

KNOCK WOOD!

Skinner, B. F. (1948). Superstition in the pigeon. *Journal of Experimental Psychology*, 38, 168-172.

We will examine one study from a huge body of research carried out by one of the most influential and most widely known psychologists ever, B. F. Skinner. Deciding how to present Skinner and which of his studies to explore was a difficult task. It is clearly impossible to represent adequately in one short article his contributions to the history of psychological research. After all, Skinner is considered by most to be the father of radical behaviorism, is the inventor of the famous (or infamous) *Skinner Box*, and is the author of over a dozen books and more than 70 scientific articles. This article, with the somewhat humorous-sounding title "Superstition in the pigeon," has been selected from all of his work because it allows for a clear discussion of Skinner's basic theories, provides an interesting example of his approach to studying behavior, and offers a "Skinnerian" explanation of a behavior with which we are all familiar: superstition.

Skinner is referred to as a radical behaviorist because he believed that everything psychological is, essentially, behavioral, including public, or external behavior, and private, or internal, events such as feelings and thoughts. Although he believed that *private* behavior is difficult to study, he acknowledged that we all have our own subjective experience of these behaviors. He did not, however, view internal events, such as thoughts and emotions, as causes of behavior, but rather as part of the mix of environment and behavior that he was seeking to explain (see Michael, 1985, or Schneider & Morris, 1987, for a detailed discussion of the term *radical behaviorism*). So, for Skinner, all behavior, whether internal or external, could be explained by the environmental consequences it produces.

To put Skinner's theory in very basic terms: In any given situation, your behavior is likely to be followed by consequences. Some of these consequences, such as praise, receiving money, or the satisfaction of solving a problem, will make the behavior more likely to be repeated in future similar situations. These consequences are called reinforcers. Other consequences, such as injuring yourself or feeling embarrassed, will tend to make the behavior less likely to be repeated in similar situations and are called punishers. The effects of these relationships between behavior and the environment are called reinforcement and punishment, respectively (Morris, 1997). Reinforcement and punishment are two of the most fundamental processes in what Skinner referred to as operant conditioning and may be

diagramed as follows:



Within this conceptualization, Skinner also was able to explain how learned behaviors decrease and sometimes disappear entirely. When a behavior has been reinforced and the reinforcement is then withdrawn, the likelihood of the behavior reoccurring will slowly decrease until the behavior is effectively suppressed. This process of behavior suppression is called *extinction*.

If you think about it, these ideas are not new to you. The process we use to train our pets follows these same rules. You tell a dog to sit, it sits, and you reward it with a treat. After a while the dog will sit when told to, even without an immediate reward. You have applied the principles of operant conditioning. This is a very powerful form of learning and is effective with all animals, even old dogs learning new tricks and, yes, even cats! Also, if you want a pet to stop doing something, all you have to do is remove the reinforcement, and the behavior will stop. For example, if your dog is begging at the dinner table, there is a reason for that (regardless of what you may think, dogs are not born to beg at the table!). You have conditioned this behavior in your dog through reinforcement. If you want to *put that behavior on extinction*, the reinforcement must be totally discontinued. Eventually, the dog will stop begging. By the way, if one member of the family cheats during extinction and secretly gives the beggar some food once in a while, extinction will never happen.

Beyond these fundamentals of learning, Skinner maintained that all human behavior is created and maintained in precisely the same way. It's just that with humans, the exact behaviors and consequences are not always so easy to identify. Skinner was well known for arguing that if a human behavior was interpreted by others (such as cognitive or humanistic psychologists) to be due to our highly evolved consciousness or intellectual capabilities, it was only because psychologists had been unable to pinpoint the reinforcers that had created and were maintaining the behavior. If this feels like a rather extreme position to you, remember that Skinner's position was called radical behaviorism and was always surrounded by controversy.

