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Becky L. Nastally
Southern Illinois University, bnastall@siu.edu

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A Review of Petry & Madden's Chapter *Discounting and Pathological Gambling* in *Impulsivity: The Behavioral and Neurological Science of Discounting*

Becky L. Nastally
Southern Illinois University

Petry and Madden contribute a revealing chapter on the relationship between discounting and pathological gambling to Madden and Bickel's (2010) *Impulsivity: The Behavioral and Neurological Science of Discounting*. Within the chapter, the authors note the increased interest in the topic of delay discounting and gambling while presenting some obscurities in the existing body of literature further research will need to address, including the co-occurring role of substance abuse in pathological gamblers. Additionally, the chapter outlines theoretical interpretations of discounting as they relate to gambling behavior as well as highlights the need for further research in the area of probability discounting in this population. The present review provides a brief overview of all chapters in the book, critically evaluates Petry and Madden's contribution, and argues that impulsivity as a variable in the analysis of gambling in general warrants conceptual clarification.

Keywords: discounting, gambling, impulsivity, review

Petry and Madden contribute a noteworthy, thought provoking chapter on the relationship between discounting and pathological gambling to Madden and Bickel's (2010) book on the study of impulsivity more generally as it relates to various discounting procedures. Although delay discounting has garnered an increasing amount of attention among psychological researchers in the last decade (see the Introduction for a 2008 citation analysis), the book is an account of both delay and probability discounting, including current areas and findings from the literature and the theoretical implications that follow from these.

Address all correspondence to:
Becky L. Nastally, PhD BCBA
Behavior Analysis and Therapy Program
Rehabilitation Institute
Southern Illinois University
Carbondale, IL 62901
Email: bnastall@siu.edu

The goals of the present review are to provide a brief synopsis of the various chapters included in the book, highlight the need to expand the study of gambling in general, offer a critique of Petry and Madden's chapter on discounting and gambling, and finally, present additional areas for future research on this topic in order to reveal a more refined conceptual understanding of impulsivity as it relates to gambling behavior.

The first chapter, a 'primer' on delay discounting by Madden and Johnson, sets a tone of accessibility for the book in terms of the audience it seeks to attract. The editors contend it is written for basic and applied researchers, clinicians, and those in academic programs interested in the study of impulsivity and the scientific issues that surround it. The book accomplishes this goal and arguably goes beyond it by, in several instances, relating the study of discounting to many relevant and mainstream 'decision making' problems in American society such as fiscal responsibility, behavioral addiction, and en-

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vironmental conservation. Additionally, the book offers a variety of theoretical perspectives on the study of discounting from experimental to personality psychology.

The first part of the book comprises chapters on methodological issues including the various procedures, equations, and variables that can be utilized in controlled research on discounting behavior. Next, its relation and application to neural processes studied largely using animal models is outlined in the second part of the book. These three chapters represent a biological basis of decision making and elucidate changes in brain chemistry and activation that potentially accompany discounting behavior. Part III features the chapter on gambling that serves as the impetus for the present review, as well as three other chapters devoted to discounting's relation to, effect on, and predictive power over the development of a substance abuse problem. An abundance of literature on this topic has confirmed that substance abusers discount delayed outcomes (both monetary and non-monetary commodities) to a greater degree than their non-substance abusing counterparts (Yi, Mitchell, & Bickel, 2010), and these chapters highlight some of the most important and exciting advances that have been made in the world of discounting research. Part IV includes two chapters on non-addiction related psychological problems that may be informed by investigations of delay discounting, namely decisions related to health behavior and attention-deficit/hyperactivity disorder (ADHD). The final section of the book offers theoretical interpretations of discounting including one from Stevens and Stephens grounded in the foraging behavior of organisms in their natural environments, a discussion by Ainslie advocating for the adoption of a bottom up approach to uncovering the mechanisms responsible for discounting, and Rachlin and Jones present an interesting analysis of the 'social dilemma' of altruism by way of a systematic discounting paradigm.

Pathological gambling fits into the conceptualization of impulsivity offered above in that the compulsive gambler may repeatedly choose to spend money in exchange for small (and probabilistic) outcomes, possibly at a craps table, over saving money to buy school clothes for his or her children in a few months, for example. The percentage of regular gamblers who end up engaging in such behavior is only beginning to come to light, but the statistics appear troubling. For example, Stucki & Rihs-Middel (2007) compiled prevalence studies on gambling conducted world-wide between 2000 and 2005 in an attempt to identify the most accurate and recent statistics. Their sample was selected using strict methodological criteria and the results of some studies using the South Oaks Gambling Screen (Lesieur & Blume, 1987; SOGS) reported rates of excessive gambling (problem and pathological types combined) to be as high as 6.4% (low range .6%). Still, these numbers should be viewed conservatively as some studies incorporated the use of more than one assessment (e.g. the DSM-IV and/or CPGI) and the overall weighted mean of pathological gambling in others may have been inflated.

