Functional Analysis of Gambling

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FUNCTIONAL ANALYSIS OF GAMBLING

by

Mack S. Costello

A dissertation submitted to the Graduate College
in partial fulfillment of the requirements
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FUNCTIONAL ANALYSIS OF GAMBLING

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Given high rates of gambling and the growing population of disordered gamblers, there is a need to develop assessment strategies with improved treatment validity. More specifically, assessment strategies are needed that identify the controlling variables for disordered gambling and, thus, provide guidance in the selection of treatment and prevention strategies. This study sought to develop a functional analysis for gambling by utilizing a simulated gambling environment in which contextual variables hypothesized to be causally linked to disordered gambling could be systematically manipulated. Seven experienced gamblers participated in the multi-element, single-subject experimental study. Participants who endorsed at least some problems from gambling were found to have their behavior under control of negative reinforcement variables, whereas non-disordered gamblers had undifferentiated (positive and negative reinforcement) controlling variables. Limitations of the experimental conditions and implications for research are discussed.
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INTRODUCTION

Gambling is an age-old activity in which players risk losing a particular amount of something valuable, usually money, for the chance of gaining more of the valuable. Gambling has been prevalent in human society for thousands of years; today gambling is a popular leisure activity, has become a powerful economic industry, and is a topic of significant research. Gambling is a very popular form of entertainment; in the United States (U.S.), a large majority of adults (86%) has reported gambling in their lifetime (see National Gambling Impact Study Commission [NGISC] final report, 1999). Gambling takes many forms, ranging from betting on sporting events and playing slot machines to betting on card games, video games, and other activities that may not have been developed for betting purposes. The gambling industry is a multi-billion dollar industry in the U.S. alone, with consumer casino spending over $30 billion in 2012 (American Gaming Association, 2013). Based on historical growth data and the positive impact of casinos on local economies and state governments, the gambling industry is likely to continue to grow (see American Gaming Association, 2013; Mawhinney, 2006 for more information). As the industry continues to thrive, and societal problems related to gambling increase with industry growth, research on gambling and gambling’s effect on individuals can be expected to grow as well.

Researchers have reported a correlation between gambling availability and prevalence of “disordered gambling,” a psychological diagnosis that affects 1-3% of the general population characterized by gambling behavior that is compulsive and harmful to the individual (Abbot & Volberg, 2000; Petry, 2005; Shaffer, Hall, &
The prevalence of disordered gambling has been increasing; while availability of gambling opportunities provides one contributing factor for this increase, the etiology of the disorder remains unclear. Individuals with gambling problems commonly endorse preoccupation with gambling, chasing losses, lying about gambling, tolerance, and gambling to escape (see Blanco, Hasin, Petry, Stintson, & Grant, 2006; Gerstein et al., 1999; Petry, 2009; Toce-Gerstein, Gerstein, & Volberg, 2003). Disordered gambling first appeared as a diagnosis in the DSM-III as “pathological gambling” and was categorized with impulse control disorders (American Psychiatric Association [APA], 1980), but is now defined in the DSM-5 with substance-related and addictive disorders (APA, 2013). Categorization of disordered gambling in the DSM-5 also involved a lessening of the number of symptoms required for diagnosis; this change was partly due to the fact that many people did not reach previous criteria for disordered gambling, but still experienced negative consequences from gambling. This sub-diagnostic category has been referred to as “problem gambling” (see Petry, 2009).

Given gambling’s popularity and the reported economic, societal, and psychological impact, there is a continuing need to research behavioral factors that influence gambling, especially the development of disordered gambling. The goal of the present study is to present research on a behavioral method of assessing factors that influence gambling. This method can be used to research gambling in a laboratory as well as validate other assessment methods for identifying the contextual factors that affect gambling. An overview of gambling assessment and gambling research within behavioral psychology will first be provided.
Classifying Gambling Problems for Assessment

In this section, reviews of the conceptualizations and classification of disordered gambling are provided. As mentioned above, while currently classified as a “behavioral addiction,” the etiology of disordered gambling is unclear. Addiction is derived from the Latin verb “addicere” and the Latin noun “addictus.” Addicere translates as “to sentence,” and sometimes, “to doom.” The term “addictus” was often used to refer to a gambler in debt, implying a long history of gambling being viewed as behavior with troublesome consequences. While the ancient versions of addiction have little to do with contemporary views of addiction, both views are a bit nebulous.

Although there is controversy as to an acceptable definition, addiction generally refers to a maladaptive pattern of behavior that is repetitive, harmful in some ways to the individual (usually deferred and cumulative financial and social consequences), resistant to behavior change efforts, and characterized by a high rate of relapse following attempts to stop the addictive behavior. Nicotine and alcohol dependence are often referred to as the prototypical addictions (U.S. Department of Health and Human Services, 1988). Different substances (and activities) have been labeled as addictive when similar behavior patterns emerge, suggesting some common underlying mechanisms for the development and persistence of addictive behaviors. Discovery of these mechanisms has been an important line of research within addiction studies for pragmatic efforts to prevent and treat addiction. Also, identifying behavioral and physiological mechanisms may reduce the tendency to define addiction by focusing on the characteristic behaviors and then explaining the
observed patterns as a result of addiction. While this type of descriptive definition is acceptable, it likely has limited treatment utility as it is an example of circular reasoning and reification of addiction.

For an addiction to develop in the most common examples (e.g., smoking, alcohol abuse), a biological agent (i.e., a drug) must be identified as the source of the dependence. This is consistent with what may be the most agreed upon definition of addiction as a brain disease resulting from ingestion of a drug (in which repeated use of the substance results in physical and long-term changes in the mesolimbic reward system), with the environment playing a contextual role (Leshner, 1997). The mesolimbic reward system is a pathway within the brain that extends from the ventral tegmentum (VTA) to the nucleus accumbens, with offshoots to other areas such as the limbic system and orbitofrontal cortex; this pathway is important for dopamine in the brain, a neurotransmitter heavily implicated in rewards and pleasure. According to Leshner, all addictive substances affect this pathway. Hypothetically, taking addictive drugs can reduce neurological sensitivity to other non-drug forms of reinforcement, such that the addictive drugs are then sought out to activate the pathway as other forms of reinforcement become less effective (see Volkow, Fowler, Wang, & Goldstein, 2002).

“Gambling addiction” has been referenced often in gambling literature, but without a biological agent that would parallel drug addiction, gambling problems do not qualify as addictions according to the definition put forward by Leshner in the 1997 issue of Science. Originally, in the DSM-III, pathological gambling was considered a disorder of impulse control (APA, 1980). Impulse control disorders, not
unlike addictions, have somewhat nebulous inclusion criteria and defining features. They are generally defined as a failure to resist an impulsive act that may be harmful to the self or others. Researchers have suggested that impulse control disorders should be considered part of the obsessive-compulsive disorder (OCD) spectrum (Hollander & Wong, 1995). The reasoning for this suggestion is that impulse control disorders, like OCD, involve an uncontrolled aspect of behavior despite what should appear to be punishing consequences. This suggestion is not universally accepted, however (e.g., Black, Goldstein, Noyes, & Blum, 1994). Part of the supposed distinction between OCD and disorders like pathological gambling is that pleasure is not a consequence gained from true compulsions, but, instead, relief from anxiety (i.e., escape or negative reinforcement) is the critical consequence that is postulated to motivate compulsive behavior. Pathological gambling, on face, involves positive reinforcement and pleasure from gains or the possibility of gains. This discussion has been reframed by behavior analysts to focus on the roles of both positive and negative reinforcement as maintaining variables for gambling behavior. There is little doubt that generalized escape and/or avoidance (i.e., negative reinforcement) do, in fact, play an important role in disordered gambling (see Weatherly, 2013a). There have been reports that pathological gamblers have withdrawal-like symptoms when they stop gambling (Rosenthal & Lesieur, 1992; Wray & Dickerson, 1981). Withdrawal symptoms are commonly associated with addiction and, when relief occurs from re-engaging in the activity, this can be conceptualized as negative reinforcement (see Lyons, 2006 for a detailed analysis of gambling as an addiction).
Gambling as an addiction was formalized as a diagnostic category in the DSM-5 (APA, 2013). Prior to the DSM-5, diagnostic categories that referred to addiction were typically restricted to disorders of substance abuse, dependence, or substance-induced disorders (APA, 2000). The DSM-5 reclassified these disorders as Substance Use and Addictive Disorders, and included gambling disorder as the lone behavioral addiction. There has been debate as to whether or not disordered gambling is, and should be, considered an addiction. Quite obviously, gambling does not involve the ingestion of a biological agent with known biological and addictive properties. However, some have speculated that gambling activates many of the same biological processes that are involved in drug addiction. Despite these classification issues, there is certainly a need to identify the behavioral mechanisms that underlie disordered gambling, as gambling may continue to grow as a social problem that would merit prevention and treatment efforts based on behavioral and psychological strategies.

