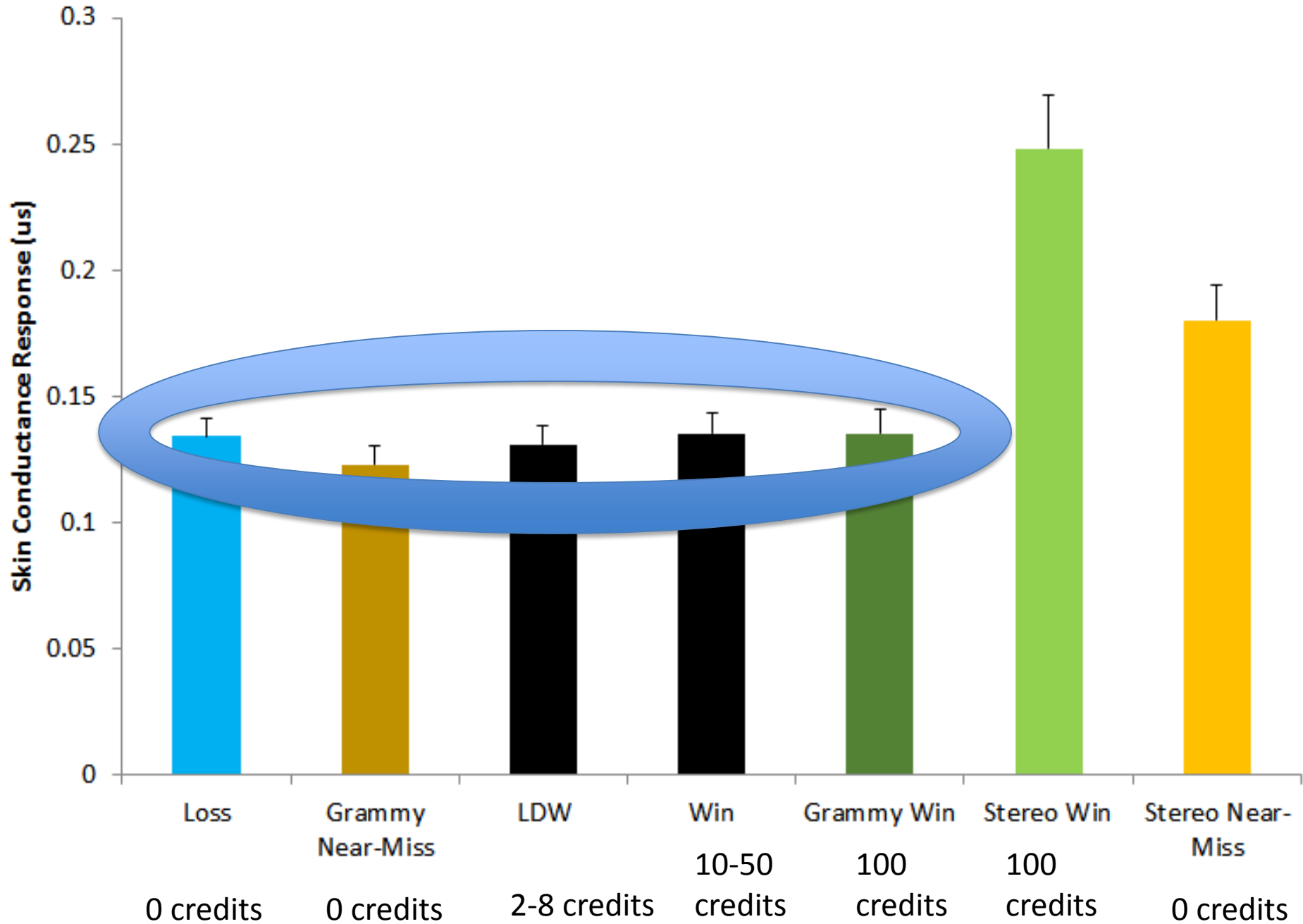




What about Multiline Games?



Post-Outcome Skin Conductance Responses



Ignore those wires!!!!

Don't move your left hand whatever you do!!!!

Now just play the game as you would normally.....



The flow killers

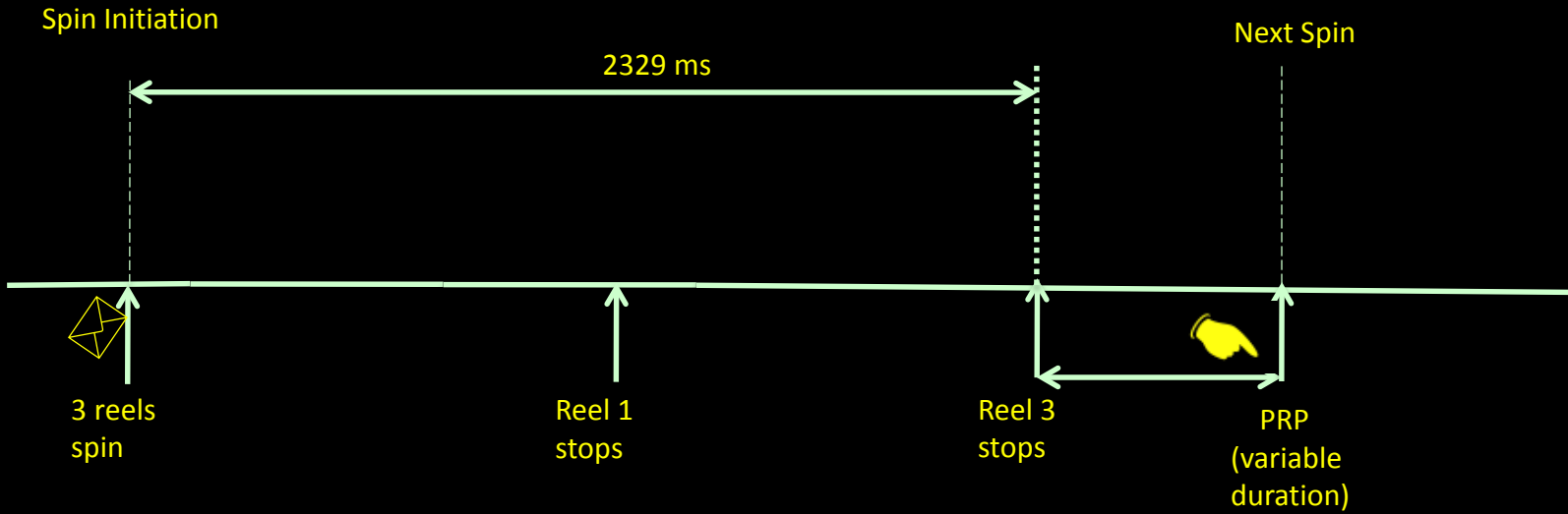
Post Reinforcement Pauses and Reward

- The reward system is composed of two components
 - 1) Appetitive reward seeking (wanting)
 - 2) Consummatory enjoyment of rewards (liking)

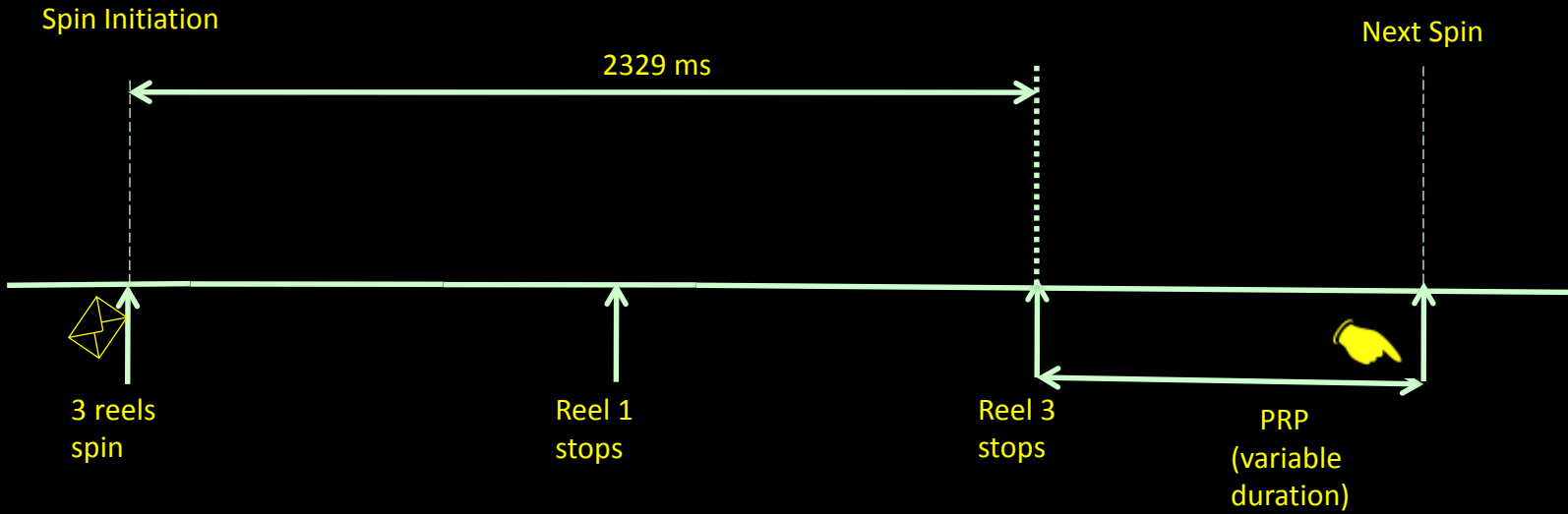
Post Reinforcement Pauses

- In naturalistic slot machine play, following a loss, players tend to spin quickly
- Following a win, however there is a brief pause, the bigger the win, the longer the pause
- These pauses are called the post reinforcement pauses (PRPs)

