Biopsychosocial Aspects of Disordered Gambling

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Overview

• Goal for today:
  – Synthesis between biopsychosocial aspects of etiology and treatment for disordered gamblers
  – Bridge the gap between research and practice
  – Function based interventions
GAMBLING...

...any instance where a valued commodity is wagered in hopes of gaining something of greater value in return

...legal across 143 countries
PUTTING IT INTO PERSPECTIVE

How many of you have
...gambled at least ONCE in your life?
...consumed an alcoholic beverage at least ONCE in your life?
...consumed illegal substances at least ONCE in your life?
Gambling Spectrum

- Most people: No gambling problems
  - Entertainment
  - Hobby
  - Social activity
  - Pleasant surrounding

- Moderate gambling problem
  - Chasing losses
  - Guilt
  - Arguments
  - Concealment of gambling
  - Some depression
  - High expenditures

- Severe gambling problems
  - Depression
  - Serious suicide thoughts
  - Divorce
  - Debt and poverty
  - Crime

Image: Government of South Australia
Given the accessibility to gambling establishments and prevalence rates of recreational gambling, why do only some of us develop a gambling problem?
Something to consider...

- Are behavior problems...
  A) A trait, like personality, that will always be?
  B) A state someone is in, like a bad mood or hunger?

- Which approach gives room for influencing behavioral change?
Want to quit ______________?

- I will give you a thank you note
- I will give you 100 bucks
- I will tell you _______ will kill you
- I will double the price of ________
- I will take away your TV
- I will give you a 50:50 chance of getting terminal disease in 40 years
- I will give you 1,000,000 dollars tomorrow
Consequences are Best When Immediate and Powerful

- If substance use/gambling gives our clients immediate powerful consequences and we dangle delayed weak consequences we will lose every time.

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Gamble

Feel Better Now

Don’t Gamble

“Good job”
Biopsychosocial Approach to Addiction

- Addiction is a multifaceted mental health disparity
  - Gambling is no different!

- Three primary areas of focus
  - Behavioral
  - Cognitive
  - Biological and Dispositional

- Theoretical explanations of gambling
  - Onset
  - Persistence/maintenance
  - Mechanisms for treatment

*Sharpe, 2002
*Sharpe & Tarrier, 1993
Biological Features

Dopamine Pathways
- Frontal cortex
- Nucleus accumbens

Functions
- Reward (motivation)
- Pleasure, euphoria
- Motor function (fine tuning)
- Compulsion
- Perseveration

Serotonin Pathways
- Striatum
- Substantia nigra
- Hippocampus
- Raphe nuclei

Functions
- Mood
- Memory processing
- Sleep
- Cognition

*Gyollai, Griffiths, Barta, Vereczkei, Urban, Kun, et al. (2014)
*Nestler (2004)
*Potenza (2008)
*Slutske & Richard-Raker, 2014
Brain Imaging Technologies

- ECoG
- EEG
- MEA
- Fluorescence Calcium Imaging
- fMRI
- Single cell recording
fMRI Event Analyses

Average images across condition A - Average images across condition B = Brain activation patterns unique to A-B

***Analysis across within subjects for all conditions

**Analysis then conducted between subjects
fMRI Event Analyses

Average images across WIN (A) - Average images across NEAR MISS (B) = Brain activation patterns unique to A-B
fMRI Event Analyses

Average images across NEAR MISS (B) - Average images across LOSS (C) = Brain activation patterns unique to B-C
Neurological Aspects of Gambling

The purpose of this translational study was twofold: (1) to contrast behavioral and brain activity between pathological and nonpathological gamblers, and (2) to examine differences as a function of the outcome of the spin of a slot machine, focusing predominately on the “Near Miss”—when two reels stop on the same symbol, and that symbol is just above or below the payoff line on the third reel. Twenty-six participants (11 nonpathological; 11 pathological) completed the study by rating the closeness of various outcomes of slot machine displays (wins, losses, and near-misses) to a win. No behavioral differences were observed between groups of participants, however, differences in brain activity were found in the left midbrain, near the substantia nigra and ventral tegmental area (SN / VTA). Near-miss outcomes uniquely activated brain regions associated with wins for the pathological gamblers and regions associated with losses for the nonpathological gamblers. Thus, near-miss outcomes on slot machines may contain both functional and neurological properties of wins for pathological gamblers. Such a translational approach to the study of gambling behavior may be considered an example that gives life to B. F. Skinner’s conceptualization of the physiologist of the future.

