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The Impact of Derived Relational Responding on Gambling Behavior

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The present article describes existing research on the impact of derived relational responding on gambling behavior. First, it is argued that a greater understanding of the role of verbal behavior in gambling behavior is made possible by research findings and theoretical advances in research on derived relational responding generally, and the transformation of stimulus functions in particular. Second, the findings of several recent studies are described in order to describe the key features of this contemporary approach for verbal events. Finally, implications for the verbally based treatment of disordered gambling are outlined.

Keywords: gambling behavior, verbal behavior, derived relational responding, transformation of functions, verbally based interventions.

Gambling is an activity enjoyed by many, yet is one that is increasingly becoming problematic for a growing proportion of the world's population. Evidence from several countries now shows that the increased availability of opportunities to gamble, in a diverse and growing range of formats, is often followed by increases in the prevalence rates of problem and pathological gambling, and in the number of people seeking treatment (Petry, 2005; Wardle et al., 2007). For instance, in the United States, a 1974 telephone survey found that 0.7% of a national sample was classified as pathological gamblers and 2.3% as problem gamblers (Kallick, Suits, Dielman, & Hybels, 1976). Some decades later, the lifetime prevalence rates of pathological and problem gambling were 1.4% and 5.1%, respectively (Volberg, 1994, 1996). More recently, the lifetime prevalence rate of pathological gambling has been estimated to range between 1 and 3% (Petry, 2005).

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A key challenge for contemporary efforts to design effective treatment services for the cluster of repertoires often referred to as "disordered gambling" (Petry, 2009) is the need for them to be empirically validated through initial basic research before eventual, applied intervention. Empirical research on gambling behavior is growing (Weatherly & Dixon, 2007) and several treatment approaches have been devised that are based on empirical findings (Petry, 2009). However, considerably more research effort is now needed if behavior scientists are to be at the forefront of the development of effective technologies for altering disordered gambling (Fantino, 2008; Mace & Critchfield, 2010). "Pure basic" and "pure applied" research (Mace & Critchfield, 2010) have important roles to play in furthering our understanding of the basic behavioral processes involved in gambling and in the development of effective interventions for disordered gambling. A similar effort is needed to facilitate "translational research" on gambling, which is usefully defined as "an essential complement to "pure basic" behavioral research because it explicitly considers the generality and everyday relevance of fundamental behavior principles" (Mace & Critchfield, 2010, p. 296).

To continue to inform effective treatment, basic, applied and translational research should seek to address how, for instance, "verbal rules can augment the actual contingencies of games of chance to further promote future gambling" or "completely overcome those contingencies altogether" (Weatherly & Dixon, 2007, p. 13). A key challenge, therefore, for any contemporary account of gambling behavior is to identify the role of verbal behavior. After all, "gambling is a behavior that is engaged in by verbal humans…The verbal human is exposed to a variety of contingencies and verbal stimuli when engaging in a gamble ... assuming such verbal stimuli do not exist, or arranging artificial laboratory conditions to eliminate verbal stimuli from the environment seems counterproductive to understanding why a gambler engages in the behavior he/she does" (Dixon & Delaney, 2006, pp.173-174). This article will outline an approach to understanding the role of verbal behavior in gambling behavior based on research conducted on derived relational responding and the transformation of stimulus functions. It will describe the features of this approach for explaining verbal events and suggest possible verbally based interventions based on the approach. Before this, it is necessary to consider existing research aimed at developing an experimental analysis of the role of verbal behavior in gambling behavior.

Towards a Contemporary Analysis of the Impact of Derived Relational Responding on Gambling Behavior

Nonarbitrary Relational Responding

In research on slot-machine gambling, procedures based on nonarbitrary relational responding have been shown to systematically alter gamblers' preferences over and above that predicted by the underlying reinforcement schedule. For instance, Hoon, Dymond, Jackson, and Dixon (2008) showed that recreational gamblers' choices of one of two simultaneously presented slot machines of equal payout probability (0.5) and reinforcement magnitude could be altered when a structural characteristic of one of the machines, such as background color, was established as a contextual cue for "greater than" relations. The identical reinforcement schedules operating with either slot machine should have resulted in relatively equal levels of response allocation (i.e., a "matching" of responding with relative reinforcement rates; Baum, 1979), and this is indeed what participants tended to do during a pretest phase. Following the relational intervention, however, the same slot machines were re-presented and participants' allocated a significantly greater proportion of their responses to the slot machine associated with the "greater than" cue, despite the identical reinforcement schedules.

