SUPERSTITIOUS BEHAVIOR CLASSROOM GAME TEACHING

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Superstitions flourish in cultures around the world and in everyday life. Superstitions are so prevalent and influence personal and political decisions, therefore, we sought to develop a classroom demonstration of superstitious behavior that could be used to show quickly and effectively how powerful adventitious reinforcement could be in modifying behavior. An online game was developed and played by one hundred thirteen university students enrolled in a class on critical thinking. Participants gained points (reinforcement) arbitrarily during either 25% or 50% of each game’s (A or B) 3 minute duration. Although points were non-contingent, students often engaged in superstitions rules or patterns. Results of both self-reports and computer generated data showed, the games were successful in producing superstitious behavior patterns in about 50% of our participants. More students showed superstitious behavior in the 50% game than in the 25% game. We conclude that this is due to the higher reinforcement rate of in 50% game. For future studies, rearranging the stimulus array into a pattern that does not itself strongly control behavior could help refine the results.
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CHAPTER 1

INTRODUCTION

Superstitious Behavior Classroom Game Teaching

Superstitious Behavior is a Widespread Cultural Phenomenon. Superstition, as defined by the Oxford English Dictionary, is “a widely held but irrational belief in supernatural influences, especially as leading to good or bad luck, or a practice based on such a belief.” Paranormal, superstitious, and magical beliefs have been found in a diverse range of cultures for thousands of years (Jahoda, 1969). According to Gallup polls, superstitious beliefs in the US increased by 18% between 1990 and 1996 alone, showing that these beliefs continue to thrive in modern times (Newport & Strausberg, 2001; Wiseman & Watt, 2004). A 1996 Gallup poll revealed that 53% of Americans said that they held some form of superstitious belief. The poll went on to show that 25% of Americans acknowledged that they were "very" (1%) or "somewhat" (24%) superstitious, up from 18% reported in 1990. Belief in superstition declines with age; self-identified superstitions were present in 35% of respondents under 30 years of age, and that value declined to 17% of respondents 65 years and older, but overall, the data indicated significant prevalence of superstitious beliefs across the lifespan.

Examples of widespread superstitious behavior can be seen in professional athletes. There is a long history of strange and bizarre pre-game rituals in professional athletics (e.g., Bleak & Frederick, 1998; Vyse, 1997). Many athletes carry charms or wear a particular article of clothing for good luck, and it has been reported that many athletes display ritualistic superstitions. Superstitions are common among non-professional athletes as well. One study of high school and college athletes found that 40% of them engaged in superstitious behavior before or during games (Buhrmann & Zaugg, 1981).
Some superstitions are so embedded in a culture that they evoke large behavioral changes throughout an entire society. Consider the infamous unlucky number “13” that is, even today, banned from many hotel rooms, elevator floors, airplanes, and other public buildings all over the world. Lachenmeyer (2005) explains that many designers and architects exclude the number “13” because of its tradition and momentum in the culture; it is not clear how many people would not rent an apartment or stay in a hotel room on the “13th” floor, so it is easier to exclude them. Overall, Lachenmeyer identified 46 countries around the world that have demonstrable fears of the number “13.”

Perhaps more impactful are accounts of superstitions in world leaders. For example, the Reagan administration made several decisions around whether or not the First Lady Nancy Reagan’s astrologer decided the day was a good or bad one for making decisions. It has been noted by Donald Regan (no relation), former White House Chief of Staff to former President Ronald Reagan that “virtually every major move and decision the Reagans made during my time as White House Chief of Staff was cleared in advance with a woman in San Francisco who drew up horoscopes to make certain that the planets were in a favorable alignment for the enterprise” (as quoted in Vyse, 2013, p. 31). Suggestions that certain days were “bad” for the president led to cancelling speeches and even travel for days at a time (Vyse, 2013). This is a noteworthy example of how far-reaching superstitions can be; something as important as a presidential schedule is based upon something as unscientific as superstition.

