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The Simultaneous Observing of Concurrently Available Schedules Procedure as a means to study the Near Miss Event in Simulated Slot Machine Gambling

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Benjamin N. Witts

Dr. Patrick M. Ghezzi/Dissertation Advisor

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We recommend that the dissertation
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BENJAMIN N. WITTS

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Patrick. M. Ghezzi, Advisor

Linda J. Hayes, Committee Member

W. Larry Williams, Committee Member

James Sundali, Committee Member

Mark Pingle, Graduate School Representative

Marsha H. Read, Ph. D., Dean, Graduate School

August, 2013

Abstract

The near miss event in slot machine gambling is seen when nearly all symbols required to win line up on a payline. Traditionally, the near miss has served a feedback function in games of skill. As a game of chance, however, near miss events in slot machines serve no such role, though the individual gambler may behave as though it does. Attempts to study the near miss have relied almost exclusively on resistance to extinction and preference research, both of which fail to adequately capture putative reinforcement properties of this event. The current investigation sought to introduce and test a new methodology for assessing reinforcement properties of stimuli, termed the *simultaneous observing of concurrently available schedules*. This procedure incorporates an observing response, the gold standard of reinforcement assessment, to concurrently available schedules. Tests of the methodology on win percentage and near miss densities provide evidence for its use as a tool for assessing putative reinforcers.

Dedication

This dissertation is dedicated to my mother and father, for thinking I was going to drop out of college after my first year…

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Introduction

The Importance of the Near Miss

The near miss in slot machine gambling carries great import in the area of responsible gaming, as Skinner (1953; 1980), for one, hypothesized that the near miss may be a factor in sustained play despite a preference to terminate play (see also Reid, 1986). In such cases, the near miss may be viewed as a type of reinforcement. In fact, there is at least one grant-funded investigation into the treatment of slot machine-based problem gambling centered on the near miss presentation (National Center for Responsible Gaming, 2013). However, while the near miss in slot machine gaming has been present as early as Fey's original slot machine design in 1895 (Jensen, 2010), and at least as late as Mill's 1907 variant (see below), there has been a paucity of research conducted on it. What has been done is at times mixed and unclear as to the function of the near miss in gambling. Therefore, prior to an increase in efforts to treat the phenomenon, we must first begin a more refined program of study to investigate if, in fact, the near miss in slot machine gambling actually functions as a conditioned reinforcer. However, we must first turn to a structural analysis of near miss in slot machine gambling before tackling these important issues.

The Near Miss in Games of Chance and Skill

The Oxford English Dictionary defines the near miss as "*(a)* a shot that only just misses a target; also in extended use; *(b)* a situation in which a collision is narrowly avoided" (OED, 2012 – accessed 8.20.2012). Thus, in reference to definition (a), a near miss is a miss that was spatially near the target. While some have argued that the term is contradictory, opting for a near win instead (e.g., Côté, Caron, Aubery, Desrochers, &

Ladouceur, 2003), the term is in fact accurate with respect to skill-based endeavors. For example, a basketball player may be experimenting with a different form for free-throw shots. A ball that hits the rim of the basket is closer to going through the hoop than previous shots that simply bounced off the backboard and landed on the court. In this case, the near miss (i.e., hitting the rim rather than the backboard) serves as helpful feedback in that the adjustments made in the last shot better approximates the preferred result of the ball going in. In a sense, the shot missed, but was near the target.

There are effects referred to as near misses in other areas where the definition does not apply, however. The difference is between games of skill, such as basketball and archery, and games of chance, in which the player is unable to alter the probability of contacting a successful outcome on future occasions based on the current outcome. In games of chance, for example, a near miss would be more accurately defined as a full miss. For example, knowing the outcome of a single roll of a pair of dice provides nothing that can be of service in identifying the outcome of the next roll as each roll is independent of all others.

As might be expected, near miss events have been documented in several games of chance, including blackjack (Dixon, Nastally, Hahs, Homer-King, & Jackson, 2009), roulette (Dixon, 2010; Sundali, Safford, & Croson, 2012), and slot machines (e.g., Ghezzi, Wilson, & Porter, 2006). Our central concern here is the near miss phenomenon with respect to slot machine play, in which the outcome of any one spin of the reels is independent from the next (e.g., Parke & Griffiths, 2004), and thus the presentation of near miss events provides no helpful feedback to the player.

Structural Characteristics of Slot Machine Near Misses

In its simplest form, a near miss in slot machine gambling may be described as two of three winning symbols aligning on the payline in a traditional three-reel slot machine. How these symbols are arranged may be important to how the gambler responds, and thus a positioning effect may be involved (e.g., Ghezzi, et al., 2006). As multi-payline slot machines become more prevalent, the ease of identifying the near miss in slot machines may become more challenging, though the traditional two-out-of-three winning symbols formulation may persist in the form of bonus game features.

The near miss was not always as prominent in slot machines as it is today. The original slot machine, developed by August Fey in 1895, had a window that only allowed the player to view the symbols on the payline (Jensen, 2010). In other words, the slot player was able to see three symbols in a horizontal display, and nothing else. In a near miss presentation, the player could see winning symbols in the first two reels, but no immediate information on the reel stops above and below the third symbol were provided. In 1907, Herbert Mills modified Fey's design with additional symbols and a modification to the window such that a row of symbols above and below the payline was also visible (Jensen, 2010). This was the first slot machine that was able to produce the modern formulation of near miss phenomenon. That is, the player was able to observe whether or not the three payline symbols approximated a winning combination by seeing if the non-matching reel contained a matching symbol immediately above or below the payline.

Not only must some form of feedback be present in near miss presentations, but some form of control over future occurrences must be had such that the organism can continue to achieve success. The payline and window in the slot machine provides the former, but there exists no means by which to improve the odds of winning on future reel spins. Traditional slot machines consist of a set number of reels in which winning symbols are printed. Typically, reels in the first position carry more top prize symbols than the subsequent reels, with diminishing numbers of big prize symbols on each reel thereafter (Mead, 1983). This distribution of symbols produces a greater frequency of big prize symbols to appear early on, with fewer such symbols as the reels continue to spin and eventually stop. Modern slot machines, on the other hand, use a random number generator that, in essence, functions the same as the traditional machines just described (Legato, 2013). The difference with a random number generator is that the list of possible stops is not limited to the physical arrangement of symbols on the reel (Harrigan, 2007; 2008; Jenson, 2010). When incorporated with a physical reel, the random number generator may make it more likely that one type of symbol on a certain reel will land on the payline, even though that probability is not apparent by simply looking at the reel. In other words, although there may be a finite number of physical stops, the machine may be programmed to represent one stop more often than others in the random number generator. Thus, what the player sees is the result of the random number generator, and not the game itself (Harrigan, 2007).

Some confusion exists over the formation of near misses in modern slot machines with random number generators. Contrary to some opinion, near miss scenarios are in fact likely to occur in slot machines with random number generators[1]. Because of the discrepancy between virtual and physical stops, it is possible, and indeed likely, for the

[1] See Harrigan, 2008 for a review of the 1988 Nevada Gaming Commission ruling that has mistakenly been cited as stopping near miss presentation in slot machines in the U.S.

slot machine display to over-represent the number of near misses (Harrigan, 2007). For example, a slot machine reel may have 22 physical stops, yet be accompanied by 256 virtual stops (see Harrigan, 2007). Some physical stops will have more or fewer virtual stops than others. The inflated near misses that may occur from the physical-virtual discrepancies are legal (see Harrigan, 2007). Indeed, one use of this arrangement is called *clustering*, in which additional stops are placed above and below a jackpot symbol, while keeping the virtual stops on the jackpot symbol itself quite low (Harrigan, 2009).

According to Harrigan (2007; 2008; 2009), manufacturers of modern slot machines are legally restricted from artificially increasing the number of near miss presentations subsequent to the random number generator’s determination of a losing trial. This was based on a legal case in which one slot manufacturer was found guilty of artificially inflating the number of near miss presentation on losing spins, an outcome very different from the naturally-occurring inflated near miss rates that come with a lower number of physical reel stops compared to virtual reel stops.

Thus, with physical reels or virtual ones, there is no method of play that will serve to increase one’s success with slot machine gambling. While some individuals have offered strategies to improve play (see Jensen, 2010, for a review), no such opportunity exists for the slot machine gambler. Nonetheless, the near miss in slot machine continues to be source of purported control for slot machine gamblers. For example, Griffiths (1994) found that regular fruit machine (i.e., European slot machine) gamblers were more apt to endorse skill-based elements to their play (e.g., claiming a strategy that would help them win). While the fruit machine of the U.K. offers features not available in the U.S. (e.g., “gamble” button and “nudge” features), the endorsement of skill may help explain why some argue for the feedback function of the slot machine near miss (e.g., Reid, 1986).

Dixon and Schreiber (2004) found further evidence of similar skill-based endorsements in U.S. slot play. Twelve participants were asked to play 100 trials of an actual, unaltered slot machine and then report on how close they thought each outcome approximated a win on a scale of 1 (far from a win) to 10 (very close to a win). Results indicate that all 12 participants rated a near miss, which occurred on 27-42% of all trials, as being closer to an actual win than outcomes in which no near miss occurred.

It is clear, then, that while the structural characteristics of slot machine near misses hold no bearing on future outcomes, players may see them as being something different, similar to a near miss in games of skill. A behavioral account of the near miss event may help to elucidate the false functionality given to such events.

Behavior Theory

The experimental literature suggests that near misses are responsible for extending play in slot machine gambling, and several theories are available as to why this may be the case. Theoretical explanations include psychological (Reid, 1986), psychobiological (Boyd, 1976; Clark, Crooks, Clarke, Aitken, & Dunn, 2012; Griffiths, 1991), biopsychosocial (Griffiths, 1999), and behavioral accounts (Skinner, 1953; Reid, 1986; see also Porter & Ghezzi, 2006, for a review). With respect to the behavioral account, reinforcement is believed to play a central role in establishing and maintaining play on slot machines. It is to that account to which we now turn.

Conditioned Reinforcement

Reinforcement is described as a process by which a stimulus serves to strengthen the behavior that precedes it. The stimulus following the behavior in question can be referred to as a *reinforcer*. A reinforcer is defined in an historical context, and confirmed on some future occasion. That is, a reinforcer is described as such when it has proven successful in increasing the probability of a given response in a given context on future occasions. An operant reinforcement account of behavior allows for flexibility in the form, frequency, and characteristics of the response (e.g., intensity), and is differentiated from respondent accounts in which the response is elicited from an environmental stimulus (e.g., sneezing in the presence of airborne pepper).

Reinforcers are identified as unconditioned (e.g., unlearned, primary) or conditioned (e.g., learned, secondary). An unconditioned reinforcer has its effects on behavior without a prior learning history. Examples of unconditioned reinforcers include food, water, sex, and escape from harmful events (e.g., Skinner, 1974, Ch. 3).

There are other reinforcers that are not so quick to enter into a functional relation with an operant response. These are conditioned reinforcers, and are based in an historical account of their relation to unconditioned reinforcers. Take, for example, money. As the typical American child develops, money comes to take on new significance. To a young child the value of money may be lost, and it is only through a series of encounters where money is exchanged for goods and services that it comes to take on a new meaning. There is nothing inherent in money that results in a person allocating 40 or more hours a week to its pursuit. Instead, it is its relation to other things and events, such as food, water, temperature regulation, and so forth that bring about its function as a conditioned reinforcer.

The correlating of stimuli and unconditioned reinforcers is a process that leads to multitudes of conditioned reinforcers. Should a future disconnect exist between conditioned reinforcer and the unconditioned reinforcer, the function of the conditioned reinforcer would revert to that of a stimulus of some other function (e.g., neutral, aversive, etc.). For example, if eating one's vegetables results in access to dessert, then vegetables will come to take on conditioned reinforcement properties. However, if eating vegetables no longer results in access to dessert, or dessert is always readily available without prior vegetable consumption, then vegetables may cease to function as a conditioned reinforcer.

Skinner (1953) discusses the near miss as a conditioned reinforcer in a behavioral account of persistent slot play. In Skinner's example, three bars on the payline result in a jackpot, and as such, "the device eventually makes two bars plus any other figure strongly reinforcing" (p. 397). Further, the result of the left-to-right stopping of the standard three-reel slot machine is temporal (Skinner, 1980) and thus may be functionally similar to the conditioned reinforcement effects of the final link in a chain (i.e., the delay-reduction hypothesis; e.g., Case & Fantino, 1981; Fantino & Moore, 1980; Fantino, Preston, & Dunn, 1993). This point, that the near miss may approximate a chain schedule, is worth further exploration in the present context, and thus will be visited briefly before returning to a more cognitive interpretation of the near miss.

In an early study on the delay to reinforcement as being the obligatory requirement for the establishment of conditioned reinforcement, Fantino (1969; also summarized in Fantino, 2008) arranged concurrent chain schedules to produce local differences in variable interval (VI) schedules, yet equivalent overall rates of reinforcement. Specifically, in one condition of the study, six pigeons were provided with initial links on a two-component chain that were either VI 30-s or VI 90-s, with the terminal link being a VI 90-s or VI 30-s, respectively. That is, the overall rate of reinforcement was the same in that both chains required a VI 90-s and a VI 30-s. However, preference was given to the VI 90-s VI 30-s schedule, as the terminal link, the VI 30-s, was correlated with a greater reduction in delay to reinforcement than the VI 90-s terminal link in the other chain. The stimuli correlated with the terminal VI 30-s component served as a more potent conditioned reinforcer and maintained responding on that chain.

Fantino (2008) makes note of a doctoral dissertation that provides some of the most potent evidence for the delay reduction hypothesis. Gollub (1958, as cited in Fantino) arranged for pigeons to respond on five-link concurrent schedules. In one schedule, a chain schedule procedure was used in which each link was correlated with a different stimulus. In the other, a tandem schedule was used in which the same stimulus was present in each link. All links were completed with a fixed interval (FI) one-minute requirement. As Fantino notes, most would predict the chain schedule would be preferred, as it presents more putative reinforcers. However, preference is given to the tandem schedule. Delay reduction hypothesis predicts these results, as the first four links in the chain schedule are predictive of a greater distance to reward, whereas the tandem schedule presents only the stimulus that is correlated with reward. Numerous studies on the delay reduction hypothesis have been conducted, and the reviews by Case and Fantino (1981) and Fantino, Preston, and Dunn (1993) offer more in-depth analyses.

Reid (1986) describes this as forecasting (also known as the uncertainty-reduction hypothesis) in which the outcome of a gamble is less clear at the beginning of the gamble, but is made clearer as the respective reels stop spinning. Before the first reel stops spinning, any outcome is possible. After the first reel has stopped, the outcomes are fewer, and as each successive reel stops, predicting the final outcome becomes more probable. If the second reel's stop produces a winning symbol that matches the payline symbol on the first reel, however, the prediction may be of a favorable outcome. Strickland and Grote (1967) found evidence for the temporal character of symbol presentation influencing sustained play in slot machines when participants seeing winning symbols early in the sequence persisted longer after completing the required number of trials than those who saw the same arrangements later in the sequence. However, the uncertainty-reduction hypothesis, in which greater predictability is had with each successive step, has proven ineffective when compared to the delay-reduction hypothesis of conditioned reinforcement in that observing (a test for conditioned reinforcement) occurs in the presence of S+ (reinforcement present) and not in the presence of S- (reinforcement not present) (Fantino & Moore, 1980; Shahan, 2002). In other words, the delay reduction hypothesis explains conditioned reinforcers as those stimuli that are correlated with a reduction in the time from their presentation to the presentation of an unconditioned reinforcer, and find that 'information' that reduces uncertainty, such as S-, fail to maintain observing.

While the conditioned reinforcement account of the near miss has been acknowledged widely throughout the gambling literature, it is not without its critics. For example, Griffiths (1999) states that "…no simple parsimonious explanation of gambling maintenance [e.g., operant conditioning] will ever be sufficient to explain all cases" (p. 444), even referring to reinforcement contingencies as being "simple" (Griffiths & Parke, 2003; p. 12). This, however, is likely due to a lack of understanding of the robustness inherent in a behavioral approach, encompassing, as Griffiths argues any theoretical account of gambling should, "sociological, psychological and biological processes" (1999; p. 444; i.e., social, behavioral, and biological, respectively). This is further evidenced when Griffiths and Parke (2003) distinguish behavioral accounts of gambling from the "psychology of colour, sound, lighting, familiarity, player involvement, the [cognitive account of] near miss and the suspension of judgment" (p. 12), all of which are subsumed and accounted for within a behavioral paradigm.

The Experimental Analysis of Conditioned Reinforcement

Temporal proximity to unconditioned reinforcement alone does not provide a method of studying conditioned reinforcement. There are, however, several methods by which one can investigate the conditioned reinforcement properties of a stimulus hypothesized to function as such. These tests include the new response method, preference assessments, resistance to extinction, the changeover delay procedure, choice procedures, and the observing response procedure. Each of these will be taken in turn and examined on their applicability to testing the near miss event in slot machine gambling.