More consistent data suggest, however, that the prevention and treatment efforts that exist are not sufficiently deterring individuals from gambling. In the United States, gross gaming revenue was $32.54 billion in 2008 and this only takes into account profit generated from commercial casinos (AGA, 2009). As is the conundrum in the understanding of other potentially 'addictive' behaviors, gambling may be a recreational pastime enjoyed on infrequent occasions for some, however others develop the inability to control the frequency in which they engage in the behavior along with the aversive consequences that follow it. Because of this,

a greater understanding of the basic processes involved in gambling is necessary.

To present a rationale for a chapter devoted to the topic of gambling and discounting, Petry and Madden open with the DSM classification of pathological gambling as an impulse control disorder including its diagnostic criteria (4th ed.; American Psychiatric Association, 1994). Interestingly, with the upcoming release of the newest edition of the *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.) in 2013, developers are considering changing the classification of pathological gambling from 'impulse-control disorder not elsewhere classified' to an expanded version of the classification 'substance-related disorders' that will be titled 'addiction and related disorders' (American Psychological Association, 2010; see Petry, 2006 for a discussion of potential implications of this change). Closely related to diagnostic criteria, the authors then present findings from several studies on both the prevalence of pathological gambling, as well as the slightly less severe form, problem gambling.

The next section outlines the important issue of comorbidity as it relates to incorporating discounting procedures to enhance the study of pathological gambling. As the authors point out, some studies have shown co-occurring problem gambling behavior to be as high as 14% in treatment seeking substance abusers (Gerstein et al., 1999; Welte, Barnes, Wieczorek, Tidwell, & Parker, 2001) and recent research has elucidated these findings by showing this association exists independent of non-substance related mental disorders (Rush, Bassani, Urbanosky, & Castel, 2008). Germane to the present topic of discounting then is the question of whether one topography of addictive behavior is disproportionately related to the differences in discounting rates among the population that exhibits both and that which exhibits neither. Further research is necessary to answer this question and may benefit from focusing on which problem behavior is more likely to develop first, which one is manifested in more severe forms, and if treatment for one is likely to affect the other.

Related to the present topic of discounting, the authors of the chapter offer 'an underlying disorder of impulse control' as a possible 'explanation' of why these two disorders occur together. Following from this, the authors contend there is utility then in utilizing discounting procedures to better understand the fundamental problem of impulsivity. Two issues with this line of reasoning are as follows: first, the potential problem of adopting the construct or disorder of impulsivity as an explanatory device (which will be further explored below), and second, focusing on impulsivity as the root cause instead of the function of each specific behavior makes it difficult to examine the relationship between individuals who exhibit only one of these problem behaviors (that may be maintained by a distinct function) and the degree to which they discount delayed outcomes. For example, how do pathological gamblers (without a history of substance abuse) perform on discounting tasks and other indices of impulsivity? As specified in the chapter, it is rare that studies assessing personality inventories in pathological gamblers have reported participant history of substance abuse, only one study assessing the Iowa Gambling Task has (Goudriaan, Oosterlaan, de Beurs, & van den Brink, 2006), and there are only a few studies on delay discounting that have sought to isolate the variables necessary to determine the answer to the above question (e.g. Petry 2001).

Next, Petry & Madden offer a hypothesis of discounting as a predictor of addiction along a continuum (i.e. steep rates of discounting are predictive of either gambling or substance abuse while even steeper rates predict the development of both). They use

evidence from the literature on substance abuse, incorporate Rachlin's (1990) string theory, and propose ways in which the shape of hyperbolic delay-discounting functions through both Equations 1 and 2 lend support for the role of delay discounting in pathological gambling as a predictive variable. Although there does appear to be some data in support of this theory (Petry 2001; Alessi & Petry, 2003), additional research is necessary to strengthen the hypothesis that high rates of discounting are indicative of a potential gambling problem. For example, in one study Weatherly, Chase, & Derenne (2008) found that demographic risk factors of developing a gambling problem (age, gender, ethnicity, etc.) were not predictive of rates of delay discounting.