Key words: pathological gambling, fMRI, near-miss, slot machine, addiction

B. F. Skinner described gambling as perhaps one of the most naturalistic examples of human behavior under a given schedule of reinforcement (Skinner, 1974). He stated: “all gambling systems are based on variable-ratio schedules of reinforcement, although their effects are usually attributed to feelings” (p. 60). With regard to the slot machine, the apparatus resembles a simple operant chamber, as it consists of a single lever (the slot machine arm), a reinforcer hopper (the coin tray), and a series of visual stimuli (the slot reels and displays) that accompany the delivery of reinforcement. This latter component, the slot reel display, is often misconstrued by the gambler, however, as a discriminative stimulus that provides information regarding the differential reinforcement effect may occur, while costing casino nothing for its delivery (Skinner, 1974). An increasing number of conceptual experimental investigations have been conducted involving slot machine gambling: behavioral perspective in the years tailed Skinner’s initial comments. We and Dixon (2007) introduced a complete conceptualization of excessive gambling that included additional variables beyond the grammatical reinforcement of the gaming. These authors noted that perhaps pathological gambling was a dynamic interaction between programmed contingencies, verbal behavior, and various contextual stimuli (i.e., financial status, race, comorbid psychological disorders). Although purely conceptual, this model has
Neurological Aspects of Gambling: Jackpot Size Dose Effect

Neurological correlates of slot machine win size in pathological gamblers

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Brain neurology

Abstract
The present study examined the neurological correlates of slot machine gambling by pathological and nonpathological gamblers while undergoing an fMRI scanning procedure. Twenty-two total participants were exposed to a series of losses, small wins, and large wins on a computerized simulated slot machine. Results indicate that the two types of gamblers responded differently to the various game options, and that an apparent “dose effect” exists when small and big wins are compared for pathological gamblers. Specifically, more neural activation occurred in the dopaminergic pathway under conditions of large wins. These data suggest that a non-drug substance such as gambling may mimic typical drug dose effect shown in previous literature. Implications for the treatment of pathological gamblers are discussed.

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Neurological Aspects of Gambling:
Gambling Subgroups

- N=35
  - Disordered gamblers (SOGS ≥ 5)

- Gambling Functional Analysis (GFA; Dixon & Johnson, 2007)
  - Highest component score <1 SD

- Wins-Losses across group

RESULTS
Psychological features of gambling

• Behavioral psychology
  – Include overt behavior and cognition (such as thoughts, feelings, etc.)
  – Impulsivity, risk taking, cognitive distortions, etc. related to gambling

• Behavioral perspective suggests gambling is maintained by
  – Structural characteristics of game
  – Verbal behavior
  – Contingencies of reinforcement
Structural Characteristics

Are Slot Machines About to Get Smart?
A perfect storm of new laws and millennial apathy is—finally—forcing slot makers to innovate.

Casino-executives are removing slots to make way for craft beer and third-wave coffee. ILLUSTRATION: SPLENDID DODG.
Slot Machine Outcomes

• Traditional outcomes:
  – Win
  – Loss
  – Near-miss (anything “close” to a win)

• Today’s outcomes:
  – Win
  – Loss
  – Loss disguised as win (LDW)
Losses Disguised as Wins (LDWs)

• Subjectively rate LDW’s closer to wins than to losses (even though outcome functions more like a LOSS; Dixon et al., 2009; Dixon & Schreiber, 2004; Wilson & Dixon, 2014; Templeton et al., 2014)

• Gamblers prefer games with higher rates of LDW’s (Harrington et al., 2010)
Role of Verbal Behavior

• Gambling addictions are more complex than simple control by structural nuances and schedules of reinforcement

• Verbal events participate across range of contexts to occasion choice making including
  – Risk
  – Magnitude
  – Persistence
How do humans learn?

**Learning through direct contingencies**

A. Presence of hot pan → B. Grab pan → C. Get burned

A. Presence of hot pan → B. Put on an oven mitt → C. Avoid burn
How do humans learn?

How many of you have ever jumped off a bridge? Why not?

**Learning through indirect contingencies**

A → B → C

“If you jump off a bridge, you will die”

Avoid jumping off bridges

Avoid death; continue with life
How many of you thought you failed a test, but you actually passed it?

**Learning through self-rules**

A: Wearing pink socks
   - Coffee for breakfast
   - No sleep

B: Take test

C: Pass test

How do humans learn?
Rules as Verbal Stimuli

• Rule following is an essential aspect of problem solving

• What do we know about rules?
  – Humans are *insensitive* to changes in schedules of reinforcement
    • (Matthews et al., 1985; Hayes et al., 1986)
  – Verbal stimuli in equivalence classes formulate verbal rules
    • (Hayes & Hayes, 1989; Hayes et al., 1989)

• Components of rule following:
  – Formation
  – Contacting
  – Stating
  – Following

• Impact of verbal history and interaction with contingencies
Rule Contacting and Stating
How are rules formed?