Efforts to comprehend the underlying neurology implicated in disordered gambling were demonstrated in a notable study. Habib and Dixon (2010) compared subjective ratings of “closeness to win” on outcomes from a slot machine while gamblers were in an fMRI brain scanner. Comparisons between groups of disordered and non-disordered gamblers (twenty-two subjects; 11 in each group) revealed no significant differences in their ratings of how close the outcomes were to wins. Interestingly though, differences in brain activity on the fMRI scans between the two groups of gamblers were documented, including differences in neural activity in the left midbrain, near the subsantia nigra and VTA. These structures are precisely those
of the mesolimbic reward system implicated in addiction. Additionally, the disordered gamblers appeared to have a hyposensitive reward system, consistent with a hypothesis about drug addiction described earlier in terms of reduced sensitivity to sources of reinforcement other than the addictive substance (Volkow, Fowler, Wang, & Goldstein, 2002). In the Habib and Dixon study, the disordered gamblers displayed a lower level of activity in the mesolimbic dopaminergic system and the activity of the system was positively correlated with the nucleus accumbens activity. While the data lend support to disordered gambling as an addiction with respect to the neural activity of the brain, this was a correlational study, thus making it impossible to determine whether the differences in brain functioning between the two groups were a cause or a result of gambling, or simply a co-occurrence. What is interesting in Habib and Dixon’s results is that the same neural pathway is implicated both in disordered gambling and addiction, a finding that has since been replicated (Dymond et al., 2014).

The neural pathways implicated in addiction and fMRI research involved dopamine transport and metabolism. This observation is congruent with a case study reported by Dodd et al. (2005) involving patients suffering from Parkinson’s disease who were prescribed a dopamine agonist (which works mostly with the D3 dopamine receptors), pramipexole. A number of these patients developed disordered gambling patterns subsequent to taking the dopamine agonist. Furthermore, opioid agonists have been examined in the treatment of pathological gambling, and show some promise (Grant et al., 2006). While intriguing, much research needs to be conducted on the underlying neural mechanisms before a reliable strategy to prevent and treat
disordered gambling can be developed and recommended. For example, it is unclear whether the neurological correlates of disordered gambling are a function of genetic factors, family history, or idiosyncratic conditioning history. It is also unclear whether these neurological correlates are pliable and whether neurological changes are a prerequisite or an outcome of successful behavior change. Regardless of the progress at the neurological level, there is still a pressing need to identify the behavioral and contextual factors that contribute to gambling behavior. In summary, although there is no drug involved in gambling addiction, disordered gamblers do show behavior consistent with an addiction. The effect of disordered gambling on the brain is not as well understood as the effect of addictive drugs. Part of the reason for this is that the specific variables that may predict disordered gambling, whether genetic, environmental and behavioral, or both, have yet to be identified.

Many people are able to gamble without problematic consequences, while others develop persistent gambling behaviors that cause significant personal, social and societal harm. This discrepancy in the trajectory of gambling behavior across people has led to speculation about inherited genetic characteristics that render some people especially susceptible to gambling addiction. This biological susceptibility model is precisely the early medical model of alcohol addiction; Alcoholics Anonymous (AA) still utilizes this model, where not drinking is not a sign of absence of alcoholism, and, even if abstinent for many years, an alcoholic is still in recovery. The early medical model of alcoholism that placed the key characteristic in the individual rather than the substance or the environment necessarily leaves these people always alcoholics, and is still used by AA. The moral outrage over alcohol
addiction led to prohibition in 1920, in fact many addictive substances remain attached to criminal activity. In 2011, the U.S. Justice Department targeted online gambling as criminal (see United States Attorney, District of Maryland, 2011; United States Attorney, Southern District of New York, 2011). However, with alcohol addiction, it has been shown that unproblematic social drinking is possible (Raistrick, 1987), and interventions not targeting abstinence and brief interventions are perhaps as effective as extended treatment (see Bien, Miller, & Tonigan, 1993; Miller, et al., 1995); furthermore, among a variety of addicts, drug use can be at least postponed for other incentives (e.g., Bigelow, Brooner, & Silverman, 1998; DeFulio, Donlin, Wong, & Silverman, 2009).

Drawing on the model of individual and biological susceptibility, Gamblers Anonymous (GA) was founded in 1957 and views disordered gambling as an incurable disease. Like AA, GA offers a 12-step support group that focuses on abstinence as the intervention goal. The intervention processes in GA rely heavily on public commitment and social support. In spite of glowing testimonials, empirical data from adequately controlled experiments are seldom published for GA. In a study that followed individuals after an initial GA meeting, less than 8% abstained from gambling (Stewart & Brown, 1988), showing that relapse is high and long-term gain, when equated to abstinence, is low. However, participation in GA has been correlated with success in therapist-directed treatment (Petry, 2003a), indicating that the motivation of those in GA to engage in behavior change is legitimate. Recently, researchers have suggested controlled gambling may be a desirable and attainable goal for at least some disordered gamblers (see Ladouceur, Lachance, & Fournier,
Regardless of how gambling problems are classified, and the emphasis on underlying neurological correlates, gambling remains a behavioral problem. More specifically, research should seek to discover why people engage in destructive patterns of gambling behavior and what steps can be taken to prevent or treat such behavior patterns. Thus, there is a compelling need to develop a model to assess and understand the behavioral factors that contribute to gambling and to develop prevention and treatment strategies that are informed by the results of that assessment.

Gambling and Behavioral Psychology

Gambling presents a social issue that behavior analysts have begun to address with greater intensity. In an editorial concerning the future of behavior analysis, Edmund Fantino proposed that gambling is an area of research in need of a strong behavior-analytic contribution (2008). Fantino is not alone in making this proposition; other researchers have commented on the lack of gambling research in behavior analysis (Dickerson, 1979; Dixon, Nastally, Jackson, & Habib, 2009; Weatherly, 2004). Until recently, gambling research in behavior analysis has been sparse (see Ghezzi, Lyons, Dixon, & Wilson, 2006 for a review of gambling prior to the founding of the behavior-analytic journal Analysis of Gambling Behavior in 2007). The methodological and ethical difficulties posed by gambling research may have deterred behavioral researchers from addressing this topic in the past, but more recently, a behavioral research base has grown as gambling has been acknowledged.
as a widely-accepted and socially-valid problem (see Witts, 2013 for a cumulative record of behavior analytic gambling publications).

Early behavioral work on gambling was largely composed of conceptual and laboratory-based research. Skinner (1953a; 1974) hypothesized that disordered gambling behavior was maintained by variable ratio (VR) schedules of reinforcement. Per this view, gambling behavior that persists despite great monetary loss is analogous to resistance to extinction. Slot machines operate on random ratio (RR) or constant probability schedules, which have topographical similarity to VR schedules (Crossman, 1983). Indeed, many gambling games operate on an RR schedule (e.g., there is a constant probability in card games of being dealt a given hand), and while monetary rewards are perhaps the ultimate reinforcers, stimuli that signal increased probability of a win are reinforcers as well (e.g., having a strong hand in poker, or slot machine visual displays that approximate a winning outcome).

Studies examining non-human animal behavior (hereafter referred to as “animal research” as a contrast to human research) have shown that RR schedules control high rates of behavior. Furthermore, RR schedules are highly preferred when compared to other reinforcement delivery schedules and are particularly resistant to behavioral disruptions such as ratio strain (see Madden, Ewan, & Lagorio, 2007). Interestingly, the nature of the reinforcement schedule (VR or RR delivery) appears to have a separate and powerful influence on preference above and beyond the characteristics of the stimulus delivered (e.g., money/tokens, edibles), and this observation may contribute to our understanding of disordered gambling. Laboratory research using animals has an advantage of having much more control over
environments and history of subjects compared to human, naturalistic, or applied research. Madden et al. (2007) asserted that closed economy, long-duration choice laboratory experiments are particularly useful in developing the animal model of gambling; the long duration allows motivating operations to fluctuate, and there is a continuously available choice between a fixed income and gambling, which is analogous to the human condition of gambling (at least analogous when the humans in question have the option to live on a fixed income salary). Kendall (1989) conducted a seminal closed economy study which showed that pigeons preferred gambling (RR schedule) that involved lengthy time-out to a fixed-ratio (FR schedule) option that provided a much richer schedule of food. Follow-up studies have shown that as income decreases on FR schedules within choice paradigms, preference for RR schedules increases in animals (Goldshmidt & Fantino, 2004; Madden & Hartman, 2006; see Madden et al, 2007 for a review).

Gambling research in animals and humans that focuses on the role of reinforcement contingencies is in contrast to other behavioral models that emphasize the role of verbal behavior in humans as a major determinant of disordered gambling among humans (see Dixon, 2000; Dixon & Delaney, 2006; Weatherly & Dixon, 2007). Risky gambling behavior that has traditionally been considered to be controlled by heuristics has been modeled with pigeons (see Zentall, 2011). However, in gambling with human participants in non-laboratory settings, the schedules of reinforcement for monetary rewards are only one part of a large and complex set of sensory stimuli and contingencies that operate across a range of gambling venues (i.e., casinos and online gambling web sites). These contingencies may operate on VR
schedules, RR schedules, or any other schedules that are experienced by a gambler, programmed or otherwise. Reinforcement is presented on a schedule, whether it is contrived or naturally occurring, and it is the reinforcement contingency (of which a schedule is one mechanism) that operationalizes the temporal connections between gambling behavior and sensory stimuli that precede and follow, and ultimately influence the behavior. Considering this, researchers have also taken approaches less focused on “molecular” contingency analysis and more focused on “molar”, long-term, contextual behavioral allocation (see Rachlin, 1990; 2000; Rachlin, Safin, Arfer, & Yen, 2015). This research has suggested potential variables for targeting in treatment, though the variables have not been explicitly examined.