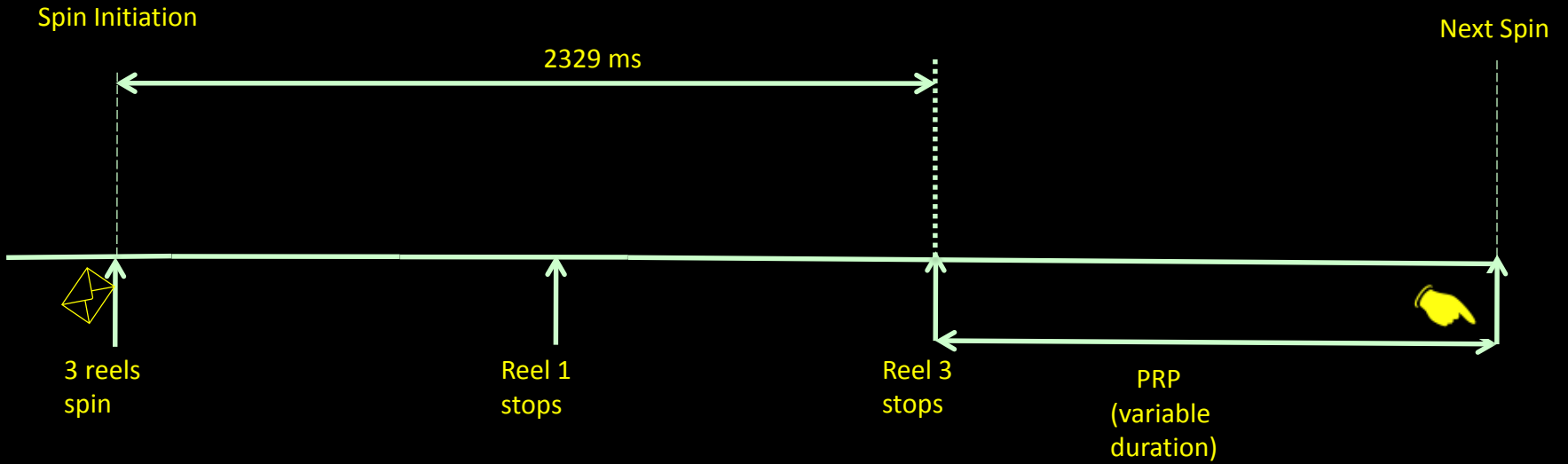
loss

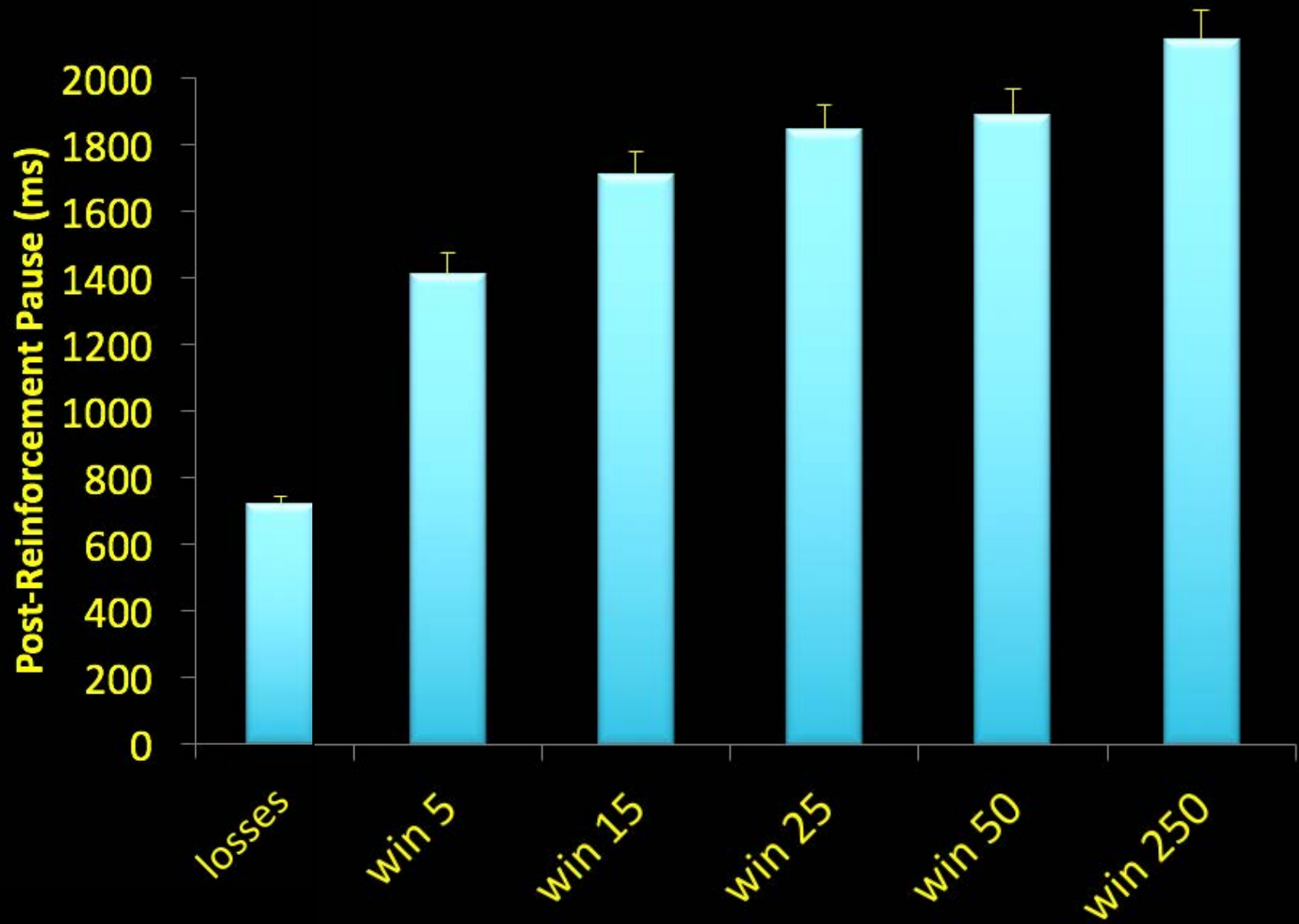


Win 15

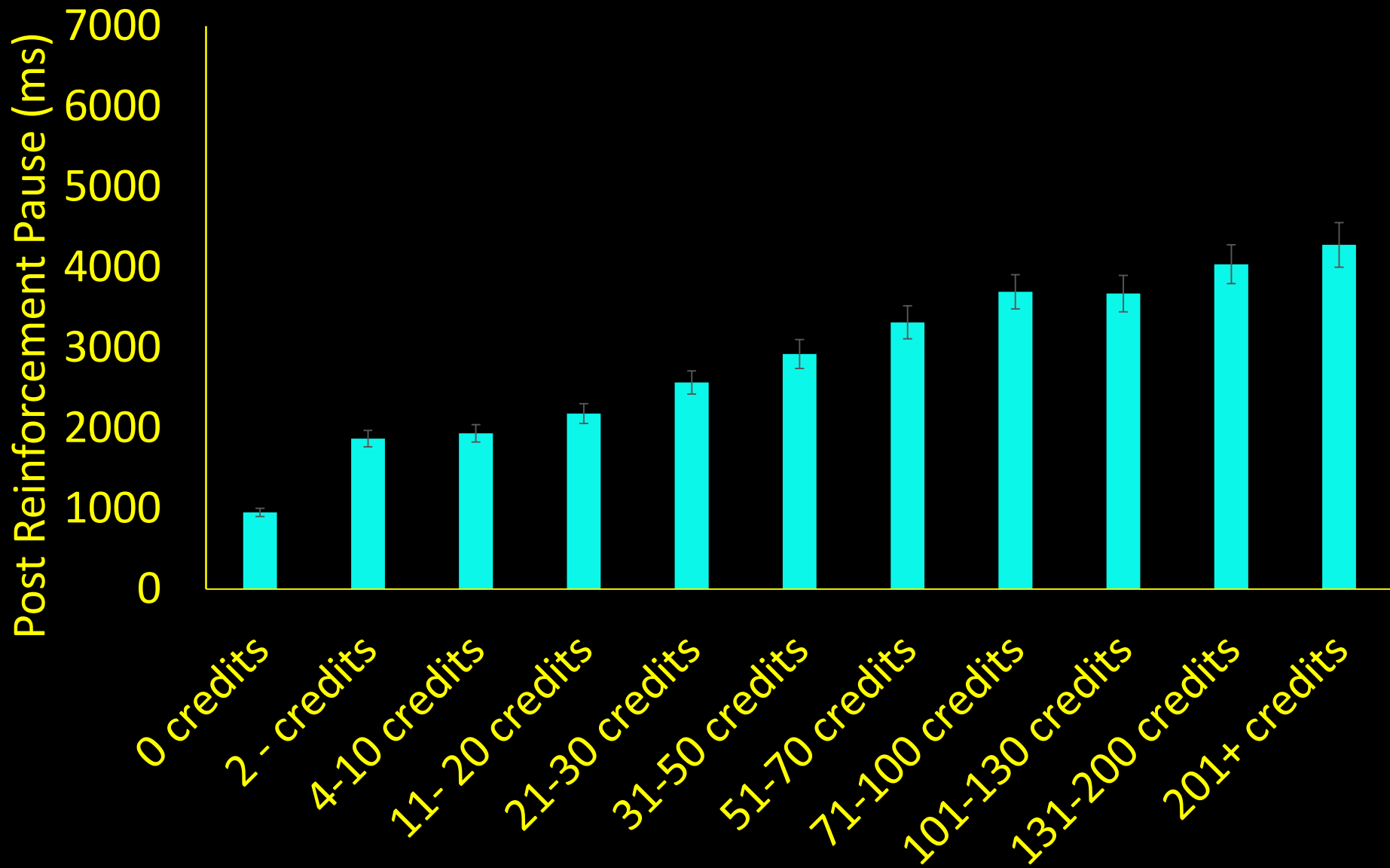


Win 250

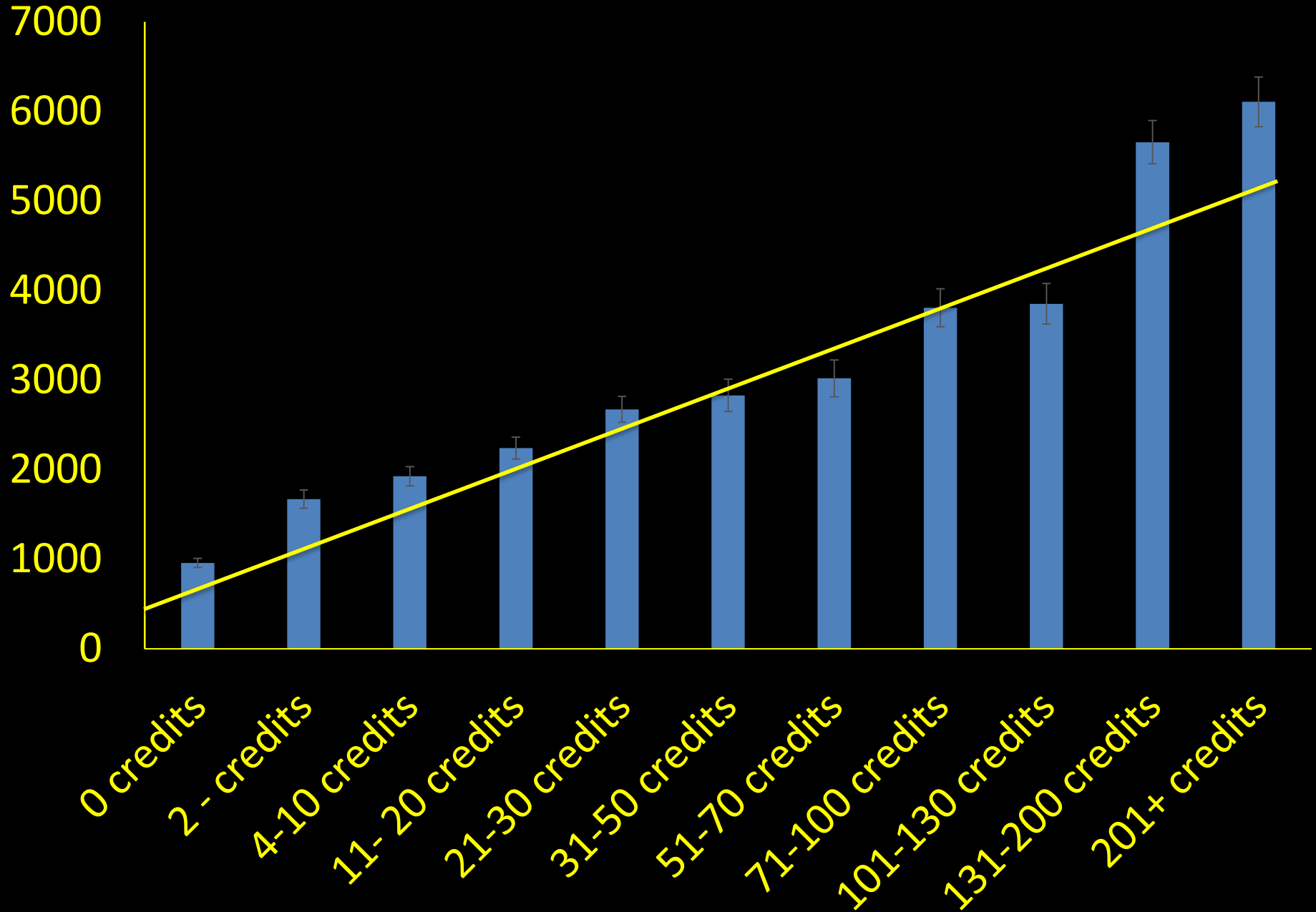




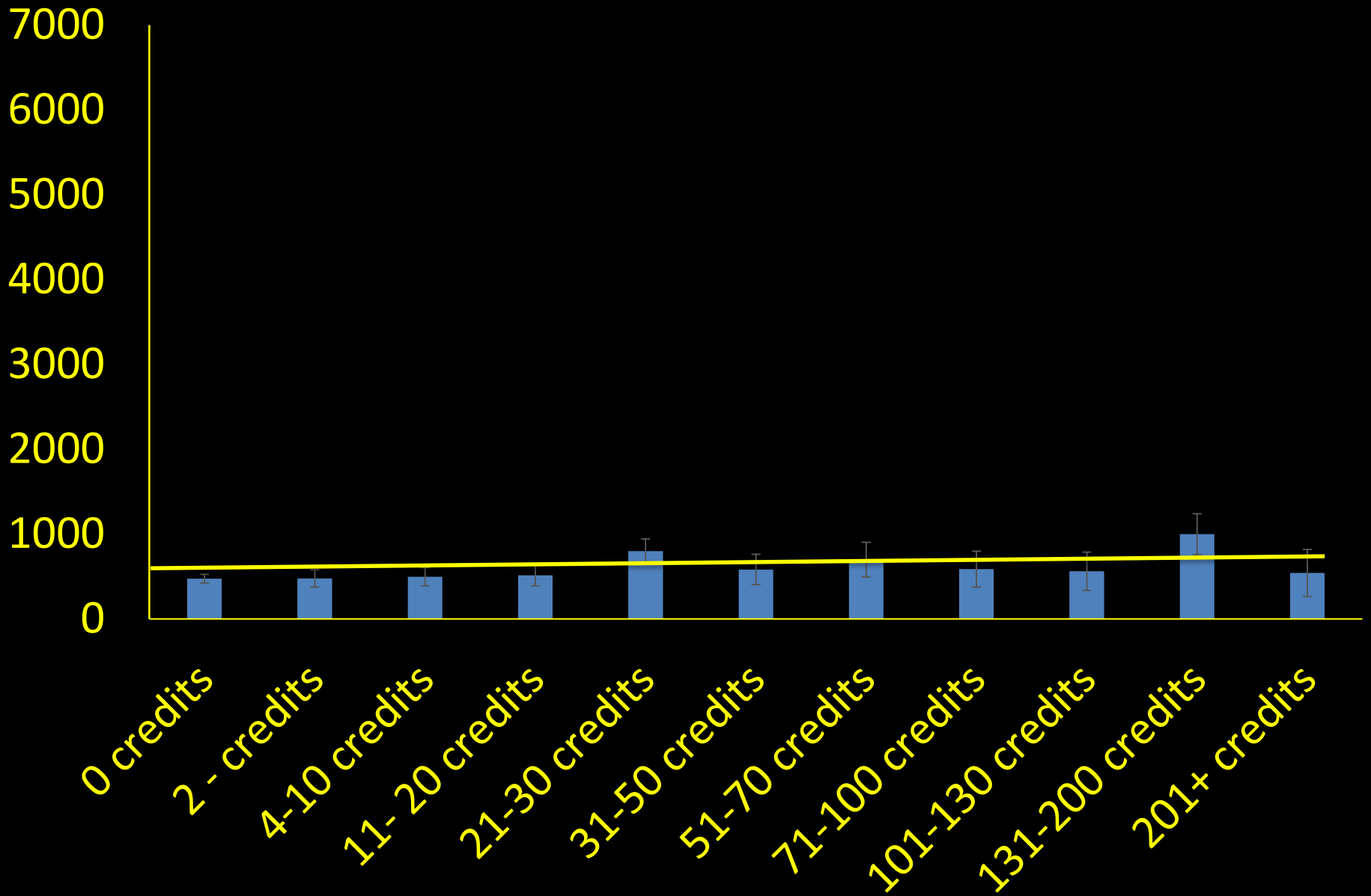
Average Post Reinforcement Pauses Over Credit Gains In a 20 line game