For the purposes of this paper, superstition is divided into two classes: superstition and loss of control, and superstition and adventitious reinforcement. Keinan (1994) proposed that superstitious and magical beliefs are more predominant among populations exposed to missile attacks than among those not exposed to such violence. Keinan suggested a possible
explanation: stress reduces a person’s sense of control, and to regain control he or she engages in superstitious behaviors. Skinner’s classic study “Superstition in the Pigeon” is a prime example of adventitious reinforcement that can translate to human behavior. Hungry pigeons were placed in an experimental apparatus in which a food hopper delivered food in regular increments, independent of the pigeon’s behavior. However, Skinner observed that whatever the pigeons did during food delivery reinforced their actions and six out of eight pigeons repeated those actions. In this study, we developed a classroom demonstration to illustrate how easily superstitions can be produced, under the assumption that adventitious reinforcement leads to superstition.

Superstition and Loss of Control

Prominent cognitive accounts of superstitions underscore their role in giving people a sense of control in stressful, seemingly uncontrolled circumstances. Rudski (2004), for example, notes that a hallmark of superstition is a person’s false belief that he/she has the ability to influence an outcome in a situation when in reality he/she has no control. Also, Whitson (2008) suggested that superstitions grow out of our need to take charge of situations and to help reduce anxiety. Several studies suggest correlations between conditions of stress and/or danger and the increase in the frequency of superstitions (for reviews see Shermer, 1998 and Vyse, 2000). Keinan (1994) found that superstitious and magical beliefs were predominant among people living in regions exposed to missile attacks (e.g., high-stress condition) than among those living in regions not exposed to such attacks (e.g., low-stress condition). Keinan also suggested a possible explanation for this finding, suggesting that stress reduces the individual’s sense of control and in order to regain control she or he engages in magical rituals or superstitious behaviors.
A recent study, however, challenges the cognitive views on superstition. Again, all major cognitive interpretations suggest superstitions arise from an emotional need to feel empowered and in control of a situation where there is no control. Recently, Yarritu, Matute, and Vadillo (2014) asked pairs of participants to play the role of a health care provider in a computer simulation. In the simulation, participants read fictitious medical reports and decided whether or not to provide treatment. One member of the pair was designated as the caregiver and decided when to give medications; the other member of the pair simply observed and did not play a role in the decision making (yoked observer). Unknown to all participants, the medical reports showed spontaneous improvement 80% of the time; the medication had no effect on improvement and did not alter the fictitious patient’s outcome. Choice of delivering medications was limited across conditions by the number of doses per patient available to the “health provider” (either 7 to 10 or 3 to 10 doses per patient). The results showed that “health providers” saw the medication as useful when they could deliver 7 doses, but not 3, per patient. Interestingly, yoked observers reported similar outcomes. When observers watched “health providers” deliver medication more frequently, they were also more likely to conclude that the medication worked.

Yarritu et al. (2014) suggested the results challenged the notion that superstitions arise to protect the illusion of control (e.g., provide a sense of control, reduce anxiety in uncontrolled situations, etc.) because the yoked participant never had control to lose or regain. Instead, they suggest that superstitions are the outcome of contingency learning. In the 7:10 dose, there were more opportunities to deliver medications and observe “recovery” than in the 3:10 condition. Yarritu et al. suggest that superstition is simply the result of a high probability of observing chance occurrences of action and outcome, not a mechanism to foster feelings of control.
Superstition and Adventitious Reinforcement

The chance conjunction of action and outcome is at the heart of behavioral theories of superstition (Beck & Foster, 2007), which may provide a better account for superstitions because they do not rely on unobservable entities (e.g., stress reduction). The classic example in this regard to this is Skinner’s (1948) study “Superstition in the Pigeon.” In this study, hungry pigeons were put into an experimental apparatus each day. A food hopper operated every few seconds, irrespective of the pigeon’s behavior. Skinner observed that whatever the pigeon did coincidental with food delivery was strengthened by reinforcement, and in six out of eight pigeons a robust stereotype ensued. Skinner’s interpretation of this effect was that the pigeon was trapped in a vicious cycle. Behavior made more likely by strengthening becomes more likely to contact reinforcement, further strengthening the response.