In the Hoon et al. (2008) and related studies (Hoon, Dymond, Jackson, & Dixon, 2007; Johnson & Dixon, 2008; Nastally, Dixon, & Jackson, 2010; Zlomke & Dixon, 2006), a conditional discrimination procedure was used to train the two colors (blue and red) as contextual cues for more than and less than nonarbitrary relational responding, respectively. With such a procedure, correct selections are conditional on the presence of a particular stimulus. For instance, participants were presented with two comparison stimuli of differing physical quantities, such as three apples and six apples, and reinforcement delivered for selecting the three apples in the presence of the contextual cue for less than (i.e., background color of blue), and for selecting the six apples in the presence of the contextual cue for more than (i.e., background color of red). On reaching criterion, participants were presented with novel stimulus sets in the absence of feedback to test whether the cues were functioning as contextual cues for "more than" and "less than", respectively. The findings of several studies on this topic have now consistently shown that is possible to alter preferences by juxtaposing background, situational characteristics such as colors with concurrently available slot machines of identical reinforcement probability, density and magnitude (Hoon et al., 2007; Nastally et al., 2010; Zlomke & Dixon, 2006).

Recently, Johnson and Dixon (2009) extended this approach to show how an experimental history can lead to gambling behavior that appears to indicate "the presence of erroneous beliefs" (Delfabbro, Lambos, King, & Puglies, 2009) and override programmed reinforcement contingencies. Children, aged 7 to 10 years, played a simulated board game in which they could choose, on each turn, either of two concurrently presented dice that differed only by color (one red, one blue). Each die was programmed to roll a random number between 1 and 6, and each child's preselected game piece then moved the corresponding number of spaces along the on-screen racetrack. Next, in a relational training and testing phase, children were taught to select stimuli of differing physical quantities in the presence of a contextual cue for more than (red background color) and a contextual cue for less than (blue background color), before being tested with novel stimulus sets. Then the children played the simulated board game again. Although the contingencies governing dice rolling were unchanged, all but one child showed increased use of the die whose color served as the more-than contextual cue (red). In the language of stimulus relations, these results show how, through relational experience, contingency-irrelevant features of a game of chance can come under nonarbitrary contextual control by formal features (such as dice colors).

Procedures such as these (e.g., Dymond & Barnes, 1995; Whelan, Barnes-Holmes, & Dymond, 2006) are considered demonstrations of nonarbitrary relational responding because the relational response of picking the smaller or larger comparison is controlled by formal, physical features of the particular stimuli involved (Stewart & McAlwee, 2009). Nonarbitrary relational responding is entirely bound by the formal properties of the related events and is said to occur when for instance, in the absence of reinforcement, an organism selects the larger of two stimuli based on a history with multiple stimulus sets and contexts. Nonhumans are readily capable of acquiring nonarbitrary relational responding, and a nonhuman model of this generalized nonarbitrary performance is possible, and may even be desirable (Madden, Ewan, & Lagorio, 2007).

However, burgeoning empirical evidence now shows that verbally able humans can also learn to respond relationally to objects and events when the relation is defined by the physical properties of the objects but rather by additional contextual cues (Hayes, Barnes-Holmes, & Roche, 2001). For example, consider a young child who learns that ''X is taller than Y.'' Subsequently, he or she may when asked, ''which is shorter?'' respond ''Y,'' without any further training. According to relational frame theory (RFT), this response, which is controlled solely by the contextual cues ''taller'' and ''shorter'' and not by any physical relations, is arbitrarily applicable because it can be applied to any stimuli regardless of their physical properties. An unequivocal demonstration of a nonhuman model of arbitrarily applicable (derived) relational responding has yet to emerge. Therefore, a degree of caution is needed when interpreting the findings showing contextual control of altered preferences in slot-machine simulations and pregambling tasks because the findings do not demonstrate *derived, verbal control*. The combined performances of the gamblers, recreational gamblers, nongamblers, and children in these studies were not derived, in the technical sense that the color contextual cues did not participate in derived stimulus relations. What, then, are derived relations?