Reactive Participant



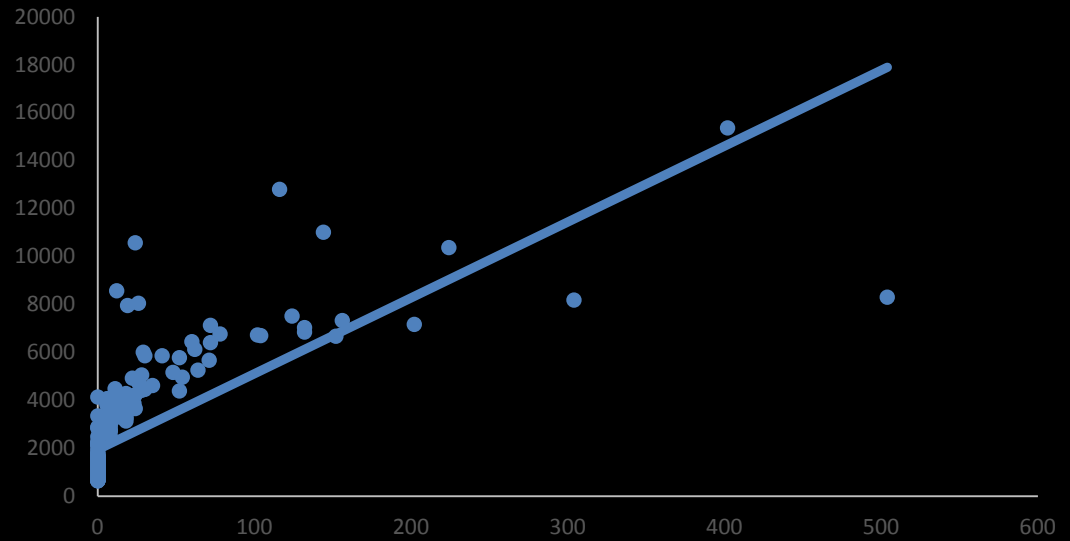
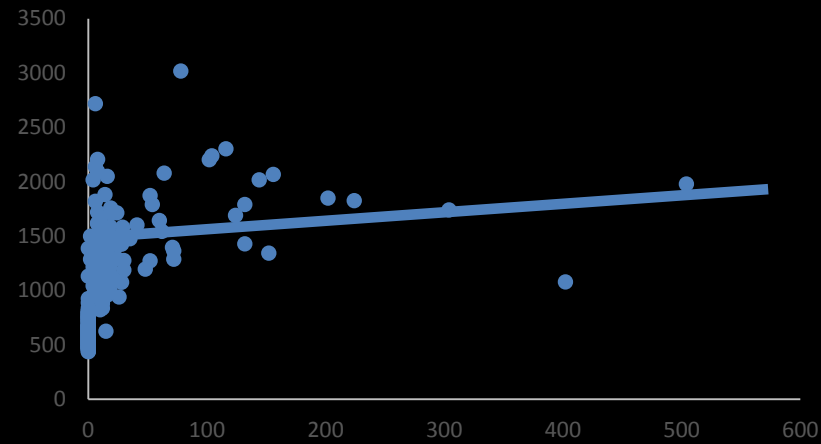
Non-Reactive Participant





PRPS

PRPS



HAVE PLAYERS PLAY A SLOTS SESSION (MIN 250 SPINS)

- Measure Reactivity to Rewards
 - Those with steeper slopes will report enjoying the session more
 - No relation to problem gambling or depression
- Measure Dark Flow
 - Those who experience dark flow more will report enjoying the session more
 - Strong relation to Problem Gambling and Depression

Light and Dark Paths to Enjoying slots



Light and Dark paths to enjoying slots play

- Positive Valence During Slots Session
 - Assessed using 5 items of GEQ

I enjoyed it.

- Not at all
- Slightly
- Moderately
- Fairly
- Extremely

I felt content.

- Not at all
- Slightly
- Moderately
- Fairly
- Extremely

I thought it was fun.

- Not at all
- Slightly
- Moderately
- Fairly
- Extremely

I felt happy.

- Not at all
- Slightly
- Moderately
- Fairly
- Extremely

I felt good.

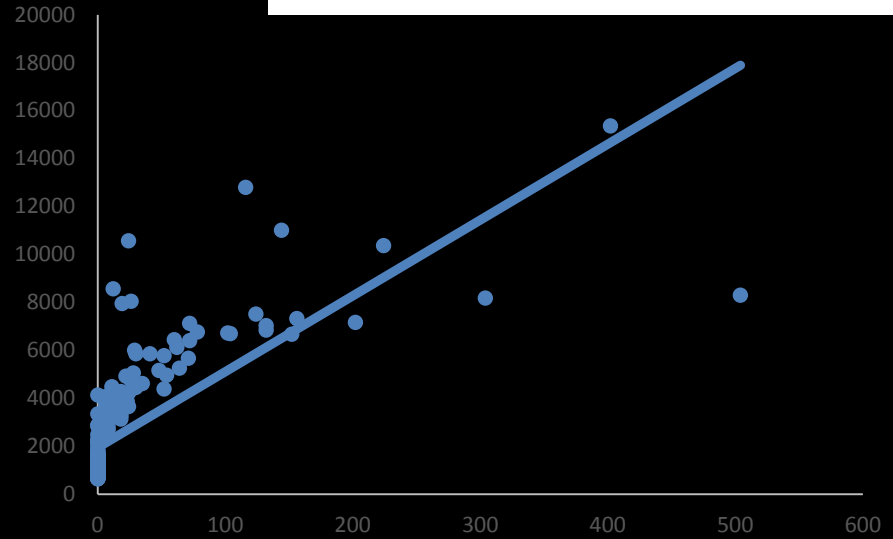
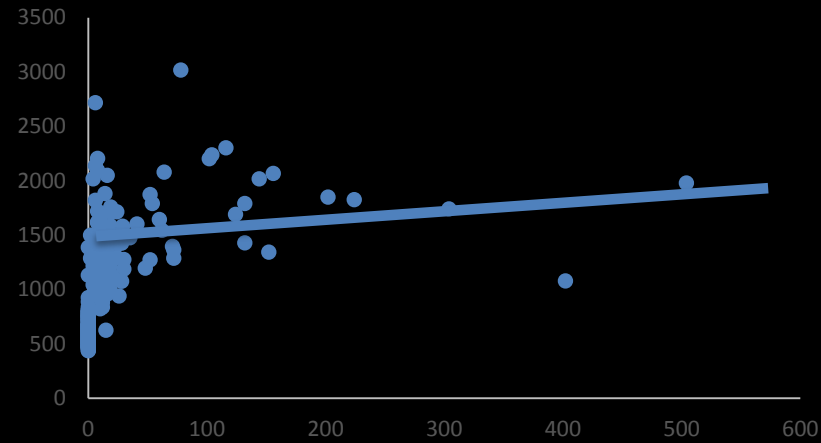
- Not at all
- Slightly
- Moderately
- Fairly
- Extremely

Each item converted to a 5 point - 0-4 scale

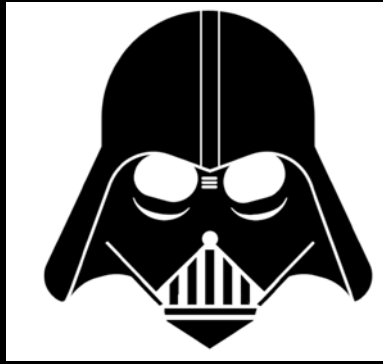
Summed to assess Positive valence during Slots session (range 0 to 20)



PRPS



• Dark Flow



I forgot everything around me.

- Not at all
- Slightly
- Moderately
- Fairly
- Extremely

I was deeply concentrated in the game.

- Not at all
- Slightly
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I lost track of time.

- Not at all
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I was fully occupied with the game.

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I lost connection with the outside world.

- Not at all
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- Moderately
- Fairly
- Extremely

Each item converted to a 5 point - 0-4 scale

Summed to assess Dark flow during Slots session (range 0 to 20)

Light(er) and Dark Paths to Enjoying slots



Apply both measures to enjoyment of a slots session

Casino Study

- Specific attempts to recruit large #s of PGs
 - NPG (PGSI 0) = 20
 - Low risk (1-4) = 53
 - Moderate Risk (5-7) = 34
 - Problem Gamblers (8 plus) = 46



Casino Study

- Assessed players for Depression using the Depression, Anxiety, Stress Scale (21 items)
- Following the DASS21 play 250 spins on a 20 line game using our simulator

Hierarchical
Multiple
Regression
predicting
Positive
Valence
during
slots
session

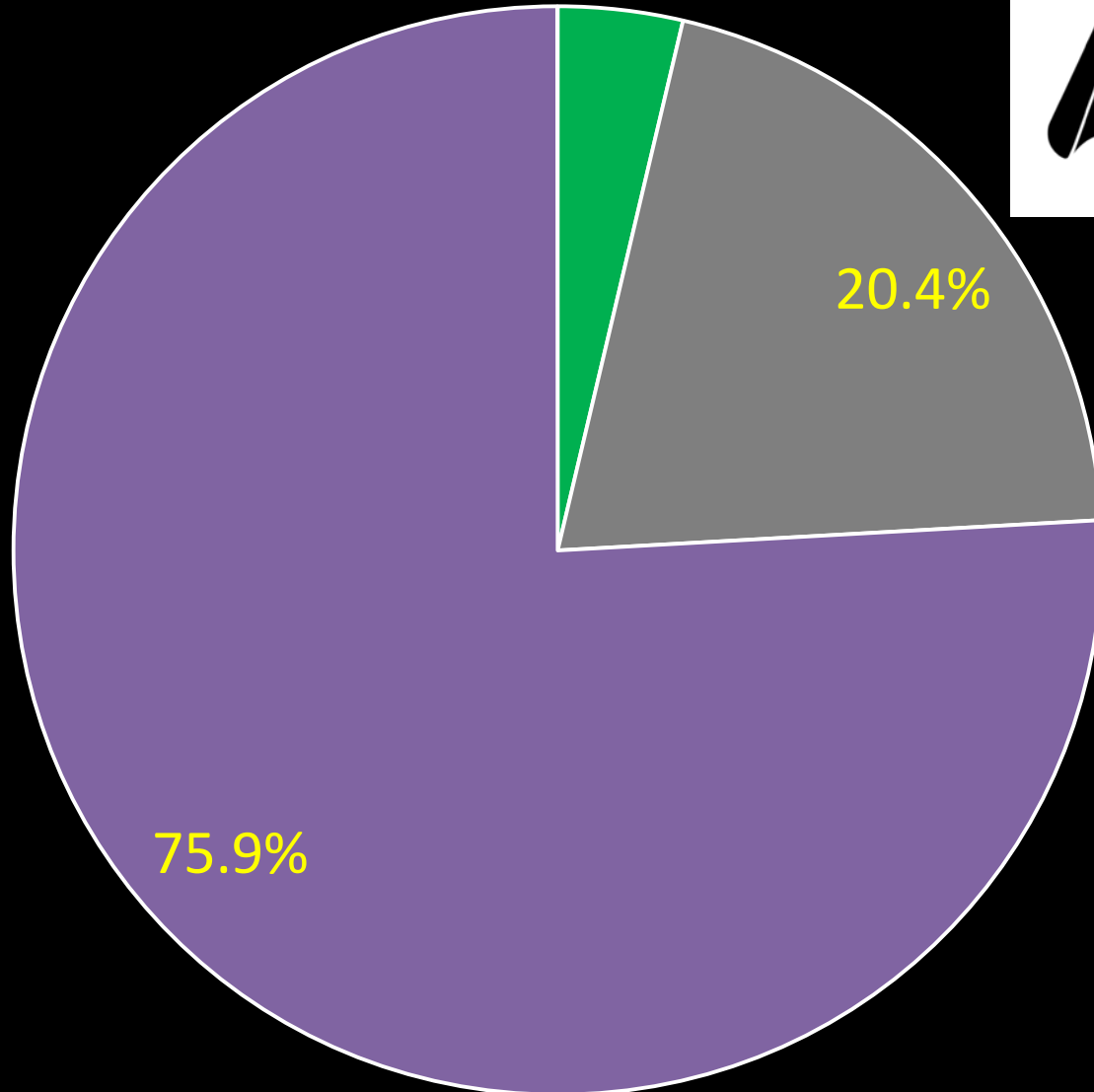


3.7%




20.4%

75.9%



PGSI

Depression (DASS21)

 $r(148) = .029$

$r(148) = .08$

 $r(149) = .553, p < .001$

$r(149) = .444, p < .001$

Replication (another Casino Study)

- Recruited anyone who plays once per week
 - NPG (PGSI 0) = 27
 - Low risk (1-4) = 38
 - Moderate Risk (5-7) = 20
 - Problem Gamblers (8 plus) = 22

Replication (another Casino Study)

- Played 301 spins on our simulator

Hierarchical
Multiple
Regression
predicting
Positive
Valence
during
slots
session