Researchers have noted that as the behavioral analyses of gambling mature, the validity of research performed in laboratory analogue settings may become more problematic, with humans or animals (e.g., Brandt & Pietras, 2008). For example, gambling studies with humans that do not involve an actual risk of monetary loss may have difficulty determining the degree to which monetary reinforcement contingencies affect behavior. Research has shown that monetary incentives do differentially affect laboratory gambling (Brandt, Sztykiel, & Pietras, 2013; Weatherly, McDougall, & Gillis, 2006). However, under laboratory discounting paradigms, researchers have found that the loss of hypothetical money functions in a similar way to the loss of real money (e.g., Johnson & Bickel, 2002; Madden, Begotka, Raiff, & Kastern, 2003). The utility of experimental models comes from the availability of control and the reliability and validity of research findings; examining what affects behavior and how it can be changed in an environment as complex as the
world of human gambling requires excellent systematic control. Experimental research should ultimately shed light on the processes involved in disordered gambling and lead to refined functional analyses and treatment technologies.

Empirical research is needed to help understand the causal variables involved in the development and maintenance of disordered gambling behavior, as well as to link these variables to the development of effective interventions to treat disordered gambling. Understanding the variables that maintain disordered gambling is key to treatment. Treatments generally are either prevention or exposure-based from the findings of a functional assessment. A functional assessment can be considered a non-experimental attempt to determine causes of behavior; an experimental attempt is often called a functional analysis (meaning an experimental analysis, not an experimental method). Fortunately, empirically supported treatments for disordered gambling do exist (see Rash & Petry, 2014; Petry, 2009). For example, Petry et al. (2006) reported a cognitive-behavioral therapy (CBT) that included functional assessment of gambling triggers and subsequent alternative behavior training, addressing faulty rules/irrational thoughts, and relapse prevention skills. Participants in the CBT condition had reductions in days and dollars gambled compared to other conditions. The use of this CBT with the addition of tracking actual gambling behavior has been replicated and also yielded positive results (Guercio, Johnson, & Dixon, 2012). Although abstinence is often the goal of gambling treatment, it is not always achieved, and brief or harm reduction treatments have been shown to be effective at reducing gambling behavior and negative effects from gambling (Costello & Fuqua, 2012; Ladouceur, Lachance, & Fournier, 2009; Nastally & Dixon, 2012;
Petry, Weinstock, Ledgerwood, & Morasco, 2008). Function-based treatments, if they can be further developed, will likely improve on the effect of interventions, full or brief, and allow for greater congruence between treatment goals and client goals.

In behavior analysis, a “functional analysis” refers to a demonstration of a cause and effect relationship (Baer, Wolf, & Risley, 1968; Schlinger & Normand, 2013; Skinner, 1953a). At its core, an experimental functional analysis (FA) consists of sessions where antecedents and consequences of a target behavior are systematically manipulated so that different reinforcement contingencies that may be maintaining the target behavior can be evaluated. The reinforcement contingencies that are found to effectively maintain the target behavior can be targeted in treatment design (Iwata, Dorsey, Slifer, Bauman, & Richman, 1982/1994). Considering the breadth of research on experimental functional analyses and treatment in applied behavior analysis (see Hagopian, Rooker, Jessel, & DeLeon, 2013; Hanley, Iwata, & McCord, 2003; Kurtz et al., 2003; Mueller, Nkosi, & Hine, 2011), such analyses in the context of psychological disorders, such as gambling, could be effective in understanding the behavioral factors that are functionally linked to gambling; this, in turn, would inform the development of treatment strategies that are tailored to the unique controlling variables for each person (see Harvey, Luiselli, & Wong, 2009; Iwata & Dozier, 2008).

The present research sought to develop a functional analysis for gambling by simulating a gambling environment in which contextual variables that are hypothesized to be causally linked to disordered gambling could be systematically manipulated in an experimental functional analysis design. This manner of simulated
environment allows for the isolation and systematic manipulation of hypothesized controlling variables for disordered gambling. Identifying idiosyncratic controlling variables through a functional analysis assessment is the first step to developing and validating treatments that are linked to the controlling variables for disordered gamblers.

Functional Behavioral Assessment of Gambling

Developing an FA methodology for gambling could help classify different disordered gamblers based on the mechanisms of action for their gambling problems. There is evidence that a subset of different consequences maintain disordered gambling behavior among different gamblers; different gamblers gamble in different manners (see Petry, 2003b). For example, gamblers who prefer skill oriented games and gamblers who prefer chance games may have relevant differences in reported rule-governed behavior (see Myrseth, Brunborg, & Eidem, 2010). Another possibility is that gamblers who prefer live gambling versus gamblers who prefer online gambling would differ in the social contingencies maintaining their respective problem behaviors. These differences are likely relevant in creating effective treatments.

Researchers have developed strategies to identify the idiosyncratic controlling variables for gamblers. For example, Dixon and Johnson (2007) proposed a self-report functional assessment tool titled the Gambling Functional Assessment (GFA), which was designed to identify factors maintaining gambling behavior. The GFA consisted of five questions associated with one of four factors (the factors were
attention/social positive reinforcement, escape/social negative reinforcement, sensory/automatic reinforcement, and tangible/positive reinforcement; 20 total questions) modeled from previous functional assessment factors for self-injury (e.g., Durand & Crimmins, 1988).

Research has suggested that negative reinforcement (escape) endorsements from the GFA may predict pathology (Miller, Dixon, Parker, Kulland, & Weatherly, 2010). Testing has been done on the construct validity of the GFA (Miller, Meier, Muehlenkamp, & Weatherly, 2009) in the form of exploratory and subsequent confirmatory factor analyses on the responses of 949 undergraduates. Results of Miller et al. (2009) suggested the original GFA separated positive and negative reinforcement factors of gambling behavior. The GFA-Revised (GFA-R) (Weatherly, Miller, & Terrell, 2011) incorporated items with the strongest factor loadings from Miller et al. (2009) and added items to balance and assess additional positive and negative reinforcement contingencies. This was followed by exploratory and subsequent confirmatory factor analyses. The final GFA-R included 16 items: Eight associated with a positive reinforcement factor, 8 with a negative reinforcement factor. The items did not cross-load, and did load strongly in their respective factors. The GFA-R is consistent ($\alpha = 0.91$; Weatherly et al., 2012) and reliable ($r = 0.80$ at four weeks and $r = 0.81$ at 12 weeks; Weatherly et al., 2012). The factor structure of the GFA-R has also been validated in samples from Japan and the United Kingdom (Weatherly, Aoyama, Terrell, & Berry, 2014; Weatherly, Dymond, Samuels, Austin, & Terrell, 2014). Endorsing the negative reinforcement, or escape, subscale, has been shown to be correlated with endorsing disordered gambling symptoms (Weatherly,
The GFA-R assesses several potential controlling variables for escape, suggesting that gambling may function as a behavior maintained by generalized negative reinforcement, or may be part of a generalized response to aversive stimuli. The researchers noted that data on other psychometric properties, such as predictive validity, should also be collected and analyzed (Weatherly, Miller, & Terrell, 2011), as other function-based self-report assessments have been shown to have low validity when compared to experimental behavioral assessments (Iwata, DeLeon, & Roscoe, 2013). While more research is desirable, the GFA and subsequent GFA-R are notable accomplishments in research on functional analysis of gambling.

Laboratory work has attempted to simulate positive and negative reinforcement for gambling, although not in a functional analysis format or around an explicitly functional analysis question (Martner, Montes, & Weatherly, 2012; Weatherly, Mari, & Montes, 2012). Martner et al. (2012) used unsolvable anagrams as a hypothetically aversive task to increase gambling via escape after attempting to solve the anagrams. They found that participants who endorsed escape motivations on the GFA-R did gamble more than other participants, but their gambling did not vary with the unsolvable versus solvable anagrams (i.e., the in-session aversive tasks did not affect their behavior). The anagrams may not have been sufficiently aversive, may not have induced any escape responding related to the gambling, or issues with the sample may have been culprit.

Weatherly et al. (2012) compared participants gambling in two sessions: one in which participants competed for a gift card (positive reinforcement), and one in which participants gambled after unsolvable anagrams (escape). Participants who
endorsed escape gambled more in the anagram session, but not in the gift card session. This suggests endorsing escape does predict differential functional behavior in gambling contexts. However, the researchers cautioned against using the unsolvable anagrams procedure, as the difference between the sessions (anagram and gift card) was slight and not statistically significant. A different negative reinforcement paradigm may assist in creating a more valid functional analysis (and was developed for the current study).