The New Response Method. One procedure to test conditioned reinforcement effects is to use the hypothesized conditioned reinforcer to bring about and maintain a new response (Williams, 1994). In the case of money operating as a conditioned reinforcement, a test could consist of providing monetary outcomes for performance on unique operandi or for the production of unique response patterns. Life in Western societies abounds with examples of new behaviors coming about and being maintained from monetary incentives, notably in the workplace when the job is novel or new elements are added to an existing job. Of course, such procedures require that the conditioned reinforcer have its reinforcement properties maintained separate from the response in question.

In slot machine research, the apparatus in question (i.e., the slot machine) limits the opportunity to produce and maintain new responding. That is, the slot machine as an apparatus comes pre-equipped with limited operandi, and additional operandi would at best be odd, and at worst overly conspicuous to the research participant. Modern slot machines do not typically have accompanying levers, and if they do, they are often inoperable. Thus, the gambler is left with a limited number of button presses, which typically consist of repeating the last betting option (e.g., two credits per line) or hitting the “Repeat Bet” button, if available. Neither of these responses is new in terms of the apparatus, and therefore any additional buttons, levers, plungers, or treadles would be likely to serve as a confound or a potential impetus for participant-based hypothesis generation as to the experimental question.

An additional confound to the new response method is the finding that in several studies on choice, putative reinforcers are involved with an increased rate of responding to some operandum in their presence, but fail to affect preference for one chain schedule over another (see Fantino, 2009; Fantino & Romanowich, 2007 for reviews). In fact, preference is given the chain schedule with the fewer number of putative conditioned reinforcer presentations. The question, then, is whether the putative conditioned reinforcer is involved in the maintenance of responding or with the evocation of responding. It is in this light that serious skepticism must be cast upon increased rates of responding in the new response procedure.

Preference Assessments. Additionally, conditioned reinforcement can be examined through preference (e.g., Hendry, 1969). Traditionally, an organism would be provided with two operandi of equal unconditioned reinforcement rates (i.e., equivalent schedule(s)). However, one operandum is correlated with several presentations of a putative conditioned reinforcer, while the other is not. Should an organism allocate more responses to the operandum correlated with the putative conditioned reinforcer, an argument of conditioned reinforcement can be made. Thus, response allocation in nearly-identical apparati can serve as a means to explore conditioned reinforcement properties of stimuli.

A cautious argument of conditioned reinforcement in preference studies is warranted, however. As we shall see below, these preparations serve better as initial starts to an investigation rather than as a conclusion. Specifically, one can say that preference is not necessarily a test of conditioned or unconditioned reinforcement. Take, for example, a preference between surrendering $100 or $1,000. Most rational individuals would opt for the $100 option, though neither outcome is likely to serve as a reinforcer on its own (i.e., the money is not exchanged for any goods or services; one must simply give up an amount). In a positive example, one may be asked to choose between receiving two rocks from a gravel driveway or three ounces of dirt from the backyard. Surely there is a preference, but undoubtedly neither outcome would serve to reinforce behavior. Thus, just because a preference is had does not mean, too, that reinforcement has been identified.

Indeed, the fact that preference does not guarantee reinforcement is the same claim made in research in the applied subfield of behavior analysis (DeLeon, Bullock, & Catania, 2013). A sharp contrast, then, is drawn between preference assessments and reinforcement assessments (e.g., Cooper, Heron, & Heward, 2007; DeLeon, Bullock, & Catani, 2013). In a reinforcer assessment, the putative reinforcer must serve to generate or maintain more responding when present than when absent (Cooper, Heron, & Heward, 2007) or show greater resistance to extinction (DeLeon, Bullock, & Catania, 2013). The distinction, then, is between choosing between options and working for the production of a stimulus. The former is preference, the latter is reinforcement. As a variant of this latter option, one could also argue for the opportunity to continue responding, paid with effort or as a cost, should also serve to identify putative reinforcers of this sort. This, then, is the observing response, which is discussed further in the following sections.

Resistance to Extinction. Resistance to extinction (e.g., Hendry, 1969; Williams, 1994), or persistence, is offered as another method by which condition reinforcement properties may be examined. Persistence research requires some response to be maintained with the presentation of both the conditioned and unconditioned reinforcers. That is, after each response both types of reinforcement are produced. Following steady states, the experimental design branches out into one of two alternatives for the organism under study; either a condition where both types of reinforcement are no longer produced, or a condition where the unconditioned reinforcer ceases while the putative conditioned reinforcer continues to occur following the response requirement. The conditioned reinforcement effect is determined by the difference in the frequency or duration of responding between the two groups based on the extinction condition used. If equivalent patterns of responding are found between groups, it can be assumed that no conditioned reinforcement effect is found with the stimulus in question. However, should responding persist longer in the group with the putative conditioned reinforcement being produced in the extinction condition, then the argument can be made that the putative reinforcer serves such a function.

However, resistance to extinction research has proven problematic. The main concerns pertaining to the decrement of reinforcement value in the conditioned reinforcer during extinction (Hendry, 1969) and the obvious stimulus differentiation between conditions (Williams, 1994). Due to these problems, the method has been discouraged as a test of conditioned reinforcement (e.g., Hendry, 1969; Williams, 1994). Additionally, resistance to extinction research with humans may have additional confounds, such as competing reinforcers resulting in early study termination (e.g., urgent restroom requirements, boredom).

Changeover Delay. An alternative strategy, the changeover delay (COD), may also serve as a test of conditioned reinforcement. Reviewed by Shahan and Lattal (1998), the COD serves to either punish, and thus reduce, switching between concurrent simple or chain schedules of reinforcement by introducing a delay between the first response on the other schedule, the last response on the current schedule, or the first response on a changeover key and when the selected schedule is in effect. For example, a pigeon may peck at a key with vertical lines, relating to an FR10 schedule of reinforcement. Were the pigeon to switch to an alternative key, one with horizontal lines, the first peck on the horizontal line key (or the last pack on the vertical line key, or the first peck on the changeover key) would start a 5 second delay, after which the horizontal lined key's FR5 schedule comes into effect. The changeover delay, then, serves to prevent accidental reinforcement of switching or as a means to achieve matching (see Shahan & Lattal, 1998). The latter seems suggestive of an analysis of conditioned reinforcement distribution on two or more concurrently available schedules when primary reinforcement is held constant.

In gambling research, one can arrange an experiment in which two or more slot machine simulations is made available to the participant. Alternations between machines can be made contingent upon some response, which serves to enact the COD. As the simulation is necessarily displayed with computer technologies, a procedure similar to that used by Madden and Perone (1999) would likely prove familiar and inconspicuous for the participant. In their study, Madden and Perone implemented a COD of 3-seconds on switching behavior in a computer-aided study of human sensitivity to concurrent VI schedules. The COD locked the screen and presented the message “computer reconfiguring” during the switch. Similar uses of this procedure in slot machine gambling might present a “loading” screen in which a progress bar is filled simulating the loading of a streaming video file from the Internet.

A potential drawback to COD procedures with humans is competition from alternative reinforcers, which directly influence the value of study termination. Take, for example, a scenario in which a participant has plans to meet friends for drinks after completion of the study. Any behavior that lengthens the duration of time spent in the study may have an impact on subsequent responding. Thus, the possibility exists that by pursuing responding on a COD operandum, the participant is contacting a competing source of punishment. While the COD procedure is perhaps more amenable to studies of slot machine gambling, the inherent competition from outside sources of reinforcement serves as a difficult variable to overcome.

Choice Procedures. Studies of choice permit an analysis of reinforcement through the presentation of concurrently-available alternative schedules. Often these schedules are chained schedules where exclusive entry into a terminal link is achieved after completing schedule requirements in one of the two initial links.

It is conceivable to arrange concurrent chains based on slot machine simulations. In such an arrangement, one machine might complete its initial link on a small VI or fixed ratio (FR) schedule. Subsequent links could vary the schedule requirements and thus align choice research using concurrent chains with concurrently-available slot machines. In these arrangements, winning outcomes could be superimposed on each link's schedule requirements, or they may exist solely in the terminal links. External validity would be achieved more readily in concurrent mixed schedules, in which link-related stimuli are absent.

Of central concern to our discussion is the involvement of conditioned reinforcers in the choice literature. It can be said that conditioned reinforcers do in fact influence choice. In our earlier examples, Fantino (1969) and Gollub (1958, as cited in Fantino, 2008) demonstrated that different component schedule arrangements show evidence of conditioned reinforcement effects on choice. However, in slot machine gambling, near miss presentations are not background stimuli correlated with different schedules of reinforcement. It is possible to compare the presentation of near misses with a brief stimulus procedure (e.g., Marr, 1969); however, in doing so one must also take into account that a winning outcome cannot be had simultaneously with the near miss presentation. Indeed, the near miss is a participant in the schedule, and is better accounted for with conjoint schedules of wins and near miss presentations that operate simultaneously, yet separately. Thus, to study the near miss event in a choice procedure would require the varying of near miss densities, at least in the terminal link. That one must vary the density, or rate of near misses, raises the question as to whether or not the rate of conditioned reinforcement has an effect on choice. It appears that the answer to this question is quite mixed, and thus warrants further discussion here.

In 2006, Shahan, Podlesnik, and Jiminez-Gomez assert that studies on choice can be affected by differential rates of conditioned reinforcement. As Shahan et al. note, past research on choice and conditioned reinforcement rates have been confounded by the interplay between the rate of conditioned reinforcement and the necessary change in reinforcing value that accompanies varying rates when primary reinforcement is held constant. Shahan et al. sought to remedy this issue by presenting four pigeons with a mixed schedule that alternated between a VI 90-s and an EXT component. Concurrently available on either side of the mixed schedule response key were two observing response keys. Pressing either of the observing response keys served to alter the mixed schedule to a multiple schedule across all keys, where the stimulus correlated with S+ was made available when the VI schedule was in operation, but no stimulus change when the S- was in effect. Were the schedule to switch from VI to the EXT while observing, the stimulus correlated with S+ was removed. Ratios of delivery between the left and right observing keys were set at 1:9 (i.e., VI 100-s, VI 11.1-s), 1:3, 1:1, 3:1, and 9:1. Preference was accounted for with matching law equations, and greater preference was given to the key that produced more frequent observing stimuli.

As a follow up, Fantino and colleagues (cited in Fantino, 2008) arranged responding on two concurrent chains for pigeons. Both chains had a VI 30-s initial link that resulted in a mixed FI 30-s EXT schedule (VI 30-s EXT in a comparison group). Each chain came equipped with an observing key that when pressed would produce stimuli correlated with S+ (it is still unclear whether or not stimuli correlated with S- were produced). However, the observing key for one chain produced S+ stimuli either equally, three times as often, or nine time as often. Regardless of whether the terminal link was FI or VI, no preference was found for either of the chains. Thus, Fantino's reported results are at odds with those of Shahan et al. (2006).

While the current conditioned reinforcement research tends to be in line with a delay reduction hypothesis approach that lacks a term to account for rate of conditioned reinforcement, the overall findings are still yet tentative. As such, it seems unwise to subject analyses of preference for stimuli that, by default in the case of near misses, must vary in their rates of putative conditioned reinforcement to concurrent chain choice procedures.

Observing Responses. An observing response is a response that serves to bring about schedule-correlated stimuli without impacting the schedule itself. While much of the work in the observing response literature has made use of single and concurrent chain procedures, its use may be applicable to the study of the near miss in simulated slot machine gambling. Thus, the review and discussion of the observing response's applicability to slot machine gambling will be postponed until a review of current behavioral research on the near miss event has been addressed.

Behavioral Research

As a putative conditioned reinforcer, behavior scientists are poised to shed light on the function of the near miss in slot machines gambling. Behavioral research on the near miss has enjoyed a long theoretical history, though relatively few empirical studies have actually been conducted. Currently, there are two primary approaches to behavioral investigations into the near miss as a conditioned reinforcer in slot machine gambling. The first involves analyzing play under extinction conditions, and the second is centered on preference between concurrently available machines, both of which were discussed above. Additional studies that do not fit into either category are also available, though these studies are not as well-represented in the literature.

Resistance to Extinction

Despite the problems inherent in resistance to extinction research (e.g., Hendry, 1969; Williams, 1994), it is still a frequently used method of testing conditioned reinforcement of the near miss in slot machine gambling. In one of the first studies of the near miss, Strickland and Grote (1967) replaced reel symbols on a mechanical slot machine for 44 participants such that each of the 20 symbols on each reel was replaced with red or green bars. Reel 1 had 14 red and 6 green stops, Reel 2 had 10 of each, and Reel 3 contained 6 red and 14 green. As a control for a potential color preference, some participants played on a machine in which Reels 1 and 3 were switched. In one condition, participants were informed that matching red symbols produced a win, while in the other condition participants found that matching three green symbols produced the win. Across the four conditions (color of win (2) x reel sequence (2)) it was found that participants persisted longer after 100 forced trials in those conditions in which winning combinations were seen more often earlier rather than later in the sequence. That is, if matching red produced a win, then a participant would persist longer when Reel 1 contained 14 red symbols rather than Reel 3.

Resistance to extinction as an indicator of reinforcement strength regarding the near miss in slot machines remains a focal point of research in the decades following Strickland and Grote's (1967) article. However, despite the attention received by researchers, the data gleaned from such studies prove inconsistent, with no discernible pattern between experimental preparations and outcomes (see Table 1). Indeed, Knapp (1976) refers to persistence as being of great import in studying individual gambling behavior, indicating that research in this area may help to account for prolonged play in the presence of continued losses, though it is unclear if Knapp was referring to experimental procedures or more general observations of gamblers. Kassinove and Schare (2001), for example, investigated the potential influence of a big win (a win of 40 times the bet size) and near miss presentation densities of 15%, 30%, and 45% on a 4-reel slot machine simulation across 180 undergraduate participants. While no differentiation in persistence after a 50-trial acquisition phase were found during extinction (i.e., no wins or near misses) between those in the big win versus no big win conditions, differences were found in persistence for the various near miss densities. Specifically, participants played more trials during an extinction condition after gambling in a 30% near miss density condition (M = 10.26; SD = 11.47) as compared to the 15% (M = 5.88; SD = 8.06) and the 45% (M = 6.66; SD = 8.22) conditions.

Côté et al. (2003) advanced the near miss literature on resistance to extinction research by incorporating near misses into the win-extinction condition. In their preparation, 59 participants played a modified video lottery terminal (VLT) in which a

3x3 matrix of virtual reels (one reel per spot, nine total reels, and one symbol per reel) presented one of nine different symbols. The VLT was modified with aid of the manufacturer to allow for varying reel presentations. Participants were allowed to play the central horizontal payline only. They were then divided into two groups; a near miss and a non-near miss group. All participants played two phases of the VLT. In Phase 1, 48 forced trials saw 9 wins with a near miss presentation (two winning symbols and one non-matching symbol, left to right) presenting immediately prior to the win. Three additional near misses were randomly presented during this first phase. In Phase 2, the near miss condition was comprised of 25% of trials result in a near miss presentation, with no winning trials on the remaining trials. In the non-near miss condition, spins result in neither a win nor a near miss. Players were allowed to terminate participation during Phase 2 at any point. Participants were staked with 240 credits worth $0.05 each, exchangeable for actual money at the end of the study. Individuals in the near miss condition played an average of 72 trials in the extinction phase, while the control group played an average of 54 trials, a statistically significant difference.

In three experiments of the near miss, Ghezzi, Wilson, and Porter (2006) investigated the effects of altering (1) the number of forced trials prior to extinction, (2) the magnitude of reinforcement, and (3) the form of the near miss itself. In their first experiment examining the effects of varying the number of forced exposure trials, 320 undergraduate participants play a simulated 3-reeled slot machine for 25, 50, 75, or 100 trials (spins). Near miss densities for each of the four trial-numbers were 0%, 33%, 66%, or 100% of all non-winning trials. In each condition 40% of all trials presented a win, with the remaining 60% being divided amongst losses and losses via a near miss presentation. For example, at 100 forced choice trials with a 33% near miss density, a participant would win on 40 trials and see a near miss presentation on 20 trials. The remaining 40 trials would be outright losses (i.e., losses with no near miss). All participants started with 0 points, and as a result, each trial-number condition saw an inverse relation between number of trials played and number of points earned such that the 25, 50, 75, and 100 forced trials conditions saw losses of 10, 20, 30, and 40 points, respectively, prior to engaging in the persistence condition.

The resistance to extinction condition in Ghezzi et al.'s (2006) first study presented the same win and near miss densities found in the forced trial condition. This preparation differentiated this experiment from others (e.g., Kassinove & Schare, 2001) in that no extinction condition was used. Two significant findings resulted from this experiment. First, individual in the 25 trials condition persisted significantly longer than those in the 50, 75, and 100 trial conditions. No significant differences were found between the 50, 75, and 100 forced-trials conditions. Second, individuals in the 66% near miss density condition persisted significantly longer than those in the 0%, 33%, and 100% conditions. No significant differences were found between the 0%, 33%, and 100% conditions.