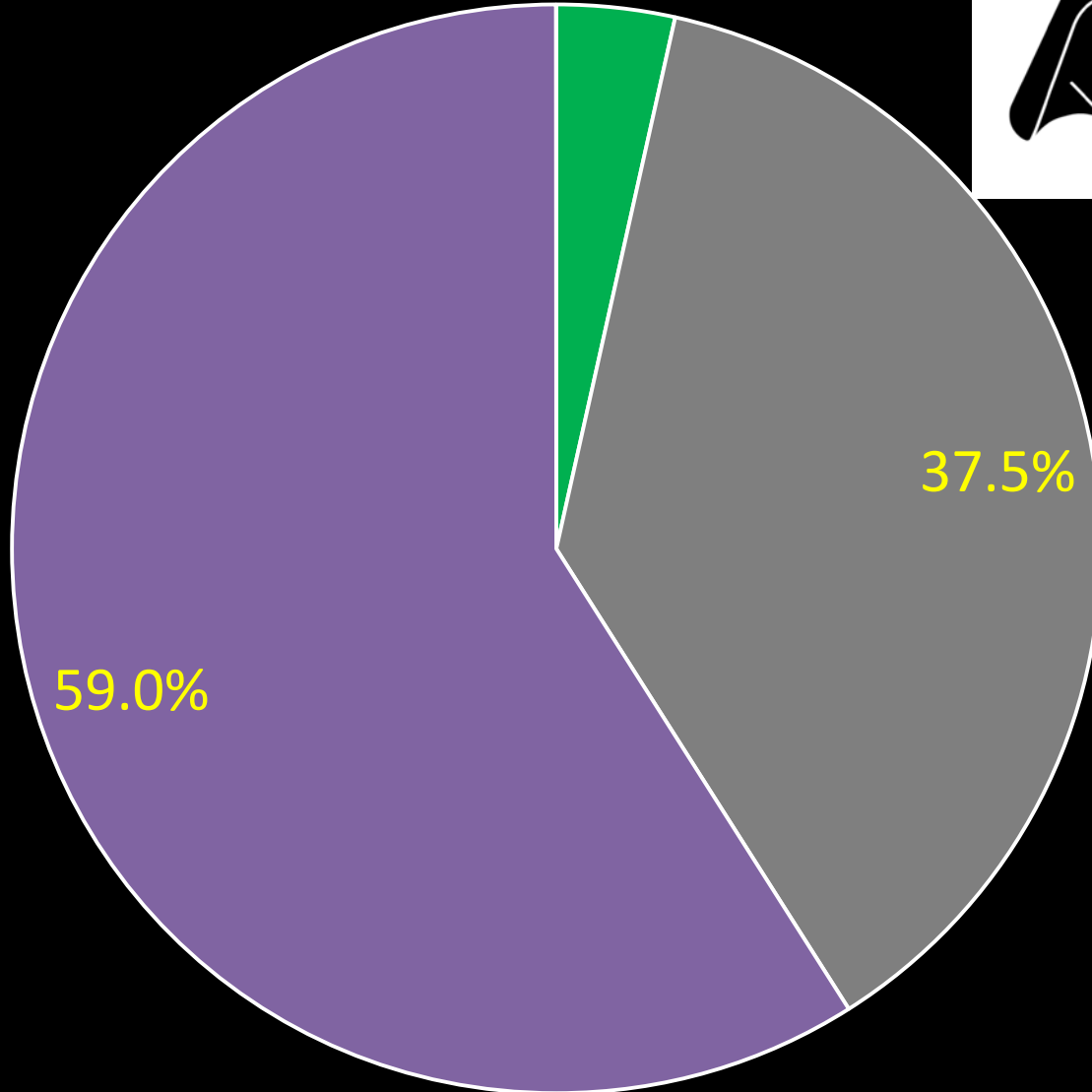


3.5%



37.5%

59.0%



PGSI

Depression (DASS21)



$r(122) = -.181, p < .05$

$r(122) = -.004$



$r(127) = .250, p < .01$

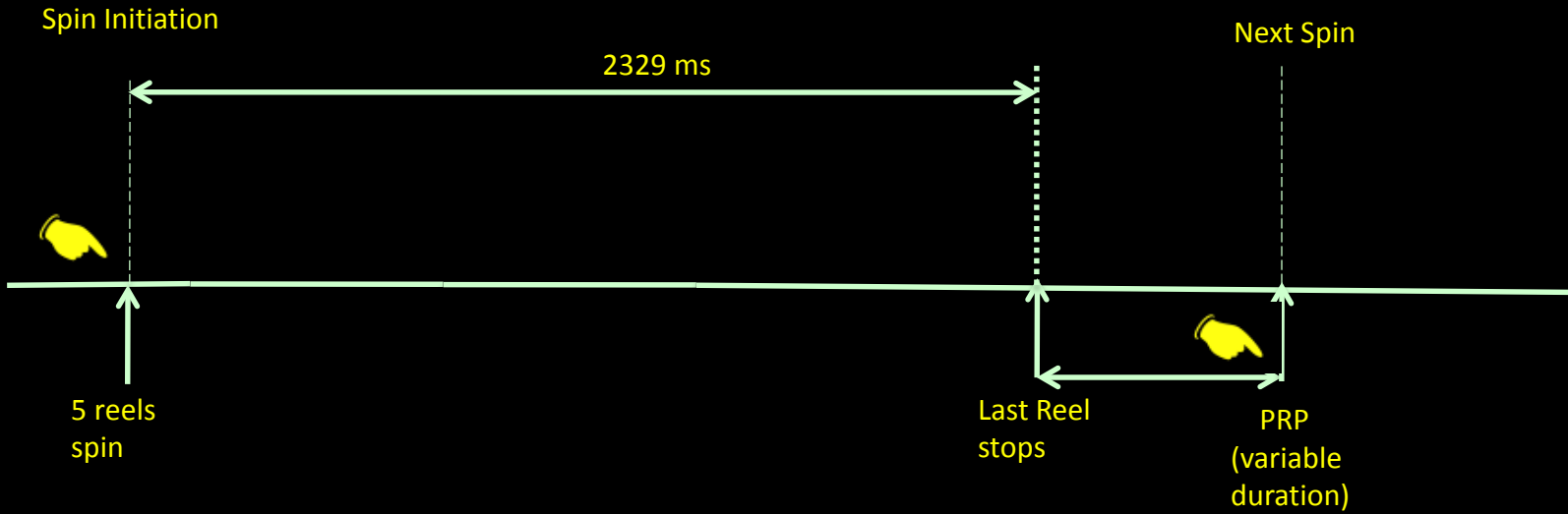
$r(127) = .462, p < .001$

Reward Reactivity

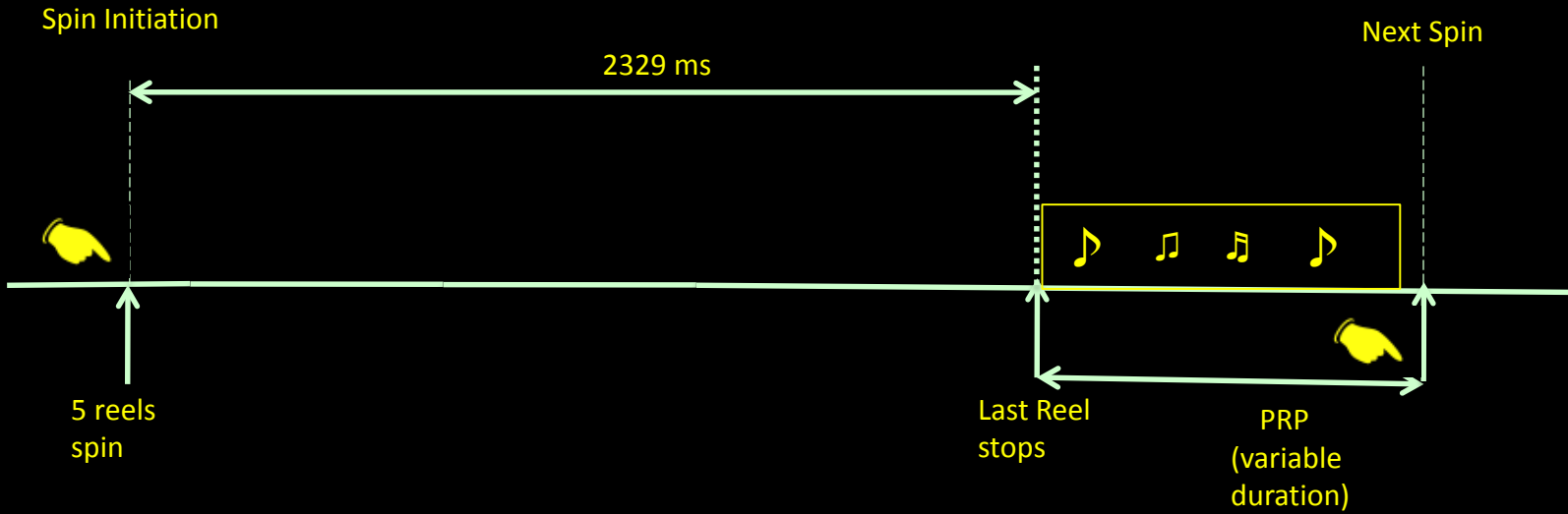


- Is the slope of PRPs over win size the best measure of reward reactivity?
 - Problem of celebratory feedback