Other researchers have suggested escape from aversive stimuli, which may include non-reinforcement in gambling conditions after exposure to reinforcement, may contribute to gambling persistence. Research has shown that response latencies to initiate an analogue gambling trial varied depending on the outcome of the immediately prior gambling trial. More specifically, shorter latencies were observed immediately following a losing gambling trial compared to a winning gambling trial, with increasingly short latencies observed as the number of consecutive losing trials increased (Dixon & Schreiber, 2002; Schreiber & Dixon, 2001). These observations have been interpreted as indication that losing gambling trials are aversive, and that latencies to the next trial shorten as a means of escaping an aversive condition by initiating the next, potentially non-aversive gambling trial. Similar results (longer latencies after wins) have also been found in non-human gambling research (Peters, Hunt, & Harper, 2010; Weatherly & Derenne, 2007).

Research has shown that base rates of endorsing gambling for positive reinforcement are high, even when also endorsing gambling for generalized escape (Miller, Dixon, Parker, Kulland, & Weatherly, 2010; Weatherly, Miller, & Terrell,
2011; Weatherly, Montes, & Christopher, 2010). The more escape items endorsed, the less likely a clear function will be seen; this style of endorsement is common, and endorsing escape has been correlated with potential pathology (for a treatment of the GFA-R and escape, see Weatherly, 2013a; b).

In synopsis, much of the research on functional behavioral assessment has been based on self-report. However, there is some evidence from laboratories that the distinctions of positive and negative reinforcement are meaningful in predicting disordered gambling and correlate with gambling behavior.

An experimental FA of gambling could be particularly useful considering research has repeatedly shown indirect assessment methods such as interviews or questionnaires to be unreliable, particularly in contexts where experimental FA’s can be used (see Arndorfer, Miltenberger, Woster, Rortvedt, & Gaffaney, 1994; Iwata, DeLeon, & Roscoe, 2013; Sigafoos, Kerr, Roberts, & Couzens, 1993; Thompson & Iwata, 2007), indicating indirect assessment methods may not be the best basis for developing treatment. Descriptive or structural assessments are a long-standing option in psychology that involves some direct observation. While these assessments are more reliable than questionnaires in many cases, descriptive or structural assessments are also limited in efficacy when compared to experimental FAs (Marion, Touchette, & Sandman, 2003; St. Peter et al., 2005; Thomson & Iwata, 2007).

For above reasons, an experimental FA of gambling behavior was developed in the Behavioral Medicine Laboratory at Western Michigan University. A laboratory simulation of a gambling environment was replicated so that gambling behavior could be directly observed under a variety of possible controlling variables.
Contextual factors of a gambling environment (sounds, other players, etc.) were simulated with equipment and confederates. Additionally, alternatives to the gambling environment (e.g., non-gambling games, work tasks, etc.) were available in the FA. Observing gambling under relevant and plausible controlling variables derived from self-report measures such as the GFA-R allowed for comparison between self-report measures and the results of experimental functional analyses of gambling behavior in a simulated gambling environment.

METHOD

Participants

Participants were recruited using flyers (Appendix A) posted on and around Western Michigan University campus. In addition, participants were recruited in local gambling venues (there were nearby poker rooms, and casinos as short as an half-hour drive). The flyers described a research study for persons who gambled in their leisure time. Interested participants could contact the Behavioral Medicine Laboratory for more information. Eight people finished the study, although one participant’s data were excluded from analysis due to a software issue with the gambling simulator used. Functional analyses utilize a single subject design, and such studies are often rely on repeated measures of a small number of participants under specific test conditions. Prospective participants were instructed to e-mail the experimenter or call the Behavioral Medicine Lab. Upon receiving an inquiry, the experimenter responded with an email, or a phone call to the potential participant to confirm interest and to set up an initial meeting. Phone and email scripts are in
Appendices B and C respectively.

*Inclusion and Exclusion Criteria*

To participate in this study, participants must have reported that they gamble in their leisure time regularly (at least twice per week). Furthermore, participants must have agreed to keep a gambling diary. A screening questionnaire assessed these criteria (see below).

The experimenter and the potential participant set up individual meetings to go over consent and initial questionnaires. During the meeting, the experimenter provided the potential participant with an informed consent form (Appendix D) and summarized the form, then the experimenter allowed time for the potential participant to read the form. The experimenter then stated, “Please understand this is a research study, not a treatment study. There is no treatment available in the study.” Then the experimenter asked: “Do you have any questions about the research or about the risks and protections of the research?” If the potential participant indicated they had questions, the experimenter would answer or clarify. If the potential participant declined to participate, they were thanked for their time. If the potential participant (hereafter referred to as participant) was willing to participate in the study, he or she was provided with a copy of the consent form to keep.

*Setting and Apparatus*

Experimental sessions were conducted in rooms in the Behavioral Medicine Laboratory suite on Western Michigan University campus. Three rooms were
utilized: The simulated game room was a larger room with a small bank of computers that had playable gambling games available on-screen, a couch, tables containing prepared food, drink, or both, and reading material. A second room was sparsely decorated with a computer that displayed the work task. A third room, that was similar to the second room, was also used for a confederate to sit in when not participating in sessions.

Two gambling programs were utilized in the present study; one was a video poker program titled WinPoker (Zamzow Software Solutions, 2007; described in Jackson, 2007), and the second was a slot machine simulation written in visualBASIC (Brandt, 2011) available through the Gambling-Special Interest Group of the Association for Behavior Analysis International.

Procedure

After consenting and prior to any sessions, all participants completed a screening questionnaire (Appendix E; written by the researchers to assess inclusion criteria), GFA-R (Appendix F) and another version titled the GFA-II (a revision that includes the four original functions; A. Wilson, personal communication, June 6, 2013), and a version of the South Oaks Gambling Screen (SOGS; Lesieur & Blume, 1987) (Appendix G).

The screening questionnaire (appendix E) assessed inclusion criteria and determined a) gambling game(s) of choice (e.g., roulette, poker, blackjack, etc.), b) gambling setting(s) of choice (e.g., casino, sports venues, home games, online, etc.), and c) if the participant would keep a gambling diary (Appendix H).
The SOGS has been shown to be a reliable method for identifying potential disordered gamblers. Originally developed as a measure of lifetime disordered gambling, the SOGS has been found to have consistent psychometric properties when measuring more finite time frames (Wulfert, Hartley, Lee, Wang, Franco, & Sodano, 2005) and has been shown to have temporal reliability at four weeks and 12 weeks (Weatherly, Miller, Montes, & Rost, 2012). The SOGS was used to assess severity of potential disordered gambling and recent gambling history. Scores of 0 on the SOGS indicate no problems with gambling; scores 1-4 on the SOGS indicate some problems with gambling; scores of 5 or more on the SOGS indicate potential pathology. The SOGS took 5 to 10 minutes to complete. The GFA-R and GFA-II also took 5 to 10 minutes to complete. The GFA-II was unpublished at the time of the study, and loaded items into the four functions used in the original GFA (attention, escape, tangible, and automatic). Participants were also given a gambling diary to keep over the course of their time in the study (Appendix H).

The next meeting involved training on a work task, and introducing the participant to the simulated game room and showing the participant the play options. Participants then went through a short preference assessment to choose a game to play in the following phases.

Work Task:

Before gambling sessions, participants performed a work task (coding information from psychology journal articles) to earn a “stake” (for which they used to gamble). The earned stake was actually a fixed amount of “money”, the
participants were not told the amount, only that the payout would be at the end of the study, and that most participants earned $20. After 10 minutes of work, participants had the opportunity to risk their earnings with a simulated gambling game on a computer in either a baseline or FA condition. Participants were told that the points won or lost in the game contributed to their final point totals, which would ultimately affect their payout at the end of the study. Participants were also told that at least a minimum guaranteed amount of their money would be credited to their “bank account” every time they worked, so they could not reach zero. This prevented participants from hypothetically losing their entire stake and allowed sessions containing the opportunity to gamble to start with the same amount of money. This transformation from digital points to dollars mimics how money is tracked in many gambling venues. Additionally, common direct deposit and debit transactions give this method some face validity. Furthermore, previous research has indicated that handling actual cash lowers subsequent participant rate of gambling (see Weatherly, McDougall, & Gillis, 2006). Participants were not told their balances at any point before the end of the study; all participants received the same $20 payout at the conclusion of the study and were debriefed with the information that the gambling had not affected their payout.

Preference Assessment:

The experimenter showed participants the available games on a computer and gave them the opportunity to play each game for a few minutes. Participants were told to choose a favorite game to potentially play in upcoming sessions; hereafter, this will be referred to as the “preferred” game for each individual participant. Some
participants chose a favorite simply by viewing the interfaces (not playing) or by indicating to the experimenter their out-of-session game of choice (i.e., what they typically played with friends or at casinos).

Baseline with Preferred Game (Intrinsic game qualities + stake):

Participants engaged in the work task for 10 minutes, then had the opportunity to play their preferred game for 10 minutes in the work room. This constituted a baseline session to have a measure of gambling behavior without any explicit manipulation or programmed alternative behaviors. The baseline sessions consisted of playing the game with the earned stake to gamble, but without alternative activities available or programmed reinforcers in the room, and absence of the manipulations in the functional analysis conditions described below. All participants reported an extensive history gambling, and the baseline sessions were not expected to differentiate substantially from the rates of gambling in the FA. Participants with a well-established history of gambling should be expected to play the games at a relatively high rate when there are not many other options. The games should still maintain behavior through conditioned reinforcement (i.e., the observing response, see Kelleher & Gollub, 1962; Wyckoff, 1952). Then sensitivity to the programmed contingencies beyond the conditioned reinforcement from gambling can be demonstrated through the differentiation from each other in the experimental conditions. If the rates in baseline had been low, then presumably participants would have been learning the game, or gambling may not have been a high-probability behavior to begin with. Additionally, there was no component in the multi-element
design that addressed playing alone, as presumably this would always be at a high rate when it occurs naturalistically.