In their second experiment, Ghezzi et al. (2006) used the same apparatus as in their first experiment, but the parameters were different. Again, four near miss densities were used (i.e., 0%, 33%, 66%, and 100%) amidst a 40% win condition for 120 participants. However, unlike the first experiment, this experiment used 100 forced-choice trials for all participants. Participants were further divided by the amount won per winning trial, such that there were small, medium, and large payout conditions (2 points, 4 points, and 8 points, respectively). All participants started with 0 points, and thus at the end of 100 forced-choice trials participants either had -120 points (small payout), -40 points (medium payout), or 40 points (large payout) when they entered the choice condition in which they could terminate play at any time. No statistically significant differences were found between the various conditions, including interaction effects between win magnitude and near miss density.

The third study by Ghezzi et al. (2006) centered on the effects that different near miss arrangements may have on persistence, thus extending the original work by Strickland and Grote (1967). Six different near miss presentations were used (see Figure 1). The payout schedule matched what Kassinove and Schare (2001) used, such that 10% of all trials were winning trials, as opposed to the 40% of trials used in the first two experiments, as it arguably parallels those conditions found naturally in casino slot machines. This experiment used 50 forced-choice trials prior to the choice trials and paid 4 points per winning spin. As before, 0%, 33%, 66%, and 100% near miss densities were programmed into each of the six conditions. A total of 240 participants concluded the forced-choice phase with a total of -80 points. While no results were statistically significant, trends indicate that form 3 (see Figure 1) produced the most sustained play in the 33% near miss density condition, form 5 in the 100% near miss density condition, form 6 in the 33% and 100% near miss density conditions. From this final study, we can conclude that not only is rate of near miss presentation important, but topographical features of the near miss may play a vital role as well.

Daugherty and MacLin (2007) extended previous work with the addition of a near "loss" event in a Wheel-of-Fortune-based slot machine simulation based on the television show of the same name. In this simulation, a near loss occurs when two of three Bankruptcy symbols appear left to right on the payline, with a Bankruptcy symbol resulting in a complete loss of credits for the slot machine. Thus, the near loss event was in relation to the loss of credits, whereas the near miss event was in relation to the earning of credits. Participants interacted with a three-reeled slot machine that produced 0%, 15%, 30%, or 45% near misses or near losses on the remaining 22 of 50 acquisitions trials. The remaining 28 trials consisted of 13 losses and 15 wins, held identical across conditions. Results indicate that only the 45% near miss condition produced significantly more persistent play in an extinction condition. Further, Daugherty and MacLin investigated perceptions of luck with the Belief in Good Luck Scale (BIGL). Scores on the BIGL, which are indicative of endorsements of a belief in luck, were directly related to the percentage of near miss occurrences, such that experiencing more near misses resulted in higher post-test scores on the BIGL, though significant differences were only found in the near loss 15%, 45%, and control groups (a drop in BIGL scores in all three).

In an investigation of American-Indian gamblers compared to non-American-Indian gamblers, Whitton and Weatherly (2009) compared differences in gambling patterns between each group on a slot machine simulation and a video poker simulation, while either drinking an alcoholic or nonalcoholic beverage. With respect to the slot machine simulation, Whitton and Weatherly programmed machines to produce either 0%, 33%, or 67% near misses on losing trials, with a near miss being a matched winning symbol on the first and second position on the payline but not the third. No information was provided on the win rate or payback percent on winning trials. No significant differences were found between ethnicity, type of beverage, and near miss density on the number of trials played.

A potential limitation for Whitton and Weatherly (2009) is that participants were provided three 5-minute sessions for the slot machine simulation, and thus a ceiling effect may have been imposed under these conditions. However, significant differences were found in the number of hands played in video poker across ethnicities, indicating differences may be had, although differences in trial speed (e.g., reel spin times versus card dealing times) may have aided in restricting the number of possible hands played. Whitton and Weatherly reported a significant interaction between beverage and near miss density, though the specific trends were not reported. Thus, it may be concluded that the effects of near miss densities on play are better accounted for when participants are not restricted in their play, adding weight to the use of persistence as a dependent variable as opposed to rate under tight time constraints.

The research on resistance to extinction with respect to the near miss in slot machine gambling is mixed, with most studies reporting no statistically significant differences between near miss densities. Table 1 presents the research reported here along with their respective near miss densities and which, if any, proved more effective at sustaining play under non-forced trial conditions. Given these discrepancies, other sources of data are considered, and one such prominent area in the near miss event in slot machine gambling, preference, is explored.

Preference. While preference for payback rate and percentages have been conducted (e.g., Dixon, MacLin, & Daugherty, 2006; Haw, 2008; Weatherly, Thompson, Hodny, & Meier, 2009), relatively little research has been conducted on preference with respect to near miss density. In the initial preference assessment of near miss density, MacLin, Dixon, Daugherty, & Small (2007) programmed three concurrently available slot machines with either 15%, 30%, or 45% near miss presentation on losing trials, with all machines paying back at 20%. Eighteen participants were asked to play 100 trials on any machine, and were then given the option to continue or terminate playing, with a chance at a $10.00 prize for the highest score. Responding during this second phase always resulted in a losing trial, though the same near miss densities were presented. Response allocations for both the forced trials and extinction conditions showed no statistically significant difference in allocation, though a trend toward the 45% machine was observed.

Győző and Körmendi (2012) had participants play four 50-trial slot machine simulations that held total win equivalent (273 credits, 73 credits per bet) while varying near miss densities between each 50-trial round (15%, 30%, 0%, and 45%, respectively). Starting with the end of the second round, participants were asked which of the previous rounds they would like to play again. Participants selected the 30% condition as the one they most wanted to repeat, with the 45% condition being the least selected. However, participants were unable to identify which round contained the most and least near miss densities during a post-gambling follow-up questionnaire.

Additional Preparations

Dillen and Dixon (2008) introduced a 10% near miss presentation (left, split, and right, see forms 6, 4, and 3 in Figure 1, respectively) during an extinction phase in an ABABC design (C = extinction phase) to test the effects of varying jackpot magnitude. During the A phases, participants won 5 out of 50 trials, whereas B phases saw the presentation of winning symbols lining on the payline, but without any payment made to the participant's bankroll. Participants were split into two groups, one receiving $0.50 per win during the A phase, and the other receiving $2.00 per win. During the extinction phase, there were no significant differences with respect to persistence between each group, adding some initial validity to the notion that jackpot size does not influence persistence in extinction with near miss presentations.

Dillen and Dixon (2008) did find, however, that inter-response times (IRT) for individuals after near miss presentations in extinction (C phase) were greater for those in the $2.00 per win group than for the $0.50 per win group. IRTs for complete losses (i.e., no near miss) were nearly identical between the two win magnitude groups during this phase. As IRTs were longer for wins versus losses in the A and B phases for both groups, these results suggest that the near misses in the C phase may more closely approximate a win (i.e., similar response pattern) than a loss for the $2.00 per win group. No discussion was made as to the topography of the near miss, however, which could affect IRTs (e.g., Ghezzi, et al., 2006). Thus, this study lends some support to the conditioned-reinforcement properties of near miss presentations.

As part of a larger study, Clark, Lawrence, Astley-Jones, and Gray (2009) had participants play a 2-reel slot machine over 60 trials. Wins were programmed to occur on 16.67% of trial, near misses (a matching symbol on the second reel immediately above or below the payline) on 33% of trials, and the remaining trials as full misses (i.e., no symbols matching on the payline). In addition, 30 of the 60 trials were initiated automatically, that is, they were not participant initiated. After each trial, participants were asked to rate, on a scale of 1 to 21 (21 being a full endorsement of the statement) how pleased they were with the results and how likely they were to continue to play. Overall, participants endorsed near miss outcomes as aversive, yet reported that their presence resulted in them being more likely to continue playing, especially when they could initiate their own trials. Similar results were found in a follow-up study (Clark et al., 2012).

What the Clark et al. (2009) and Clark et al. (2012) results suggest is that the near miss may acquire a negative reinforcement function. Discovering the conditions under which this occurs seems to be a worthwhile pursuit.

Critique of the Behavioral Research

The resistance to extinction literature in slot machine gambling is mixed with respect to how the extinction conditions are conducted, often times being at odds with standard procedures (e.g., Hendry, 1969; Williams, 1994). For example, Kassinove and Schare (2001) omitted near misses during their extinction condition, whereas Côté et al. (2003) included them in their extinction preparation. Differences of this sort may be to blame for inconsistent results between studies, as are outlined in Table 1. The persistence literature would benefit from additional groups in which conditions were replicated, save that the extinction conditions either included or excluded the near miss presentation, depending upon the original method.

Another potential limitation to the use of resistance to extinction procedures is that individuals may terminate their participation for reasons outside of the experimenter's control, such as to get to class or another appointment, or simply to be done with the experiment (see Shull & Lawrence, 1998 for a brief review). And, while not a test of conditioned reinforcement per se (e.g., Piazza, Fisher, Hagopian, Bowman,

& Toole, 1996), preference assessments can help shed light on what near miss arrangements might function as conditioned reinforcers while avoiding the issue of early experimental termination.

As stated, persistence research, even when proper preparations are adhered to, is not ideal for examinations of conditioned reinforcement (Hendry, 1969; Williams, 1994). Persistence in human subjects may be influenced by several factors outside the experimenter's control. Even less convincing is the literature on preference with respect to putative conditioned reinforcers. Taken together, the studies outlined above provide evidence for, but not proof of, the near miss functioning as a conditioned reinforcer, at least under some conditions. What is needed, then, is an alternative methodology that reduces or eliminates the above-mentioned concerns. Such a preparation exists in the observing response (Shahan, 2002; Williams, 1994).

A New Direction: The Observing Procedure

First identified in the literature by Wyckoff (1952), the observing response procedure is defined as "…any response which results in exposure to the…discriminative stimuli involved…and [is]…distinguished from the responses upon which reinforcement is based" (p. 431). Wyckoff's argument is that by requiring a response-contingent presentation of a discriminative stimulus, the field could do away with hypothetical formulations of the role of attending in discrimination learning. Further, Wyckoff hypothesized that these discriminative stimuli could acquire conditioned reinforcement properties of their own.

It is important to note that two different responses must be made in the observing response procedure, one that produces the putative conditioned reinforcer, and one that produces the unconditioned reinforcer. The responses may be similar or dissimilar in form, so long as the location of the operandum or response is changed, such as when key-pecks are used.

Since the inception of the observing procedure, notable modifications have been made. Primarily, much of the research on the observing response makes use of single or concurrent schedules of reinforcement. Observing responses in these preparations produce discriminative stimuli correlated with the current schedule on a separate operandum, changing the schedule from a mixed to multiple schedule of reinforcement. Such preparations produce and maintain the observing response, but only when at least some of the stimuli are correlated with the presentation of reinforcement at least some of the time (see Fantino & Silberberg, 2010; Silberberg & Fantino, 2010). That is, the observing response is most likely when some or all of the stimuli are correlated with S+, but no observing when the stimuli are only correlated with S- (see Silberberg & Fantino, 2010, for a potential exception).

Much of the research using the observing response procedure deals with responses with respect to unconditioned reinforcers. Less is known about observing responses with respect to conditioned reinforcers. In one of the few studies to address this issue, Shahan (2002) arranged self-administrations of a drug (10% ethanol solution) to be effective (random-ratio (RR) schedule) or ineffective (extinction) with four rats. The rats were trained to respond steadily in the presence of a blinking house light and pulsating tone (both S+) during a RR 25 schedule of reinforcement and to refrain from responding to the operandum during a constant house light and constant tone (both S-) during extinction. Next, Shahan removed the S+ and S- stimuli and introduced an observing response on a separate lever. Responses to the observing lever occurred reliably. Shahan then tested observing under different conditions in which the drug was replaced with a 2% sucrose solution, while keeping all other conditions equal. Observing responses under these conditions decreased significantly, and returned to high levels once the 10% ethanol solution was re-introduced. While observing during the 2% sucrose condition was low, it was not as low as the responses made to the other lever that produced the primary reinforcer. Thus, the conditioned reinforcement properties of stimuli correlated with drug administration maintained observing under conditions of extinction.

Shahan's (2002) experiment provides a general approach to study the conditioned reinforcement properties of stimuli through the removal of the primary, or central, reinforcer. A study that combines the concurrently-available slot machine procedure of MacLin et al. (2007) with the observing response procedure as arranged by Shahan (2002) would constitute a first step toward capturing the putative conditioned reinforcement effect of the near miss, if indeed one exists. Such an arrangement is proposed here in the context of two experiments. In Experiment 1, three concurrently-available slot machines will differ on one of two factors: background color and win rate. Win rate is arguably a more salient reinforcer than the near miss, and thus sets the stage for Experiment 2 contingent upon successful use of the proposed methodology. That is, is the proposed methodology can demonstrate a reinforcing effect of win rate, then the same methodology should be applicable to the near miss.

The Simultaneous Observing of Concurrently Available Schedules

The term *simultaneous observing of concurrently available schedules* (SOCAS) is proposed to describe the current methodology and consists of three phases. In the first phase, participants are given the same exposure regarding the putative reinforcers on their respective schedules. This is accomplished through interactions with each of the schedules in isolation, with each component being matched to an arbitrary stimulus (e.g., background color). The second phase is an assessment whereby preference of a particular component is determined through the analysis of response allocations. This preference is made more certain with the random rotation of each component. In the third phase, the test for reinforcement, participants lose the ability to discern machines, which continue to rotate position, as their background colors are removed. An observing response is made available which serves to bring back all such stimuli. In the current study, in one condition the observing response was free to the participants, and in the other, a three-credit cost was issued enforced. Thus, this observing procedure allowed for the simultaneous observing of several schedule-related stimuli across differing contexts and parametric variations on the cost to observe (though cost can be substituted or used in combination with increased response effort). There various outcomes that can be derived through this procedure. For example, preference for one stimulus arrangement in Phase 2 may be observed again in Phase 3. Such a pattern is indicative of reinforcement in the current context. However, if the same preference is seen in Phase 2 for another participant, but fails to show any preference in Phase 3 when a cost to observe is enacted, then the same stimulus identified as a reinforcer would fail to function as such under the current conditions (i.e., under cost conditions). These and other potential outcomes are elaborated in Table 2.

Experiment 2 tested the SOCAS on a more elusive aspect of gambling; the near miss. A pre-experimental phase identified potential near miss densities, replicating resistance to extinction procedures as outlined above. In the experimental phase, three concurrently-available slot machines were available that differed on two factors; 1) the density of near misses (the putative conditioned reinforcer), and 2) discriminative stimuli correlated with each near miss density. All other factors (e.g., win percentage and magnitude) remained equivalent across machines. It can be concluded that if the near miss functions as a conditioned reinforcer, then participants should engage in greater response effort and cost to identify which of three machines is the machine that carries their preferred near miss density (cf. MacLin et al., 2007; Shahan, 2002), and allocate more responding to that machine. Significant departures from Shahan's study were configured to conform to slot machine play.

General Method

Participants and Setting

Undergraduate students were recruited via online recruitment software from the University of Nevada, Reno. Research was conducted in either a small, windowed room located in the University's library, which contained a large conference table, several chairs, and additional electronic equipment (e.g., television), or in a private room located in an off-campus university building. The latter experimental location was housed in the building's basement and consisted of several chairs, desks, and desktop computer units. Each session lasted between 20 and 40 minutes, depending upon which experiment and phase was being conducted.

Apparatus

A slot machine simulator compatible with Windows 7 and 8 was built for this study, as shown in Figure 2. The apparatus was designed to provide the experimenter with control over several features of the procedure. Specifically, the program permitted manipulating the number of trials played, starting credit amount, the reel strip used, an option to randomize starting positions on the reels, sound effects for various events, spin time for each reel, stopping positions for each reel for each machine on every trial, position of each slot machine, number of credits won, background color, button colors, and the availability and visibility of several buttons (i.e., Spin, Show, Exit) and characteristics (i.e., background color of individual slot machines). After each trial the program exported the data (from the parameters above) to a .csv file for review in Microsoft Excel. All .csv files were time stamped and coded with a randomly generated 8-digit participant code. Several of the features that require additional description and appear below.

Reel strip. A 109 x 179 pixel reel strip was constructed with stock images of traditional reel strip symbols, specifically a plum and a liberty bell. A winning trial was comprised of three liberty bells on the payline, while all other combinations resulted in a loss. Each strip consisted of eight symbols: 1) liberty bell, 2) plum, 3) plum, 4) plum, 5) plum, 6) liberty bell, 7) plum, and 8) plum. These eight symbols are shown on Figure 3. This arrangement permitted multiple positions of liberty bell (above, on, below payline) and for reels to display only plums, void of any winning symbols.