**Physiological responses**
- Increased heart rate
- Dopamine activation
- Neurological and biological changes

**Psychological responses**
- Increased motivation to play longer
- Excitement
- Rules formed re: winning strategies

**External Environment Changes**
- Winnings awarded
- Enhanced lights, sounds, etc.

**Questions**
- How are rules formed?
What do you want?

“I want a jackpot”
What do we know about rule formulation and following in gambling context?

6 recreational gamblers completed slot machine task
Participant 1
Baseline Play and Rule Stating → Rule Training
Post-Treatment Play and Rule Stating

Participant 2
Baseline Play Rule Stating → Rule Training
Post-Treatment Play and Rule Stating

Participant 3
Baseline Play and Rule Stating → Rule Training
Post-Treatment Play and Rule Stating

Time
Rule stating

- EO: “follow these and you’ll get finished quicker”
Conditional Discrimination Training

Diagram:

- Column A: Numbers 1, 2, 3
- Column B: Arrows pointing to Column C
- Column C:
  - Row 1: Play
  - Row 2: Red / Silver
  - Row 3: Coins
Example of training display
Replication and Extension

• Same effects on different gambling activity?

Participants

• 6 gamblers (5F)
• Mean age 24.3 (Sd = 6.4)
• 5 Caucasian, 4 with Bs

Setting/Apparatus

• SLU Gambling Addictions Lab
• Avatar Roulette Game
• Red, Blue, Black chips

Implications of Derived Rule Following of Roulette Gambling for Clinical Practice

Alyssa N. Wilson • Tara Grant

Abstract Problem gambling is a global concern, and behavior analytic attention has increasingly focused on reasons for why problem gambling occurs and conditions under which it is maintained. However, limited knowledge currently exists on the process to which self-generated rules maintain gambling behaviors. Therefore, the current study assessed six recreational gamblers on a roulette game before and after discrimination training to establish a self-rule to wager on red or black. Following discrimination training, all six participants altered their response allocation among red or black and consistently responded according to the newly derived self-rule. Results maintained during 1-week follow-up sessions across all participants. Implications for clinical application of self-awareness and self-generated rule following are discussed.

Implications for practice

• Demonstration of how stimuli such as color can alter gambling behavior
• Procedures to assist clients with changing self-rules about gambling behavior
• Using self-generated rule formulation for more contextually appropriate target behaviors
• Highlights how self-generated rules can be altered to change clinical target behaviors

Behavior analysis has been applied across a range of socially significant behaviors, from disruptive classroom behaviors to medication compliance and recycling. One area of recent focus is problem gambling (Ziemke and Dixon 2006; Hoon et al. 2008; Guarino et al. 2012). Problem gambling is often maintained by a combination of reinforcement schedules and verbal behavior (Weatherly and Dixon 2007; Dymond and Roche 2010). For example, the development of stimulus equivalence classes and transformation of function has been shown to alter gambling preference and response allocation (Ziemke and Dixon 2006; Nastally et al. 2010; Wilson and Dixon 2014), and self-reporting of slot machine outcomes (Dixon et al. 2009).

While behavior analytic attention on problem gambling is growing (e.g., Witts 2013), limited knowledge currently exists on how problem gambling is established or the process to which verbal behavior in the form of self-rules is developed and subsequently maintained. Wilson and Dixon (2014) demonstrated self-tainting and subsequent self-rule following of recreational gamblers’ preferences for concurrently available coin options on a slot machine. Six gamblers were asked to (a) tact arbitrary stimuli posted on the slot machine by completing fill-in-the-blank and multiple-choice assessment, (b) wager red or silver coins on a slot machine, which had no impact on the contingencies of the game; and (c) complete a conditional discrimination training procedure to establish a three-member equivalence class (A1-B1-C1; A2-B2-C2; and A3-B3-C3), where the C stimuli were presented as the words “play,” “red,” or “silver” and “coins.” Following training, transitive relationships emerged between stimulus sets A and C as all six participants correctly tacted the rule “play red/silver coins,” while five participants altered response allocation to the color coin as indicated by stimulus C2 (e.g., red or silver).
Fig. 2 Cumulative response allocation across 1-min trial blocks
Rules and Rule Following

• Demonstrated HOW rules and formed

• Illusions of control (e.g., Cowley, Briley, Farrell, 2015; Dixon, 2000; Dixon, Wilson, et al., 2010; Ladouceur et al., 1984; Orgaz et al., 2014; etc.)