FA Procedure:

Sessions for Programmed Positive Stimuli, Programmed Negative Stimuli, and Control (or Programmed Extinction; all defined below) occurred separately in a rotating fashion with one session lasting 10 minutes (i.e., a multi-element design format). The targeted gambling behavior was defined as placing a wager. Each game took a moment to operate between the wager and the outcome, allowing for programmed consequences to be provided by the experimenter or confederate. Before each FA session, participants performed the work task, then they were told they could wait in the game room while their work was checked, with the exception of the control condition. The control condition occurred without participants engaging in the work task first, as playing the game without the stake was a part of the control condition, where all potential motivating operations manipulated in the Positive and Negative sessions were controlled. After experimental sessions, participants were invited back to their work room. The sessions are described below:

Programmed Positive (PP from here): Under this experimental condition, participants were asked by the experimenter to wait in the game room while their work was checked. Participants entered the game room and the preferred gambling game was available at a computer. A confederate had been escorted into the room moments before in a similar fashion to the participant, and was sitting at an adjacent computer playing another gambling game; the confederate was presented in such a
way that they appeared to be another study participant. This session essentially included contingent social positive reinforcement and sensory reinforcement. This session also included consumable reinforcers. Also, monetary wins were larger than usual, but on the typical ratio of the game. Wins were decided by the game’s randomization generator applied to the available ratio of symbols (slot machine simulator) or cards (poker simulator) (i.e., a naturalistic random ratio schedule). This condition featured several identified sources of potential positive reinforcement for placing a wager, including praise, edibles, and sensory stimuli. Social reinforcers were operationalized by having a confederate offer social attention and positive verbal comments contingent on wagering at an FR 1 schedule. Examples included: “I love that game,” “Nice,” “I feel it coming,” and so on. When participants did not gamble, confederates directed their attention to their game, and engaged in only terse or distracted conversation if prompted. Material reinforcers were operationalized as an initial complementary “comp” prize for placing their first wager, such that participants had drinks, food, or both while wagering. Stopping the session time in order to account for time eating or drinking was considered, but ultimately not done in this study. Participants did not stop their wagering to eat or drink during the study, but instead would multi-task, and consume with one hand and wager with the other hand. If the participant ran out, the next wager would result in another delivery. Sensory reinforcers were operationalized as wagering provided contingent sounds (e.g., bells and celebratory noises) beyond those normally displayed by the game (extra sound files were presented) on an FR 1 schedule. Additionally, monetary reinforcers were increased in magnitude via a higher pay scale (i.e., the magnitude of
wins was increased by 50%, but no change in the programmed frequency of wins) than normal. Participants were not verbally instructed as to the change in pay scale so as to eliminate the role of instructions and, thus, isolate the effect of the experience to the contingency with higher pay scales. Considering that changing the schedule of wins and losses has a replicable effect on behavior described previously (Dixon & Schreiber, 2002; Peters, Hunt, & Harper, 2010; Schreiber & Dixon, 2001; Weatherly & Derenne, 2007), and naturally, gambling schedules are not changed without the knowledge of the gambler, modification of the schedule of wins and losses was not included as a condition in the present study. Changing pay tables is a more naturalistic modification, which may emphasize more valid functional differences for persons who already gamble, as this only affects the magnitude of wins when they occur, not the schedule. Magnitude has not been shown to have a reliable effect on rate of behavior in humans. This allows rate to still be used as a measure for comparisons of behavior. Rate of responding is well established as a preferred measure in the experimental analysis of behavior (Skinner, 1950; 1953b; 1966).

*Programmed Negative* (PN from here): Under this experimental condition, participants were asked to come into the game room where their preferred game was available on a computer. A confederate had been directed into the room moments before, and was seated at an adjacent computer with a gambling game. This condition essentially included negative reinforcement via a setting event of escape from the aversive interaction in the work room, and then contingent social avoidance on an FR 1 for wagering. This condition featured several identified sources of potential aversive events that had been hypothesized to relate to gambling, described
next. Participants initially completed the work task and were provided feedback that their performance was poor, independent of actual performance. The experimenter complained about participant performance (e.g., “You’re not doing enough.”, “This is too slow, you should be getting better.”). Then, in the game room, the confederate sat at their game while not actively playing (e.g., attending to a smart phone), and attempted to interact with the participant every few seconds (e.g., “Any luck?”, “Did it work for you?”, “I’m not winning at all right now.”, “This game sucks and I need to go.”). The confederate would also huff and sigh when not talking. The confederate ceased complaining contingent on the wagering of the participant (on an FR 1), and the confederate subsequently watched the participant play or wagered on their own game. The preferred game was programmed with a lower pay scale than the game normally provided (decrease of 50%), such that when a win occurred the magnitude was lower, although participants were not informed.

**Control:** In this session, the programmed social, material, monetary, and sensory stimuli were removed from playing the game as much as possible. There was no work task before this session; games were available, but participants were told that the games did not add or subtract points. The purpose of this session was to rule out intrinsic or automatically reinforcing aspects of the games which could maintain the behavior. The confederate and the experimenter provided non-contingent social attention in the room that also contained non-gambling leisure activities (e.g., books, magazines); playing the preferred game did not involve comp prizes or sounds.
A flowchart of a participant’s sessions in the study is available in Appendix I. Sessions were videotaped for integrity scoring by trained experimenters and research assistants.

**Planned Analysis**

The gambling behavior was compared across sessions with graphical visual inspection to determine potential functions of gambling behavior. Researchers examined data for differences in mean level, trend, and variability between the conditions.

Results from the GFA-R, GFA-II, diary, and FA were analyzed for agreement. Though a variety of both positive and negative reinforcement sources were simulated in the FA conditions, not all controlling variables from the GFA-R were simulated; some variables were not practical to simulate (e.g., fighting with spouse) or involved covert automatic reinforcers (e.g., feeling of excitement). The functions that were not simulated were compared with the gambling diary. The GFA-R items were utilized in creating the items in the diary, and were considered either indicative of positive reinforcement or negative reinforcement/escape (see Appendix J). For the diary items, the intervals of time corresponding to each reported function for gambling were compiled. If positive and negative reinforcement items were endorsed for an hour-long interval, the interval was counted for both functions. Whichever reported function (positive or negative reinforcement) had the most reported hour-intervals was labeled as the controlling function per the diary. The endorsed functions were compared with the GFA-R and FA results.
All sessions were video-recorded. Confederate interactions were evaluated for protocol integrity in a sampling of approximately 20% of the videos. Agreement was calculated between two independent observers for the number of 10-second intervals following the protocol and was 100% in all cases.

RESULTS

Two participants did not respond with differentiation between their PP and PN conditions. Five participants did show differentiation with data in PN being higher than PP in most conditions, but both PP and PN contingencies did maintain behavior. The two participants who did not show much differentiation (C1 and C2) were more casual gamblers (i.e., they reported that they typically gambled weekly, but did not estimate that they spent more than two hours a week gambling), hence the “C” designation. They both scored “0” on the SOGS, indicating that they did not have history with gambling problems. The remaining participants (P1-P5) all scored in a range on the SOGS indicating at least some history with gambling problems, and all indicated they gambled more than two hours per week, hence the “P” designation.

Participant C1 was a 23-year-old male who played poker and blackjack. He enjoyed playing online computer games for fake or real money, which he played sporadically on his phone or computer throughout the week, and made occasional casino trips. He scored a 0 on the SOGS, indicating no problems with gambling. The results of his FA are shown in Figure 1 (top panel), showing initial control by PN. This, however, could be contributed to a big win in his initial PP session (in which he had more than doubled his credits at the end of this first session). This big win may
have resulted in a motivating operation in place with his credits being so high, thereby decreasing his playing frequency immediately after. Big wins followed by decreases in gambling (i.e., longer post-reinforcement pauses) constitute a robust effect across both human and non-human animals (see Armour & Bizo, 2014; Dixon & Schreiber, 2004; Weatherly, Sauter, & King, 2004). The “big win effect” has been shown to have somewhat adverse effects on rate measurement in past research as well (see discussion in Dixon, Miller, Whiting, Wilson, & Hensel, 2012). Subsequent sessions showed PP as having more control, though the differentiation was slight.

Participant C2 was a 23-year-old male who played poker and wagered on the outcome of contests in computer games (e.g., battles in role playing games). He scored a 0 on the SOGS, indicating no problems with gambling. The results of his FA are shown in Figure 1 (bottom panel) and also showed undifferentiated results with a potential bias for PP.

Participant P1 was a 21-year-old male who played poker and blackjack at casinos and also bet on sports and at sports venues. He scored a 3 on the SOGS, indicating some problems with gambling. The results of his FA are in Figure 2 (top panel).