Reel stop position and timings. With this software, reel strips may be programmed to randomize position with the start of each trial or to remain on the last reel stop position. In other words, if a particular slot machine ends on positions 1, 6, and 8, the next trials could be programmed to keep that arrangement or randomize reel positions for the next trial. This feature prevented participants from identifying which slot machine moved to which spot in the absence of other information (i.e., slot background color) on trials where slot machines rotated position. Each trial provided the opportunity to determine the final position of each reel for each slot machine, thereby eliminating individual variability in outcome between participants. Further, the duration of each reel's spin could be controlled for in approximately 1.25 second intervals (e.g., a stopping time of 3 would equate to approximately 3.75 seconds of reel spinning). As each machine had 3 reels, stop times of 1, 2, and 3 would equate to 1.25, 2.50, and 3.75 seconds of spinning, respectively.

Sound effects. Specially created sound effects for several events on the slot machine simulation were stored as .wav files. Professionally developed studio quality sound effects were used, which included sounds for the spinning of the reels, winning outcomes, and pressing the observing response button ("Show"). Two sounds were created for the reel spins; one for trials in which no win nor near miss was presented, and a longer version with increased tempo and additional effects for winning symbol stops for those trials that resulted in a win or a near miss. Further, if a sound for any event was shorter than the event it was tied to, it looped until the event terminated.

Visible and hidden features. The slot machine simulator contained the option of hiding certain characteristics of each slot machine. For the current investigation, this meant hiding the assigned background color of each slot machine during the observing-response conditions. The option of a "Show" button provided the means by which a participant could undo the hiding of the color of the individual slot machines. That is, by pressing the Show button, the program revealed to the participant the color of each machine.

Ordering of conditions. Conditions consisted of a set of trials with specific parameters that differed from other conditions within the same experiment. For example, in the pre-experimental phase of Experiment 2, the first 30 trials were forced trials, while the unlimited extinction condition that followed permitted the participant to exit the program at any time. In this case, two conditions were created, with the second condition including an Exit button to terminate the study. The apparatus permitted the coding of several conditions to be executed sequentially, though seamlessly, during participation. The ordering of the conditions makes it possible to complete one condition with an amount of money uncertain to the programmer, and have that exact amount carry over to the next condition (e.g., if a participant ended a condition with 120 credits, their next condition would start with 120 credits).

Procedure

All participants were first asked to complete the South Oaks Gambling Screen (SOGS; Lesieur & Blume, 1987), a 20-item self-report measure of past gambling behavior. The SOGS is designed to identify non-, probable-, and pathological-gamblers. Participants scoring a 2 or above, thus indicating probable-pathological gambling, were excluded from analysis. Upon completion of the SOGS, participants completed a demographics questionnaire that assessed age, gender, ethnicity, year in school, and parental annual income (see Appendix A). Participants were then read a script that pertained to their respective condition (see Appendix B for Experiment 1 and 2 and Appendix C for Pre-Experimental Phase for Experiment 2) prior to interacting with the slot machine simulator. After completing the slot machine simulator, the participants answered questions on an exit survey that asked about their opinions on what the study was about, if they had a strategy, how they thought they did compared to other players, and if and how often then play slot machines (see Appendix D).

Several similarities existed between slot machine simulation preparations, and thus are covered here for the sake of brevity. All wins paid five credits to the participant, and each spin cost one credit. Participants were provided with incentive to optimize response allocation (Experiment1, 2) and sustain persistence (Experiment 2 pre-experimental phase) with the notification of a $50 prize to the three participants who ended the study with the most credits (see Peterson & Weatherly, 2011 for evidence of equivalent gambling behavior between real money and gift card incentives). However, to satisfy IRB regulations, one participant from each condition was randomly selected to win $50 cash. Reel timings were set at 2, 4, and 6 (left to right) on non-winning trials. On winning and near miss trials, timings are set at 2, 4, and 8 (left to right). The Near-Miss-Winning-Spin sound was played on all winning and near miss trials, and the Losing-Spin sound was played on all losing trials. Subsequent to the termination of the reel spins, either no sound (losing and near-miss trials) or a Win sound (winning trials) was played, with the latter occurring while the total credits won for that trial were displayed on the screen. Near misses were programmed such that Reels 1 and 2 (left and middle, respectively) produced a liberty bell, while Reel 3 (right) produced a liberty bell either above or below the payline. Losing trials produced no liberty bells on the payline for Reels 1 and 2, and were occasionally present on Reel 3. The specific number of wins, losses, and near misses were predetermined, while their distribution amongst the condition's trials was made possible with a random number generator function in Microsoft Excel. Thus, while the number of events was known, their actual presentation was randomized and then coded into the apparatus. This randomization was done to reduce potential experimenter biases that may result in the creation of more favorable conditions for success, such as placing near misses temporally close to winning trials, which may create a sort of delay-reduction effect in the near miss (see Fantino, Preston, & Dunn, 1993).

Experiment 1

Experiment 1 was designed to test the SOCAS with a more salient reinforcer, a win. Thus, this preparation aimed to present the participant with favorable conditions to bring about an observing response. This first experiment, then, is a test of the SOCAS methodology

Method

Ten participants completed Experiment 1 and were split evenly between Condition 1 and Condition 2 (see Table 3)[2]. Participants in Experiment 1 were staked with 50 credits and progressed through three phases of the slot machine simulation. In Phase 1, participants played three slot machines individually for 10 trials each from left to right. That is, the first slot machine was available for play on the left of the screen, while the middle and right machines were disabled (i.e., spin button did not function; background color was set to gray). Subsequent to the 10 trials on the leftmost machine, the middle, then right, machines were made available, while the remaining two machines were inoperable. Machine color and win percent were counterbalanced to control for sequence and color preference effects (see Table 4), such that participants were assigned to one of two color/payback configurations. During Phase 2 machine positions alternated

[2] One additional participant was excused from the study as their SOGS score was too high.

in a random pattern for 30 trials. After the conclusion of each trial, the starting positions on each reel was randomized. All machines were simultaneously operable during this phase. While machines alternated positions, their respective win percentages remained consistent. That is, if the Red machine produced a win on 67% of all trials, it would do so regardless if it was on the left, middle, or right of the screen. This procedure was reproduced in Phase 3, with the exception that the background colors were hidden. An additional button, the "Show" button, was made available, which when pressed made available the background colors of each machine. Half of the participants (Condition 1) were given a Show button that had no cost, while the other half (Condition 2) paid three credits for its use. If the participant paid three credits to observe across all thirty opportunities, with response allocation strictly to the 67% machine, they would yield a 20 credit loss overall in the third phase.

Results

A planned one-tailed independent samples t-test (Gravetter & Wallnau, 2008) was conducted between Condition 1 and Condition 2 with respect to the number of observing responses made. A significant difference was found ($t(8) = 2.26$, $p < .05$) such that there were significantly more observing responses made when there was no cost ($M = 13.40$, $SD = 10.71$) as compared to the three-credit cost ($M = 1.80$, $SD = 4.02$). There were no significant differences in show button responses between Configuration 1 and 2 (see Table 4) for Conditions 1 ($p > .05$) and 2 ($p > .05$).

A Friedman test (Gravetter & Wallnau, 2008) was conducted to evaluate differences in preference between the 67% (Median = 2.7), the 33% (Median = 1.9) and the 0% win machine (Median = 1.5) for all participants in Phase 2. The test was significant; $\chi_r^2 = 6.95$ (2, n = 10), $p < .05$. Subsequent pairwise comparisons with a Wilcoxon test were conducted with adjusted alpha based on a Bonferroni correction ($\alpha = 0.017$). There was a significant difference between the 67% win machine and the 0% win machine, z = 2.57, $p < .017$, but not between the 67% and the 33% or the 33% and the 0% machines (*p*s > .017; see Figure 4). Participant 3 demonstrated a preference for the 33% machine during Phase 2, which was reflected in a comment on the exit survey indicating such a preference, though this did not maintain during Phase 3 (see Figure 5).

A Friedman test for repeated measures ordinal data was conducted to evaluate differences in preference between the 67% (Median = 2.9), the 33% (Median = 1.4), and 0% win machines (Median = 1.7) for all participants in the 0 and 3 cost conditions during trials in which the individual engaged in the observing response. The test was significant, $\chi_r^2 = 7.75$ (2, n = 6), $p < .05$. Subsequent pairwise comparisons with a Wilcoxon test were not conducted as the n was too small to calculate significance based on the critical value. However, visual inspection of the data revealed a preference for the 67% win machine over the 33% and 0% machines, with no preference between the 33% and 0% machine (see Figure 5).

A Friedman test was conducted to evaluate differences in preference between the 67% (Median = 2.9), the 33% (Median = 1.3), and 0% win machines (Median = 1.8) for those in the no cost condition during trials in which the individual engaged in the observing response. The test was significant, $\chi_r^2 = 6.70$ (2, n = 5), $p < .05$. Subsequent pairwise comparisons with a Wilcoxon test were not conducted as the n was too small to calculate significance based on the critical value. However, visual inspection of the data revealed a preference for the 67% win machine over the 33% and 0% machines, with no preference between the 33% and 0% machine (see Figure 5).

As only one participant engaged in the observing response when the cost was set at 3 credits, no statistical analyses were conducted. However, visual inspection of the data revealed a preference for the 67% win machine over the 33% and 0% machines, with no preference between the 33% and 0% machine (see Figure 5).

A Friedman test was conducted to evaluate the differences in preference between the 67% (Median = 2.1), the 33% (Median = 1.8), and the 0% win machines (Median = 2.2) when no observing response was made for all participants in Phase 3. The test was insignificant ($p > .05$), indicating that participants were unable to allocate responding to a given machine unless schedule-correlated stimuli were present (see Figure 6).

Data from Experiment 1 were re-analyzed with the SOCAS scoring method outlined in Table 2 (see Table 6). The SOCAS scoring method relies on category-based outcomes that combine information from the preference phase (i.e., Phase 2) and the test for reinforcement phase (i.e., Phase 3) that result in 8 possible outcomes. In this experiment, preference for a particular machine was determined if two conditions were met. First, at least 50% of responses needed to be allocated to one machine, and second, the most preferred machine could not be less than 15 percentage points within the second-most preferred machine's response allocation percentage. For example, Participant 1 allocated 66.67% of responses to the 67% win machine, and 10.00% and 23.33% of responses to the 33% and 0% win machines, respectively. Given that there are more than 15 percentage points between 23.33% and 66.67%, preference was awarded to the 67% win machine. It must be noted that these criteria, the 50% allocation and no less than 15% difference, were selected prior to any data collection. The a priori nature of these criterion-related decisions prevented the criteria from being selected after visual or statistical inspection of the data. That is, although these criteria are somewhat arbitrary, they were in no way influenced by the data as they were selected prior to any data collection.

Of the 5 participants in Condition 1 (no cost), 3 met criteria for Category A (participants 1, 2, and 5), indicating a likely conditioned reinforcement effect. All 3 participants who met these criteria preferred the 67% machine in Phases 2 and 3. The remaining 2 participants in Condition 1 met criteria for Category E, suggesting that either the win percent did not function as a reinforcer, or that the training phase was ineffective.

In Condition 2 (three-credit cost), 2 participants (participants 6 and 8) met criteria for Category G, suggesting the preferred machine in Phase 2 (67% machine, in this case), did not serve as a reinforcer at this particular cost. In addition, Participant 9 switched from the 67% win machine in Phase 2 (86.67% of responses) to the 0% machine in Phase 3 (50.00% of responses), though no observing responses were made. Participant 7 met criteria for Category D, switching from undifferentiated responding in Phase 2 to a preference for the 67% machine in Phase 3 with 9 observing responses being made. Finally, participant 10 exhibited undifferentiated responding in both conditions without engaging in any observing response, thus meeting criteria for Category H, suggesting this configuration of win percentages did not serve a reinforcing function.

Discussion

These statistical and categorical data suggest that when there is no cost for engaging in the observing response, individuals will observe stimuli correlated with machine win percent. In this case, when observing responses were made, they were allocated to the machine with the highest win percent. This result provides further evidence of the reinforcing value of win percent in simulated slot machine gambling (e.g., Nastally, Dixon, & Jackson, 2009), while also providing evidence for the use of the SOCAS as a method to discern reinforcing value. In other words, the SOCAS provided data indicative of a decrease in reinforcing value of the highest win percent when a cost was imposed for observing relevant stimuli correlated with win percent. Given the relatively undifferentiated responding when no observing response was made compared to more orderly data when all relevant stimuli were present, it can be argued that this software protected against participants being able to guess which machine was in which position when discriminative stimuli were hidden. These arguments regarding the SOCAS are backed by statistical analysis that, generally speaking, confirmed the conclusion that the SOCAS can be useful in determining both the presence and strength of conditioned reinforcement. In terms of the present experiment, the SOCAS procedure appears to be a worthwhile pursuit in the identification of reinforcers.

Experiment 2

Pre-Experimental Phase

Given the variability in procedures in testing for the effects of the near miss and their subsequent outcomes (see Table 1), the Pre-Experimental Phase of Experiment 2 served as the method by which the specific near miss densities were determined for the Experimental Phase. While persistence studies are not the most suitable for testing conditioned reinforcement properties (Shahan, 2002; Williams, 1994), they may prove useful in the identification of differing near miss preferences for future study. In other words, this phase was conducted not to test for conditioned reinforcement but to identify which near miss densities may prove useful in the final experimental preparation.

Method. Twenty-five participants completed a slot machine simulation programmed with one of five near miss densities (i.e., 0%, 10%, 25%, 33%, and 50%). The participants' demographics are outlines in Table 3. The phase was split into two conditions: a 30-trial 20% win condition and an extinction condition that presented near misses at the same density from the first 30 trials. Participants were staked with 100 credits, and broke even at the end of the 30-trial 20% win condition. Near miss distributions were determined as a function of total trials available. For example, in the 10% near miss condition the 30-trial 20% win condition consisted of 3 trials presented as near misses (10%), 6 trials presented as wins (20%), and the remaining 21 trials as losing trials. The trial number that served as a winning trial was programmed to be the same for all participants across all near miss densities.

The extinction condition presented an "Exit" button which allowed the participant to terminate the experiment. In this phase, the near miss density that sustained gambling the largest, smallest, and median number of trials was used in the subsequent Experimental Phase.

Results. A One-Way ANOVA showed no significant differences between near miss density conditions when measured on number of trials in extinction ($F(4, 20) = 1.15$, $p > .05$; see also Figure 7). This result is consistent with the outcome of 25% of near miss research using extinction methodologies (i.e., Ghezzi, Wilson, & Porter, 2006, Experiment 2; Whitton & Weatherly, 2009). General trends were identified that permitted the use of this Pre-Experimental Phase to select the three near miss densities for use in the following Experimental Phase. Specifically, the 25% near miss density was selected as achieving the most trials played in extinction (*M* = 12.40, *SD* = 7.93), the 0% density for the least trials (*M* = 1.20, *SD* = 1.79), and the 50% density for being the closest to falling between the 25% and 0% in terms of trials played in extinction (*M* = 7.80, *SD* = 7.43).

Experimental Phase

The Experimental Phase combined the methods of Experiment 1 with the outcomes from the Pre-Experimental Phase and tested for the conditioned reinforcement properties of the near miss in simulated slot machine gambling.

Method. Nineteen participants completed the second phase of Experiment 2 (see Table 3)[3]. The procedure for Experiment 2 replicated Experiment 1 (i.e., Phase 1, 2, and 3), with the exception that all machines paid back at 20%, and thus differed only on background color and correlated near miss density (see Table 5 for specific counterbalancing). Additionally, participants were staked with 100 credits, whereas in Experiment 1 they were staked with 50 credits. Were the participant to observe, at a cost of three credits across all thirty opportunities in Phase 3, they would lose 90 credits.

Results. A planned one-tailed independent samples t-test was conducted between Condition 1 and Condition 2 for the Experimental Phase of Experiment 2 with respect to the number of observing responses made. A significant difference was found ($t(17) = 2.308$, $p < .05$), indicating that there were more observing responses made when there was no cost (*M* = 13.67, *SD* = 14.56) compared to when a three-credit cost was enforced

[3] Two additional participants were excused due to their SOGS scores being too high, and a third participant voluntarily withdrew during the experiment.

(*M* = 2.20, *SD* = 5.69). There were no significant differences in observing responses between Configuration 1 and 2 (see Table 5) for Conditions 1 ($p > .05$) and 2 ($p > .05$).

A Friedman test was conducted to evaluate the differences in preference between the 50% (Median = 2.0), the 25% (Median = 2.1), and the 0% near miss machines (Median = 1.9) for all participants in Phase 2. The test was insignificant ($p > .05$), indicating that there was no preference for any one machine type (see Figure 8).

A Friedman test was conducted to evaluate differences in preference between the 50% (Median = 1.9), the 25% (Median = 2.1), and 0% near miss machines (Median = 2.0) for those in the two cost conditions during trials in which the individual engaged in the observing response. The test was insignificant, $p > .05$ (see Figure 9).

