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A computerized simulation for investigating gambling behavior during roulette play

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The present paper describes a computerized roulette program for the conducting of psychological research on gambling behavior. The program was designed to simulate an actual roulette game found in casinos and gambling riverboats throughout North America. The roulette program collects detailed trial-by-trial data on player/participant behavior that can easily be transferred into data analysis and graphics programs. This multimedia simulation was designed in the Visual Basic programming language, and it is capable of running on any IBM-compatible personal computer running the Windows 2000 or higher operating system.

The opportunity to engage in legalized gambling in North America has drastically risen over the course of the past two decades. Only 2 of the 50 states permitted some form of legalized gambling (Nevada and New Jersey) 20 years ago. Today 48 states allow a type of gambling while only two (Utah and Hawaii) prohibit it (Ghezzi, Lyons, & Dixon, 2000). The increase in gambling opportunities has come at a considerable social cost. For example, it has been reported that the percentage of our national population who have problem gambling behavior has risen from an estimate of 1% in 1974 (Ladouceur, Boisvert, Pepin, Loranger, & Sylvain, 1994) to approximately 3% today (American Psychiatric Association, 1994). In addition, people with gambling problems have been shown to commit more income-related crimes than do people from nongambling comparison groups (Blaszczynski & McConaghy, 1994). The increase of pathological gamblers suggests that either this personality type is on the rise, or that the availability of gambling itself can produce financial hardship and problem behaviors in a previous nongambler.

Previous psychological research has shown that there are a variety of reasons why people may engage in gambling when the stakes of winning are against them. It has been claimed that certain individuals are attracted to sensation-seeking opportunities, and that gambling is one such activity (Anderson & Brown, 1984). Others have argued that certain people generally lack an objective view of actual probabilities, and take irrational risks or make poor decisions on the basis of their possession of inaccurate subjective probabilities (Kahneman & Tversky, 1972). Another approach that has been growing in acceptance is that the pure chance consequences of the gamble itself tend to strengthen future gambling behavior (Dixon, Hayes, Rehfeldt, & Ebbs, 1998; Ladouceur, Gaboury, Domont, & Rochette, 1988).

One way to better understand the potential controlling variables of various casino games is to study them via a computerized simulation. Such simulations allow researchers to conduct experimental analyses far more extensively then they can in a casino where heavy regulations govern the observation and recording of player data. Furthermore, simulations allow the researcher to control and manipulate variables in ways that would never be possible in such naturalistic settings. Such variables include the minimum or maximum bet wagered per person, the size or probability of a given payoff, or the level of risk (or perceived risk) that a player takes on a given wager.

To date there have been two computerized simulations of the most popular machine type games found in the casino, video poker and the slot machine. The video poker simulation published by Dixon, MacLin, and Hayes (1999) allowed researchers to manipulate jackpot sizes, the maximum number of coins wagered per hand, and the total number of hands played. It also allowed for a subjective probability question asking the participant to estimate the chances of winning on the next hand to be either present or absent following specific trials. The poker program permitted the collection of a number of time-based dependent measures, including engagement time and response latency, along with response-based dependent measures, including the number of coins wagered, won, or lost on each hand. Published data obtained from this simulation have revealed temporal regularities in poker players whereby the rate of play accelerates following losing trials and decel-

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erates following winning trials (Dixon & Schreiber, 2002). Many players also tended to underestimate their frequency of winning trials and underestimate their frequency of losing trials when given a postsession estimation questionnaire of wins (Dixon & Schreiber, 2002).

The slot machine simulation published by MacLin, Dixon, and Hayes (1999) allowed researchers to manipulate probabilities of payoffs, visual display of potentially winning symbols, size of the maximum bet per spin, and the jackpot sizes of winning combinations. The slot machine program also allowed for the collection of a number of time-based and participant response-based measures, including response latency and subjective probability estimations. Published data obtained from this simulation have also revealed temporal regularities in slot machine players whereby the rate of play accelerates following losing trials and decelerates following winning trials (Schreiber & Dixon, 2001). Both simulations were programmed in the Visual Basic programming language and were designed to run on any IBM-compatible computer equipped with the Windows 95 operating system or higher.

Although the programs of Dixon et al. (1999) simulated the most common forms of gambling games found in the casinos, they did not simulate the more lucrative forms. A great deal of the casino's business, and eventual income, results from the playing of table games. These table games include roulette, blackjack, and craps. In attempts to further our understanding of the characteristics of casino games, gambling behavior, and risk-taking in general, we have devised a computerized simulation of the first of these table games, roulette.