There have been several studies to examine superstition in humans that result from adventitious reinforcement. An early study by Cantania and Cutts (1963) provided human participants two response keys. Presses to one key produced points on a counter according to variable-interval 30-s schedule; a second key never produced points, i.e., the schedule was extinction. Catania and Cutts found that response was, in fact, maintained on the extinction key at low rates, and such response was due to adventitious reinforcement. The role of chance consequences was confirmed by imposing a change-over delay such that points on the “VI” key could never produce points within 4.5-15 s of a press on the “extinction” key. Other studies have found similar results showing that adventitious reinforcement can produce superstitious behavior in both children and adults (Ono, 1987; Wagner & Morris, 1986).

Developing a Classroom Demonstration of Superstitious Behavior
The previous review suggests that superstitions are widespread and pervasive and that they are the outcome of chance contingency between a response and reinforcer. Given the importance of reinforcement in the development of superstitions, the present study was designed to develop an instructional tool to demonstrate how easily superstitions could be produced. Our primary goal was to develop a short-term class exercise for teaching undergraduates about the relationship between adventitious behavior and superstitions to provide direct demonstration on the powerful ability reinforcers have to modify behavior. In this study, we developed a rapid, online game environment that students could learn and explore easily. We chose a game-type setting because of the growing use of such strategies in education, which could contribute both to greater engagement in the task and widespread adoption of teaching tools (Morford et al., 2014). Our overall game structure was informed by prior work in superstitions. It was important for us to try to develop a game that had a fast learning curve, could be delivered online for broader dissemination and exposure, and balanced ease of learning with potential boredom. We also wanted to re-examine the role of reinforcer density in the emergence of superstitions, as previous findings have shown that superstitions become more likely as the density of reinforcement increases. Given the importance of reinforcement density in determining superstitions, identifying its role in the present game would aid us in identifying critical parameters needed for learning.
CHAPTER 2

METHOD

Participants

Participants were 113 university students enrolled in a class on critical thinking. Students were asked to play two games as part of class study. The present data were generated from that class assignment and coded so that no personal information was attached to the data. Students earned bonus course credit for their participation; credit was contingent only on participation, not performance in the game. For purposes unrelated to the game, students were randomly assigned to one of twenty small groups in the class; groups were identified by numbers (e.g., Group 1, Group 2, etc.).

Materials and Procedure

An online game was developed that could be accessed via the student’s secure login. The game was developed using Adobe Flash™ and accessed by students though a secure site maintained by UNT’s Center for Learning Enhancement, Assessment, and Redesign. The login allowed students access, but was not recorded with the data. Upon logging in the game, the students were presented with two links labeled “Game A” or “Game B.” The following instructions were provided:

*Below are links to two games. In each game, you will press buttons and earn points.*

*Your task is to figure out how to earn points. Also, the games are not identical. A second task is to figure out how the games differ.*

*If you are in Groups 1 - 10, play Game A first, then Game B.*

*If you are in Groups 11 - 20, play Game B first, then Game A.*
Upon entry into the game, the students were shown an array of buttons with a counter located just off the center of the middle of the buttons (see Figure 1.1). The game began with the first button press to any button in the array. Each successful button press resulted in the background of the screen flashing red for 0.3 s, which was intended as response feedback. Occasionally, presses to buttons produced points; points were accompanied by a green flash, instead of red, a green “checkmark” appearing on the button for 0.3 s, and the counter on the screen increased by one.

The only difference between the games was that Game A produced points probabilistically 25% of the time and Game B produced points 50% of the time (e.g., on average one-fourth to one-half of responses produced points, respectively). The button positions were irrelevant to the production of points. The game ended after 3 minutes and the students were returned to the main selection screen. Once the students played both games, they were told (in class) they could play both games as often as possible to figure out how to earn points, but only the first exposure to each game is included in the present analysis.

As stated above, the 113 students were split into 20 groups. From those students, only 90 students played at least one game, and only 64 played both games as instructed, where members of Groups 1-10 played Game A first and members of Groups 11-20 played Game B first; the data shown here are from those 64 students who played both games as instructed.