A Friedman test was conducted to evaluate the differences in preference between the 50% (Median = 1.8), the 25% (Median = 2.1), and the 0% near miss machines (Median = 2.1) for participants in the no cost condition during trials in which the individual engaged in the observing response. The test was insignificant ($p > .05$), indicating no preference between participants for near miss density.

As only two participant paid to observe in the cost condition, no statistical analyses were conducted. Furthermore, visual inspection of the data failed to reveal a preference for any one machine type (see Figure 9).

Finally, A Friedman test was conducted to evaluate the differences in preference between the 50% (Median = 1.9), the 25% (Median = 2.1), and the 0% near miss machines (Median = 2.0) when no observing response was made for all participants in Phase 3. The test was insignificant ($p > .05$; see Figure 10).

SOCAS-based categorical analyses were conducted for each participant in Experiment 2, and are outlined in Table 6. Of the 9 participants in Condition 1, 3 met criteria for category A (participants 12, 13, and 16), which is indicative of the near miss having a reinforcing effect. Specifically, Participant 12 selected the 0% near miss machine, Participant 13 selected the 25% near miss machine, and Participant 16 selected the 50% near miss machine in Phase 2 and Phase 3. The remaining 6 participants met criteria for categories E (n = 2), G (n = 3), and H (n = 1), which all suggest weak evidence for a conditioned reinforcement effect for the near miss.

Condition 2 SOCAS categories were distributed among categories E (n = 1), G (n = 4), and H (n = 5). These categories argue for the lack of a conditioned reinforcing effect for these particular near miss densities in simulated slot machine gambling when a three-credit cost is instated.

Discussion. Statistical data reveal a weak reinforcing effect for the near miss event in simulated slot machine gambling, at least within the current preparation. It should be noted here that although Participant 20 allocated responses exclusively to the 25% near miss machine when observing, this participant engaged in only 4 observing responses, and thus the data are not likely representative of conditioned reinforcement. One possible explanation for these results might be found in the magnitude of reinforcement found in a winning outcome. In this case, a five credit return on a one credit investment to spin the reels might not be strong enough to support and maintain a preference for one near miss density over another. However, as Ghezzi, Wilson, and Porter (2006) have demonstrated, at least tentatively, reinforcer magnitude does not appear to play a major role in determining the role that near miss events play in simulated slot machine gambling.

However, SOCAS-based categorical analyses of the data suggest a possible, however elusive, reinforcing effect for near miss events when there is no cost. The effect is identified as being more elusive for two reasons. First, 33% of participants in Condition 1met criteria for Category A in Experiment 2, unlike the 67% of participants in Experiment 1. Second, of the three participants in Condition 1 in Experiment 2 whose data were designated as Category A, not one participant's preferred machine was the same as another. In fact, Participant 12 preferred the machine that produced no near misses, perhaps suggesting an escape function to the near miss. Thus, even if there is a reinforcing effect to near miss events, the effect may be specific to certain individuals. This last finding, that the putative conditioned reinforcing effects may be idiosyncratic, adds weight to the argument that the SOCAS is a useful tool for assessing conditioned reinforcers. This is particularly evident as idiosyncratic differences were masked in the statistical analyses.

General Discussion

Experiments 1 and 2 were conducted to answer the question as to whether the near miss event serves as a conditioned reinforcer in simulated slot machine gambling. To aid in answering this question, the SOCAS was developed. The SOCAS is a versatile procedure that brings observing response methodologies into the human operant laboratory without the requirement of extended training. As a test of this new methodology, participants were asked to choose amongst three concurrently available slot machines that differed on win percentage and background color.

Participants in Experiments 1 and 2 engaged in observing more frequently when there was no cost associated with observing. Further, in Experiment 1, responses were allocated to the highest of three win percentages. This pattern suggests that with some methodological refinement, the SOCAS procedure can be useful in determining reinforcing value of various stimulus arrangements. Namely, there may be a point at which participants will pay to observe background colors correlated with the differing schedules, and the higher this point is relative to the reward (in this case, payout amount), the more reinforcing the stimulus or schedule is at that time for that individual.

However, attention must be paid to the fact that even when observing was free, many trials did not see this option used. While it is unclear at this point why observing did not occur at optimal rates under zero cost conditions, several hypotheses may be put forth. First, participants might be trying to guess or figure out what the experimenters were looking for, and thus some participant effects might have been captured. Second, participants may have been uninterested in the study and any additional efforts might have been seen as prolonging their efforts. Finally, and perhaps most worthy of future exploration, is the possible connection between show button presses and subsequent trial outcomes. Specifically, if pressing the show button is met with several non-winning trials, an unintended function of the show button (that of repressing winning outcomes), no matter how incorrect, might have emerged. Future efforts that directly manipulate win percentage as a result of show button presses may prove fruitful, and perhaps be in line with a new response method of testing conditioned reinforcement if the observing response results in a greater density of near misses regardless of machine choice.

A subsequent analysis was conducted which varied near miss densities while keeping the win rate constant at 20% of all trials. These effects were less robust than the they were from the win percentage manipulation experiment. Of particular interest was the idiosyncratic nature of responding to the near miss. Specifically, two individuals responded to the near miss as a conditioned reinforcer, and neither responded in the same manner. A third participant responded to the near miss as one would expect if the near miss were an aversive stimulus—the participant observed and allocated responding to the machine with no near miss events. This effect was only salient when conducting a criterion-based analysis using the SOCAS and its categorical classification system (see Table 2).

Given the elusive nature of the near miss, and the novelty of the new methodology, further exploration of both near misses and the SOCAS is warranted. It is in this light that we will turn to the future directions of a) the near miss event and b) the SOCAS given the current findings.

The Near Miss Event

The results of the current investigation argue against the near miss as serving a conditioned reinforcement function. However, there are several factors that require further exploration before any claims as to the reinforcing properties of the near miss in slot machine play can be made. First, as a test of the methodology, Experiment 1 may have been hampered by the fact that participants tended to finish Phase 2 with approximately twice the number of credits they started with (*M* = 106.00, *SD* = 17.13; see Table 7). Recent findings from Witts, Ghezzi, and Weatherly (2011) suggest that individuals who win more than chance amounts tend to become risk averse. Thus, the absence of observing from some participants in Phase 3 of Experiment 1 may be accounted for by the fact that most had more than doubled their staked credits. If observing costs credits, and the outcome of the subsequent reel spin is uncertain, an argument for risk aversion can be made for those who did not observe. Future research could capitalize on the SOCAS procedure by looking at differences in observing when participants are winning or losing, particularly if the analysis is conducted as a within-subjects approach. In other words, alternating between Phases 2 and 3 when Phase 2 terminates as a winning, losing, or a break-even outcome and the resultant impact this has on Phase 3 observing.

The near miss densities selected may have also played a role in the current outcomes. The Pre-Experimental Phase of Experiment 2 showed greater resistance to extinction for the 25% near miss density, yet participants in the Experimental Phase tended to allocate responses to the 50% density machine (see Figures 6 and 8). Different patterns may have emerged if instead the near miss densities in the Experimental Phase were 0%, 25%, and 100%, or any other combination for that matter. It may be the case that a 25% near miss density becomes a more robust reinforcer in the presence of extreme densities (i.e., 0% and 100%), or that contrasts between different amounts may influence response allocations (see DeLeon, Bullock, & Catania, 2013). Parametric variations would allow for better refinement, and such analyses are easily executed with the SOCAS.

Additionally, temporal proximity between near miss presentation and wins may have been an unintended confound in this experiment. While the allocation of near misses, full misses, and wins were determined with a random number generator, it is possible that certain temporal configurations may lend themselves more readily to the development of conditioned reinforcement properties for the near miss. Said differently, if near misses are highly correlated with an upcoming win, a reinforcement function may emerge. If, instead, near misses were programmed with several losses following, near misses may then serve to predict subsequent losses. Indeed, this is an empirical question, and work will need to be done to determine what role the temporal arrangement of wins, losses, and near misses has on this topic.

As has been suggested elsewhere (e.g., Ghezzi, Wilson, & Porter, 2006), the density of the near miss event may play a secondary role to its topography. It is simple enough to use a SOCAS-based analysis that compares observing responses with respect to varying near miss topographies (á la Ghezzi, Wilson, & Porter, 2006) all with similar densities. Subsequent these analyses, changes in cost or near miss densities could elucidate our understanding of the near miss with respect to a potential topography by density interaction. Said differently, if topography X is found to be reinforcing when in the presence of topography Y and Z at a constant density of 25%, then raising or lowering the densities for X, Y, and Z amongst varying costs will yield truly informative data.

Given the fact that little research has been conducted on the near miss event, and that what was found in this analysis was elusive, at best, several additional post-hoc analyses were conducted. In an exit survey given to participants, 72.24% reported having previously played slot machines in casinos. Of these, 85.71% stated having only played slot machines rarely, considering themselves ‘inexperienced.’ Inspections of the data with respect to slot machine experience yielded no discernible pattern worthy of a post-hoc analysis, and thus no additional hypotheses regarding this variable were generated.

Peterson and Weatherly (2011) reported that in a videopoker simulation participants were more risk seeking (i.e., more hands played, more money bet per hand) if they also reported a higher economic status. In the current study, no appreciable trend could be identified between observing responses or response allocations in Phase 2 with respect to reported annual income. Similarly, no identifiable pattern was discernible in the Pre-Experimental Phase of Experiment 2 when considering reported annual income. It is unclear if a larger sample size or a non-college sample would yield different results, as the majority of the participants reported annual incomes below $10,000 (51.85%) and only 5 reportedly above $50,000. Additionally, income may be related to other near miss preparations, or emerge in a topographical analysis of near miss presentations.

The SOCAS

The SOCAS procedure provides an analysis of putative reinforcement for conditioned and unconditioned reinforcers. As evidenced in Experiments 1 and 2, its use in identifying conditioned reinforcers (i.e., wins and near misses) is likely effective. The effectiveness of the SOCAS is enhanced when considering the addition of the adjusted alpha for subsequent Wilcoxon tests post-Friedman tests. While unnecessary, an effort was made to use a more stringent alpha as the SOCAS methodology is unique and may be prone to Type I errors. The significant findings in Experiment 1, then, yield added credibility to the use of the SOCAS procedure. The SOCAS, then, is not just applicable to gambling research, but any investigation that would make use of concurrently available schedules. While the SOCAS is amenable to statistical analyses, its utility is perhaps best captured in the analysis of idiosyncratic trends at the individual level. Table 2 provides a suggested scheme of categorizing outcomes of a two-phase analysis (with the addition of a training phase). This, of course, is the simplest of preparations, and more elaborate designs would provide further control. However, additional phases would render the proposed categories unusable as the changes in responding would need to be analyzed with respect to condition order and response allocation.

Four primary variables have been identified as being readily manipulable with the SOCAS. First, the number of schedules concurrently available in each phase can be altered. Of course, the more schedules that one incorporates, the more difficult it may be for participants to achieve discriminated responding. In other words, too many concurrently available schedules could result in false negatives with respect to the identification of putative reinforcers. Two possible exceptions exist. In one, the use of stimuli discriminative for punishment or extinction may create a great deal of contrast between stimuli, thus bolstering the potential reinforcing value of the stimuli correlated with reinforcement. The second lies with schedules correlated with different reinforcers, such as with an investigation comparing the putative reinforcing value of several edibles, types of praise, and varieties of leisure activities, all accessible upon completion of some response (e.g., clicking a picture of that activity). Observing, in this case, would serve to bring back those pictures prior to selection.

The second primary variable is the schedule of reinforcement correlated with each stimulus. In the present study, schedules of wins or near misses were concurrently available to participants. That is, each schedule is studied in concert with at least one other schedule. As previously mentioned, these schedules can include punishment or extinction schedules in addition to the reinforcement schedules. The utility of such an approach is in the contextual analysis, thus gaining a better understanding of how an individual comes to respond to the putative reinforcer. Take, for example, the differences in the Pre-Experimental and Experimental phases of Experiment 2. In the former, the 25% near miss density condition produced the most responding during extinction. However, when placed in context with a 0% and a 50% near miss density schedule, preference was more apparent for the 50% density. It is unclear at this point if resistance to extinction preparations result in different identified reinforcers than the SOCAS preparation does, but thus far the data seem to indicate that they do.

These contextual variables allow one to investigate a particular schedule in relation to other schedules. In the example just mentioned, a participant may, after having been part of a 0%, 25%, and 50% near miss density context, be switched to a 10%, 50%, and 100% near miss density context. Here, the participant may continue to engage in observing, but may switch responding to some other density (e.g., from 50% in the first phase, and 100% in the second). This is akin to saying, “I like Stimulus X, but not when I have access to Stimulus Y.”

The third major variable is the cost and/or effort involved with observing. In the current study, a three-credit cost was imposed on observing for approximately half of the participants in the SOCAS preparations. As a result, observing significantly declined. In this study, we can say that for those who observed, there is likely a point between 0 credits and 3 credits where the participant will switch from observing to not observing. Within subject parametric analyses would permit researchers to identify the indifference point. As that indifference point increases with cost or effort, one can attribute to that stimulus selected a greater degree of reinforcement.

As a form of response effort, participants had to only press a button in the current investigation. However, it is conceivable to require several clicks to one or several buttons, or to require responding on a schedule to complete the observing response. Additional apparati can be developed that require different degrees of effort (i.e., force) on the operandum.

The fourth primary variable is the magnitude of reinforcement (or punishment) correlated with completing a schedule. In the current study, a constant five-credit outcome was correlated with each schedule. Outcomes could easily have changed if it were possible to achieve larger payouts, or with the inclusion of jackpots, as they are incorporated in casino slot machine gambling. Reinforcement (and punishment) magnitude can be manipulated between conditions and/or between schedules. Thus, a participant may not opt to complete the requirements for observing unless a certain reinforcement or punishment magnitude is presented, in an effort to contact the former and/or avoid the latter.

In the current analyses, use of the SOCAS led to results suggestive of a weak, arguably non-existent, conditioned reinforcement effect for the near miss event in simulated slot machine gambling. However, with further manipulation of the four variables outlined above, we can seek to achieve an even firmer understanding of the contextual nature of this, and indeed other, putative conditioned reinforcer. While the current study can be seen as a first step in the examination of the near miss serving a conditioned reinforcement role, it will undoubtedly take several more parametric variations on this theme before any conclusions can be drawn.

References

Boyd, W. H. (1976). Excitement: The gambler's drug. In W. R. Eadington (Ed.) *Gambling and Society* (pp. 371-375). Springfield, IL: Charles C Thomas.

Case, D. A., & Fantino, E. (1981). The delay-reduction hypotheses of conditioned reinforcement and punishment: Observing behavior. *Journal of the Experimental Analysis of Behavior, 35,* 93-108.

Clark, L., Lawrence, A. J., Astley-Jones, F., & Gray, N. (2009). Gambling near-misses enhance motivation to gamble and recruit win-related brain circuitry. *Neuron, 61*, 481-490.

Clark, L., Crooks, B., Clarke, R., Aitken, M. R. F., & Dunn, B. D. (2012). Physiological responses to near-miss outcomes and personal control during simulated gambling. *Journal of Gambling Studies, 28*, 123-137.

Cooper, J.O., Heron, T.E., & Heward, W.L. (2007). *Applied Behavior Analysis* (2nd ed.). Upper Saddle River, NJ: Pearson Education Inc.

Côté, D., Caron, A., Aubert, J., Desrochers, V., & Landouceur, R. (2003). Near wins prolong gambling on a video lottery terminal. *Journal of Gambling Studies, 19*, 433-438.

Daugherty, D., & MacLin, O. H. (2007). Perceptions of luck: Near win and near loss experiences. *Analysis of Gambling Behavior, 1*, 123-132.

DeLeon, I. G., Bullock, C. E., & Catania, A. C. (2013). In G. J. Madden, et al. (Eds.) *APA Handbook of Behavior Analysis: Vol. 2. Translating Principles Into Practice*. Washington, DC: American Psychological Association.

Dillen, J., & Dixon, M. R. (2008). The impact of jackpot and near-miss magnitude on rate and subjective probability of slot machine gamblers. *Analysis of Gambling Behavior, 2*, 121-134.

Dixon, M. R. (2010). The roulette near-miss effect. *Analysis of Gambling Behavior, 4*, 54-60.

Dixon, M. R., MacLin, O. H., & Daugherty, D. (2006). An evaluation of response allocations to concurrently available slot machine simulations. *Behavior Research Methods, 38*, 232-236.

Dixon, M. R., Nastally, B. L., Hahs, A. D., Homer-King, M., & Jackson, J. W. (2009). Blackjack players demonstrate the near miss effect. *Analysis of Gambling Behavior*, *3*, 56-61.

Dixon, M. R., Schreiber, J. E. (2004). Near-miss effects on response latencies and win estimations of slot machine players. *The Psychological Record*, *54*, 335-348.