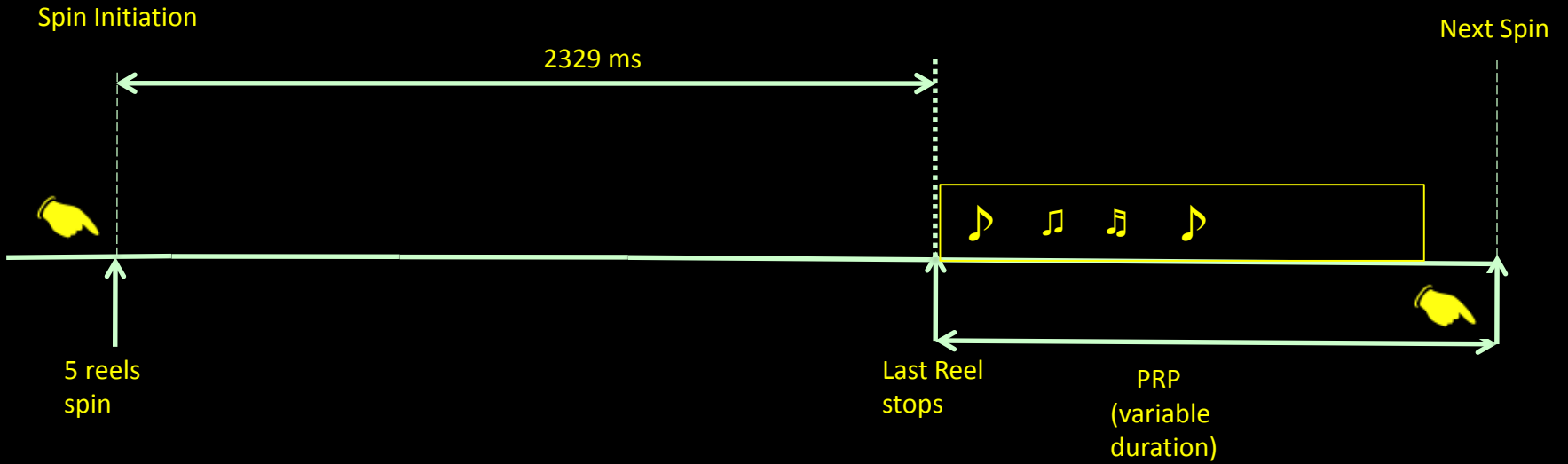
loss



Win 15



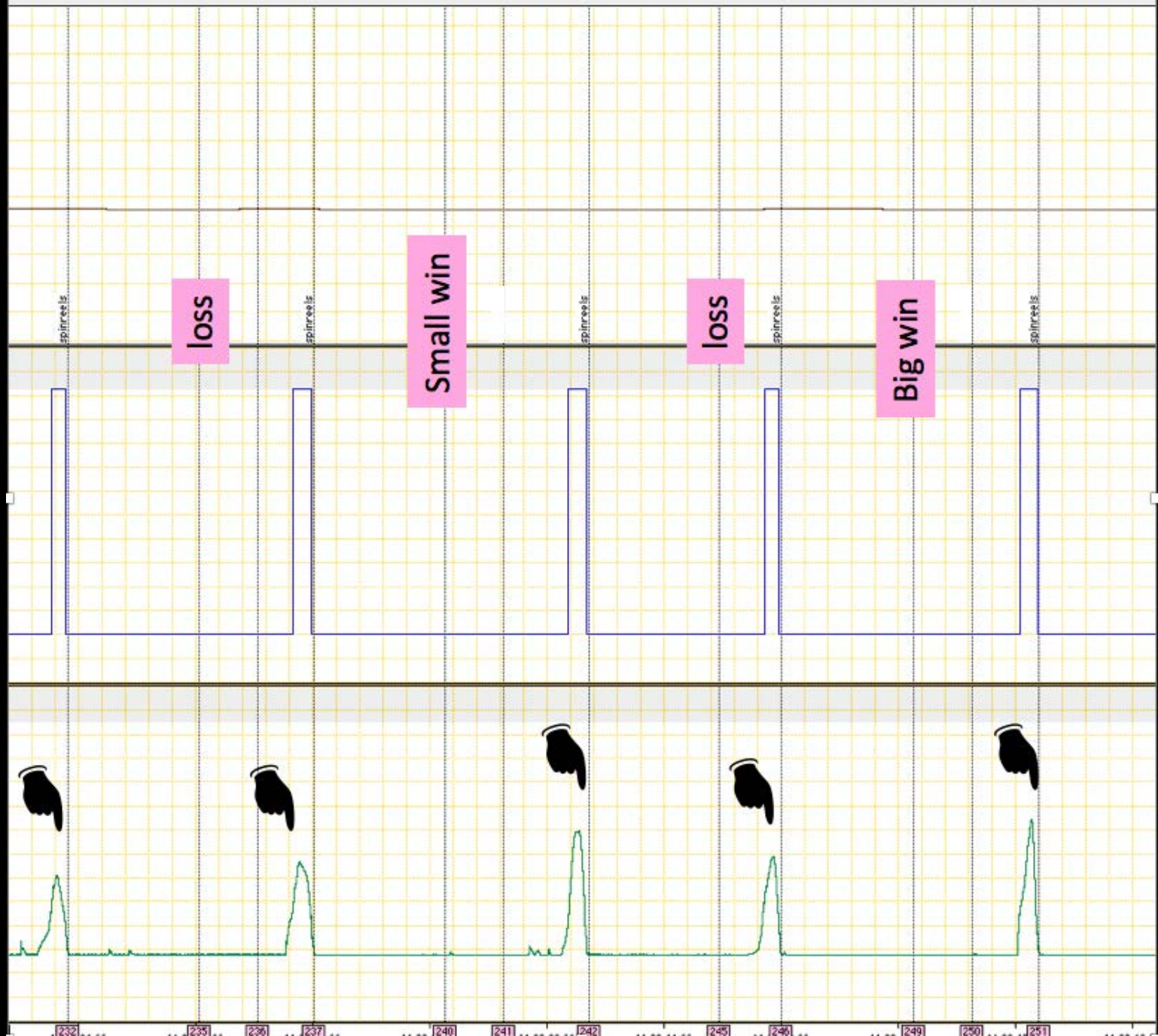
Win 250



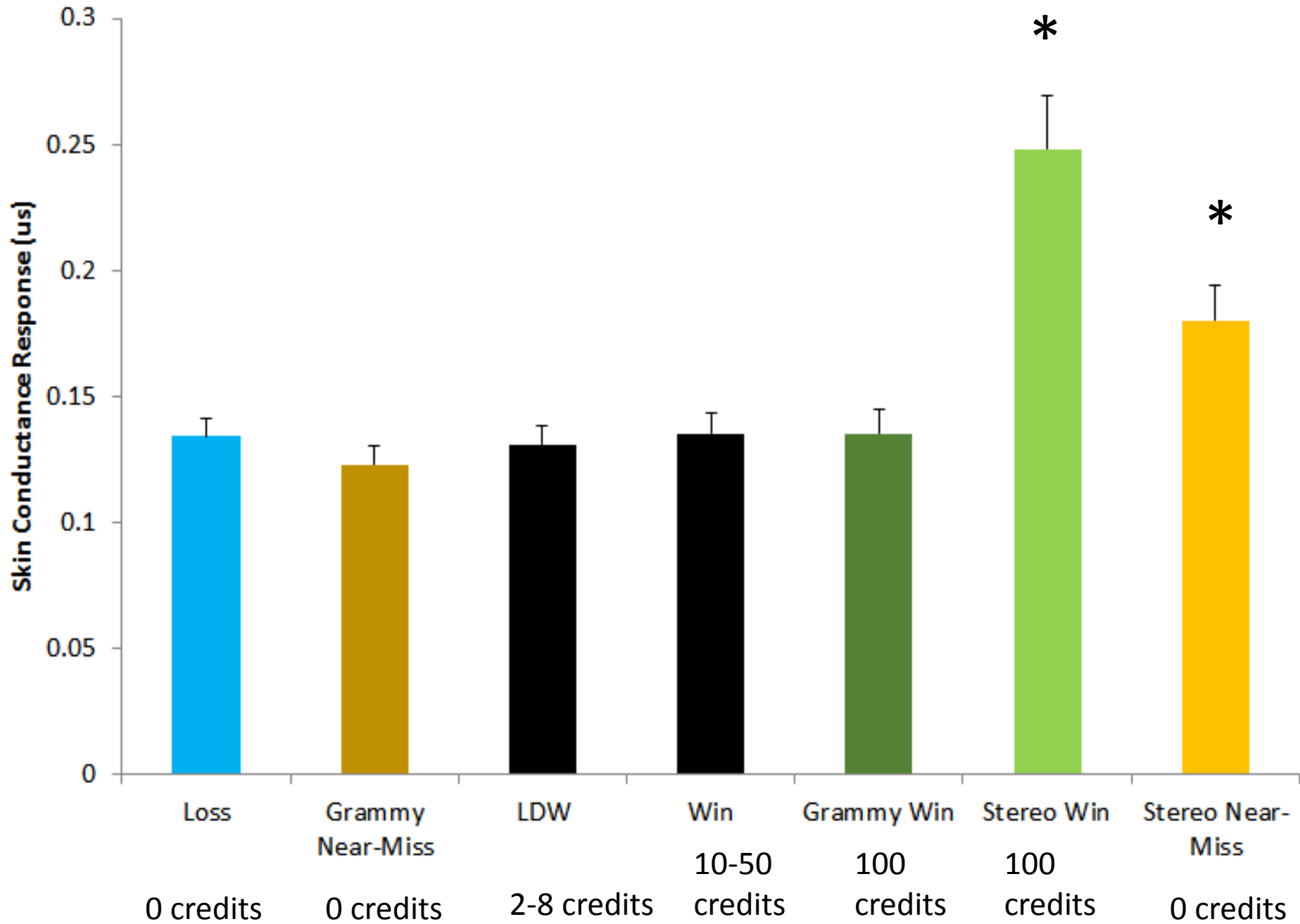
An Alternative Measure of Reward Reactivity



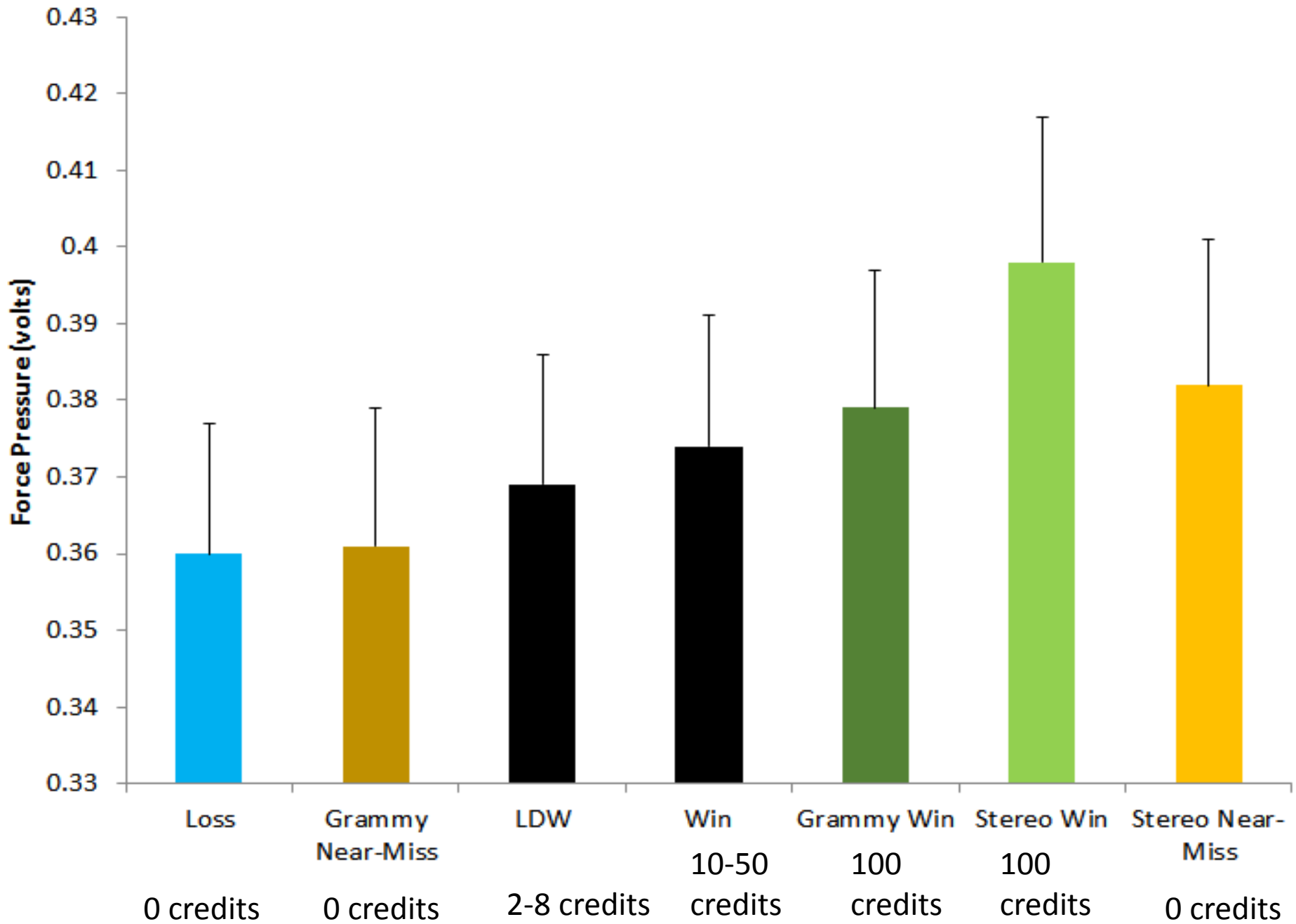
- Mounted a force transducer under the spin button
- Measure the force with which players press the spin button following each outcome



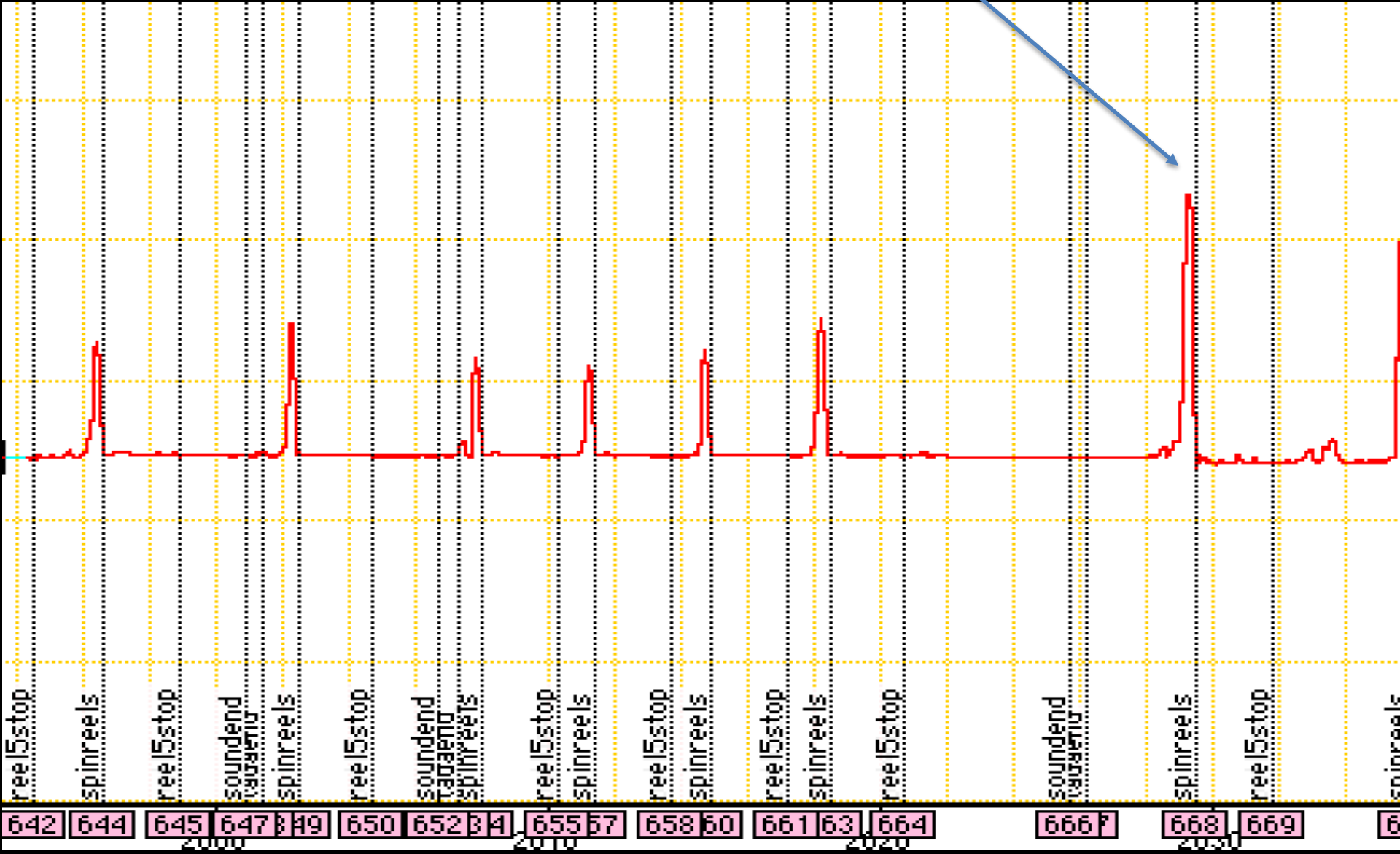
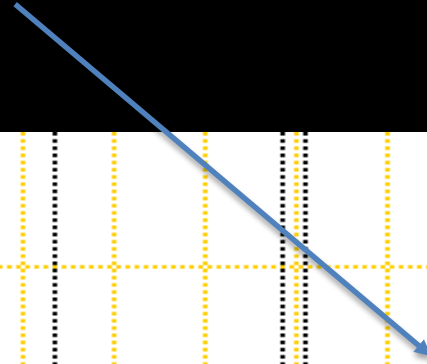
Post-Outcome Skin Conductance Responses