Overview of the Roulette Game

The game of roulette is played with a wheel, a ball, and a board consisting of black, red, and green numbers ranging from 00 to 36. The object of the game is for the player to bet chips on the number(s) on the board that he/she believes the ball will land on when the wheel is spun. If the number that the ball lands on is a number that the player has placed a bet on, the player wins additional chips. But if the number on which the ball lands is not a number that the player has placed a bet on, the player loses all chips bet for that game. To make a bet, the player places the chips on the desired location(s). Once the bets are made, the dealer spins the roulette wheel and the small ball, made of metal, is dropped onto the spinning wheel. The number that the ball eventually lands on is the winning number, or the number that has "hit." Bets that correspond to this winning number are paid accordingly; bets that do not correspond are forfeited. Bets can be made in a variety of different ways in roulette, yet due to programming complexity and experimental practicality, we have limited the types of bets in our simulation to four types: 1 to 1 bets, 2 to 1 bets, 8 to 1 bets, and 36 to 1 bets.

A 1:1 bet, or "even money" bet is made by the player by placing a chip(s) in any location on the bottom row of the board (odd, even, black, red, 1–18, 19–36). If the number (and/or its corresponding color) on which the ball lands matches a bet that the player has made, the player wins double the chip(s) bet. For example, if a player bets 2 chips on the space "red," and if the number that comes up is red, the player receives a total of 4 chips in return.

A 2:1 bet is made by the player by placing a chip(s) in the next row up on the board (1st 12, 2nd 12, 3rd 12) or the right column of the board (2:1s). If the number on which the ball lands matches the bet the player has made, the player wins three times the chips bet. For example, if the player bets 2 chips on the space "1st 12," and if the number that comes up is between or includes 1 and 12, the player receives a total of 6 chips in return.

An 8:1 bet is made by the player by placing a chip(s) in the intersections of every four numbers located in the middle of the board (e.g., the intersection of 8, 9, 11, and 12). If the number on the wheel on which the ball lands matches the bet the player has made, the player wins eight times the chip(s) bet. For example, if a player bets 2 chips on the space between "8, 9, 11, & 12," and if the number that comes up is 8, 9, 11, or 12, the player receives a total of 16 chips in return.

A 36:1 bet is made by the player by placing a chip(s) directly on one number located in the middle of the board (e.g., on the 8). If the number on the wheel on which the ball lands matches the bet the player has made, the player wins 36 times the chip(s) bet. For example, if a player bets 2 chips on the "8," and if the number that comes up is 8, the player receives a total of 72 chips in return. No bets can be made on the 0 or the 00 spaces in our simulation. In the casino, these bets would also take the form of a 36:1 bet.

Program Operation

The program is written in Visual Basic 6.0 for IBM-compatible computers running the Microsoft Windows 2000 or higher operating systems. (Note that this software has not been tested for computers using PC emulation such as Virtual PC for Macintosh.) Visual Basic is an object-oriented program that uses the Windows file libraries to display graphical images, play audio (.wav) and video (.avi) files, and collect responses when the participant uses the mouse to click buttons on the computer interface, which makes it ideal for behavioral research (Dixon & MacLin, 2003). Visual Basic programming code is compiled into an executable file (.exe) and can run on any IBM-compatible system with Windows 2000 or higher without the need for the user to purchase the Visual Basic programming language itself. This allows for potential researchers to run the computerized simulation without adding the Visual Basic software to their current computer system.

Using a graphical control panel, the experimenter can effortlessly customize many characteristics of the roulette game for his/her specific research purpose. These parameters can be set up before a potential participant arrives, and they can be modified or kept constant for each subsequent participant. Figure 1 displays a graphical image of the roulette control panel.