Data Analysis

We examined data for superstitious patterns in button pressing. Again, the production of points was irrelevant to particular buttons. The growth of predominant patterns in button pressing, however, could be construed as evidence of adventitious reinforcement, owing to the chance production of points with particular button presses. If Skinner’s (1948) interpretation of
superstition is correct, we would then expect to see those adventitious point productions to raise the level of response to particular buttons. To analyze such changes in behavior, we examined the conditional probability of repeating a particular button press when the previous response on that button produced a point, and we compared that the probability of a repeating a button press when that particular press produced no point.

A second way to determine if point delivery altered patterns of button pressing was to examine the correlation between the number of points delivered on a particular button and the number of responses made to that button. Note, out of necessity, the total number of points delivered across sessions must be perfectly correlated with the total number of button presses across all buttons because the production of points depended on button presses occurring somewhere; however, there was a wide range that the actual correlation might vary across because all button presses contributed equally. If participants came to concentrate their button presses on only a few buttons, the expected correlation, then, would approach 1 as points would then be constrained to only those few buttons. Such a shift would also be consistent with a putative reinforcement process increasing the frequency of button presses that produced reinforcement. In particular, we would expect a reinforcement process to change the correlation over time as responding was reallocated across buttons. To determine changes in correlation between point delivery and button presses, correlations were computed for each of the 3 minutes in the session. Again, if something like adventitious reinforcement was operating on button pressing, we would expect these correlations to rise over time; constant or declining correlations would not be consistent with superstitious patterns.

Finally, when students finished playing the game, we asked them to provide open-ended responses to questions about how points were determined and how the games differed. We
analyzed those responses and scored them simply for the presence or absence of identified rules on how points were earned.
CHAPTER 3

RESULTS

The main variable manipulated in the present study was frequency of point delivery and order of exposure. Figure 2 shows the average number of points for Group A (played 25% condition first) or Group B (played 50% condition first). Overall, the data suggest that as a group the contingencies did operate as planned, with the 50% condition generating roughly twice the points as the 25% condition, although it appears that slightly more points, on average, were earned in the 50% condition in Group A than Group B. Figure 3 shows this is due to an increase in the average total button presses emitted by participants in Group A compared to Group B. On average, then, it seems that total button presses tended to increase in the second game relative to the first, and this accentuated the differences in the 50% condition between the two groups.

In terms of superstitious patterns, we examined the possibility that points served as reinforcers by comparing the probability of repeating a button press following a point versus repeating a button press when no point was delivered. Figure 4 shows the effects of point delivery on conditional probabilities for participants in Group A. The y-axis shows the probability of a repeated press given a point was earned against the probability of a repeat given no point on the x-axis. If points had no effect on behavior, then the probabilities should be equal and would fall on the line y = x. If the points had effects consistent with reinforcement, points should lie above the line y = x. Points lying below the line y=x would indicate that points had effects consistent with punishment. In general, points tended to lie above the line y=x, indicating the delivery of points tended to increase the probability of repeating the same button press.

Two other features of the data are of note. First, the baseline probability of repeating presses given no point ranged from 0 to 0.5 in the 25% condition and increased from roughly 0
to 1 in the 50% condition. Second, there appears to be a cluster of data points about the origin (0,0); these points reflect behavior patterns that never repeated. Approximately 20% of the participants showed essentially no repetition in behavior regardless of point delivery, and this number was the same for both the 25% and 50% conditions. A further examination of pressing, however, did reveal a dominant pattern. Participant responses appear to have been strongly controlled by the clock-like array of buttons, and button presses moved in a clockwise fashion around the screen, which gave rise to the (near) absence of repetition from press to press. Although this movement could have been due to a “higher order” pattern, whereby clockwise movement itself was the dimension of behavior strengthened by point delivery, it would be difficult to conclude such an effect from the present data.