Post-Outcome Force Pressure

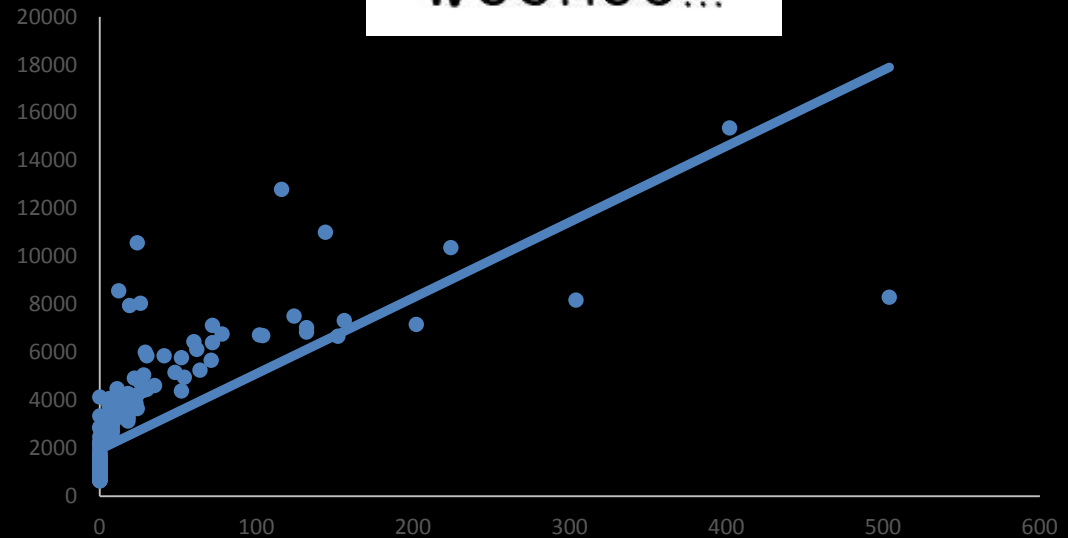
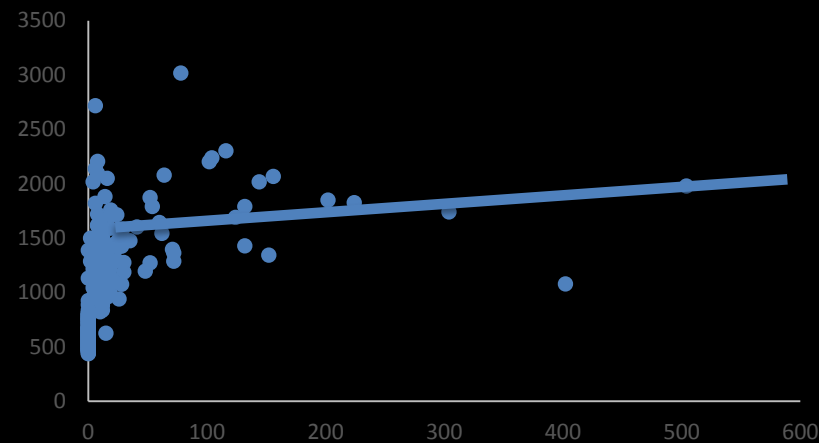


More reactivity to win

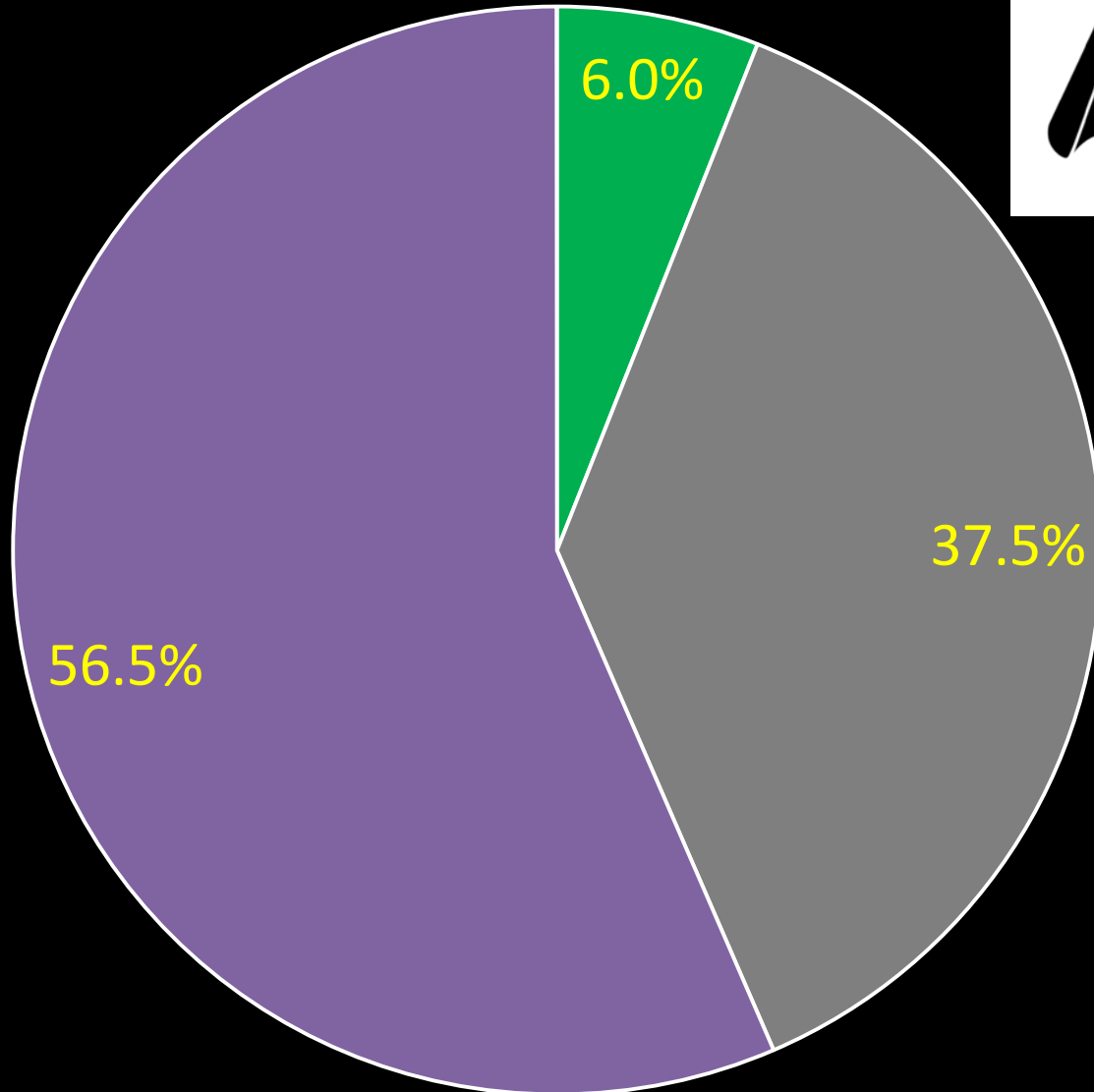


Reward Reactivity – slope of FORCE over win size

Uncontaminated by song lengths – simply how hard they press to initiate the next spin after different sized wins




Hierarchical
Multiple
Regression
predicting
Positive
Valence
during
slots
session



PGSI

Depression

A cartoon illustration of Homer Simpson from The Simpsons, wearing his signature white shirt and blue pants, with his arms raised in a cheering gesture. Below him, the text "WOOHOO!!!" is written in a simple, bold font.
$$R(122) = - .138$$

$$R(122) = -.032$$

A stylized, high-contrast black and white graphic of Darth Vader's helmet from Star Wars. The helmet is centered, with the iconic breathing apparatus and visor visible.
$$R(127) = .250, p < .01$$

$$R(127) = .462, p < .001$$

Light(er) Path to Enjoying slots



Light (er) Path to Enjoying Slots

- The degree to which players react to wins determines (in part) how much they enjoy slots play

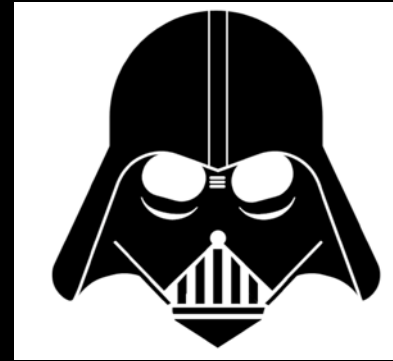


- This reward reactivity is unrelated to the negative aspects of gambling (PGSI status, Depressive Symptoms)

Dark Path to Enjoying slots



- Dark flow is strongly related to enjoyment during slots play (accounts for separate variance)



- Dark flow is robustly related to both PGSI status and Depression

WHY IS IT THAT PGS ARE THE ONES WHO ARE MORE PRONE TO EXPERIENCING DARK FLOW

Lose track of time

Effortless Concentration

Lose sense of the self

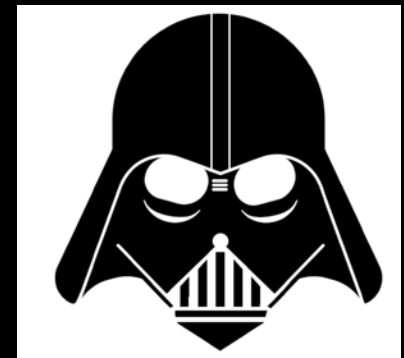
Complete Absorption

Lose track of everything else

PROBLEM GAMBLERS

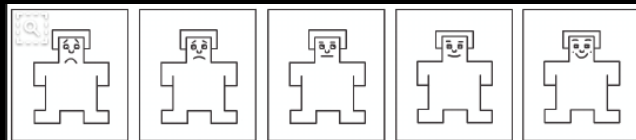


Dark Flow



Method

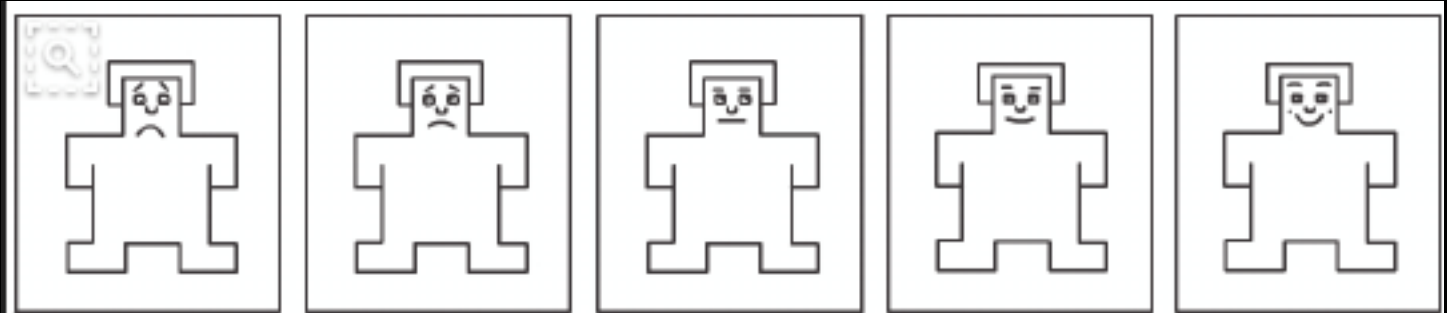
- 129 Participants completed the Mindful Attention Awareness Assessment Scale (MAAS), PGSI, DASS21
- Then completed 301 spins of Sands of Splendor
- Received thought probes every 50 spins
 - Asked if their thoughts were “on-game” or “something else”
 - Pointed to a self Assessment Manikin to indicate their mood



- After playing they completed the positive affect and dark flow items of the GEQ

Results

- Validity Check
- Ratings of positive affect from the GEQ should correlate with



GEQ
positive
affect

$$r(127) = .433***$$

Results

- Validity Check
- # of “On-game” answers to probes should be positively correlated to dark flow

On
game!!!