Skinner often met skepticism and defended his views by demonstrating experimentally that behaviors considered to be the sole property of humans could be learned by lowly creatures such as

pigeons or rats. One of these demonstrations involved the contention by others that superstitious behavior is uniquely human. The argument was that superstition requires human cognitive activity (thinking, knowing, reasoning). A superstition is a belief in something, and we do not usually attribute such beliefs to animals. Well, Skinner said in essence that superstitious behavior could be explained as easily as any other action by using the principles of operant conditioning. He performed an experiment to prove it.

THEORETICAL PROPOSITIONS

Think back to a time when you have behaved superstitiously. Did you knock on wood, avoid walking under a ladder, avoid stepping on cracks, carry a lucky coin or other charm, shake the dice a certain way in a board game, change your behavior because of your horoscope? It is probably safe to say that everyone has done something out of superstition at some time, even if some of them might not want to admit it. Skinner said that the reason people do this is that they believe or presume that there is a connection between the superstitious behavior and some reinforcing consequence, even though, in reality, there is not. This connection exists because the behavior (such as shaking the dice that certain way) was accidentally reinforced (such as a good roll) once, twice, or several times. Skinner called this *non-contingent* reinforcement, a reward that is not contingent on any particular behavior. You believe that there is a causal relationship between the behavior and the reward, when no such relationship exists.

"And if you think this is some exclusive human activity," Skinner might have said, "I'll make a superstitious pigeon!"

METHOD

In order to understand the method used in this experiment, a brief description of what has become known as the Skinner Box is necessary. The principle behind the Skinner Box (or conditioning chamber, as Skinner called it) is really quite simple. It consists of a cage or box that is empty except for a dish or tray into which food may be dispensed. This allows a researcher to have control over when the animal receives reinforcement, such as pellets of food. The early conditioning boxes also contained a lever which, if pressed, would cause some food to be dispensed. If a rat (rats were used in Skinner's earliest work) was placed in one of these boxes, it would eventually, through trial and error, learn to press the lever for food. Alternately, the experimenter could, if desired, control the food dispenser and reinforce a specific behavior. Later it was found that pigeons also made ideal subjects in conditioning

experiments, and conditioning chambers were designed with disks to be pecked instead of bars to be pressed.

One of these conditioning cages was used in the study discussed here, but with one important change. In order to study superstitious behavior, the food dispenser was rigged to drop food pellets into the tray at intervals of 15 seconds, regardless of what the animal was doing at the time. You can see that this produced noncontingent reinforcement. In other words, the animal received a reward every 15 seconds, no matter what it did.

Subjects in this study were eight pigeons. These birds were fed less than their normal daily amount for several days, so that when tested they would be hungry and therefore highly motivated to perform behaviors for food. (This increased the power of the reinforcement.) Each pigeon was placed into the experimental cage for a few minutes each day and just left to do whatever a pigeon does. During this time, reinforcement was being delivered automatically every 15 seconds. After several days of conditioning in this way, two independent observers recorded the birds' behavior in the cage.

RESULTS

As Skinner reports:

In six out of eight cases the resulting responses were so clearly defined that two observers could agree perfectly in counting instances. One bird was conditioned- to turn counterclockwise about the cage, making two or three turns between reinforcements. Another repeatedly thrust its head into one of the upper corners of the cage. A third developed a tossing response as if placing its head beneath an invisible bar and lifting it repeatedly. Two birds developed a pendulum motion of the head and body in which the head was extended forward and swung from right to left with a sharp movement followed by a somewhat slower return. The body generally followed the movement and a few steps might be taken when it was extensive. Another bird was conditioned to make incomplete pecking or brushing movements directed toward but not touching the floor. (p. 168)

None of these behaviors had been observed in the birds prior to the conditioning procedure. The new behavior had nothing to do with the pigeon receiving food. Nevertheless, they behaved as if a certain action would produce the food; that is, they became superstitious.