Fantino, E. (1969). Choice and rate of reinforcement. *Journal of the Experimental Analysis of Behavior, 12*, 723-730.

Fantino, E. (2008). Choice, conditioned reinforcement, and the Prius Effect. *The Behavior Analyst, 31*, 95-111.

Fantino, E., & Moore, J. (1980). Uncertainty reduction, conditioned reinforcement, and observing. *Journal of the Experimental Analysis of Behavior, 33,* 3-13.

Fantino, E., & Romanowich, P. (2007). The effect of conditioned reinforcement rate on choice: A review. *Journal of the Experimental Analysis of Behavior, 87*, 409-421.

Fantino, E., Preston, R. A., & Dunn, R. (1993). Delay reduction: Current status. *Journal of the Experimental Analysis of Behavior, 60*, 159-169.

Fantino, E., & Silberberg, A. (2010). Revisiting the role of bad news in maintaining human observing behavior. *Journal of the Experimental Analysis of Behavior, 93*, 157-170.

Ghezzi, P. M., Wilson, G. R., & Porter, J. C. K. (2006). The near-miss effect in simulated slot machine play. In P. M. Ghezzi, C. A. Lyons, M. R. Dixon, and G. R. Wilson (Eds.) *Gambling: Behavior Theory, Research, and Application* (pp. 155-170). Reno, NV: Context Press.

Gravetter, F. J., & Wallnau, L. B. (2008). *Statistics for the Behavioral Sciences*. Belmont, CA: Wadsworth.

Griffiths, M. (1991). Psychobiology of the near-miss in fruit machine gambling. *The Journal of Psychology, 125*, 347-357.

Griffiths, M. (1994). The role of cognitive bias and skill in fruit machine gambling. *British Journal of Psychology, 85*, 351-369.

Griffiths, M. (1999). The psychology of the near-miss (revisited): A comment on Delfabbro and Winefield (1999). *British Journal of Psychology, 90*, 441-445.

Griffiths, M., & Parke, J. (2003). The psychology of the fruit machine. *Psychology Review, 9*, 12-16.

Győző, K., & Körmendi, A. (2012). Can we perceive near miss? An empirical study. *Journal of Gambling Studies, 28*, 105-111.

Harrigan, K. A. (2007). Slot machine structural characteristics: Distorted player views of payback percentages. *Journal of Gambling Issues, 20*, 215-234.

Harrigan, K. A. (2008). Slot machine structural characteristics: Creating near misses using high award symbol ratios. *International Journal of Mental Health, 6*, 353-368.

Harrigan, K. A. (2009). Slot machines: Pursuing responsible gaming practices for virtual reels and near misses. *International Journal of Mental Health Addiction, 7*, 68-83.

Haw, J. (2008). The relationship between reinforcement and gaming machine choice. *Journal of Gambling Studies, 24*, 55-61.

Hendry, D. P. (1969). Introduction. In D. P. Hendry (Ed.) *Conditioned Reinforcement.* Homewood Illinois: The Dorsey Press.

Jensen, M. (2010). *The Big Book of Slots and Video Poker* (2nd ed.). Las Vegas: Cardoza Publishing.

Kassinove, J. I., & Schare, M. L. (2001). Effects of the "Near Miss" and the "Big Win" on persistence at slot machine gambling. *Psychology of Addictive Behaviors, 15*, 155-158.

Knapp, T. J. (1976). A functional analysis of gambling behavior. In W. R. Eadington (Ed.), *Gambling and Society* (pp. 276-294). Springfield, IL: Charles C Thomas.

Legato, F. (2013). Random definitions. *Casino Player, 25*(4), 32-33.

Lesieur, H. R., & Blume, S. B. (1987). The South Oaks Gambling Screen (SOGS): A new instrument for the identification of pathological gamblers. *American Journal of Psychiatry*, *144*, 1184-1188.

MacLin, O. H., Dixon, M. R., Daugherty, D., & Small, S. L. (2007). Using a computer simulation of three slot machines to investigate a gambler's preference among varying densities of near-miss alternatives. *Behavior Research Methods, 39*, 237-241.

Madden, G. J., & Perone, M. (1999). Human sensitivity to concurrent schedules of reinforcement: Effects of observing schedule-correlated stimuli. *Journal of the Experimental Analysis of Behavior, 71*, 303-318.

Marr, M. J. (1969). Second-order schedules. In D. P. Hendry (Ed.) *Conditioned Reinforcement.* Homewood Illinois: The Dorsey Press.

Mead, D. R. (1983). *Handbook of Slot Machine Reel Strips*. Las Vegas, NV: Mead Publishing Company.

National Center for Responsible Gaming (2013). Project Grants. Retrieved from http://www.ncrg.org/research-center/ncrg-funded-research/project-grants

Nastally, B. L., Dixon, M. R., & Jackson, J. W. (2009). The effect of stopping devices and win rate on preference in slot machine players. *Analysis of Gambling Behavior, 3*, 27-30.

Near Miss. (n.d.). In *OED Online*. Retrieved from http://0-www.oed.com.innopac.library.unr.edu/view/Entry/125544?redirectedFrom=near+miss#eid34963145

Parke, J., & Griffiths, M. (2004). Gambling addiction and the evolution of the "Near Miss". *Addiction Research and Theory, 12*, 407-411.

Peterson, J. M., & Weatherly, J. N. (2011). Comparing three strategies of motivating gambling behavior in the laboratory environment. *Analysis of Gambling Behavior, 5*, 28-34.

Piazza, C. C., Fisher, W. W., Hagopian, L. P., Bowman, L. G., & Toole, L. (1996). Using a choice assessment to predict reinforcer effectiveness. *Journal of Applied Behavior Analysis, 29*, 1-9.

Peterson, J. M., & Weatherly, J. N. (2011). Comparing three strategies of motivating gambling behavior in the laboratory environment. *Analysis of Gambling Behavior, 5*, 28-34.

Porter, J. C. K., & Ghezzi, P. M. (2006). Theories of pathological gambling. . In P. M. Ghezzi, C. A. Lyons, M. R. Dixon, and G. R. Wilson (Eds.) *Gambling: Behavior Theory, Research, and Application* (pp. 19-44). Reno, NV: Context Press.

Reid, R. L. (1986). The psychology of the near miss. *Journal of Gambling Behavior, 2,* 32-39.

Shahan, T. A. (2002). The observing-response procedure: A novel method to study drug-associated conditioned reinforcement. *Experimental and Clinical Psychopharmacology, 10*, 3-9.

Shull, R. L., & Lawrence, P. S. (1998). Reinforcement: Schedule performance. In K. A. Lattal and M. Perone (Eds.) *Handbook of Research Methods in Human Operant Behavior* (pp. 95-129). New York: Plenum Press.

Silberberg, A., & Fantino, E. (2010). Observing responses: Maintained by good news only? *Behavioural Processes, 85*, 80-82.

Skinner, B. F. (1953). *Science and Human Behavior*. New York: Macmillan.

Skinner, B. F. (1974). *About Behaviorism.* New York: Knopf.

Skinner, B. F. (1980). *Notebooks* (edited with an introduction by Robert Epstein). Englewood Cliffs, NJ: Prentice-Hall, Inc.

Strickland, L. H., & Grote, F. W. (1967). Temporal presentation of winning symbols and slot-machine playing. *Journal of Experimental Psychology*, *74*, 10-13.

Sundali, J. A., Safford, A.H., & Croson, R. (2012). The impact of near-miss events on betting behavior: An examination of casino rapid roulette play. *Judgment and Decision Making*, *7*, 768–778.

Weatherly, J. N., Thompson, B. J., Hodny, M., & Meier, E. (2009). Choice behavior of nonpathological women playing concurrently available slot machines: Effect of changes in payback percentages. *Journal of Applied Behavior Analysis, 42*, 895-900.

Whitton, M., & Weatherly, J. N. (2009). The effect of near-miss rate and card control when American Indians and non-indians gamble in a laboratory situation: The influence of alcohol. *American Indian and Alaska Native Mental Health Research, 16*(2), 28-42.

Williams, B. A. (1994). Conditioned reinforcement: Experimental and theoretical issues. *The Behavior Analyst*, *17*, 261-285.

Witts, B. N., Ghezzi, P. M., & Weatherly, J. N. (2011). Altering probability discounting in a gambling simulation. *Analysis of Gambling Behavior, 5*, 83-92.

Wyckoff, L. B., Jr. (1952). The role of observing responses in discrimination learning: Part I. *Psychological Review, 59*, 431-442.

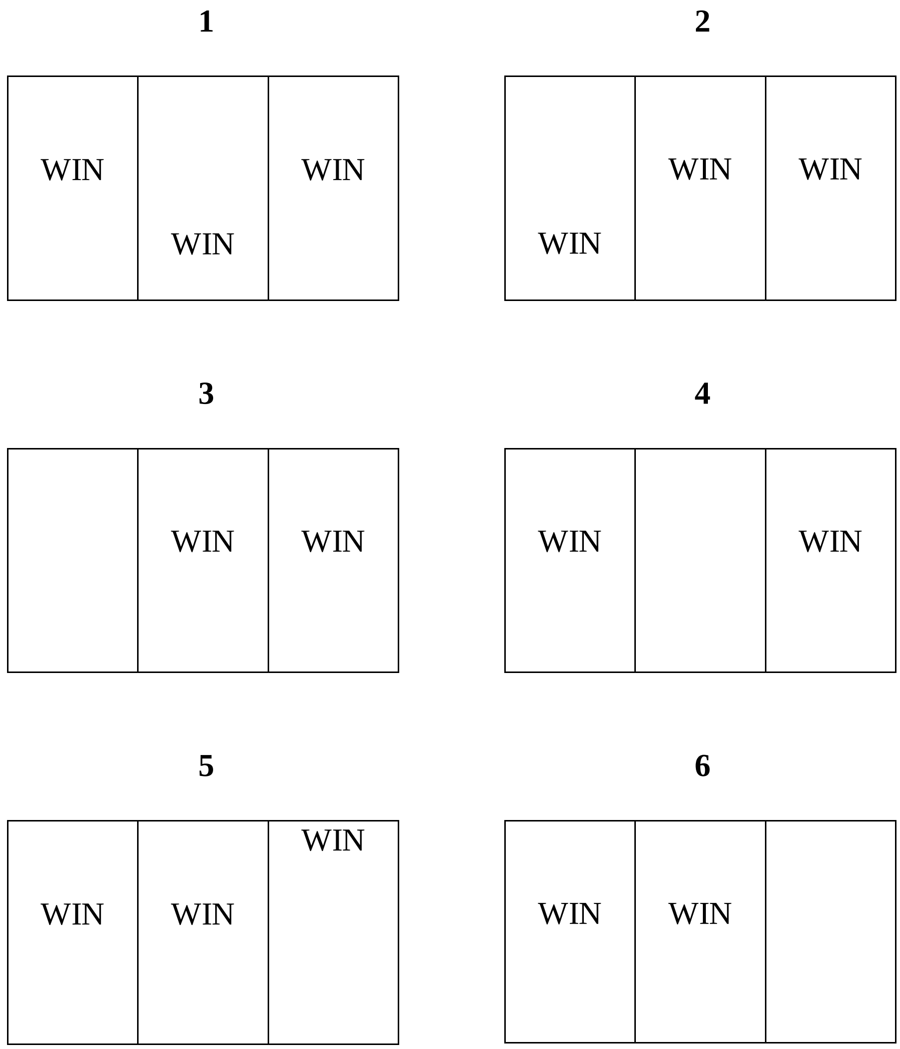


Figure 1. The six near miss presentations arranged in Ghezzi, Wilson, & Porter, 2006.

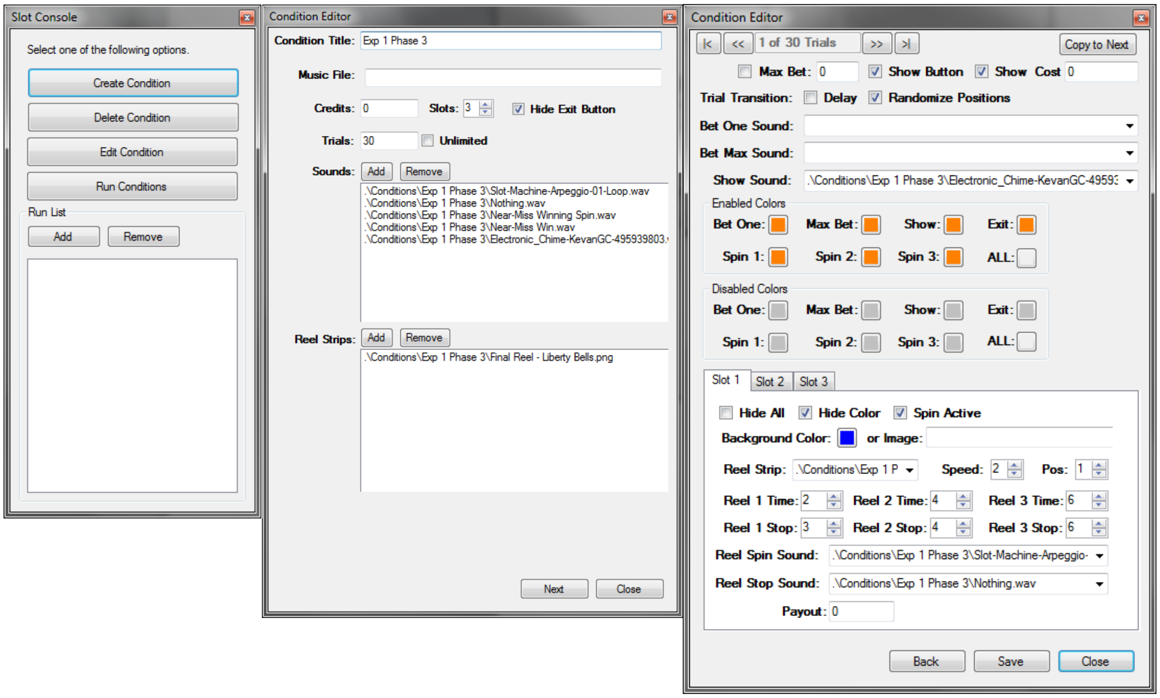
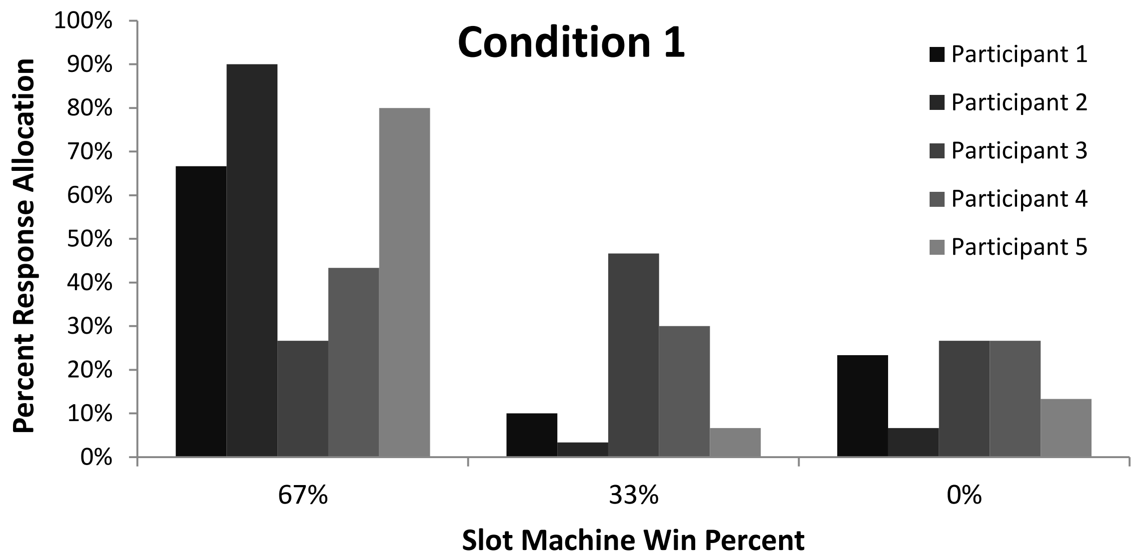