• Implications for treatment
Sociological Features

• Social learning theory (Bandura, 1974)
  • Humans model, learn, and sustain behaviors that are observed in broader culture
  • Models include family, friends, co-workers, ...

• Sociological contexts
  • Gambling venues
  • Location of gambling options
  • Community network and gambling frequency
  • Cultural practices
Cultural aspects of gambling
Cultural aspects of gambling
Cultural aspects of gambling for Youth
What do we know about the role of sociological features?

• Gambling severity is often correlated with
  – Age
  – *Gender
  – Marital status
  – Socio-economic status
  – Ethnicity/race
  – Substance use
  – Mood disorder
  – IMPULSIVITY

*Petry, 2005
*Potenza, 2006
What do we know about the role of sociological features?

• Cultural and Ethnic minority groups
  – South East Asian refugees and immigrants have higher rates of PG/DG than non-immigrants in same communities
  – Cambodian refugees

• Immigrant Paradox
  – Myth that immigrants are more likely to engage in inappropriate or problem behaviors than native-born US residents
  – Recent research has established immigrants as less likely to engage in
    • Crime and violence (Lee & Martinez, 2009; MacDonald et al., 2013; Vaughn et al., in press; Zatz & Smith, 2012)
    • Addictive disorders (Alegria et al., 2008; Salas-Wright et al., in press)
    • Antisocial behaviors (Vaughn et al., in press)
Examined multi-generational links between immigrant and gambling use among US adults

National Epidemiologic Survey of Alcohol and Related Conditions (NESARC)

Multinomial regression used to compare rates of gambling among
- 1st gen (n=5,363)
- 2nd gen (n=4,826)
- 3rd gen (n=4,746)
- Nonimmigrants (n=19,715)
Results

- Prevalence of gambling among immigrant and non-immigrant men and women
RECAP: What Do We Know About Gambling Addiction?

- Risk factors that can lead to a gambling addiction
  - Phylogenetic and ontogenetic selections
  - Sociocultural selections

Why do people gamble?
- Refining our theoretical orientation for the etiology of disordered gambling will assist us in development of successful treatment approaches
- Motivational variables—seeking positive/appetitive stimulation or removal/avoidance of aversive stimulation (or positive and negative reinforcers)
- Gambling sub-groups (e.g., behaviorally conditioned, emotionally vulnerable, biologically-based; Blaszczynski & Nower, 2002)
Behavioral cusps, open door for additional appetitive access

*Wilson, Glassford, & Matthieu (under review)
Behavioral Account for Identifying Functional Variables Maintaining Gambling

Antecedent
- Stressful Day at Work
- Social Isolation
- 2 for 1 buffet and Double Points
- Needing a “Rush” of the Game

Behavior: GAMBLE

Consequence
- Feeling Relaxed
- Attention and Relationships
- Acquisition of “Good Deals”
- Neurochemical Changes

Wilson, Dixon, Schriber (under review)
Dixon & Johnson (2007)
Without Providing Functional Treatment, We Will Lose Every Time!

• Consider extinction induced phenomenon
  – Engagement in responses under periods of extinction

• Key is to understand the whole person (across BPS analyses), and target treatment accordingly
  – To avoid relapse/resurgence/persistence

• Must determine large scale and more immediate roles of maintaining variables
  – Pay day, fight with spouse, food, etc.
Treatments for Disordered Gambling

- Gambling treatment meta-analyses have found positive effects of psychotherapeutic interventions (Oakley-Browne et al., 2003; Pallesen et al., 2005; Cowlishaw et al., 2012)
  - CBT (Gooding & Tarrier, 2009)—reducing problem gambling with significant effect sizes across 3, 6, 12, and 24 month follow up

- Treatment goals:
  - Harm-reduction or responsible gambling (Ladouceur, 2005)
  - Abstinence (Petry, 2005)
SELECTING EVIDENCE-BASED INTERVENTIONS FOR DISORDERED GAMBLING...

Evidence-Based Practice: integration of best available research with clinical expertise in the context of client characteristics, culture, and preferences (p. 273; APA, 2006).

...Overall success rates for gambling treatments estimated at 70% for 6months FU, 50% for 1yr FU (Lopez Viets & Miller, 1997)

...CBT cautiously recommended as best practice (Rickwood et al., 2010)
Alternative Approaches

- **Third wave treatment approaches** incorporate biological, psychological, and sociocultural components to treat disorders and improve well-being.

- Emerging evidence suggests mindfulness-based interventions for disordered gambling demonstrate positive and significant effects on gambling behavior and symptoms, urges, and financial outcomes (Maynard, Wilson, Labuzienski, & Whiting, 2015).