Derived Relational Responding

Research on derived relational responding may provide a behavioral model of how verbal processes might interact with, and overcome, the directly experienced contingencies of games of chance. Since the early 1970's, a vast literature has amassed on derived relational responding showing that when verbally able humans are taught a series of interconnected conditional discriminations involving physically dissimilar (arbitrary) stimuli, the stimuli involved often become related to each other in ways that are not explicitly trained. To illustrate, if choosing Stimulus B in the presence of Stimulus A is taught (i.e., A-B), and choosing Stimulus C in the presence of Stimulus A (i.e., A-C) is also taught, it is highly likely that relations will emerge between B and A, C and A (called symmetry), B and C, and C and B (called combined symmetry and transitivity, or equivalence), in the absence of any further training. When these relations have been observed, a stimulus equivalence relation is said to have formed among the relata (Fields, Adams, Verhave, & Newman, 1990; Sidman, 1994). These untrained, but nonetheless predictable, derived stimulus relations have been the focus of concerted research attention precisely because they are not readily explained by traditional behavior-analytic principles of discrimination and stimulus generalization. Neither B nor C, for instance, have a history of differential reinforcement with regard to each other (a defining feature of discrimination learning), therefore, neither should control selection of the other. Also, the derived stimulus relations that emerge cannot be accounted for on the basis of generalization because the stimuli are all physically dissimilar and cannot be explained via simpler conditioning processes.

To illustrate, it is likely that derived stimulus relations comprised of spoken words, visual stimuli and self-statements may be involved in contexts where gambling occurs. For example, the word "casino" participates in a derived relation with actual casinos. Moreover, during a visit to a casino, a gambler is likely to emit the self-discrimination that he or she "feels lucky". We may consider the spoken word, "casino" as Stimulus A, the actual casino as Stimulus B (i.e., A-B), and the self-statement, "I feel lucky" as Stimulus C (i.e., A-C). With a relational history such as this, a gambler is likely to utter the self-statement, "I feel lucky", when visiting a casino (B-C) and may also, when uttering the statement in other, non-gambling contexts "see" actual casinos (C-B) "in the absence of the thing seen" (Skinner, 1974, p. 91). Derived relations such as these are likely to highly diffused, flexibly adapting and assimilating to novel environments. This means that a gambler need only think of a casino in order to spontaneously derive relations involving self-discriminations of "feeling lucky" and others.

Research on derived relational responding has generated scores of basic research studies, applied extensions, and conceptual analyses. The chief reason for the burgeoning research and theoretical advances in this area is that it now appears possible to explain the emergence of untrained stimulus relations in the absence of a direct history of reinforcement. The behavioral process by which this occurs, and which is still hotly debated (Hayes et al., 2001; Hayes & Barnes-Holmes, 2004; Sidman, 1994), has the capacity to alter virtually all other operant behavior, and account for the complex behavior emitted by verbally able humans, be they in the classroom, therapy room, or casino. Thus, what is at stake in research on derived relational responding is the opportunity to develop a contemporary, functional analytic account of verbal behavior itself.

Transformation of Stimulus Functions: A Functional Account of Verbal Events

A central feature of derived relational responding - the transformation of stimulus functions - makes it directly relevant to an empirical analysis of gambling behavior, and with it, a contemporary approach to verbal behavior (Barnes-Holmes, Barnes-Holmes & Cullinan, 2001). Transformation of stimulus functions is said to occur when the psychological functions of stimuli in a derived relation are transformed based on the nature of the relation and the psychological functions of the other member(s) of that relation. For example, if A is related to B and B is related to C, and C is paired with a winning slot machine outcome that evokes arousal and approach functions, then presentations of A will also likely evoke similar conditioned arousal and approach functions by virtue of the derived C-A equivalence relation (for a review, see Dymond & Rehfeldt, 2000). In the context of a gambling, consider a gambler who plays Blackjack for the first time and enjoys it. Later, while on vacation in Germany, our gambler might learn that, in Germany, Blackjack is called "Seventeen plus four". If she subsequently hears "Seventeen plus four", she may show signs of approach and "see" a Blackjack table. In this way, the functions of a novel stimulus are transformed based on the functions acquired with another by virtue of the derived relation that obtains between the two.

According to prevailing behavior-analytic accounts, a verbal stimulus acquires its functions based, at least in part, on participation in a derived relation or relational frame (Barnes-Holmes, Hayes, Dymond, & O'Hora, 2001; Dymond, 2008; Dymond & Rehfeldt, 2000; Dymond & Whelan, 2007; Hayes, Fox, Gifford, Wilson, Barnes-Holmes, & Healy, 2001). Approached in this way, derived relational responding and the transformation of stimulus functions represent the key behavioral processes involved in the initiation and maintenance of gambling behavior. Such processes may interact with or override programmed contingencies of reinforcement. In effect, the transformation of stimulus functions may account for the insensitivity to direct contingency control often observed in disordered gambling and may partly explain the emergence of gambling behavior that arises in the absence of a direct learning history.