Skinner next wanted to see what would happen if the time interval between reinforcements was extended. With one of the head-bobbing birds, the interval between the delivery of food pellets was slowly increased to one minute. When this occurred, the pigeon's movements

became more energetic until finally the stepping became so pronounced that it appeared the bird was performing a kind of dance during the minute between reinforcement (such as *a pigeon food dance*).

Finally, the new behavior of the birds was put on extinction. This meant that the reinforcement in the test cage was discontinued. When this happened, the superstitious behaviors gradually decreased until they disappeared altogether. However, in the case of the *hopping* pigeon with a reinforcement interval that had been increased to a minute, over 10,000 responses were recorded before extinction occurred!

DISCUSSION

Clearly, what Skinner ended up with here was six superstitious pigeons. However, he explains his findings more carefully and modestly: "The experiment might be said to demonstrate a sort of superstition. The bird behaves as if there were a causal relation between its behavior and the presentation of food, although such a relation is lacking" (p. 171).

The next step would be to apply these findings to humans. I am sure it is not difficult for you to think of analogies in human behavior, nor was it for Skinner. He described "the bowler who has released a ball down the alley but continues to behave as if he were controlling it by twisting and turning his arm and shoulder as another case in point" (p. 171). You know, rationally, that behaviors such as these don't really have any effect on a bowling ball that is already halfway down the alley. As Skinner points out in the case of the pigeons in this study, the food was going to appear no matter what the bird did.

An additional and interesting point made by Skinner in this article was that it is not completely correct to conclude that there is no relationship between the twisting and turning of the bowler and the direction of the ball. What is true is that after the ball has left the bowler's hand, the "bowler's behavior has no effect on the ball, but the behavior of the ball has an effect on the bowler" (p. 171). In other words, it is a fact that on some occasions, the ball might happen to move in the direction of the bowler's body movements. That movement of the ball, coupled with the consequence of a strike or a spare, is enough to accidentally reinforce the twisting behavior and maintain the superstition.

Finally, the reason that superstitions are so resistant to extinction was demonstrated by the pigeon that hopped 10,000 times before giving up the behavior. When any behavior is only reinforced once in a while, it becomes very difficult to extinguish. This is because the expectation stays high that the superstitious behavior might work to produce the reinforcing consequences.

You can imagine that if the connection was present every time and then disappeared, the behavior would stop quickly. However, for humans, the instances of that accidental reinforcement usually occur at large time intervals, so the superstitious behavior often may persist for a lifetime.

CRITICISMS AND SUBSEQUENT RESEARCH

As mentioned before, Skinner's behaviorist theories and research were always the subject of great and sometimes heated controversy. Other prominent theoretical approaches to human behavior argued that the strict behavioral view was unable to account for many of the psychological processes that are fundamental to humans. Carl Rogers, the founder of the *humanistic* school of psychology, and well known for his debates with Skinner, summed up this criticism:

In this world of inner meanings, humanistic psychology can investigate issues which are meaningless for the behaviorist: purposes, goals, values, choice, perceptions of self, perceptions of others, the personal constructs with which we build our world.. the whole phenomenal world of the individual with its connective tissue of meaning. Not one aspect of this world is open to the strict behaviorist. Yet that these elements have significance for man's behavior seems certainly true. (Rogers, 1964, p. 119)

Behaviorists would argue in turn that all of these human characteristics are open to behavioral analysis. The key to this is a proper interpretation of the behaviors and consequences that constitute them. (See Skinner, 1974, for a complete discussion of these issues.)