- 18 disordered gamblers
  - M age = 19.05 (SD=.8)
  - M SOGS= 6.5 (SD=3.02)

- RCT
  - Wait-list control
  - 8hrs/8 weeks ACT (Dixon & Wilson, 2014)

- DV:
  - fMRI (BOLD)
  - Likert scale during gambling activity
Acceptance and Commitment Therapy

- Six components targeting various aspects of psychological inflexibility

- Goal is to foster psychological flexibility, to make room for entire experience, and choose to engage in behaviors that get you closer to values
  - Motivation, functional replacements, reinforcer access

Kevin Polk, 2014
<table>
<thead>
<tr>
<th>Week</th>
<th>ACT component</th>
<th>Experiential exercises</th>
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<tbody>
<tr>
<td>1</td>
<td>Mindfulness</td>
<td>--Where do you feel it?</td>
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<td></td>
<td></td>
<td>--Getting present</td>
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<td></td>
<td>Acceptance</td>
<td>--Gambling inventory: Tracking your gambling history</td>
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<tr>
<td>2</td>
<td>Values</td>
<td>--Mapping your values</td>
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<td></td>
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<td>--Treasure box</td>
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<td></td>
<td>Acceptance</td>
<td>--Movie buff</td>
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<td></td>
<td>Mindfulness</td>
<td>--Noticing the moment</td>
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<td>3</td>
<td>Acceptance</td>
<td>--If you’re not willing...</td>
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<tr>
<td></td>
<td>Defusion</td>
<td>--Taking the bait</td>
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<td></td>
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<td>--10 relations to gambling</td>
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<td></td>
<td>Mindfulness</td>
<td>--Detrimental gambling outcomes</td>
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<td></td>
<td>--Experiencing gambling</td>
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<td></td>
<td></td>
<td>--Staying in the present moment</td>
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<td>4</td>
<td>Acceptance</td>
<td>--Acceptance and gambling</td>
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<td></td>
<td></td>
<td>--Willingly cold</td>
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<td></td>
<td>Committed Action</td>
<td>--At the auction</td>
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<td></td>
<td>Defusion</td>
<td>--Getting stuck in the baggage claim</td>
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<td></td>
<td>--A thought is a thought, is a thought, is a thought...</td>
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<td>5</td>
<td>Acceptance</td>
<td>--Almost Willing</td>
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<td>--Acceptance, willingness, and the urge to gamble</td>
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<td>--Willingness 360</td>
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<td></td>
<td>Committed Action</td>
<td>--Willingness to cash out</td>
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<td></td>
<td>Mindfulness</td>
<td>--Where do you feel it?</td>
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<td>6</td>
<td>Defusion</td>
<td>--Buying a win</td>
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<td></td>
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<td>--Building space for gambling private events</td>
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<td></td>
<td>--Describing vs. evaluating</td>
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<td>--Physicalizing private events</td>
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<td>7</td>
<td>Self as Context</td>
<td>--The you that’s here, there, and everywhere you go</td>
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<tr>
<td></td>
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<td>--Who are you?</td>
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<td></td>
<td>Values</td>
<td>--Battleship</td>
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<td>--You and your values</td>
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<td>8</td>
<td>Committed Action</td>
<td>--Making and breaking commitments</td>
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<td></td>
<td>Self as Context</td>
<td>--Staying present with the you, you want to be</td>
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<td>Values</td>
<td>--Staying committed to your values</td>
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<td>--Clarifying your values map</td>
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</tbody>
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Note: exercises derived from Dixon and Wilson (2014); Hayes (2005)
Fig. 2. Average closeness to win ratings across wins and losses.

Fig. 3. Top Panel. Coronal (left) slice shows activation in bilateral ventral striatum.
Moving Beyond “Treatment as Usual”

• Treatment should be tailored to consider biological, psychological, and socio-cultural variables
  – Must be individualized for each client
  – Must take the whole person into account
  – Functional interventions result in better treatment outcomes!

• Behavior change is more than just vocal or verbal responses
  – Evidence that neurological/biological and psychological changes to gambling related responses following therapy

• Creativity and flexibility in treatment
  – Exposure?
  – Treatment goals?
  – Family?
Reconsidering Our Approach...

- Are behavior problems...
  A) A trait, like personality, that will always be?
  B) A state someone is in, like a bad mood or hunger?

- Maybe we can...
  - Expect more from ourselves and our clients
  - Move beyond treatment as usual by assessing and delivering function based treatment
  - Be open to new scientific advances to guide our treatment selection, interpretation, and implementation
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