Participant P2 was a 27-year-old male who played mostly home-game poker, but preferred playing poker and blackjack at casinos. Participant P2 indicated that some family members gambled more than he did, one of whom had a gambling problem. He scored a 1 on the SOGS, indicating little to no problems gambling. The results of his FA are shown in Figure 2 (middle panel); initially PP evoked a higher rate, but PN ultimately had higher rates of behavior.
Participant P3 was a 22-year-old male who played online, casino, and poker-room poker and blackjack. He scored a 4 on the SOGS, indicating some problems with gambling. The results of his FA are displayed in Figure 2 (bottom panel), and shows higher rates of behavior in PN.

Participant P4 was a 28-year-old male who played slots, roulette, blackjack, and poker at casinos and bars. He scored a 7 on the SOGS, indicating potential pathological problems with gambling. The results of his FA are displayed in Figure 3 (top panel), showing mostly higher rates of behavior in PN.

Participant P5 was a 19-year-old female who played slots, keno, and bingo. She scored a 7 on the SOGS, indicating potential pathological problems with gambling. The results of her FA are shown in Figure 3 (bottom panel) and showed mostly higher rates of behavior in PN.

The results of the FA, as well as agreement between the diary and endorsed GFA functions are available in Table 1. The self-report measures and FA results did not covary consistently.
**Table 1:** Results table

<table>
<thead>
<tr>
<th>Participant</th>
<th>GFA-R</th>
<th>GFA-II</th>
<th>Diary</th>
<th>FA</th>
<th>SOGS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>+</td>
<td>-</td>
<td>Attn</td>
<td>Tang</td>
<td>Sen</td>
</tr>
<tr>
<td>C1</td>
<td>37</td>
<td>7</td>
<td>6</td>
<td>20</td>
<td>16</td>
</tr>
<tr>
<td>C2</td>
<td>13</td>
<td>12</td>
<td>6</td>
<td>16</td>
<td>0</td>
</tr>
<tr>
<td>P1</td>
<td>29</td>
<td>9</td>
<td>6</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>P2</td>
<td>38</td>
<td>0</td>
<td>7</td>
<td>20</td>
<td>5</td>
</tr>
<tr>
<td>P3</td>
<td>36</td>
<td>15</td>
<td>13</td>
<td>18</td>
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<tr>
<td>P4</td>
<td>31</td>
<td>8</td>
<td>7</td>
<td>14</td>
<td>6</td>
</tr>
<tr>
<td>P5</td>
<td>35</td>
<td>22</td>
<td>10</td>
<td>13</td>
<td>12</td>
</tr>
</tbody>
</table>

*Note:* (+) refers to positive reinforcement and (-) refers to negative reinforcement. For the FA, whichever condition more often had a higher rate of wagering than the others in the multi-element design was designated controlling.
Figure 1. Results of the FAs conducted for C1 and C2. Participants played video poker as their preferred game, did not indicate any problems, and gambled less than two hours per week. Both participant results indicate an undifferentiated function but a potential positive bias.
Figure 2. Results of the FAs conducted for P1, P2, and P3. Participants played video poker, gambled more than two hours per week, and all indicated at least some problem on the SOGS. Participant results indicate multiple maintainence, but with higher rates of behavior in PN.
Figure 3. Results of the FAs conducted for P4 and P5. Participants played slots, indicated at least some problem on the SOGS, and gambled more than two hours per week. Participant results indicate multiple maintenance, but with higher rates of behavior in PN.

DISCUSSION

The results of this study show small but reliable differences in the rate of gambling between the PP and PN sessions for the five participants who reported gambling frequently and indicated at least some problems with gambling. The slightly higher rate during PN over PP for these five participants (P1-P5) occurred on most sessions. The two participants who did not endorse gambling problems and
gambled less frequently (C1 and C2) exhibited little differentiation in rate of PP or PN, and contrary to the other five participants, showed higher rates during the PP condition, although by only a very slight amount. The differences between participants point to some distinctions in behavior that are captured in the experimental sessions. The further breakdown of sessions is likely to require more research, as gambling is presumably multiply maintained by reinforcement contingencies that occur together (e.g., social reinforcers and tangible reinforcers). In addition, extended contingencies involving verbal behavior, such as faulty rules and relations, may also relate to persistence of gambling behavior. While, naturalistically, the positive reinforcement stimuli may control more behavior, negative reinforcement conditions may disproportionately control more behavior in critical contexts for disordered gamblers. Important nuances in generalized negative reinforcement, as such, may exist in a functional analysis of rule-governed behavior, in relation to how effectively individuals are able to correctly identify contingencies in their natural environments (see Hayes, Barnes-Holmes, & Roche, 2001; Skinner, 1957).

The results of the FA phase did not always map onto the endorsed functions on the GFA-R or diary. The diaries and FAs matched for the two “C” participants. Only two of the five “P” participants’ diaries matched their FA’s, and these were the two participants with the highest scores on the escape subscale of the GFA-R. This result is not necessarily surprising, as the predictive validity of indirect measures when compared to FA’s cannot be adequately assessed with a small-n study. Additionally, other similar function-based questionnaires have low validity properties (e.g., Iwata, DeLeon, & Roscoe, 2013). Even so, such measures have well-established
places in psychological assessment, as they can gleam subjects’ ideas about themselves and what they believe controls their behavior.

The functional analysis methods reported here are not without limitation. There are many possible setting events for a gambling context beyond what was examined in the present study. Furthermore, many casinos and other gambling venues have an array of sensory and social stimuli that could not be simulated within the confines of a university laboratory. Additionally, effects from properties of the experimenter and confederates are likely to be meaningful in ways difficult to predict. In this study, the confederate was female for the male participants and male for the female participant. This could theoretically effect the reinforcing effectiveness of the social components of the conditions, and represents an uncontrolled issue in the FA. Another limitation is that, in order to retain some face validity of the simulated gambling, multiple stimulus events were involved that could function as positive or negative reinforcers in the respective sessions. This makes a more fine-grained analysis of linking controlling variables to a singular process difficult. A small complex of controlling variables generated differentiated response levels in the present study; isolating aspects of the controlling variables is a possible next step. Many variables are involved in a gambling experience, however, which raises concerns of ecological validity when isolating specific aspects of controlling variables. Modern behavior analytic conceptions of gambling are not as simple as control via a particular schedule of reinforcement experienced in the game (see Dymond, McCann, Griffiths, Cox, & Crocker, 2012). Whether or not critical variables will be discovered by further breaking down the contingencies is an empirical question to be addressed
further. A tangible positive reinforcement function, for example, likely controls a large amount of behavior for a gambler, and excluding such a factor would likely affect the rate of responding in any condition. Additionally, while the variable that maintains the most gambling behavior may not be a critical variable for gambling irresponsibly or disordered gambling behavior, it may still be helpful to consider when developing function-based interventions.

Although the functions traditionally broken down in FA’s are mostly conceptualized as positive reinforcement, the importance of negative reinforcement (i.e., generalized escape or avoidance, social or covert) and gambling continues to be demonstrated, given the data from this research and other studies mentioned above. Negative reinforcement should potentially be scrutinized more closely in future research, considering its importance as a controlling variable for other problem behavior (e.g., substance abuse) and the myriad ways both negative reinforcement and escape/avoidance-related constructs are measured. The social avoidance context used in the current study may share some stimulus properties with a more automatic or rule-governed negative function (i.e., relief from aversive self-talk or more generalized aversive “emotional” states) that contributes to disordered gambling.

On a conceptual note, there have been arguments against continuing to distinguish between positive and negative reinforcement (Michael, 1975). Although the distinction may not be technically necessary, it has been argued that the distinction remains useful in practice and that there are technological advantages to maintaining the distinction (Iwata, 2006). This may be particularly true in cases
where exact function and specific contingencies are more difficult to determine, such as disordered gambling.

The Journal of Applied Behavior Analysis recently had a special issue on functional analysis research (see overview by Beavers, Iwata, & Lerman, 2013). The issue had several useful articles on functional analysis and treatment. Behavior analysts have been researching gambling at a higher rate than in previous years (see Witts, 2013). Given the success of the functional analysis methodology, and emerging evidence that behavioral treatments for gambling are effective, continued research into functional analysis of gambling and other addictive disorders is timely. Addiction rehabilitation treatment has been reported as an area of practice where evidence-based treatments are not often used (National Center on Addiction and Substance Abuse at Columbia University, 2012). Rehabilitation centers could be clinically rebuilt using effective, behavior analytic methods such as a functional analysis, if these methods are available, accessible to a broad population of treatment workers, and cost-effective.

In summary, the results of this study included small but reliable differences in the rate of gambling between positive and negative reinforcement conditions for the participants who reported problems with gambling. The positive and negative reinforcement conditions were made up of several controlling variables, and not remotely exhaustive of the variables possibly controlling gambling outside of the laboratory. Future research should examine if the differences are more apparent in more ecologically valid contexts, and if isolating aspects of the controlling variables
is possible with such a complex behavior. Future research should also examine how such analyses of reinforcement contingencies can be experientially used in treatment.
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[doi:10.4309/jgi.2014.29.4](http://dx.doi.org/10.4309/jgi.2014.29.4)


Appendix A

Flyer and Powerpoint Slide (Powerpoint does not include pull-tabs)
Do you gamble?
Are you interested in participating in a research study involving studying gambling behavior?

