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Randomness, Does It Matter?

Nigel Turner, PhD

Affiliation: Scientist, Centre for Addiction and Mental Health, Toronto, Ontario, Nigel_Turner@camh.net

Nigel Turner received his doctorate in cognitive psychology from the University of Western Ontario in 1995. He has worked at the Addiction Research Division of the Centre for Addiction and Mental Health for the past five years where he has developed psychometric tools to measure addiction processes. He is currently focused on understanding the mental processes related to gambling addiction. He has extensive experience in various research methods including psychometrics, surveys, experimental studies, computer simulations, interviews and focus groups. He has published 10 papers in peer-reviewed journals, including three on problem gambling, and he has made numerous conference presentations.

[Our Research section will occasionally have articles that combine new insights into gambling research with a popularized approach to help non-scientists understand what lies behind some principles of gambling. –The Editor]

Abstract

Many gamblers hold erroneous beliefs about the nature of random events, but is understanding randomness relevant to prevention? This paper examines the nature of randomness and the origins of misunderstandings about randomness. In addition, it examines the issue of whether or not knowledge of randomness is important in terms of the prevention of problem gambling. The goal is to provide readers with better tools to address these issues with clients or in preparing prevention materials.

Introduction

Last year on the TV sitcom *Friends*, Ross, the know-it-all science guy, pointed out a woman standing around a casino and told his friends that she was a lurker, someone who keeps track of which machines have not paid out. Then, when a player leaves, she swoops in to steal the jackpot. While many of us might scoff at the idea, some undoubtedly think, “Hmm, I should try that.”

In actual fact, the core idea makes sense. Surely if a machine pays off 1 out of every 10 spins, and it hasn't paid out in over 20 spins, it must be due to pay out any minute. According to our research, 70% of the population of Ontario believes that if a slot machine has just paid out three times in a row, the chance of winning on the next pull are lower than would otherwise be the case (Turner & Liu, 1999). The corollary that it is beneficial to look for the machines that haven't paid out recently is logical but not true.

So, Ross is wrong. Why? Slot payouts are random events. Slot machines use a computer that creates an erratic sequence of numbers generated continuously. When the player presses the spin button, these numbers determine the positions of the reels. A microsecond difference in pressing the button would result in a different outcome. Whether a machine has or hasn't paid out is irrelevant.

Considerable research suggests that gambling behaviour is associated with a wide variety of erroneous beliefs or cognitive distortions about gambling. These include mistaken myths about ways to beat the odds, superstitions and the personification of gambling machines. Since many of these errors are related to misunderstandings about the nature of randomness, or probability, it is important to consider the extent to which understanding probability contributes to the development of a gambling problem – and to treatment, recovery and prevention.

It is often said that gambling isn't about the money, it's about excitement or escape. This argument suggests that problem gamblers' erroneous beliefs are irrelevant because they aren't trying to win. However, if you took away the possibility of winning, or asked a gambler to play games without betting, there wouldn't be any escape or excitement. Gambling is only exciting because of the possibility of winning real money. And that possibility seems plausible because of erroneous beliefs. Thus, beliefs, excitement and winning aren't really separate issues and there is no clear line separating the cognitive thoughts and emotional experiences of gambling.

Does this mean that gamblers rationally weigh the pros and cons of a bet? No. In fact, when I talk about the logic of gambling, in most cases I'm talking about unconscious beliefs about the way things work – schemas or mental models. Most of our “rational” thinking, such as understanding the words in a sentence, takes place automatically. Most often our unconscious mental processes produce schemas that are accurate, but when it comes to randomness, our minds often come up with the wrong schema.

Randomness explained

Why do our minds mess up so badly when it comes to randomness? My thesis is that the nature of randomness itself messes up our minds. I'll begin by considering where randomness comes from. Every movement is caused by some force. For example, when you throw a ball it doesn't always go where you want it to go. There are always tiny little changes in how you throw it: error variance or uncertainty. Even the greatest pitcher doesn't always throw the ball accurately. In addition, randomness is the result of complexity – too many things happening to keep track of. The squareness of a dice causes it to bounce erratically. If it lands on its side it bounces one way; if it lands on an edge it bounces in a different way. In contrast, the weight and smoothness of a bowling ball make its movement fairly uncomplicated. The complexity of the dice amplifies the tiny variations in how the dice is thrown so that rolling a dice produces a much more erratic movement than rolling a ball. Statisticians would say that a ball is more reliable than a dice.