Dixon, Nastally, Jackson, and Habib (2009) showed that derived equivalence relations could alter recreational gamblers' ratings of slot machine outcomes. During a pretest phase, Dixon et al. presented participants with three graphic displays of slot machine outcomes depicting a win (i.e., three matching symbols on a payout line), a near miss (i.e., two matching symbols and one different symbol on a payout line) and a loss (i.e., three different symbols on a payout line; C1, C2 and C3, respectively), and asked them to rate how close the image was to a win. Next, participants were trained in the formation of A-B and A-C conditional discriminations, before being tested once for symmetry (B-A and C-A) and equivalence relations (B-C and C-B). The A1, A2, and A3 stimuli consisted of three abstract images, and the B1, B2, and B3 stimuli consisted of the text "win", "loss" and "almost", respectively. Finally, in the post-test phase participants were re-presented with the C1, C2 and C3 stimuli. Dixon et al. predicted that if derived equivalence relations were formed between the B-C and C-B stimuli, then the B3 stimulus ("almost") should acquire some of the functions of the C3 loss image and the B2 stimulus ("loss") should acquire some of the functions of the C2 near-miss image (the B1 stimulus, "win", should remain unchanged as it was related via equivalence to the C1 win image, and vice versa). Results indicated that, relative to pretest levels, the majority of participants rated the C3 "loss" stimulus as closer to a win than the C2 "near miss" stimulus. Moreover, when the requisite derived relations were not formed, the predicted performances failed to emerge. These findings demonstrate how intra-experimentally established derived verbal relations may influence recreational gamblers' ratings of slot machine outcomes in ways that may override the contingency-relevant functions of gambling stimuli. In effect, the gamblers behaved as if the three different symbols on the payout line were closer to a win than the "almost winning" near miss display of two matching symbols (Habib & Dixon, 2010; Reid, 1986).

Modeling Pregambling Behavior: Derived Transformation of Children's Pregambling Game Playing Functions in Accordance with Equivalence Relations

The findings of Dixon et al. (2009) are promising and show how an approach based on derived relational responding may be used to systematically alter recreational gamblers' preferences for gambling relevant stimuli. Dymond, Bateman, and Dixon (2010) sought to further investigate the impact of derived, verbal relations on gambling behavior by examining whether or not a key defining feature of derived relational responding – the transformation of stimulus functions - occurs during the same type of analogue gambling tasks Johnson and Dixon (2009) used with young children. Transformation of stimulus functions is said to occur when the psychological functions of stimuli in a derived relation are transformed based on the nature of the relation and the psychological functions of the other member(s) of that relation. For example, if A is related to B and B is related to C, and C is paired with a winning slot machine outcome that evokes arousal and approach functions, then presentations of A will also likely evoke similar conditioned arousal and approach functions by virtue of the derived C-A equivalence relation (for a review, see Dymond & Rehfeldt, 2000).

The transformation of stimulus functions may partly explain the emergence of gambling behavior, such as an increased preference for a novel slot machine, that arises in the absence of a direct learning history and may, ostensibly, appear to indicate control over behavior by "erroneous beliefs" (Delfabbro et al., 2009; Sevigny & Ladouceur, 2003). Dymond et al. (2010), therefore, sought to extend Johnson and Dixon's (2009) findings by showing that children's pregambling responses may be altered via derived relational responding and the transformation of functions. First, 12 children aged between 7 and 10 years old, were trained (A1-B1, A1-C1, A2-B2, & A2-C2) and tested for the formation of two, three-member equivalence relations (B1-C1, B2-C2, C1-B1, & C2-B2). Four participants failed to achieve mastery criterion after four equivalence test exposures and were removed from the study. The remaining 8 participants then proceeded to play an adapted version of Johnson and Dixon's simulated board game. The purpose of this phase was to attach high- and low-roll functions to two dice labeled with members of the derived relations. Specifically, the die labeled B1 was programmed to always roll high numbers (4, 5 or 6), and the die labeled B2 was programmed to always roll low numbers (1, 2, or 3). This phase established a baseline of responding between the two concurrently available dice labeled B1 ("more than") and B2 ("less than"). To complete this phase, participants were required to select the B1 ("more than") die on at least 80% of trials. Next, the test for transformation of stimulus functions was presented with presentations of dice labeled C1 and C2. As this was a test, participants' selections of each die were not followed by differential feedback (i.e., each trial ended with the participant's game piece completing the racetrack).