The final section of the chapter outlines the topic of probability discounting and what is currently known about the relationship between it and problem gambling behavior. Probability discounting differs from delay discounting in that it measures the change in value of a chance, rather than guaranteed, outcome. As the authors state, it could be expected that problem gamblers place a higher subjective value on probabilistic outcomes (given the nature of gambling activities) than non-problem gamblers. Essentially, what is known about this can be summarized in two studies that did in fact report shallower rates of probability discounting among gambling disordered college students (Holt, Green, & Myerson, 2003) and treatment seeking, male pathological gamblers (Madden, Petry, & Johnson, 2009) than matched controls. Interestingly, these results represent a negative correlation between delay and probability discounting. As the authors note, this type of discounting in particular represents a potentially important mechanism to explore regarding the formation of and treatment of this behavior.

The authors' recommendations for future directions in the area of discounting and gambling research largely favor a state variable approach which is good news for behavior analysts interested in studying this topic. They seem to endorse a position that is cautionary of using discounting to measure impulsivity as a causal construct of pathological gambling (as outlined above) or as an unchangeable trait variable in those who gamble at problematic rates. Rather, the suggestions that are offered advocate using discounting as a behavioral measure that will either help predict problem gambling or aide in the treatment of it. For example, the authors propose an increase in longitudinal studies to further reveal the relationship between discounting in children or adolescents and the development of a gambling problem later in life. Another area mentioned is teaching tolerance for delays or self-control skills through the use of basic learning principles such as reinforcement, and the authors adequately support this recommendation by pointing to the literature on reducing discounting rates as a mediator of successful treatment for nicotine addiction (Dallery & Raiff, 2007; Yoon et al., 2007). One final direction for research worth noting from the chapter is further investigation of the rate at which problem gamblers discount losses. The authors note this is a population that appears to be more insensitive to the aversive consequences involved in gambling than non-problem gamblers evidenced by behaviors such as 'chasing' losses for example.

In the last paragraph of the chapter it is rightly acknowledged that the study of impulsivity as a construct related to problem gambling is in its earliest stages. Behavior analytic conceptualizations of problem behavior typically do not include constructs in causal analyses, so the immediate problem is to determine what the role of impulsivity, or more specifically, rates of discounting should be. Not surprisingly, this is a problem that many behavior analysts have ad-

dressed (e.g. for an in depth discussion see the special section of *Analysis of Gambling Behavior* on delay discounting, 2008). What appears to be agreed upon within the delay discounting research community that adopts a behavioral perspective are two things: one, that discounting is a behavioral measure that improves upon personality inventories of impulsivity, and two, that impulsivity is best understood as a state variable. These two assumptions make advocating for research on the role of discounting in gambling behavior easier. Furthermore, given the ethical constraints experienced by many researchers attempting to study gambling in natural environments, investigating what may be termed a behavioral correlate of gambling would make for a worthy endeavor.

The utility of the above proposal of course rests upon the conclusion that specific rates of discounting definitely are related (in a predictive sense or otherwise) to problem gambling. If they are, behavioral researchers could examine discounting as a collateral behavior much in the way they do verbal behavior. Just one example of this is the study of what has been termed the 'near-miss effect'. A near miss may be defined as a special type of loss consisting of formal properties that appear very similar to a win (e.g. 2 out of 3 identical slot machine reel outcomes or a black jack hand of 22) and research has shown that it serves as a stimulus that occasions an increase in both non-verbal (Kassinove & Schare, 2001) and verbal behavior (Dixon & Schreiber, 2004) related to gambling. Like the near miss effect, delay discounting could be thought of as a behavioral measure that represents a different dimension of gambling, however still increases our understanding of this complex behavioral phenomenon. Germane to the discussion above of reducing the rates at which gamblers discount delayed rewards as to mediate effective treatment; the near miss effect offers a good example.. In fact, when conceptualizing the near miss effect as illogical rule following (as shown by Nastally & Dixon, in press), reducing it is a prominent component of empirically validated treatments for pathological gambling such as of cognitive behavior therapy (Petry, 2005). Thus, the classification of the near-miss effect exhibited by problem gamblers as collateral behavior or a varied dimension of gambling behavior represents a useful model for the conceptual treatment of delay discounting in the study of gambling.

In conclusion, Petry and Madden's chapter on discounting and pathological gambling in *Impulsivity: The Behavioral and Neurological Science of Discounting* (2010) represents a thorough account of the nascent, yet growing, body of literature on the topic. On one side, it provides an impetus for researchers seeking to advance our knowledge in this area. As outlined in the chapter, the predictive nature of discounting related to gambling (both its development and treatment) and the way in which gamblers discount not only delayed, but also probabilistic and aversive outcomes represent two areas rife with potential experimental questions. Additionally, those from the theoretical side concerned with the most functional and parsimonious way to conceptualize impulsivity byway of discounting in conjunction with gambling behavior will also find the chapter to be a stimulating read.

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