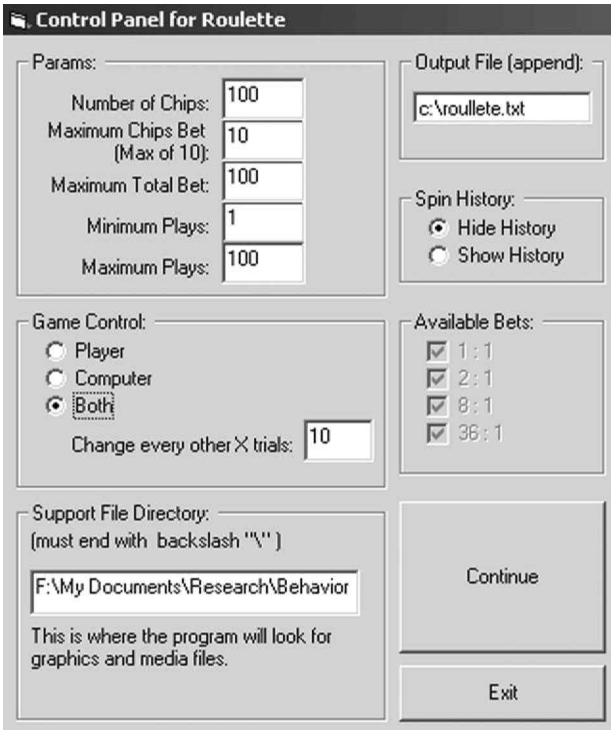

Figure 1. Screen graphic of the roulette simulation control panel.

Options that can be customized by the experimenter include (1) the number of chips the participant is given at the onset of the game, (2) the maximum number of chips that can be wagered on a given location on the roulette board, (3) the maximum total number of chips that can be wagered on a given trial, (4) the minimum number of trials that the participant must play before having the option of terminating the experiment, (5) the maximum number of trials that the participant has the option of playing, (6) the location of the output file that records participant responses, and (7) whether the computer will display the winning numbers from the previous 10 trials.

There is an additional option for "game control" on the control panel. This option is not found on actual roulette boards, yet it has been included on the simulation for additional research purposes related to the "illusion of control" hypothesis (Dixon, 2000; Langer, 1989). This hypothesis suggests that many persons behave differently under conditions where they are allowed a response that does not actually influence future outcomes, but that may seem to do so by means of a pure temporal contiguity. In roulette, this illusion would take the form of chip placement locations within a given set of odds. There is no logical reason to believe that one number may be more likely to come up the next time the wheel is spun, yet many gamblers tend to bet on "hot" or "favorite" numbers at the expense of others (Dixon, Hayes, & Ebbs, 1998).

If the experimenter selects "player" on this option, the game will run as naturally as in the casino. Yet, if the experimenter selects "computer" on this option, the player will not be allowed to select the specific location(s) on the roulette board where his/her chips will be bet. Rather, the computer will display a text box on the right side of the game interface that prompts the player for a chip number at each of the four sets of odds (i.e., 1:1, 2:1, and so on).

Once the participant has made the appropriate responses, the computer randomly places that number of chips within the given sets of odds. For example, if a participant has selected 2 chips at 8:1 odds, and 0 chips at all other odds, the computer will randomly distribute those two chips across all available 8:1 betting locations. Finally, if the experimenter selects "both" on the game control option, participant and computer control over chip placement will alternate after a desired number of prespecified trials. The latter two options of game control ("computer" and "both") allow researchers to investigate the effects of removal (or partial removal) of perceived control over purely chance outcomes (i.e., where the winning number will be).

Figures 2 and 3 show screen graphics of the program that have been designed to simulate an actual casino roulette game. The main interface is the roulette board consisting of numbers from 00 to 36. Players can select desired locations for their chip(s) to be wagered, along with the size of each wager, directly on the table by clicking the mouse pointer on the desired location when the "player control" option is in place (Figure 2). Players can simply select the size of each wager for each set of odds in the control box on the right side of the board by clicking the mouse pointer on the − or + buttons when the "computer control" option is in place (Figure 3).

Once all bets have been made, the participant can click the mouse pointer on the "Spin" button located at the bottom of the screen. A computerized audio/video file (.avi) is then activated, which includes the vocal comment "No more bets" and is followed by a visual display on the top left portion of the screen of a roulette wheel spinning, the sounds of a ball bouncing around on the wheel, and, eventually, the sound of the ball coming to rest on a randomly determined number. Following the presentation of this audio/video file, the computer displays a red and yellow circle on the roulette board to highlight the winning number. All bets that correspond to that number are immediately calculated and added to the participant's "total chips." Wagers that do not meet the winning criteria are forfeited and deducted from the player's remaining chips. The display provides the participant with information regarding the winning number for that trial, the number of chips won, the number of chips wagered, and the total number of chips remaining.

The program collects data for every trial into a text (.txt) file. The file contains comma separation between each data point so that it can be easily imported into graphical, spreadsheet, or statistical programs. Headings are provided for the experimenter to easily identify which col-

Figure 2. Screen graphic of the roulette simulation interface with the "player control" option selected and the "show history" option selected.