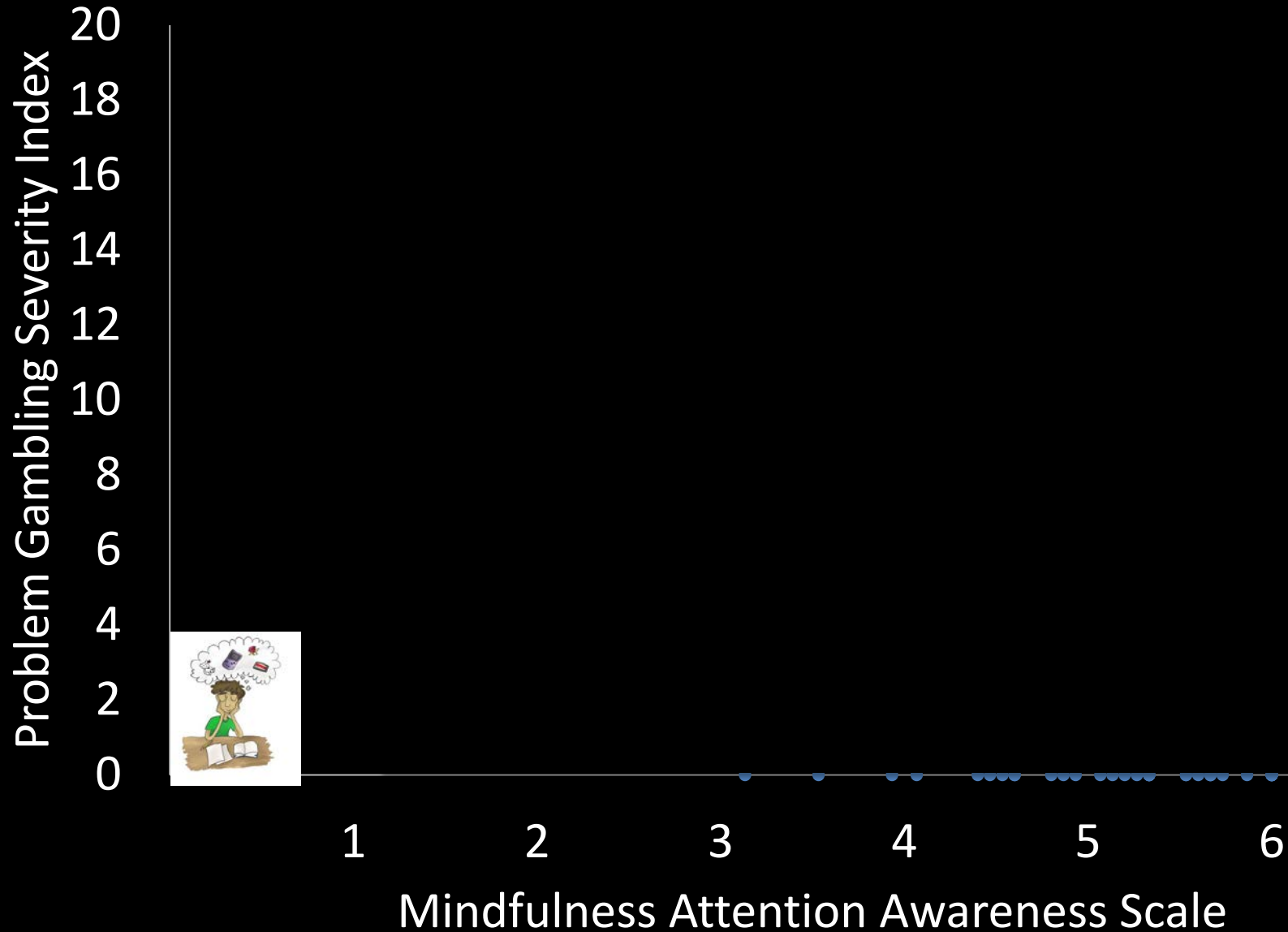
$$r(127) = .464, p < .001$$

- Problem gamblers have problems staying on task in everyday life (e.g. Reid et al., 2014; Lakey et al., 2007)

Predictions

- If Problem Gamblers have problems with mind- wandering in everyday life they should score low on the MAAS

$r(127) = -.488, p < .001^{***}$



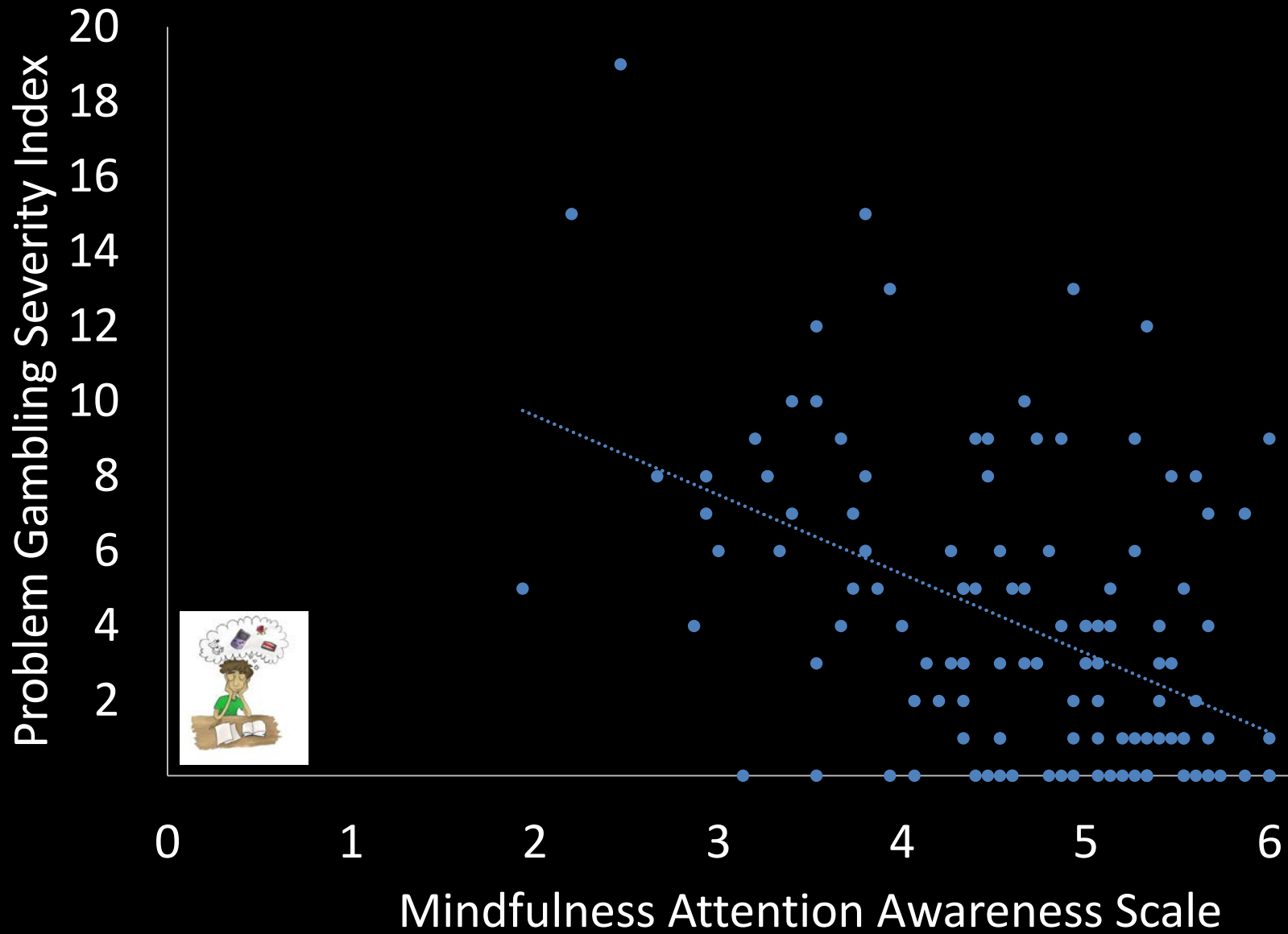
- Problem gamblers have problems staying on task in everyday life (e.g. Reid et al., 2014; Lakey et al., 2007)
- Slot machines “rein in the wandering mind”

Predictions

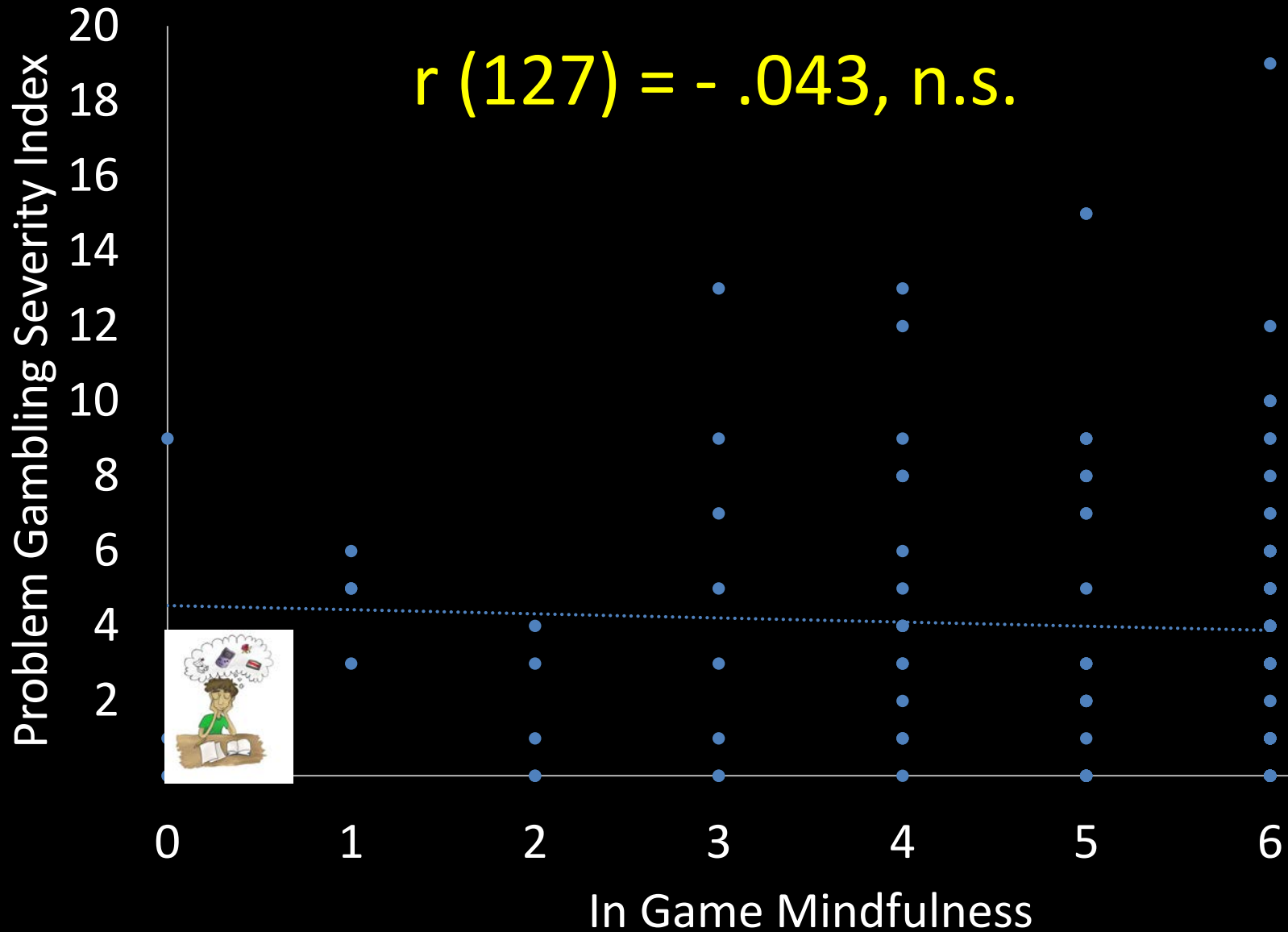
- If Slot Machines “rein in the wandering mind” then we should see an elimination of mindfulness problems **During Slots Play**