Dymond et al. (2010) found that all except one of the participants who passed the equivalence relations test selected the C1 die more often than the C2 die, despite the absence of differential feedback following each dice roll, and all except three gave C1 higher liking ratings than C2. The increased response allocation and liking ratings for C1 relative to C2 suggests that the directly trained functions of B1 and B2 were transformed in accordance with the derived equivalence relations between the B and C stimuli. These findings show, for the first time, that gambling relevant response functions may transform in accordance with derived equivalence relations. Such a demonstration greatly extends the potential utility of behavior-analytic models of gambling in explaining the emergence and maintenance of gambling behavior in the absence of direct reinforcement and contribute towards potential verbally based interventions to overcome disordered gambling (Petry, 2009). Undertaking this analysis with young children's pregambling game playing is important in developing an empirical, developmental account of verbal mediation effects in terms of transformation of functions and how it may lead to disordered gambling.

Modeling Gambling Behavior: Derived Transformation of Functions in Accordance with Equivalence and Non-equivalence Relations

These preliminary, demonstration studies go some way towards understanding the impact of derived relational responding on gambling behavior, and lend support to the view that gambling may be considered a verbal event (Dymond, 2008). However, behavior-analytic research on gambling behavior needs to do more than demonstrate, in the basic lab, a putative role for verbal relations; it must also undertake translational analyses (Mace & Critchfield, 2010) of the behavior evoked by the situations and stimuli confronted by actual gamblers. Consider, for instance, someone entering a casino. Choice of which slot machine, or of which form of gambling (roulette, craps, poker, etc.) to play is likely to be influenced by derived, verbal functions in the form of rules and self-rules like "loosest slots in the house" and "I feel lucky", along with formal features of the context (e.g., lights, colors, sounds, and names of slots machines). In gambling, stimulus functions such as these likely participate in multiple, contextually controlled derived relations. Gamblers' relational histories with various stimulus functions may come to exert control over choices and override the effects of programmed contingencies.

Dymond, Mills, Griffiths, Cox, and Crocker (submitted) have sought to develop a preliminary translational model of the choices gamblers make to play differing slot machines by testing for derived transformation under various conditions of lean reinforcement and non-reinforcement. Three experiments were conducted, each involving the formation of derived equivalence relations and the training of high- and low-probability payout functions for two members of the derived relations but which differed in terms of how subsequent transformation was tested. In Experiment 1, thirty participants (3 of whom scored 1 on the *South Oaks Gambling Screen* (SOGS; Leiseur & Blume, 1987), first formed two, three-member equivalence relations (A1-B1-C1 & A2-B2-C2). Next, they were given successive simulated slot machine exposure training with two machines labeled B1 and B2, respectively. Slot machine B1 was programmed to payout (i.e., three matching symbols on the payout line, and the addition of 1 credit to an accumulating total display) on 5 out of 25 trials (i.e., 0.2 probability), while slot machine B2 was programmed to payout on 20 out of 25 trials (i.e., 0.8 probability). Following a ratings phase in which participants rated the likelihood of winning on the two slot machines, they proceeded to the test for transformation of stimulus functions. During this phase, participants were given concurrent presentations of slot machines labeled C1 and C2, and were required to select which one they wished to play. Participants did not directly experience playing the slot machines; instead, their forced choices were recorded.

The findings of Experiment 1 showed that participants rated slot machine B1 as significantly closer to a win than slot machine B2, and during transformation of functions testing they chose slot machine C1 significantly more often that slot machine C2. This derived transformation occurred under forced choice conditions in which participants were not exposed to the underlying reinforcement schedules operating with the slot machines. Such a demonstration provides evidence of 'proof of concept' and illustrates the impact of derived relational responding on gambling behavior, but may be considered as lacking ecological validity. For instance, it is rare for slot machine gamblers to be exposed to choices of different machines, but not to actually experience outcomes on those machines. A more realistic model of slot-machine gambling would be to expose participants to a test under conditions of extinction (i.e., in the absence of feedback following each reel spin), since this more accurately reflects how random ratio schedules are arranged on slot machines. Experiment 2 addressed this issue.

In Experiment 2, the same procedural format as Experiment 1 was adopted except for the following important difference. During the test for transformation of stimulus functions, participants could actually play the slot machines labeled C1 and C2. However, when a slot machine was selected it spun as before but each reel successively stopped on a blank display. This manipulation ensured that participants were not provided with any feedback on the outcomes of the slot machines trials (i.e., extinction). Twenty-eight out of thirty participants (4 who scored 1, 3 who scored 3, and 1 who scored 6 on the SOGS) passed tests to demonstrate the formation of equivalence relations. The findings from the test for transformation of stimulus functions indicated that participants chose slot machine C1 significantly more often that slot machine C2, and rated slot machine C1 as significantly closer to a win than slot machine C2, despite never winning on either slot machine. The findings of Experiment 2 demonstrate the derived persistence of slot-machine gambling under conditions of extinction, and lend further support to the behavioral model of gambling as derived relational responding. The findings indicate that high probability winning outcome functions established during direct exposure training may come to participate in derived relations and influence the persistence of slot machine selections under conditions of extinction.