Figure 2. Slot console and editors for the slot machine simulator

Figure 3. *The 8-stop reel strip used in Experiments 1, 2, and 3*



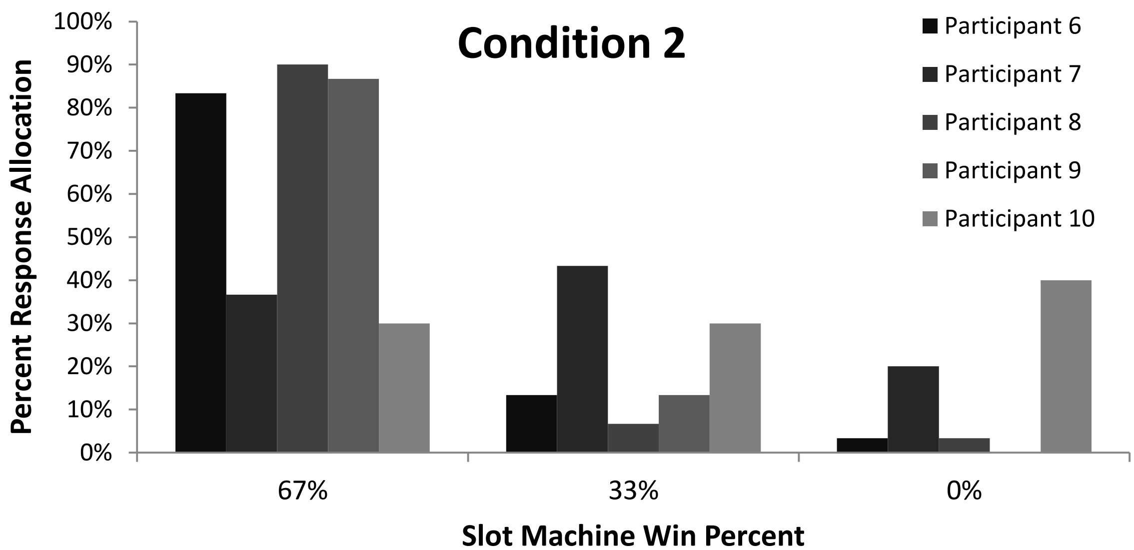
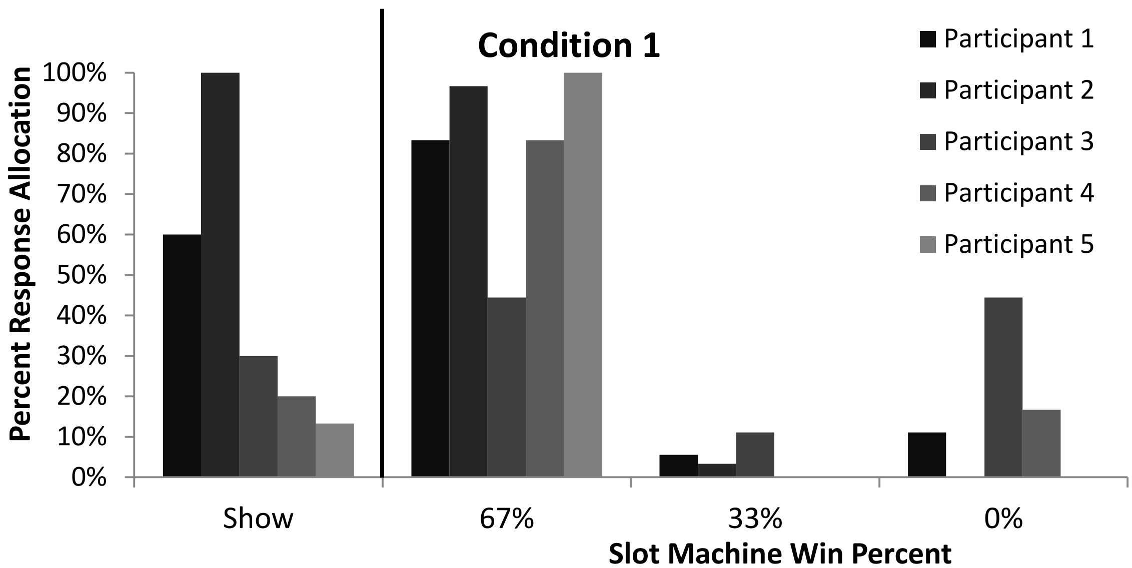


Figure 4. *Response allocation during Experiment 1, Phase 2 for Conditions 1 and 2*



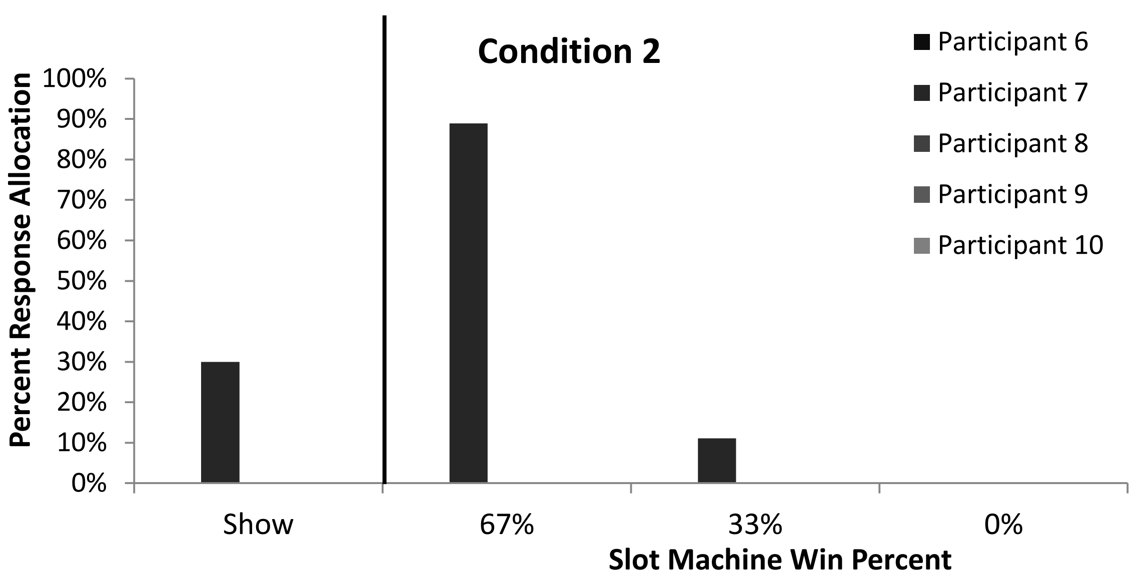
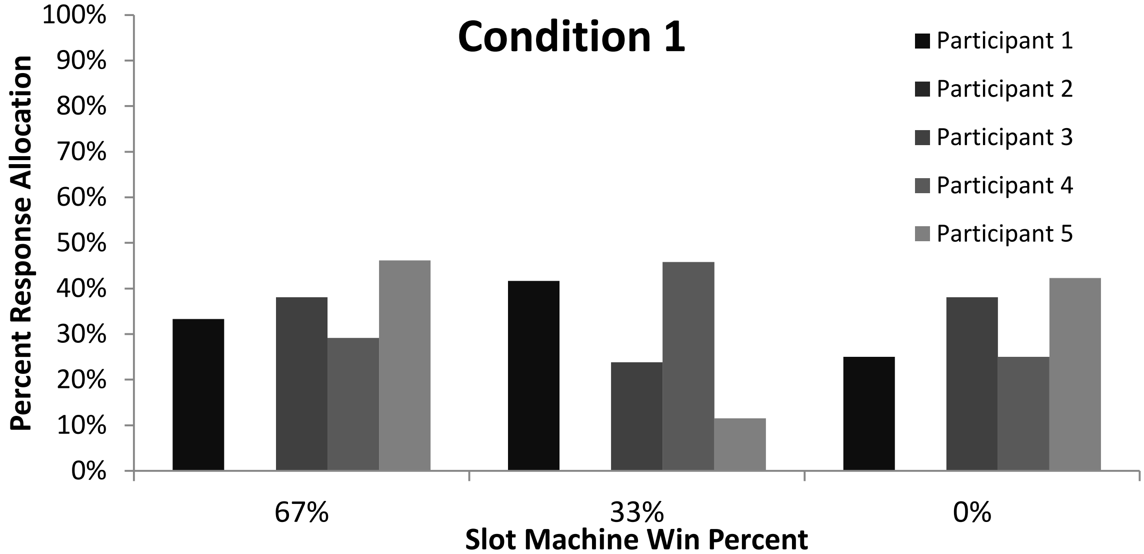


Figure 5: Percent of Show button presses and response allocation to slot machines during trials in which the Show button was pressed for Conditions 1 and 2



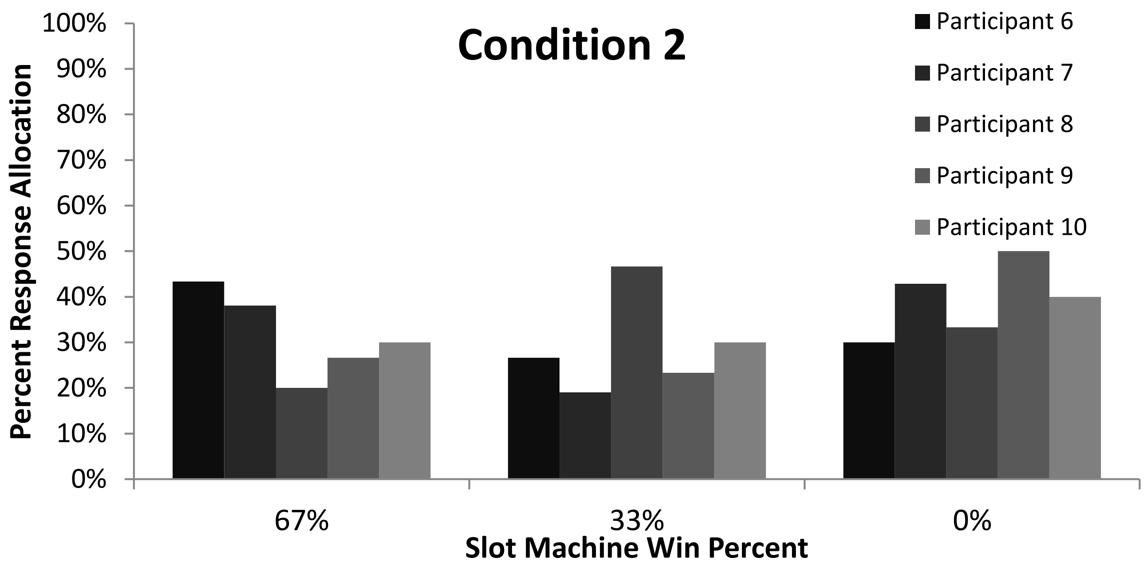


Figure 6. *Response allocation during Experiment 1, Phase 3, when no observing response was made.*

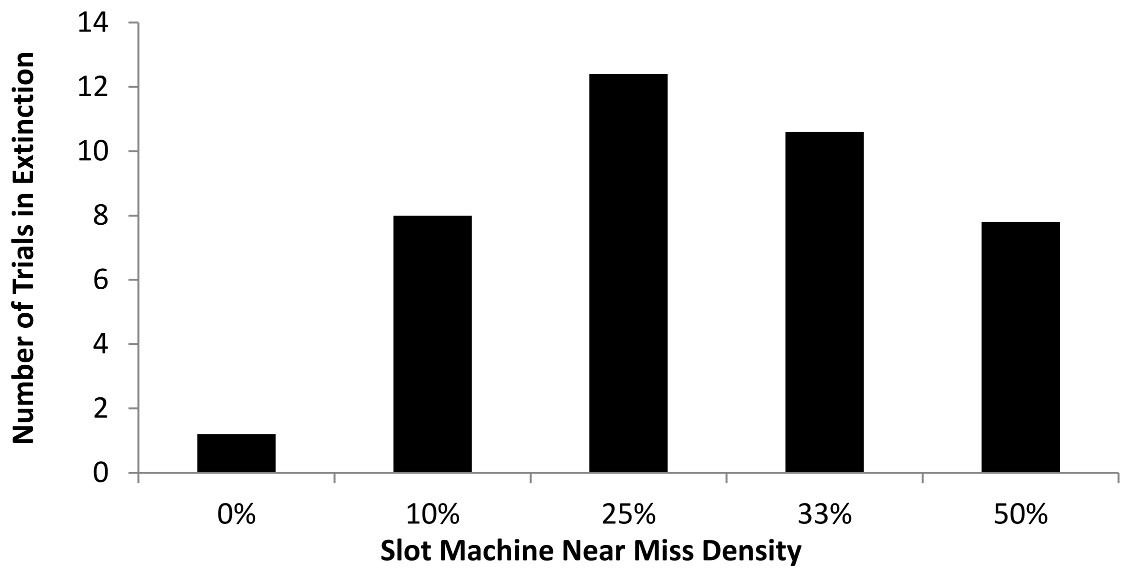
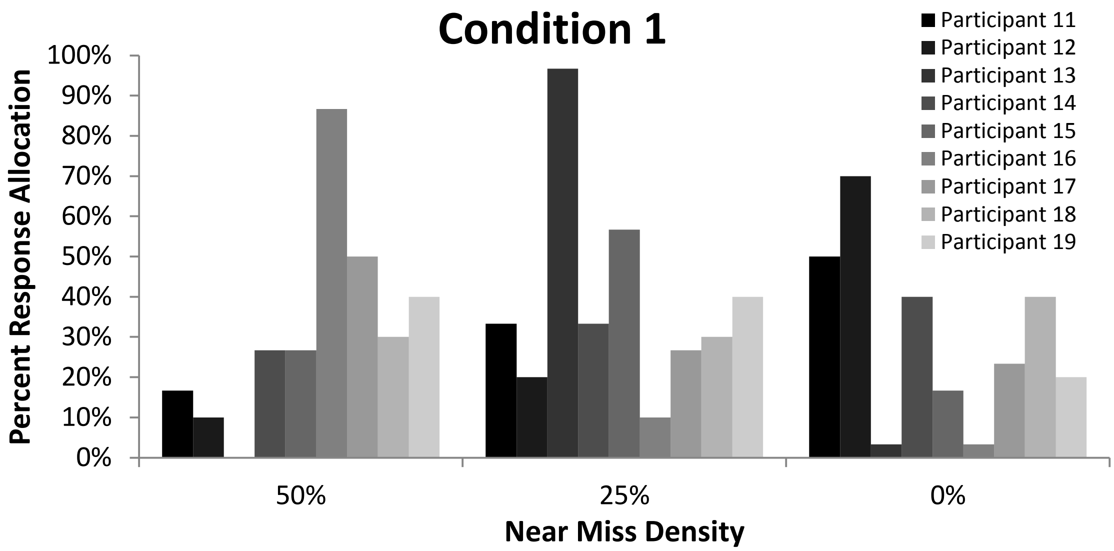


Figure 7: Number of trials in extinction for each near miss density in the Pre-Experimental Phase of Experiment 2.



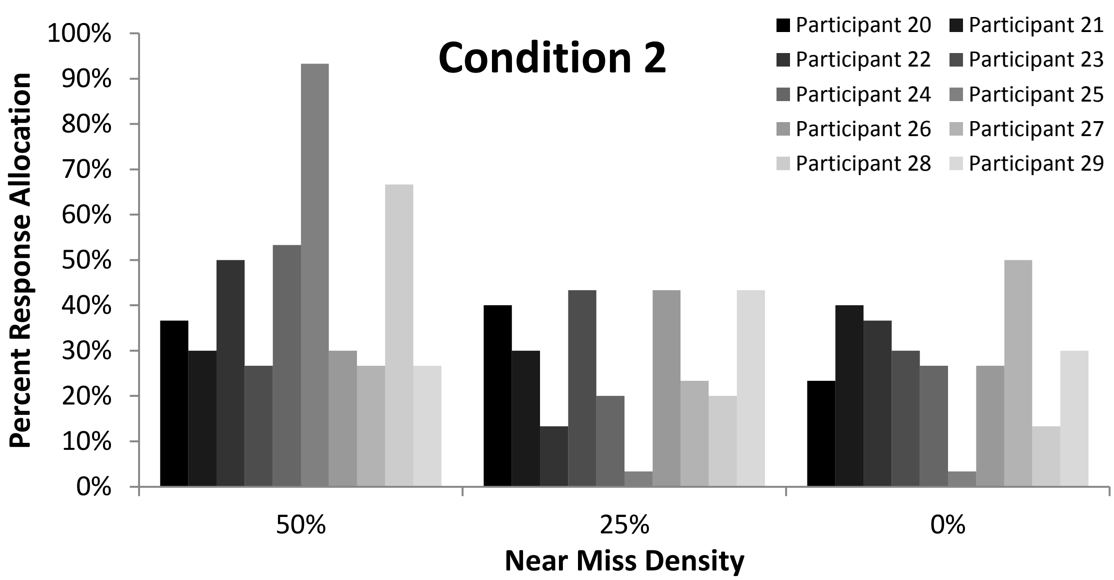
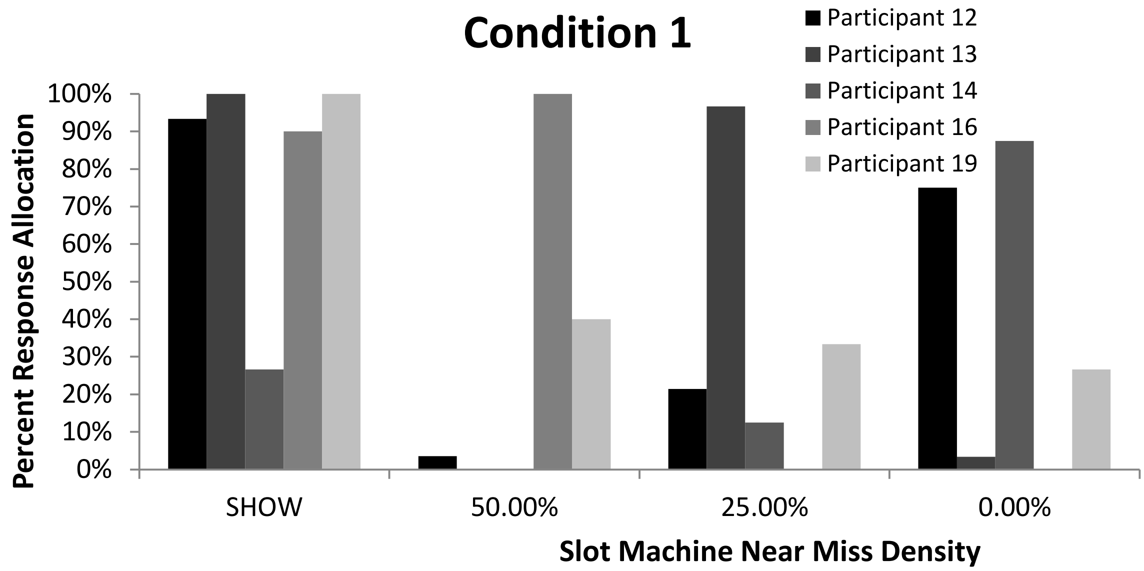