Many people, including scientists, underestimate the impact of a little error. But mathematicians have found that under some conditions, a tiny change can have a huge and unpredictable effect on the final result. In the movie *Jurassic Park*, Jeff Goldblum's character, a self-declared chaos theorist, gives the following description of this effect, "…A butterfly flaps its wings in Central Park and then it rains in China."

Chaos is in fact a very disturbing idea to many traditional physicists (Gleick, 1987) because it suggests that prediction is not possible in some situations. However, complete randomness probably does not exist. Everything is the result of some force and if you knew exactly what those forces were and you could precisely measure all aspects of the complexity of the system, you could predict outcomes. In the early 1980s a group of California engineers spent several years building a computer to predict the outcome of roulette (Bass, 1985). In theory it is possible, however, in practice, exact measurement or control is not possible and therefore many gambling devices are very good at producing randomness.

Regression to the mean

Random numbers are erratic and unpredictable. You cannot predict which number will occur based on previous numbers because each number is independent of each other. On average a coin comes up heads 50% of the time. But coins have no memory! Even if heads come up 1000 times in a row, the next flip could be a head or a tail. If a coin flip is truly random, then it must be possible (although very unlikely) for it to come up heads 1 million times in a row. Furthermore, the number of heads and tails does not have to even out. A head is just as likely to occur after five heads as after five tails. The more flips you make the closer the average gets to 50%, but nothing can force it to even out.

Yet sometimes it seems to even out. What fools many people into believing that it is self-correcting is that the more times you flip a coin, the closer the average of heads or tails gets to 50%. After 18 flips, 10 more heads than tails is a very noticeable difference (See Figure 1).

Even after 400 flips there could still be 10 more heads than tails, but the difference becomes less noticeable (See Figure 2). The per cent gets closer to 50 but the actual number of heads and tails doesn't have to even out. After 1 million flips a difference of 8000 would still round off to 50%. This process of gradually converging on 50% is called regression to the mean.

I believe that the belief that randomness is self-correcting stems from our experiences of witnessing regression to the mean. A number is never due to come up but the odds are it will sooner or later. There is a subtle but important distinction between “due” to come up and “likely” to come up in that observing the past flips of a coin will not tell you when tails will come up. So, information about past numbers, flips or spins tells you nothing, and yet it often seems to. You cannot beat the odds by lurking, looking for the machine that is “due” to come up.

Experience leads to errors

Some of my recent research indicates that problem gamblers have a poorer understanding of randomness compared to non-problem gamblers (Turner & Liu, 1999). For example, problem gamblers were more likely to believe that betting on a number that looks random gives you a better chance of winning. Random numbers don't necessarily look random. A ticket with the numbers **1 - 2 - 3 - 4 - 5 - 6** has exactly the same chance of winning as a ticket with the numbers **3 - 17 - 21 - 28 - 32 - 47** but many people have trouble believing this. Most of the time random numbers look random. In a lotto 6-49 there are only 43 possible consecutive sequenced number tickets out of approximately 14 million possible tickets. Consequently, sequenced numbers rarely seem to come up in a lottery although all ticket numbers have the same chance of winning. As a contrast, consider lotto 2/2; a lottery where the only possible ticket numbers are **1-2, 2-1, 1-1** and **2-2**. In this case, all tickets appear to have a pattern or sequence so that whatever number is drawn, the winning ticket does not appear to be a random number.

Chasing

Another important aspect of understanding randomness is “chasing.” Chasing often involves betting larger and larger sums to win back what you've lost. The problem with chasing is not that it doesn't work but that it often does. If you double your bet every time you lose, your chance of winning back what you have lost is as high as 99% depending on your bankroll and the betting limit (Turner, 1998). In contrast, betting the same amount each time gives a person at best a 45% chance of winning back what he has lost. The downside is that when chasing doesn't work the result is catastrophic.

Last year, at Casino Rama in Orillia, Ontario, I calculated that I could work out a Martingale system (doubling after each loss) starting at $5 a hand and doubling with each bet until I won, to a maximum bet of $2000. This would require changing tables occasionally since each table had a maximum bet about 10 times its minimum (e.g., min = $5, max = $50; min = $50, max = $500). I could work it so that I would have a 99% chance of winning $5 and less than a 1% chance of losing $2555. Since it works so often people may come to believe that it always works. When that one 1% event occurs, the result is as much a shock as it is a nightmare.