On the specific issue of superstitions, however, there appears to be less controversy and a rather wide acceptance of the learning processes involved in their formation. An experiment performed by Bruner and Revuski (1961) demonstrated how easily superstitious behavior develops in humans. Four high school students each sat in front of four telegraph keys. They were told that each time they pressed the correct key, a bell would sound, a red light would flash, and they would earn a nickel. The correct response was key number 3. However, as in Skinner's study, key number 3 would produce the desired reinforcement only after a delay interval of 10 seconds. During this interval the students would try other keys in various combinations. Then, at some point following the delay, they would hit the third key again and receive the reinforcement. The results were the same for all the students. After a while, they had each developed a pattern of key responses (such as 1, 2, 4, 3, 1, 2, 4, 3) that they repeated over and over between each reinforcement. Pressing the 3-key was the only reinforced behavior; the other presses in the sequence were completely superstitious. Not only

did they behave superstitiously, but all the students believed that the other key presses were necessary to "set up" the reinforced key. They were not aware of their superstitious behavior.

RECENT APPLICATIONS

Skinner, as one of psychology's most influential figures, still has a far-reaching substantive impact on scientific literature in many fields. His 1948 article on superstitious behavior is cited in numerous studies every year. One of these studies, for example, examined new behavioral approaches to understanding the meaning of dreams (see the previous section of this book for additional discussion of dreaming and dream interpretation). Dixon and Hayes (1999) suggested that through dreaming, people can substitute various stimuli in a given setting and can test various responses to them that in waking life might, or might not, produce the desired consequence. In other words, people may be more superstitious when asleep than when awake!

Another thought-provoking article citing Skinner's 1948 study (Sagvolden et al., 1998) examined the role of reinforcement in attention deficit/hyper activity disorder (ADHD). The researchers asked boys with and without a diagnosis of ADHD to participate in a game in which they would receive rewards of coins or small toys. Although the reinforcement was delivered at fixed 30-second intervals (noncontingent reinforcement), all the boys developed behaviors that they *believed* were related to the rewards. In other words, they became superstitious in much the same fashion as Skinner's pigeons. In the next phase of the study, the reinforcement was discontinued, which would be expected to cause a decrease and cessation of whatever behaviors had been conditioned (extinction). This is exactly what happened with the non-ADHD boys. But the boys with ADHD, after a brief pause, became more active and began engaging impulsively in bursts of responses at an even faster pace *as if* the reinforcement had been reestablished. The authors suggested that this overactivity and impulsiveness implied that the ADHD boys possessed significantly less ability to cope with delays of reinforcement than did the comparison group of boys. Findings such as these are important additions to our understanding and our ability to treat ADHD effectively.

One of Skinner's most famous works, his novel, *Walden Two*, was first published in the same year as his article on pigeon superstition. *Walden Two* was Skinner's personal vision of a utopian society governed by his principles of operant conditioning in which everyone is happy, content, safe, and productive. The extent of Skinner's real-life influences can be illustrated by the

fact that in 1967 a community called *Twin Oaks* was established in Virginia and was based on the behavioral concepts embodied in Skinner's novel. *Walden Two* signaled Skinner's willingness to go beyond his laboratory of rats and pigeons and extend his ideas to what might be termed a *behavioral philosophy*. Today, when psychologists write about the larger issues of human behavior in society, *Walden Two* is often cited (see Kimball & Heward, 1993; Maim, 1993).

CONCLUSION

Superstitions are everywhere. You probably have some, and you surely know others who have them. 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 such a part of a culture that they produce society-wide effects. You may be aware that most high-rise buildings do not have a 13th floor. Well, that's not exactly true. Obviously there is a 13th floor, but there is no floor that is *labeled "13."* This is probably not because architects and builders are an overly superstitious bunch, but rather it is due to the difficulty of renting or selling space on the 13th floor. Another example is that Americans are so superstitious about \$2 bills that the U.S. Treasury has a pile of four million of these bills that people refuse to use!

Are superstitions psychologically unhealthy? Most psychologists believe that even though superstitious behaviors, by definition, do not produce the consequences that you think they do, they can serve useful functions. Often such behaviors can produce a feeling of strength and control when a person is facing a difficult situation. It is interesting to note that people who are employed in dangerous occupations tend to have more superstitions than others. This feeling of increased power and control that is sometimes created by superstitious behavior can lead to reduced anxiety, greater confidence and assurance, and improved performance.

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