Contact Mack Costello at the Behavioral Medicine Lab in the Psychology Department to learn more about this research project.

Email: mack.s.costello@wmich.edu
Phone: 269-387-4492 (Leave a message with your name and phone number and ask for Mack to get back to you)
Appendix B

Telephone Script
“Hello, my name is [Mack Costello], and I am glad you called. I would like to talk to you about participating in a study. Is this a good time for you to talk about that?

You are calling in regard to a request for individuals to participate in a research study at Western Michigan University on gambling behavior.”

“I have some information for you. To participate in this study you must already gamble in your leisure time, on average twice a week or more. Are you interested in setting up an appointment for more information?”

[Wait for their answer. if they are not interested, thank them and end the call. If they are interested, continue.]

“We would like to set up an appointment with you and determine if you would be a good fit for the study. To participate you must already gamble in your leisure time, on average twice a week or more. We will also provide you with additional information so that you can decide whether or not you would like to participate in the study. The appointment should last around a half an hour. After that, if you decide to participate, you should expect to spend about two hours with the researcher or assistants during four meetings starting after two weeks. Depending on your schedule and the actual start date, you should expect to participate for no more than 8 weeks with a total of 5 meetings including the upcoming initial meeting. Does this sound like something you would be interested in pursuing further?”

“Great, we would like to meet with you as soon as possible.”
Appendix C

E-mail script
Hello,

My name is Mack Costello, and I am glad you e-mailed me. You are writing in regard to a request for individuals to participate in a research study at Western Michigan University on gambling behavior.

We would like to set up an appointment with you and determine if you would be a good fit for the study. To participate you must already gamble in your leisure time, on average twice a week or more. We will also provide you with additional information so that you can decide whether or not you would like to participate in the study. The appointment should last around a half an hour. After that, if you decide to participate, you should expect to spend about two hours with the researcher or assistants during four meetings starting after two weeks. Depending on your schedule and the actual start date, you should expect to participate for no more than 8 weeks with a total of 5 meetings including the upcoming initial meeting. Does this sound like something you would be interested in pursuing further?

If you are available during [date and time], we can meet then. If this is not good for you, please let me know some more convenient times to meet.

Thank you,

Mack Costello
Appendix D

Human Subjects Institutional Review Board Consent/Approval Document
Western Michigan University
Department of Psychology

Principal Investigator: R. Wayne Fuqua, PhD
Student Investigator: Mack Costello
Title of Study: Functional Analysis of Gambling

You have been invited to participate in a research project titled "Functional Analysis of Gambling." This project will serve as Mack Costello’s dissertation for the requirements of his Doctor of Philosophy degree. The project is supervised by Dr. Wayne Fuqua. This consent document will explain the purpose of this research project and will go over all of the time commitments, the procedures used in the study, and the risks and benefits of participating in this research project. Please read this consent form carefully and completely and please ask any questions if you need more clarification.

What are we trying to find out in this study?
This research is intended to study a method of assessing why people gamble.

Who can participate in this study?
Persons who already gamble in their leisure time at least twice a week on average for at least two hours.

Where will this study take place?
The study will take place in the Behavioral Medicine Laboratory in Wood Hall 2704.

What is the time commitment for participating in this study?
If you choose to participate, after signing this document you will be asked to fill out a questionnaire and a screening tool to answer some questions about your gambling knowledge and activity, which should not take more than a half hour. Your next visit will be in about two weeks. You will be asked to attend about four two-hour visits in the Behavioral Medicine Laboratory in Wood Hall. Over the course of the study you will be asked to e-mail or drop off information to the student investigator on a regular basis. The maximum time commitment to the study is 2 months (5 visits including today), though your participation could take much less time than that.

What will you be asked to do if you choose to participate in this study?
You will be asked to fill out some questionnaires during this study. The questionnaires focus on your gambling knowledge and activity as well as what you thought of portions of the study once you complete them. You will be asked to attend 4 sessions with the researchers where you will go through some training on some computer tasks and engage in some simulated gambling in the laboratory with points earned from the computer tasks. Sessions will be video-taped in order to be scored, then the videos will be erased.

What information is being measured during the study?
We will be measuring behavior related to gambling in sessions and analyzing your self-reports. We will assess your gambling knowledge and activity through questionnaires.

**What are the risks of participating in this study and how will these risks be minimized?**
As in all research, there may be unforeseen risks to the participant. No compensation or additional treatment will be made available to you except as otherwise stated in this consent form. Some possible risks include your gambling increasing or changing while in the study, or emotional risks from gambling in the study. Be aware that gambling in the study may differ from real-world gambling. You will be provided with a list of resources for gambling treatment should you feel at any time you desire treatment that includes the WMU Psychology Clinic, Gamblers Anonymous, and local therapists. You may re-request the list at any time, and drop from the study at any time.

**What are the benefits of participating in this study?**
One way in which you may benefit from participation in this study is the insight into gambling you may engage in. Researchers and practitioners in the field of gambling may benefit from the results of this research as well.

**Are there any costs associated with participating in this study?**
There are no direct costs associated with participating with the study.

**Is there any compensation for participating in this study?**
There is monetary compensation for participating in this study. You will earn points in a computer task and be able to gamble them in a simulated casino. At the end of the study your points will be transformed to a cash payout. If you drop out of the study before completing, the payout will not occur.

**Who will have access to the information collected during this study?**
All of the information collected from you is confidential. That means that your name will not appear on any papers on which this information is recorded. The forms will all be coded, and Mack Costello will keep a separate master list with the names of participants and the corresponding codes. Once the data are collected and analyzed, the master list will be destroyed. All other forms will be retained for at least three years in a locked file in the principal investigator's office. The data may be used in conference presentations or manuscripts for publication in peer-reviewed journals, but your identity will not be reported.

**What if you want to stop participating in this study?**
You can choose to stop participating in the study at anytime for any reason. You will not suffer any prejudice or penalty by your decision to stop your participation. You will experience NO consequences either academically or personally if you choose to withdraw from this study.
The investigator can also decide to stop your participation in the study without your consent. This may happen if you continually do not arrive for appointments or return emails. This may also happen if you indicate you are being adversely affected by the study.

Should you have any questions prior to or during the study, you can contact the primary investigator, Dr. R. Wayne Fuqua at 269-387-4474 or wayne.fuqua@wmich.edu. You may also contact the Chair, Human Subjects Institutional Review Board at 269-387-8293 or the Vice President for Research at 269-387-8298 if questions arise during the course of the study.

This consent document has been approved for use for one year by the Human Subjects Institutional Review Board (HSIRB) as indicated by the stamped date and signature of the board chair in the upper right corner. Do not participate in this study if the stamped date is older than one year.

I have read this informed consent document. The risks and benefits have been explained to me. I agree to take part in this study.

Please Print Your Name

Participant’s signature
HSIRB Approval Document

Date: October 18, 2012
To: Wayne Fuqua, Principal Investigator
    Mack Costello, Student Investigator for dissertation
From: Amy Naugle, Ph.D., Chair
Re: HSIRB Project Number 12-05-10

This letter will serve as confirmation that your research project titled “Functional Analysis of Gambling” has been approved under the full category of review by the Human Subjects Institutional Review Board. The conditions and duration of this approval are specified in the Policies of Western Michigan University. You may now begin to implement the research as described in the application.

Please note: This research may only be conducted exactly in the form it was approved. You must seek specific board approval for any changes in this project (e.g., you must request a post approval change to enroll subjects beyond the number stated in your application under “Number of subjects you want to complete the study”). Failure to obtain approval for changes will result in a protocol deviation. In addition, if there are any unanticipated adverse reactions or unanticipated events associated with the conduct of this research, you should immediately suspend the project and contact the Chair of the HSIRB for consultation.

Reapproval of the project is required if it extends beyond the termination date stated below.

The Board wishes you success in the pursuit of your research goals.

Approval Termination: May 16, 2013
Appendix E

Screening Questionnaire
1) Do you make time to gamble in your leisure time?
Yes  No

Do you make time to gamble about two hours or more on average per week?
Yes  No

How often do you make time to gamble per week on average?

Are you trying to quit gambling, or interested in quitting gambling?
Yes  No

2) What are your primary gambling game(s) of choice (e.g. roulette, poker, blackjack, etc.)?

3) What are your gambling setting(s) of choice (e.g. casino, sports venues, home games, online, etc.)?

