RESEARCH QUESTIONS
Can people’s sensitivity to the structure of the environment be reconciled with the errors and biases (e.g., gamblers’ fallacy) that people are said to make with respect to the randomness of events?

PURPOSE
Decades of research have established three aspects of people’s misperceptions of randomness: people think a sequence is more likely, and hence random, if there is some irregularity in the order of appearance; people think a sequence is more likely, and hence random, if the equally probable outcomes occur equally often; and the outcome alternation rate (e.g., how often heads switches to tails in a coin toss) that people consider to be random is higher than that associated with chance. These errors are baffling; however, if we take into account that people are good at finding structure in the world. Thus, the present paper applied a model of the experienced environment (i.e., based on the assumption that human experience is finite and human short-term memory is of limited capacity) to the sequential outputs of a random generating process (e.g., coin toss) to examine whether people’s supposed misperceptions of randomness actually have probabilistic support.

HYPOTHESIS
There is a simple way in which peoples’ supposed misperceptions of randomness reflect true environmental statistics and are actually correct.

PROCEDURE
Simulations of random event sequences (e.g., coin toss) were run and examined with respect to the probability and timing of specific outcome sequences.

KEY RESULTS
In an infinite sequence of events, all possible substrings (i.e., specific sequences of events such as a series of coin tosses resulting in: heads, heads, tails, tails) are equally likely to occur. However, when these sequences are finite, possible substrings are not equally likely to occur. Given people’s finite resources (e.g., lifespan, memory), any particular sequence of events that they might experience (e.g., someone tossing a coin several times over) is necessarily finite. Upon examining a series of 10,000 randomly generated sequences and calculating the proportion for which a given substring (e.g., heads, heads, tails, tails) was not present, the authors determined that substrings that appear ‘regular’ (e.g., perfect alternation of heads, tails, heads, tails) are less likely to be observed, especially when the total number of events is under 20. Thus, the ‘misperception’ that random events are more likely irregular in appearance is accurate given people’s finite experiences. The authors also point out that a particular sequence (e.g., heads, tails, heads, heads, tails, tails) might be viewed simply as three heads and three tails rather than being noted as a particular sequence which would change the probability associated with the sequence occurring (i.e., three heads and three tails is three times more likely to occur than a sequence with five heads and one tail). This, then, suggests that the ‘misperception’ that equally probable events occur equally often in a random sequence is also accurate given people’s finite experiences. Finally, the authors found that short sequences tend to have more alternations between heads and tails than would be expected in an infinite series of coin tosses. This then suggests that people’s ‘misperception’ that a random alternation rate is higher than chance is accurate within their finite experiences. With respect to the gamblers’ fallacy (which is an extension of the alternation rate belief), the authors point out that the amount of time one would have to wait for a given sequence (i.e., heads, heads, heads, tails) is almost half of the wait time for another sequence (i.e., heads, heads, heads, heads). Thus, the intuition that the longer the run of a given event (e.g., heads) is the more likely it is that an alternate event (e.g., tails) will occur, is a more reasonable and subtle error than might be assumed based only on an understanding of the probabilities of infinite sequences.

LIMITATIONS
None noted.
CONCLUSIONS
The main misperceptions that people have regarding randomness are actually direct reflections of statistical properties of the experienced environment or the result of reasonable inferences from that experience, given finite human experience and limited short term memory.

KEYWORDS: randomness, intuitive statistics, probability, representativeness, gambler's fallacy, erroneous cognition

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