Figure 5 shows the corresponding data from Group B. Overall, the results were similar to that in the other group. Point delivery tended to increase the probability of response repetition. Of note, the probability of repetition given no point ranged from roughly 0 – 0.25 in the 50% condition and increased to 0 – 0.75 in the 25% condition, although the overall increase was less than in Group A. Collectively, the data indicate that early exposure to the 50% condition may reduce basal levels of response repetition compared to early exposure with the 25% condition, and basal response repetition tends to increase with multiple game plays. Figure 6 shows data combined from Group A and Group B. When combined, the data show that some subset of individual data points cluster near the origin (never repeating presses), and other data points lie close to the line y = x. To further quantify this effect, we computed the distance between each data point and the diagonal (y = x). Because points were bound by the origin (0,0) and (1,1) in the Cartesian plane, we could express this distance as a percent of the maximum possible. Using 10% bins, we found that about 20% of the distances were essentially zero; these were the data
points that tended to lie at the origin. Another 35% of the data points were less than 10% of the maximum, which we take to reflect no difference from the diagonal. The remaining 45% of participants were displaced more than 10% of the distance to the diagonal, which we take to reflect a change in probability of repetition. The overall proportions falling into different distances from the diagonal were not systematically affected by condition or order of exposure. Thus, just under half the data points met this criterion and suggest that short-term exposure to contingencies of point delivery appears to function as a reinforcer and to facilitate response repetition in about half of participants, even though such repetition had no effect on the actual delivery of points.

Figure 7 shows data from Group A concerning the correlation of response number and number of points per button for each of the 3 minutes in the game. There was no change in overall pattern of button pressing when points were delivered 25% of the time. In contrast, there was a marked growth in the correlation from 0.52 to 0.61 across successive minutes of the game when points were delivered 50% of the time. Similarly, Figure 8 shows corresponding data from Group B. Again, there was no effect of the 25% condition on the correlation between number of points and number of responses by button; however, when points were delivered 50% of the time, the correlation rose from 0.55 to 0.68. Collectively, the data indicated that when points were delivered 50% of the time, the correlation between the number of responses earned on a button and the number of points earned on that button increased; this is consistent with the conditional probability data and show that across the 3-min session button presses in the 50% condition came to concentrated on fewer buttons, which in turn concentrated point delivery to those select buttons.
CHAPTER 4  
DISCUSSION

Superstitions abound in our culture and everyday life. Because superstitions are so prevalent and influence personal and political decisions, we sought to develop a classroom demonstration of superstitious behavior that could quickly and effectively show how powerful adventitious reinforcement could be in modifying behavior. In general, the game we developed was successful in producing superstitious behavior patterns in about 50% of our participants. Superstitious behavior was revealed at two levels. First, both the 25% and 50% conditions increased the probability of response repetition when points were delivered. Probabilistically, the defining feature of reinforcement is the increase in probability of a response over its basal levels. Presses to particular buttons were more likely to be repeated if a point was delivered contingent upon the press than in its absence, and this effect is consistent with a reinforcement interpretation. Second, the 50% condition resulted in increasing positive correlations between the allocation of responses and the delivery of points, indicating behavior became redistributed across response options. The latter result can be construed as a “shaping” effect, in that point delivery reduced the relative number of responses to buttons that did not produce points. Both effects are consistent with the points serving as a reinforcer. As points never depended on the particular buttons pressed, and yet point delivery both increased the frequency of button presses and resulted in reallocation of behavior, the patterns of button presses that emerged under the present paradigm may be considered superstitious behavior.

In our investigation of superstitious behavior, we examined the role of point frequency. In general, we showed that although both 25% and 50% conditions increased the frequency of particular button presses that previously produced a point, only the 50% condition resulted in a
progressive reallocation of behavior. The findings are consistent with previous work showing that denser schedules of the putative reinforcer are more likely to lead to superstitious behavior because they increase the likelihood a response will come into contact with particular responses (e.g., Yarritu et al., 2014).