4) Are you willing to keep a gambling diary and share it with the researchers?
Yes  No
Appendix F

GFA-R
### Gambling Functional Assessment–Revised

Please answer each question with the appropriate number from the following scale:

<table>
<thead>
<tr>
<th>Scale</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Never</td>
</tr>
<tr>
<td>1</td>
<td>Almost Never</td>
</tr>
<tr>
<td>2</td>
<td>Seldom</td>
</tr>
<tr>
<td>3</td>
<td>Sometimes</td>
</tr>
<tr>
<td>4</td>
<td>Usually</td>
</tr>
<tr>
<td>5</td>
<td>Almost Always</td>
</tr>
<tr>
<td>6</td>
<td>Always</td>
</tr>
</tbody>
</table>

1. After I gamble, I like to go out and celebrate my winnings with others.  
2. I gamble after fighting with my friends, spouse, or significant other.  
3. I gamble when I feel stressed or anxious.  
4. I like the sounds, the lights, and the excitement that often go along with gambling.  
5. If I have a hard day at work or school, I am likely to gamble.  
6. I gamble when my friends are gambling with me.  
7. I find myself feeling a rush, and getting excited, when I gamble.  
8. When I gamble, I choose which games to play based upon my best chance of winning.  
9. I gamble to get a break from work or other difficult tasks.  
10. I gamble when I am feeling depressed or sad.  
11. I find that gambling is a good way to keep my mind off of problems I have in other parts of my life.  
12. I gamble when I am in debt or need money.  
13. I really enjoy the complementary perks that come along with gambling, like free points, drinks, comp coupons, etc.  
14. I enjoy the social aspects of gambling such as being with my friends or being around other people who are having a good time and cheering me on.  
15. I gamble when I have a work project or class assignment that is due in the near future.  
16. I gamble primarily for the money that I can win.
Items 1, 4, 6, 7, 8, 13, 14, and 16 should be summed to give a score for gambling maintained by positive reinforcement. Items 2, 3, 5, 9, 10, 11, 12, and 15 should be summed to give a score for gambling maintained by negative reinforcement.
Appendix G

Past Month SOGS
APPENDIX H: PAST MONTH SOGS

Date: __/__/__

Past Month Gambling Urges and Behaviors

1. Please indicate which of the following types of gambling you have done in the past month. For each type, mark one box only, the box that best describes how you gambled during the last month.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Not at all in past month</th>
<th>Once in the past month</th>
<th>Between 2 and 6 times in the past month</th>
<th>More than 6x, but not daily in the past month</th>
<th>Daily for at least one week in the past month</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Played cards for money (including casino blackjack)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Bet on horses, dogs, or other animals (in off-track betting, at the track, or with a bookie)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. Bet on sports (parlay cards, with a bookie, jai alai)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. Played dice games (including crap, over and under, or other dice games) for money</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e. Played roulette</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f. Bought daily numbers, lotto, or lottery tickets</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>g. Bought scratch tickets or pull tabs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>h. Played bingo for money</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i. Wagered or gambled on high-risk stock and/or commodities market</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>j. Played slot machines, poker machines, or other electronic machines</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>k. Played video lottery terminals</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>l. Bowled, shot pool, played golf, or played some other game of skill for money</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>m. Gambled on the internet</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. What is the largest amount of money you have ever gambled with on any one day in the past 30 days?

- (0) no gambling in past 30 days
- (1) $1.00 or less
- (2) more than $1 up to $10
- (3) more than $10 up to $100
- (4) more than $100 up to $1,000
- (5) more than $1,000 up to $10,000
- (6) more than $10,000

3. When you gambled in the past 30 days, how often did you go back another day to win back money you lost?

- 0 = .................. 1 = .................. 2 = .................. 3 = ..................
  - never
  - less than half
  - most of the time
  - every time

4. In the past month, did you claim to be winning

- 0 = .................. 1 = .................. 2 = ..................
money gambling when you were actually losing? never yes, less than half the time I lost yes, most of the time I lost

5. Do you feel you had a problem with gambling in the past month? No, in the past but not now Yes, now 0...1...2

6. In the past month, did you gamble more than you intended to? No, in the past but not now Yes, now

7. Have people criticized your gambling in the past month? No, in the past but not now Yes, now

8. Have you felt guilty about the way you gambled or what happened to you while gambling in the past month? No, in the past but not now Yes, now

9. In the past month, have you ever felt like you would like to stop gambling but didn’t think you could? No, in the past but not now Yes, now

10. In the past month, have you hidden betting slips, lottery tickets, gambling money, or other signs of gambling from your spouse, children, or other important people in your life? No, in the past but not now Yes, now

11. In the past month, have you gotten in any arguments about money that have centered on your gambling? No, in the past but not now Yes, now

12. In the past month, have you borrowed from someone and not paid them back as a result of your gambling? No, in the past but not now Yes, now

13. In the past month, have you lost time from work (or school) due to gambling? No, in the past but not now Yes, now

14. If you borrowed money to gamble or to pay gambling debts in the past month, from whom or where did you borrow? (check “yes” or “no” for each):

<table>
<thead>
<tr>
<th>NO</th>
<th>YES</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. from household money</td>
<td>( )</td>
</tr>
<tr>
<td>b. from your spouse/partner</td>
<td>( )</td>
</tr>
<tr>
<td>c. from other relatives or in-laws</td>
<td>( )</td>
</tr>
<tr>
<td>d. from banks, loan companies, or credit unions</td>
<td>( )</td>
</tr>
<tr>
<td>e. from credit cards</td>
<td>( )</td>
</tr>
<tr>
<td>f. from loan sharks (Shylocks)</td>
<td>( )</td>
</tr>
<tr>
<td>g. you cashed in stocks, bonds, or other securities</td>
<td>( )</td>
</tr>
<tr>
<td>h. you sold personal or family property</td>
<td>( )</td>
</tr>
<tr>
<td>i. you borrowed on your checking account (passed bad checks)</td>
<td>( )</td>
</tr>
</tbody>
</table>
SOUTH OAKS GAMBLING SCREEN-SCORE SHEET
Scores on the SOGS are determined by scoring one point for each question that shows the "at risk" response indicated and adding the total points.

Question 1 Not counted

Question 2 Not counted

Question 3 _____ Most of the time I lose, or Yes, every time I lose

Question 4 ______ Yes, less than half the time I lose or Yes, most of the time

Question 5 ______ Yes, in the past but not now or Yes

Question 6 ______ Yes

Question 7 ______ Yes

Question 8 ______ Yes

Question 9_______ Yes

Question 10_______ Yes

Question 11_______ Yes

Question 12_______ Yes

Question 13_______ Yes

Question 14a_______Yes

Question 14b_______Yes

Question 14c_______Yes

Question 14d_______Yes

Question 14e_______Yes

Question 14f_______Yes

Question 14g_______Yes
Question 14h_______Yes
Question 14i_______ Yes

TOTAL: ___________

(maximum score = 20)

Interpreting the score:

0 No problem with gambling
1-4 Some problems with gambling
5 or more Probable Pathological Gambler
Appendix H
Gambling Diary
GAMBLING DIARY

Instructions:
1. Write the date and type of day: Work, school, vacation, or day off.
2. Put a line (l) to show when you begin to gamble. Put an (X) to show the next interval you do not gamble.
3. Indicate for when deciding to gamble/reason for gambling, (H) for a hard day at work/school or (H2) hard day/fight with friend/significant other, (S) for feeling stressed/anxious or depressed/sad, (B) for a break from some task, (D) for debt/need of money, (F) for playing or celebrating with friends/others, (E) for excitement/rush from gambling, (M) for playing with a good chance of winning/enjoying comps and perks.

| Today’s Date | Type of day | Noon  | 1 PM  | 2 PM  | 3 PM  | 4 PM  | 5 PM  | 6 PM  | 7 PM  | 8 PM  | 9 PM  | 10 PM | 11 PM | 12 AM | 1 AM  | 2 AM  | 3 AM  | 4 AM  | 5 AM  | 6 AM  | 7 AM  | 8 AM  | 9 AM  | 10 AM | 11 AM |
|--------------|-------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
Appendix I
Flowchart of participants’ sessions
Participant sessions:

1) (approx 30 min)
Consent
Screening Questionnaire
GFA-R
SOGS
Go over Diary; schedule next meeting (approx 2 weeks)

2) (approx 2 hrs)
Introduce Work Room, Casino Room, Leisure Room
Begin FA:

Work
Then Social Positive, Otherwise Positive

BREAK

Work
Then Social Negative, Otherwise Negative, Control

Schedule next meeting (ASAP on another day)

3) (approx 2 hrs)
repeat

4) (approx 2 hrs)
repeat

5) (approx 2 hrs)
repeat

Disclosure, payout
Appendix J
Item agreement for the gambling diary and GFA-R
<table>
<thead>
<tr>
<th>Diary</th>
<th>GFA-R positive (+) or negative (-)</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>1 (+)</td>
</tr>
<tr>
<td>H</td>
<td>2 (-)</td>
</tr>
<tr>
<td>S</td>
<td>3 (-)</td>
</tr>
<tr>
<td>E</td>
<td>4 (+)</td>
</tr>
<tr>
<td>H</td>
<td>5 (-)</td>
</tr>
<tr>
<td>F</td>
<td>6 (+)</td>
</tr>
<tr>
<td>E</td>
<td>7 (+)</td>
</tr>
<tr>
<td>M</td>
<td>8 (+)</td>
</tr>
<tr>
<td>B</td>
<td>9 (-)</td>
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<tr>
<td>S</td>
<td>10 (-)</td>
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<tr>
<td>S</td>
<td>11 (-)</td>
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<td>D</td>
<td>12 (-)</td>
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<td>M</td>
<td>13 (+)</td>
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<td>F</td>
<td>14 (+)</td>
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<tr>
<td>B</td>
<td>15 (-)</td>
</tr>
<tr>
<td>M</td>
<td>16 (+)</td>
</tr>
</tbody>
</table>