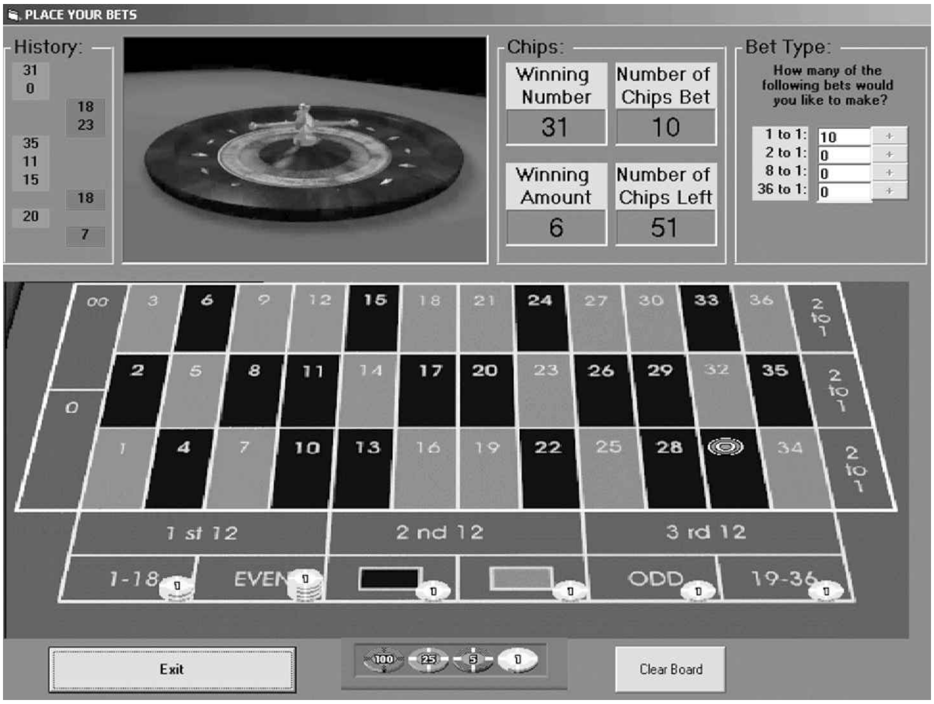

Figure 3. Screen graphic of the roulette simulation interface with the "computer control" option selected and the "show history" option selected.

umn of data represents which dependent measure. Response measures that are recorded for every trial include the trial number, control over chip placement (comp/player), the winning number, the number of chips played on that trial, the winning amount of chips (if any), the number of chips left, the number of chips wagered specifically on the Red and Black 1:1 locations, and the total number of chips wagered on each of the 1:1, 2:1, 8:1, and 36:1 locations.

The detailed data collection on a trial-by-trial basis may allow for a more micro-level analysis of the effects of various experimental manipulations on subsequent roulette play by both recreational and problem gamblers. Some ideas for future research include (1) placing a relatively low maximum total number of chips that a player can wager on each trial and examining the level of risk (either high or low) that they allocate their chips to, (2) requiring the participant to play *x* number of trials before allowing the participant to terminate the game and observing how many "optional" trials the participant continues to play before game termination, (3) assessing the various levels of risk taking (as measured by the types of odds bets are made on) as a function of winning and losing preceding trials, (4) removing the illusory control of chip placement on specific numbers in one group of participants while maintaining it in another and comparing risk-taking differences across the two groups, and (5) adding concurrent physiological measures of heart rate, breathing, or galvanic skin responses to assess relative changes across various experimental manipulations.

Availability and Equipment Requirements

The program is currently available free of charge. It comes on a single CD-ROM disk. It has been designed to run on any IBM-compatible computer equipped with Windows 2000 or higher and at least 64 MB of RAM. Although this program has been widely tested, users have had some difficulty running the program on older machines with Windows 2000. The program requires about 2 MG of hard drive space. Both a sound card and speakers are required in order to hear the game sounds of the chips' being stacked upon the board, the "computerized" dealer stating "No more bets" once the wheel is spun, the roulette wheel spinning, and the ball dropping onto the winning number. A video card is also required for one to be able to view the video of the wheel spinning during each trial.

Installation Instructions

Software for the roulette simulation is available for Internet delivery: The user should access the web site http://www.uni.edu/~maclin/software and select the roulette option. The user can then view a description of the program and/or download the program. Detailed instructions are provided on how to use the self-extracting files. During the file download, we recommend choosing the open option, which stores the installation files to a temporary file and then removes them once the installation process is complete. After the program has been successfully installed, the user can get more information about the components of the program and about the data file from the on-line overview. If the user requires a CD for installation or wishes to purchase the source code for a nominal fee, he/she should contact the first author.

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