In seeking to further develop a behavioral model of slot-machine gambling initiation and maintenance, however, it is necessary to test derived transformation under conditions that approximate real-world reinforcement schedules. Previous research on concurrent slot machine schedules has shown that participants' responding generally conforms to the predictions of the matching law (MacLin, Dixon, Daugherty, & Small, 2007): that is, relative response rates match relative reinforcement rates. Experiment 3 addressed the role of matched reinforcement schedules during transformation of functions testing. During this phase, participants could actually play the slot machines labeled C1 and C2. However, when a slot machine was selected it spun as before and displayed the outcome of each trial. Each slot machine was programmed to payout at a probability of 0.2 (i.e., on 4 of 20 trials). Forty out of forty-three participants (11 who scored 1 and 2 who scored 2 on the SOGS) passed tests to demonstrate the formation of equivalence relations. The findings from the test for transformation of stimulus functions indicated that participants chose slot machine C1 significantly more often that slot machine C2, and rated slot machine C1 as significantly closer to a win than slot machine C2, despite the matched probabilities.

The final studies to be described here sought to investigate how slot machine response functions could come to participate in, and transform, multiple, contextually controlled derived comparative relations of more than and less than (Hoon & Dymond, 2010). Following nonarbitrary relational training and testing designed to establish contextual functions of more than and less than for two arbitrary cues, participants were tested for the formation of a contextually controlled relational network, E>D>C>B>A. All mutual (e.g., D<E) and combinatorial entailment (e.g., C>E) tasks were tested. Next, a slot machine labeled with the middle-ranking stimulus, 'C', was presented that had a low payout probability (0.2). During the test for transformation of functions, pairs of slot machines labeled with members of the relational network were presented. It was predicted that participants would choose the higher-ranking stimulus of each pair in accordance with the relational network. Findings supported this prediction, with participants selecting the slot machine labeled ‘A’ least often and the slot machine labeled ‘E’ most often. Responding during the test for transformation of functions showed a graded trend in accordance with the derived comparative relations, in the absence of any differential feedback.

In a further experiment, Hoon and Dymond (2010) altered the direction of the trained relational network, A>B>C>D>E. Again, a low payout probability (0.2) function was attached to the slot machine labeled ‘C’. As predicted, participants’ choices on the tests for transformation of functions were in accordance with the comparative ranking of the relational network. That is, participants selected the slot machine labeled ‘E’ least often and the slot machine labeled ‘A’ most often. Selections occurred in the absence of differential feedback, and without actually playing the slot machines, yet a consistent pattern of transformation of functions was observed in accordance with the ranking of the relational network. These findings may help to understand those occasions when a gambler selects to play on a slot machine that he or she “likes more” than another, despite never had won before on the machine.

The findings of Dymond et al. (2010) and Hoon and Dymond (2010) illustrate how gambling relevant stimulus functions may come to participate in, and transform, contextually controlled derived relations. Taken together, these promising findings attest to the fact that because not all objects and events in a derived relation need to be directly experienced, the potential for gambling to be controlled by increasingly complex and ever more remote contingencies is both tremendous and far-reaching. These and other studies go some way towards providing an experimental analysis of verbal mediation effects seen in cognitive approaches to gambling behavior. Moreover, the findings demonstrate the utility of the experimental and translational analysis of gambling behavior. The observation that gamblers and nongamblers’ behavior came under the control of comparable contingencies indicates that common processes may underlie the transition from orderly, non-problem gambling to disordered or pathological gambling.

Implications of a Contemporary Approach to Verbal Events for the Treatment of Disordered Gambling

Derived relational responding and the transformation of stimulus functions are likely processes through which gambling behavior that at first appears to be insensitive to underlying reinforcement contingencies may, subsequently, come to be firmly established in a gambler’s repertoire. Indeed, a respectable body of experimental data now exists to support the idea that much complex human behavior, including features of gambling behavior (see above), can emerge from verbal contingencies alone. However, many research challenges lie ahead if the import of such research is to be fully realized. In particular, it is not known how immediate nonverbal and more indirect verbal contingencies controlling gambling behavior interact with each other. It may well be the case that gambling behaviors arising from verbal contingencies quickly come under the direct control of the immediate consequences of gambling (i.e., winning or losing). In other words, the direct reinforcing and punishing monetary consequences of gambling may over-ride the effects of derived relational responding contingencies. Thus, while verbal processes may initiate gambling behavior or a particular risky decision on a given occasion, such processes may not be solely responsible for the maintenance of such behavior.