PROBLEM GAMBLERS

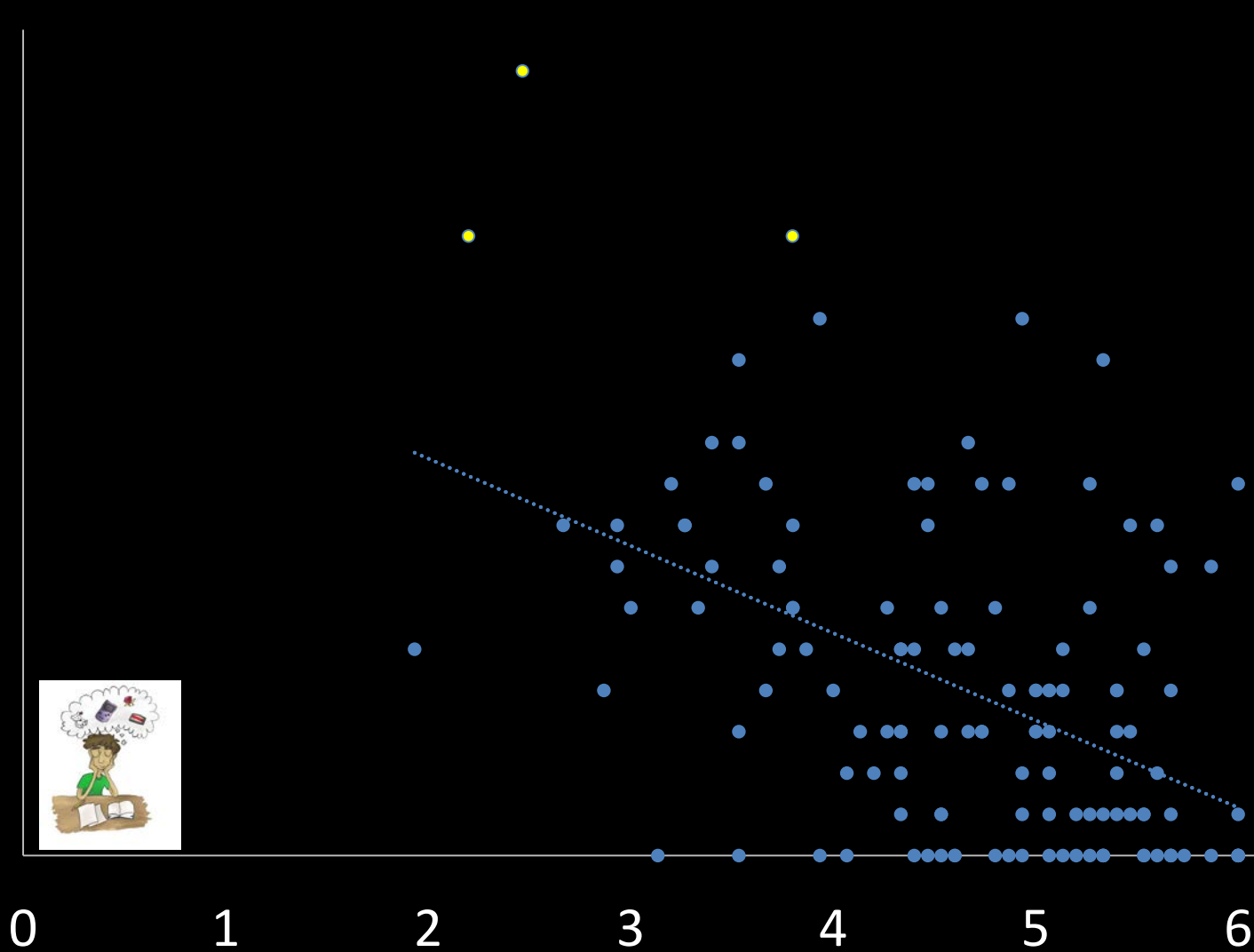




$r(127) = -.043, n.s.$



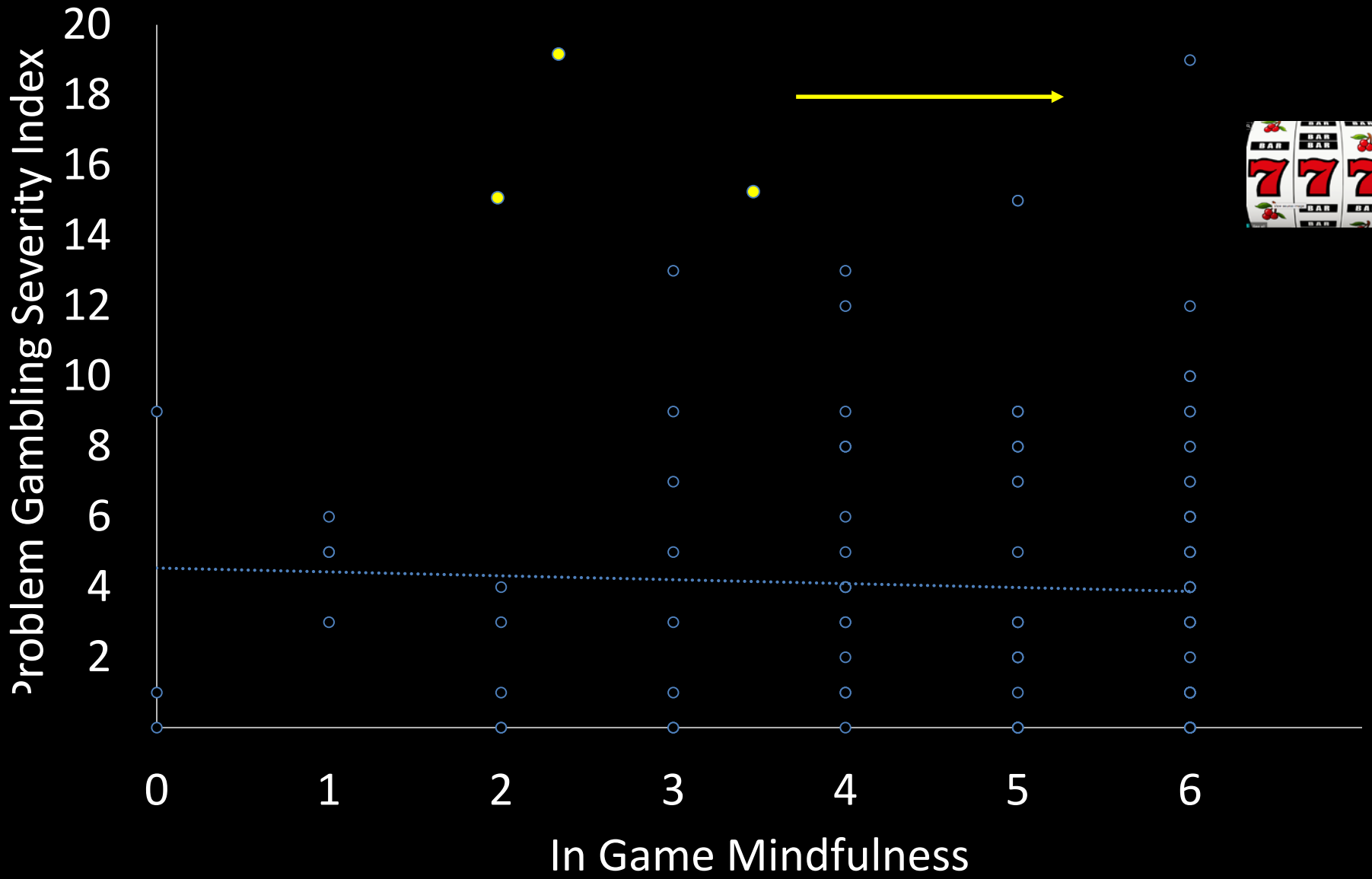
Problem Gambling Severity Index

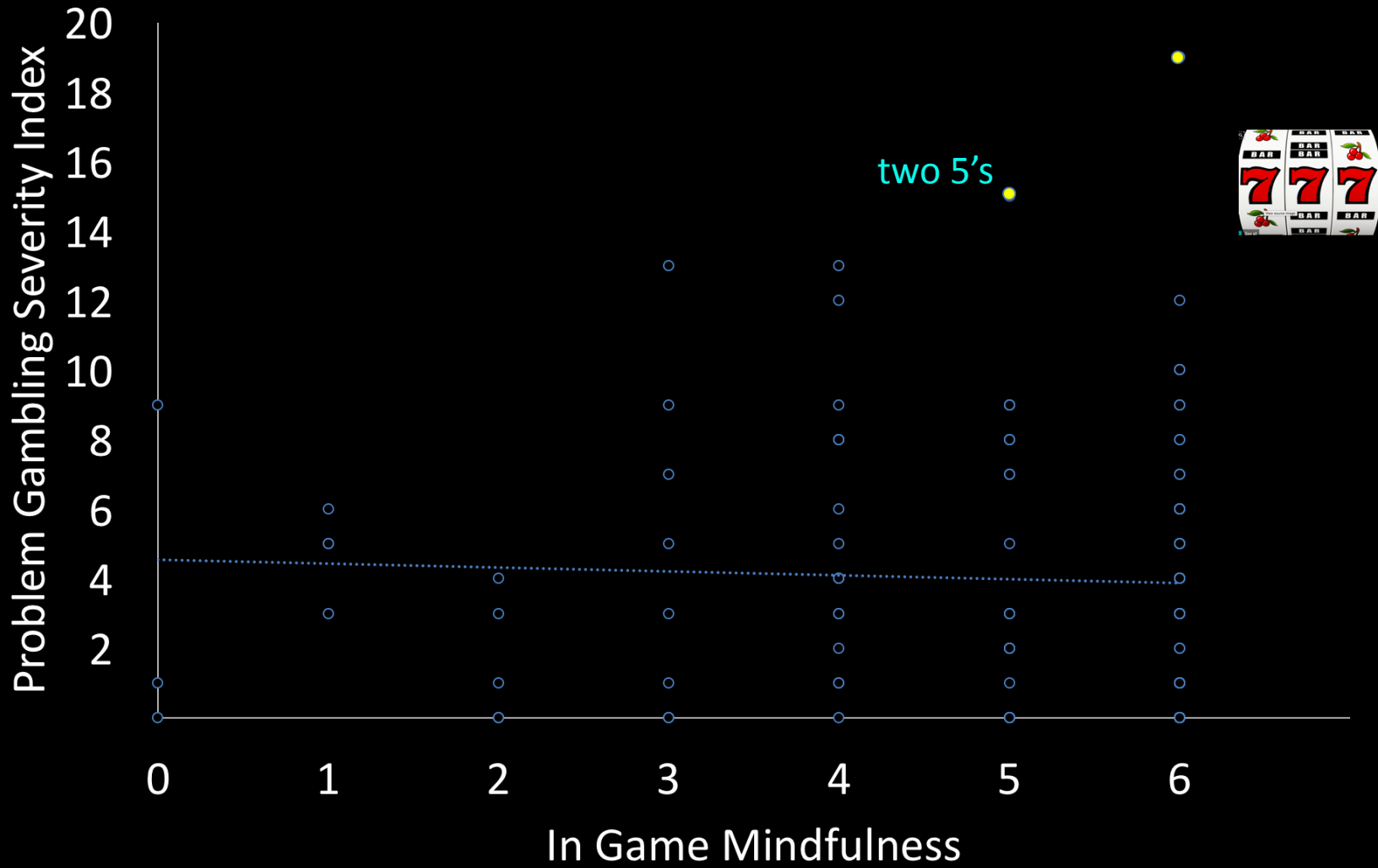


Everyday
life



Mindfulness Attention Awareness Scale





Conclude that Slots “rein in the wandering mind” and eliminate the mind wandering that they show in everyday life.

Predictions

- The experience of focussed attention during slots play is so unusual for these habitual mind wanderers it is reflected in dark flow ratings during slots play

Lose track of time

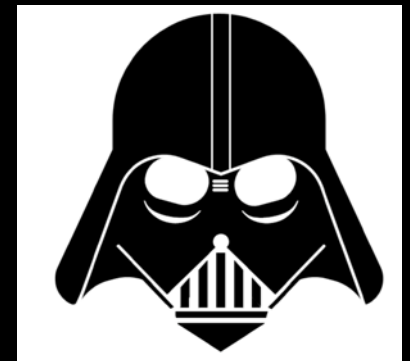
Effortless Concentration

Lose sense of the self

Complete Absorption

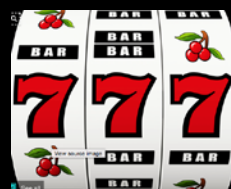
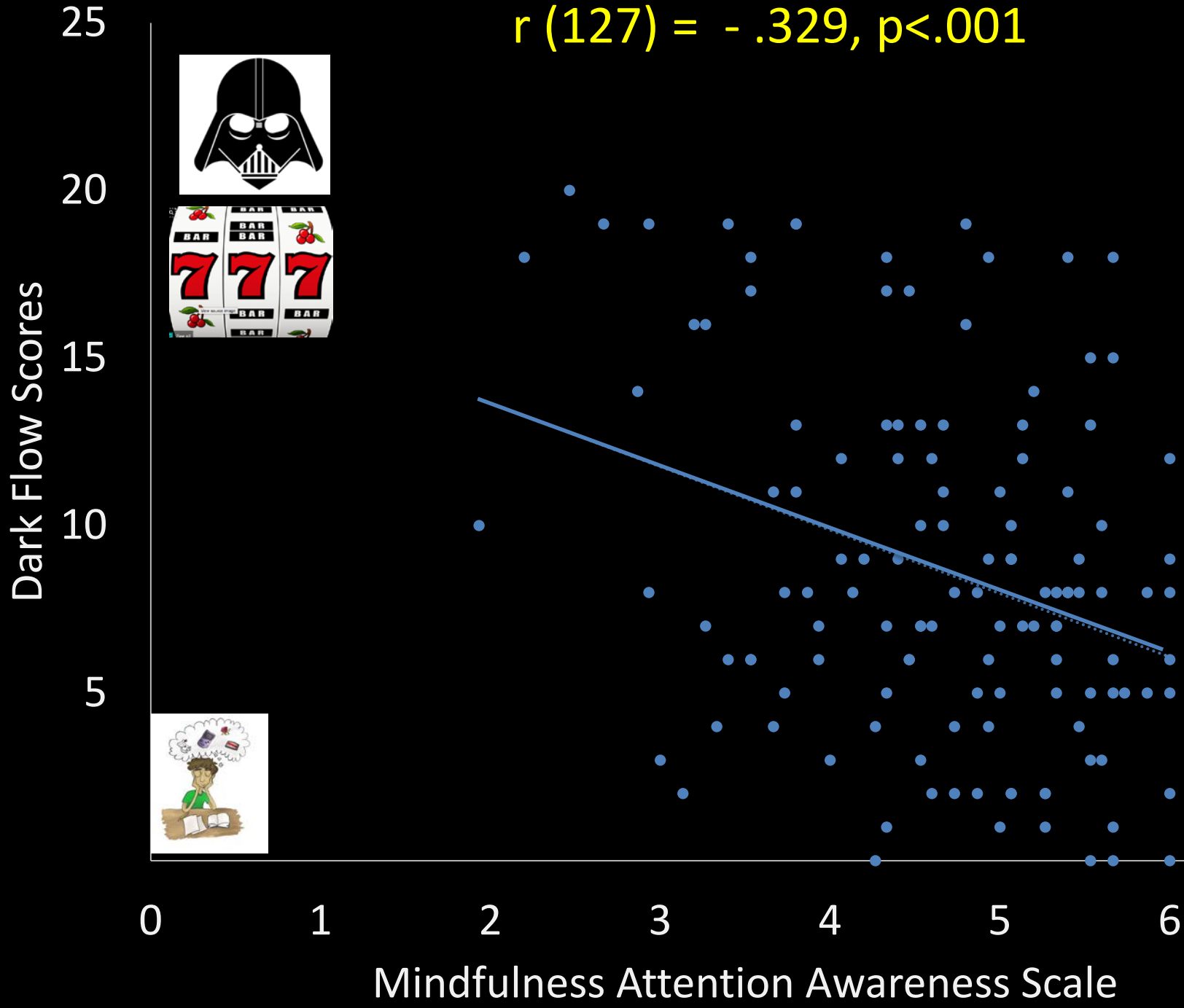
Lose track of everything else

PROBLEM GAMBLERS



Dark Flow

$r(127) = -.329, p < .001$



Lose track of time

Effortless Concentration

Lose sense of the self

Complete Absorption

Lose track of everything else

PROBLEM GAMBLERS



Dark Flow



“You go into that **trance**, that zone, that box. Nobody can touch you. You have **escaped from reality**. No one can ask you for anything”

On game!!!

PROBLEM GAMBLERS



Dark Flow



Waterloo Gambling Lab

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Director of Knowledge Translation: Kevin Harrigan

Collaborator: Jonathan Fugelsang

Amazing Grad Students: Chanel Larche M.A.,
Madison Stange M.A., G.M., Candice Graydon, PhD.