At the same time, we did not find schedule effects on the proportion of participants claiming rules or patterns, and this is inconsistent with prior work. For example, Rudski, Lischner, and Albert (1999) found that college students were more likely to describe spurious rules when the probability of reinforcement was delivered 50% of the time than when it was delivered 25% of the time. There may be, however, several reasons we did not see an effect of reinforcement density on participants’ verbal responses. First, our task was very short, lasting only 3 minutes, which may not have provided sufficient experience for verbal responses to come under control of particular patterns. A second possibility is that our task did not encourage contingency shaping of verbal behavior. In Rudski et al. (1999), for example, participants were stopped 4 times, every time they finished 25% of the trials, during the session and filled out a questionnaire prompting them to consider how points were earned and to formulate rules to describe the contingencies. Thus, participants had several opportunities to formulate rules and obtain feedback about their self-generated rules. Similarly, Cantania, Matthews, and Shimoff (1982) found that rules were consistently related to performance when the rules themselves were contingency-shaped, rather than instructed. In light of these findings, it is important to consider that effective rules are shaped as other behavior (Skinner, 1957), and there was no explicit rule-shaping in the present study.

Although superstitious behavior was generated in most participants, many students did not show superstitious behavior. While prior work has suggested superstitious behavior may not
be easily established in humans (e.g., Ono, 1987), we consider other variables that may have hindered the development of superstitions in the present task. First, the putative reinforcer (points) were not reinforcing for a small subset of participants as shown by the fact that points did not alter the probability of button repetition. In the present study, the value of points was established entirely by instruction, and course credit was earned by merely participating in the task. A future study could explore framing the instruction to indicate the point value would itself constitute course credit (e.g., “Earn as many points as possible, points will be added to your most recent test score as bonus credit”). Also, the possibility of incorporating self-report and assessments by participants, that could be used to analyze the generation of superstitious rules and how feedback shapes participant descriptions of the contingencies.

Another limitation of the present study was that a sizeable number of our participants simply moved in a clockwise fashion around the button array. The likely account of this finding is the long history our participants have had with clock faces and clockwise movement, and this structure appeared to exert control over response pattern in those participants. Future iterations of this task, then, may benefit from fewer buttons or a different arrangement of stimuli.

One may criticize the present study on the grounds that the behavior generated does not actually constitute superstitious activity because superstitions arise when there is no dependency between the response and the reinforcer. In the present case, however, there was a dependency—points would not be delivered if the participant did not respond. The findings may instead be related to a “second” type of superstition identified by Skinner and Morse (1948). In that study, pigeons pecked a key lit by an orange light and produced food. Occasionally, the key color was changed from orange to blue, with the effect that responding often increased dramatically, even though the color change had no effect on the ability of key pecks to produce
food. Thus, the stimulus change gave rise to a “sensory” superstition (Catania, 1992). In the present study, button presses had to occur to produce points, but the particular button press did not matter. Still, button presses increased in frequency, demonstrating reinforcement, and in the 50% condition, the correlation between presses on particular buttons and the points earned on those buttons increased. So, particular button locations appeared to take on a discriminative function, when in fact none existed, similar to the sensory superstition of Skinner and Morse (1948).

The goal of the present study was to develop a classroom exercise that could be used to provide a hands-on demonstration of superstition to demonstrate the power of reinforcement in shaping superstitious behavior. In this light, the project appears to be a success. The present game engendered superstitious button pressing in many of the students participating, and when rules were generated to describe performance, they were inaccurate. Anecdotally, when it was revealed to the class that the buttons were meaningless and that point delivery was entirely due to their responses, there was general surprise across the class.

The game itself was designed to capitalize on a history college students have pressing buttons on webpage to produce other stimulus changes and so pressing was acquired quickly and the online format made the task easy to deploy to a large number of students. At the same time, it appears there are a number of changes that could be made in future iterations to refine the game for a class exercise, chief among those being to rearrange the stimulus array into a pattern that did not itself strongly control behavior.
Figure 1. shows the presentation of the game upon starting point.
Figure 2. The average number of points earned in Group A and Group B, in both the 25% of 50% condition.
Figure 3. The average number of responses given per minute in Group A and Group B, in both the 25% and 50% condition.
Figure 4. The probability that the participants in Group A will repeat given that they earned a point, compared to the probability that the participants will repeat given that they did not earn a point, during both the 25% the 50% conditions.
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