Alternatively, however, it may be that the ability of derived relational processes to transform the functions of reinforcing consequences (e.g., "losing means that I must be about to win soon", otherwise known as the gambler's fallacy) may be sufficient to maintain high rate gambling behavior even in the presence of direct punishing consequences (i.e., losing). In effect, the degree to which specific types of verbal contingencies might render gambling behavior insensitive to nonverbal contingencies is not well understood, and likely varies with the strength of each contingency, the verbal fluency of the individual and salience of behavioral consequences (i.e., the response cost, or level of gambling loss), and other factors. A complete analysis of gambling behavior that is applicable to real-world gambling will need to address this complex empirical issue.

'Third Wave' Behavior Therapies

Identifying core processes at work in the emergence and maintenance of gambling behavior also bears on the issue of treatment. Indeed, the idea that many instances of problem behavior emerge from verbal contingencies has led in recent years to the development of a range of modern behavioral therapies such as Acceptance and Commitment Therapy (ACT; Hayes, Strosahl, & Wilson, 1999), Functional Analytic Psychotherapy (Kohlenberg & Tsai, 1991), and Dialectical Behavior Therapy (Linehan, 1993). These approaches to behavior therapy employ experiential exercises and rich talk-therapy metaphors of a type more commonly associated with the humanistic tradition (McCurry & Hayes, 1992). However, these approaches (known collectively as "third wave" approaches; see Vilardaga, Hayes, Levin & Muto, 2009) have in common an emphasis on verbal behavior, and in the case of ACT, a particular emphasis on derived relational responding processes. We will briefly consider here how insights gained by ACT researchers may prove helpful in harnessing the concept of derived stimulus relations and the transformation of stimulus functions in the treatment of problematic gambling behavior.

ACT is a modern behavior therapy strongly associated with relational frame theory (Hayes et al., 2001) and the mindfulness movement (Baer, 2005). This approach to therapy assumes that human suffering is ubiquitous largely due to our ability to derive bidirectional relations between words and other stimuli, and for the functions of stimuli to transform in accordance with those relations (e.g., for the thought "I feel lucky today" to transform the functions of multiple events that occur *today* such that everything from gambling to meeting an old friend to catching a bus, all produce the positive feelings of "luck").

According to ACT, the problem for many clients displaying addictions and other forms of psychopathology is that they employ coping methods that are inherently self-defeating. More specifically, a typical adult in our culture will deal with unpleasant private thoughts and feelings by using methods of distraction or avoidance, which ACT therapists refer to as experiential avoidance. For many clients, these methods may be effective in cases where the experiences being avoided are not sufficiently aversive to interfere with the individual's general social functioning. However, in some cases, the very effort to avoid uncomfortable private experiences can itself be self-destructive (e.g., excessive drinking or gambling). Alternatively, the avoidance method may fail due to the inescapable fact that avoidance efforts become related to the very experiences being avoided. Thus, avoidance itself becomes one of the experiences that produces the experiences to be avoided (Blackledge & Hayes, 2001). Put simply, the more one attempts to avoid an experience the more that effort produces the very experience being avoided (see Hayes, Luoma, Bond, Masuda & Lillis, 2006). In fact, several studies have now produced empirical evidence of this effect (e.g., Clark, Ball, & Pape, 1991; Feldner, Zvolensky, Eifert, & Spira, 2003).