Figure 8. *Response allocation during Experiment 2, Phase 2 for Conditions 1 and 2*



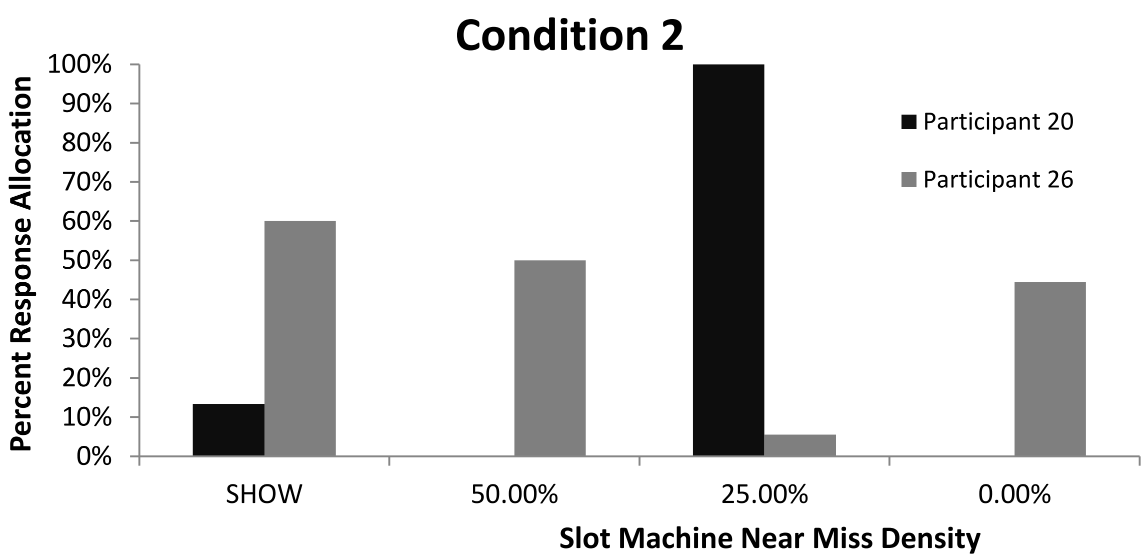
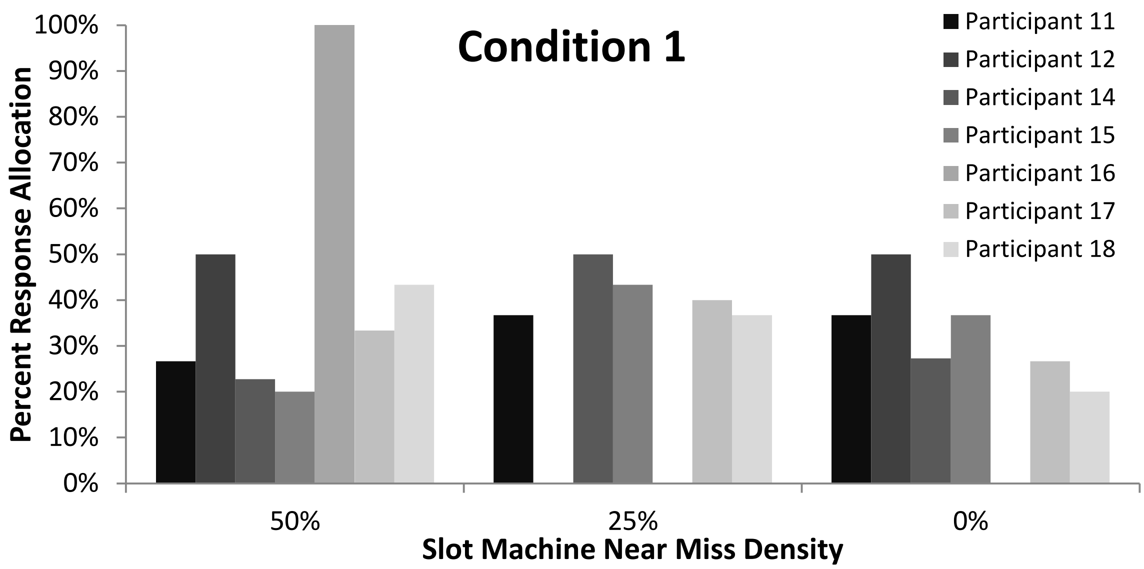


Figure 9: Percent of Show button presses and response allocation in Experiment 2 Phase 2 to slot machines during trials in which the Show button was pressed for Conditions 1 and 2



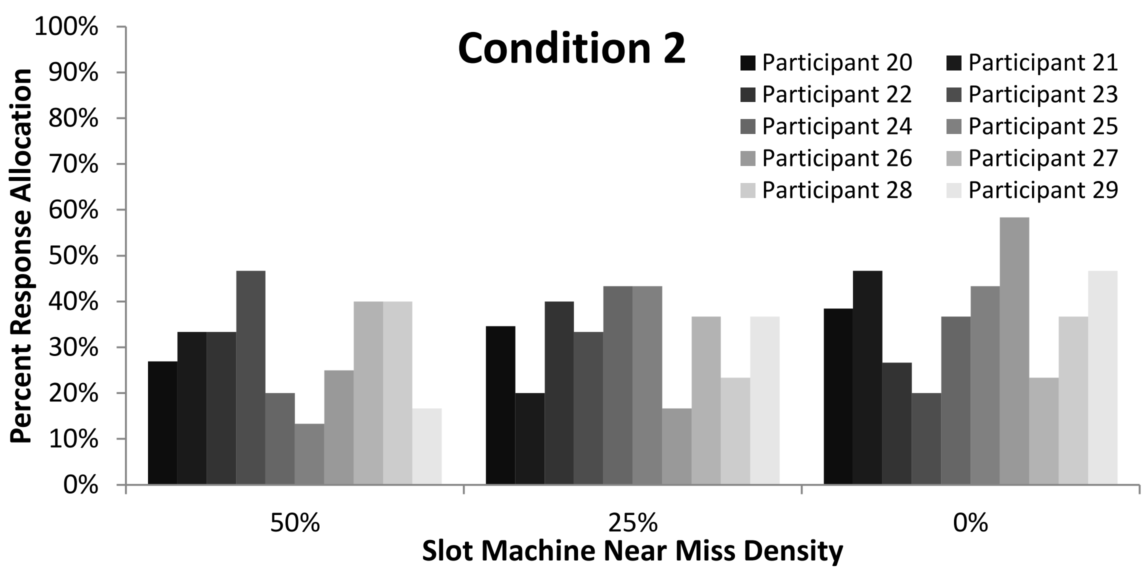


Figure 10. *Response allocation for Conditions 1 and 2 during Experiment 2, Phase 3, when no observing response was made.*

AUTHOR	FORCED TRIALS	SAMPLE	REELS	WIN RATE	NEAR MISS DENSITIES				BEST NM DENSITY
Strickland & Grote, 1967	100	44	3	10%	5%	25%			25%
Kassinove & Schare, 2001	50	180	4	10%	15%	30%	45%		30%
Côté et al., 2003	48	59	3	18.75% (0% control)	0%	25%			25%
Ghezzi, Wilson, & Porter, 2006	25, 50, 75, 100	320	3	40%	0%	33%	66%	100%	66%
Ghezzi, Wilson, & Porter, 2006	100	120	3	40%	0%	33%	66%	100%	None
Ghezzi, Wilson, & Porter, 2006	50	240	3	10%	0%	33%	66%	100%	Mixed (depending on NM topography)
Daugherty & MacLin, 2007	50	132	3	30%	0%	15%	30%	45%	45%
Whitton & Weatherly, 2009	N/A (time limit)	24	3	Not Recorded	0%	33%	67%		None

Table 1: Summary of persistence studies on the near miss and their corresponding near miss density that produced the best outcomes

Category	Observing Response	Phase 2 Response Allocation	Phase 3 Response Allocation	Conclusion
A	Yes	Differentiated	Differentiated (same as Phase 2)	Reinforcer
B	Yes	Differentiated	Differentiated (different from Phase 2)	Unknown / Possible satiation or schedule effect
C	Yes	Differentiated	Undifferentiated	Unknown / Possible satiation or schedule effect
D	Yes	Undifferentiated	Differentiated	Possible reinforcer – recheck methods and Phase 1 training length
E	Yes	Undifferentiated	Undifferentiated	Not a reinforcer OR Phase 1 was ineffective at differentiating responses
F	No	Differentiated / Undifferentiated	Differentiated	Information regarding schedule location likely available to participant
G	No	Differentiated	Undifferentiated	Not a reinforcer at this cost/effort level
H	No	Undifferentiated	Undifferentiated	Not a reinforcer / Ineffective Phase 1

Table 2: Possible outcomes for any one parametric variation of an array of concurrently available schedules of putative (conditioned) reinforcers.

	Experiment 1		Experiment 2		
				Experiment	
	Condition 1	Condition 2	Pre-Experiment	Condition 1	Condition 2
Women	3	5	19	5	8
Men	2	0	6	4	2
Average Age	20.20	23.20	21.69	21.67	22.80
Age Range	18-27	19-32	18-48	20-25	19-32
Average Year in School	2.20	3.00	2.25	2.67	3.5
Caucasian	1	4	18	7	8
Hispanic/Latino	1	1	6	1	1
Asian	2	0	1	1	1
African-American	0	0	1	0	0
Other	1	0	0	0	0
Average SOGS	0.40	0.40	0.25	0.33	0.40
Average Annual Income (estimated)	$22,000	$38,000	$12,000	$17,500	$23,000
Income Range	$10,000 - $50,000	$10,000 - $75,000	$10,000 - $25,000	$10,000 - $50,000	$10,000 - $75,000

Table 3: Participant characteristics for Experiments 1 and 2. Note that one participant endorsed 2 ethnicities, and thus the totals are greater than 100% of the participants possible

Configuration 1 (n = 6)

Background	Blue	Red	Green
Phase 1 Position	Left	Middle	Right
Payback Percent	0%	67%	33%

Configuration 2 (n = 4)

Background	Blue	Red	Green
Phase 1 Position	Right	Left	Middle
Payback Percent	67%	33%	0%

Table 4: Summary of counterbalancing in Experiment 1.

Configuration 1

Background	Blue	Red	Green
Phase 1 Position	Left	Middle	Right
Near Miss Density	25%	0%	50%

Configuration 2

Background	Blue	Red	Green
Phase 1 Position	Right	Left	Middle
Near Miss Density	50%	0%	25%

Table 5: Summary of counterbalancing in Experiment 2.

Participant #	Exp.	Cond.	SOCAS Category	Phase 2 Preference	Phase 3 Preference	Observed?	Number of Observing Responses
1	1	1	A	67%	67%	Yes	18
2	1	1	A	67%	67%	Yes	30
3	1	1	E	N/A	N/A	Yes	9
4	1	2	E	N/A	N/A	Yes	6
5	1	2	A/F/G	67%	67%	Yes	4
6	1	1	G	67%	N/A	No	
7	1	1	D	N/A	67%	Yes	9
8	1	1	G	67%	N/A	No	
9	1	2	F	67%	0%	No	
10	1	2	H	N/A	N/A	No	
11	2	1	G	0%	N/A	No	
12	2	1	A	0%	0%	Yes	28
13	2	1	A	25%	25%	Yes	30
14	2	1	E	N/A	N/A	Yes	8
15	2	1	G	25%	N/A	No	
16	2	2	A	50%	50%	Yes	27
17	2	2	G	50%	N/A	No	
18	2	2	H	N/A	N/A	No	
19	2	2	E	N/A	N/A	Yes	30
20	2	1	H	N/A	N/A	Yes	4
21	2	1	H	N/A	N/A	No	
22	2	1	H	N/A	N/A	No	
23	2	1	H	N/A	N/A	No	
24	2	1	G	50%	N/A	No	
25	2	2	G	50%	N/A	No	
26	2	2	E	N/A	N/A	Yes	18
27	2	2	G	0%	N/A	No	
28	2	2	G	50%	N/A	No	
29	2	2	H	N/A	N/A	No	

Table 6: Summary of SOCAS Categories for each participant in Experiments 1 and 2.

	Participant	Phase 2	Phase 3	Observing Responses	Condition	Configuration
Experiment 1	1	95	120	18	1	1
	2	130	195	30	1	1
	3	90	120	9	1	1
	4	90	115	6	1	2
	5	110	150	4	1	2
	6	115	135	0	2	1
	7	85	93	9	2	1
	8	130	150	0	2	1
	9	120	135	0	2	2
	10	95	120	0	2	2
Experiment 2	11	100	105	0	1	1
	12	105	110	28	1	1
	13	100	100	30	1	1
	14	100	105	8	1	1
	15	100	105	0	1	1
	16	100	100	27	1	1
	17	100	105	0	1	1
	18	105	110	0	1	1
	19	105	105	30	1	1
	20	105	93	4	2	2
	21	105	105	0	2	2
	22	100	105	0	2	2
	23	105	105	0	2	2
	24	95	95	0	2	2
	25	100	105	0	2	2
	26	105	110	18	2	2
	27	100	100	0	2	2
	28	100	105	0	2	2
	29	105	105	0	2	2

Table 7: Summary of credits earned at the end of Phase 2 and Phase 3 of Experiment 1 and the Experimental Phase of Experiment 2.

Appendix A

Demographics Questionnaire

Please check the appropriate choice for each of the following.

Age: ________

Gender:

__M __F

Ethnicity:

__African-American

__Caucasian (non-Latino)

__Hispanic or Latino

__Asian

__Other: ________

__Prefer not to say

Year in School:

__1

__2

__3

__4+

Your Estimated Annual Income:

__<$10,000

__$10,001 - $15,000

__$15,001 - $20,000

__$20,001 - $25,000

__$25,001 - $30,000

__$30, 001 - $50,000

__$50,001 - $75,000

__>$75,000

Appendix B

Before you is a slot machine simulator. Your goal is to try to win as much as you can. You win by matching 3 Liberty Bells in a row on the payline. All other combinations do not pay. When the study is over, the participants with the top 3 scores will each receive $50 cash. There are three slot machines, each with a different background color, from which to play. Each machine is different. Initially you will play each machine one at a time, and then you will be asked to choose between the machines. During this time you are free to switch machines at any point. You will also notice in this phase that the machines will change positions with each spin. Following this, the machines will continue to change positions, but you will no longer know which machine is which, because the background colors will disappear. A button will become available called the "Show" button. Pressing this button will reveal which machine is in which position. (Condition 2: Pressing the show button will cost you three credits.) You do not have to press the "Show" button.

Appendix C

Before you is a slot machine simulator. Your goal is to try to win as much as you can. You win by matching 3 Liberty Bells in a row on the payline. All other combinations do not pay. The three people who win the most when the study is over will receive $50 cash. You will be asked to play 30 spins of the slot machine, at which point you will have the option of exiting the program by clicking the “Exit” button on the lower right, or you can continue to play to try to increase your score.

Appendix D

Post-Research Follow-Up

Please answer each question. If this question does not apply to you, please write “N/A” in the space provided

1. What do you think this study was investigating?

2. Did you have a strategy you used to win?

3. How well do you think you did compared to other participants?

4. Have you ever played slot machines at a casino before?

___ YES
___ NO

4a. If so, would you say you’re:

___Inexperienced (I play slot machines a little)

___Knowledgeable (I play some slot machines when I go to the casino)

___Experienced (I play a lot of slot machined)