The role of mind

The human mind is not very good at dealing with randomness. Our minds are designed to find order, not to appreciate chaos. Ever notice how easy it is to find faces in clouds? We are wired to look for patterns and find connections, and when we find patterns we interpret them as real. Consequently, many people will see patterns in random numbers. When people see patterns in randomness (e.g., repeated numbers, apparent sequences or winning streaks) they may believe that the numbers aren't truly random, and therefore, can be predicted.

Many gamblers have experienced a wave-like roller coaster effect of wins and losses and may believe that you just have to ride out the down slope of the wave to follow the wave back up. Much of this learning process takes place unconsciously. The problem is that betting based on these patterns sometimes appears to work in the short term, reinforcing the belief. But it will not work in the long term; these patterns are flukes. Suppose you start playing roulette and you have a lucky winning streak by alternating your bets between red and black, it will actually take quite a while before you realise that the betting strategy is not working. Your initial wins may keep you on the plus side for quite a while because randomness doesn't correct for winning streaks either.

The same is true for superstitious beliefs. Because we don't understand randomness we interpret coincidences as meaningful, and consciously or unconsciously we learn associations that are merely due to chance. Implicit learning is the driving force behind both betting systems and superstitious playing strategies. Furthermore, our memory of an event is not just about what happened but about the emotional experience of what happened. An important area for future research is the interplay between emotion, experience and belief.

Randomness, prevention and treatment

My point is that these beliefs and expectations are not irrational; they are often logically induced from a person's experience with random events. In a sense we are programmed by experience, the implicit learning of expectations. Theoretically, if a person experiences enough random events, he should have a pretty good sense of its nature. However, our minds tend to focus on early experiences, and we often pay more attention to experiences that support our beliefs than to those that don't, so what we expect tends to be distorted. An early win, for example, will result in distorted expectations. Our data suggest that as many as 50% of problem gamblers have experienced a large early win (Turner & Liu, 1999). Another key factor is need. If the win fills an emotional, spiritual or practical need, the distorting effect of the win will be greater.

Our research has shown that problem gamblers tend to have a poorer understanding of random events compared to non-problem social gamblers, and that untreated recovery from gambling problems is associated with higher levels of understanding about randomness (Turner & Liu, 1999). These findings suggest that teaching people about randomness may be an important part of both treatment and prevention.

In conclusion, often problem gamblers don't have distorted thoughts, but unrepresentative experiences which have resulted in distorted beliefs. I believe that altering or preventing these erroneous beliefs is at least one important ingredient in effective prevention and treatment programs.

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Figures

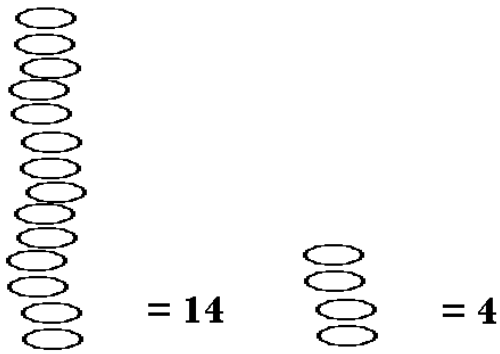

Figure 1:

After flipping a coin 18 times, a difference of 10 heads is noticeable.

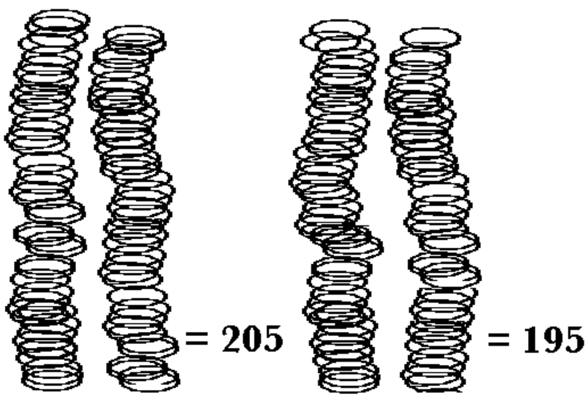

Figure 2:

After flipping a coin 400 times, a difference of 10 heads is barely noticeable.

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