ACT refers to "psychological flexibility" as the preferable alternative to psychological inflexibility or experiential avoidance. It uses nonlinear language, paradox and metaphor to undermine the literality of language, which in technical terms we may now describe as derived relational responding and the transformation of stimulus functions. Hayes et al., (1999) provided extensive examples of metaphors and experiential exercises that can be used to undermine literal language, and these have been built upon in several subsequent publications (e.g., Hayes & Stroshal, 2004). The most relevant of these exercises in the current context are known as defusion or deliteralization exercises. Defusion exercises are designed to alter the context for the derived transformation of functions. Importantly, the defusion technique aims to leave all psychological functions of stimuli, even the aversive ones, fully in tact (see Blackledge, 2007). In general terms, the technique teaches clients to see their thoughts of escape from feelings (e.g., an urge to gamble), overt actions (e.g., actual gambling) and further thoughts (e.g., intentions to gamble) as just thoughts, and to be aware of and psychologically present to the alternatives to avoidance. Such a technique seems counter intuitive insofar as it expressly involves teaching a gambling addict, for example, *not to* avoid the feelings and thoughts associated with gambling (e.g., "I am a failure", "Here I go again", "I have got nothing more to loose anyway", etc.). This approach, however, is based on a solid understanding of derived relational processes and laboratory analog studies (e.g., Healy, Barnes-Holmes, Barnes-Holmes, Keogh, Luciano & Wilson, 2008; Masuda, Hayes, Sackett, & Twohig, 2004; see also, Hesser, Westin, Hayes & Andersson, 2009; Masuda, Hayes, Twohig, Drossel, Lillis & Washio, 2009; Masuda, Twohig, Stormo, Feinstein, Chou, & Wendell, 2010) which have shown this technique to be effective in reducing the intensity of urges and the distress with which they are associated.

In a defusion exercise, the therapist socially reinforces non-avoidance and non-escape responses from aversive thoughts and feelings and thereby establishes a genuinely novel context in which the client responds to feelings of distress associated with their compulsion. More specifically, a therapeutic context is created in which escape and avoidance are not the only possibilities. Moreover, a history of non-avoidance is established in the presence of former discriminative stimuli for avoidance (i.e., thoughts of avoidance, responded to literally). In this way, the dominance of avoidance functions produced by thoughts of gambling are reduced relative to other more recently established non-avoidance functions. Avoidance may of course still occur, but not only is its probability reduced, but the distress arising from the former certainty that gambling always follows thoughts of gambling has been directly undermined. This in turn further reduces the intensity of future avoidance responses, and therefore a further weakening of the control of gambling thoughts over behavior. Paradoxically then, a reduction in gambling urges and activity can arise when the client is taught to be willing to experience those very thoughts and feelings they fear most (hence the emphasis on "acceptance" in ACT).

As a concrete illustration, defusion exercises often involve asking a client to repeat aloud a word or phrase that is discriminative for problematic urges or behavior and which are typically avoided. In the case of a compulsive gambler, they may be asked to repeat the phrase; "I am going to gamble today" repeatedly. Through such vocal repetition, the auditory functions of the phrase often come to dominate over the emotional functions of the words, such that the client begins to notice more and more the sounds of each word with each repetition. They may even begin to laugh at the amusing sounds of some of the words. Eventually, they may realize, with the help of the therapist, that the avoidance or approach functions of the word "gamble" have diminished, whist other stimulus functions have increased (see Masuda et al., 2004). This exercise can then serve as a metaphor for all disturbing thoughts and feelings in future therapy sessions. In this way, the ability of such thoughts to control (or be "fused with") overt action decreases. The outcomes of these treatment approaches may then be measured using objective indices and self-report instruments, a range of which is now available within research on gambling.

Conclusions & An Agenda for the Future

Derived relational responding research has tremendous implications for the analysis of gambling behavior and for the development of empirically supported verbally based interventions, but behavior analysts can learn from interventions in other, related domains. Indeed, it is likely that the future development of effective techniques to treat disordered gambling will involve a range of components from other, related behavioral interventions. For instance, contingency management methods that are effective in treating substance abuse disorders (Silverman, Roll, & Higgins, 2008) may be capable of being adapted to treat disordered gambling, which is often highly comorbid with substance abuse (Petry, 2005, 2009). It is likely that contingency management procedures could target the 'altered schedule of social reinforcement' that gamblers undergoing treatment must contact, and in conjunction with pharmacotherapeutic procedures could prove useful in maintaining the effects of treatment contingencies (Grant, Kim, & Hartman, 2008; Petry, Wienstock, Ledgerwood, & Morasco, 2008). However, before further combinations of interventions to treat disordered gambling are proposed, a great deal more empirical work remains to be conducted, both on the components of effective treatment interventions and the impact of derived relational responding on gambling behavior.

Great strides have been made in the experimental analysis of gambling behavior. As the research momentum grows, it becomes critical to explain the role of verbal behavior on gambling behavior. The present article has highlighted how research on derived relational responding and the transformation of stimulus functions offers a potential analytic strategy with which to approach the behavior of verbally able humans engaging in games of chance. The potential of such an approach has yet to fully realized. Yet, only further research and the continued development of empirically supported treatment interventions will help to determine whether or not the research efforts currently underway will pay off in the future.

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