



The law of large numbers and beliefs about luck: An asymmetry in recognition of the risks and benefits of chance

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ABSTRACT

Three studies ($n = 655$) examined beliefs about chance, focusing on participants' recognition of some implications of the principle that small samples are more subject to chance fluctuation. Participants consistently demonstrated an asymmetry in their views about luck. Although they tended to recognize the possible decrements of chance fluctuation, they consistently failed to appreciate its potential benefits, especially in a context in which the outcome was largely contingent on factors under their personal control. Participants preferred a 100 question exam to a 10 question exam, correctly believing that an atypically low score was more likely with fewer questions. In contrast, they failed to recognize that an atypically high score was also more likely with fewer questions, and preferred the long exam even when there was no possible detriment from a low score and a potential benefit from a high one. This asymmetry was reduced, although not eliminated, in a ball drawing task in which the outcome was entirely chance determined. Results suggest that people associate chance fluctuation with bad luck more than with good luck, and are therefore reluctant to exchange control for the possible benefits of chance.

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"The key to winning the game is maximizing the good luck and minimizing the bad luck." Yul Kwon, winner of CBS "Survivor: Cook Islands", December, 2006.

"What does chance ever do for us?" William Paley

"Depend on the rabbit's foot if you will, but remember it didn't work for the rabbit." R.E. Shay

Introduction

Survivor, a long running CBS "reality" show, features a contest involving physical, cognitive, and interpersonal skills, as well as the occasional deployment of some Byzantine stratagems of deception. Given the skill dependent nature of the game, it may seem bizarre for a winner of that contest to stress the importance of luck. The above quotation from Yul Kwon, however, represents an acknowledgment that, even when the outcome is largely controlled by the effort and ability of the players, it is still possible to benefit from the vicissitudes of fortune. In the choices that people make, they can position themselves not only to avoid the pitfalls of chance, but also to take advantage of its windfalls. Particularly when outcomes are

determined by skill and ability, however, we suggest that people's view of chance is more consistent with the last two beginning quotations. Although people may recognize the risks that are presented by chance, its benefits may be less obvious. They may be better at minimizing their bad luck than at maximizing their good luck.

The law of large numbers revisited

The principle most relevant to these studies is known as "the law of large numbers" (LLN), first identified by the eighteenth century mathematician Jacob Bernoulli (Nickerson, 2004). The law simply holds that large samples are more reliable—they are more likely than small samples to closely resemble the population from which they are drawn. Although Bernoulli claimed that this theorem was intuitively obvious, research on understanding of the principle has yielded mixed results (see Nickerson, 2004, for a summary). In their well known study of the maternity ward problem, for example, Kahneman and Tversky (1972) asked participants to choose which of two hospitals, a large one or a small one, was more likely to record more days on which more than 60% of the babies born were boys. Most participants either chose the larger hospital or saw no difference between the two, failing to recognize that deviations from the population mean of about 50% were more likely with a smaller sample.

In contrast, Nisbett, Krantz, Jepson, and Kunda (1983) contend that people do indeed have some intuitive understanding of the principle. They argue that the extent of this understanding may vary with the context, with the domain of the samples, and with their relative size.

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It seems obvious, for example, that most people would place more confidence in a poll of 100 people than in a poll of 10. Somewhat more recent research has suggested that the effects of variations in sample size may be influenced by so-called “hot” cognitions, related to perceived personal relevance and motivation. In *Darke et al. (1998)*, for example, participants who were led to believe that a proposed exam policy might affect them, and were presumably motivated to scrutinize information more closely, based their attitudes on poll information only if the poll was reliably large. Those who believed that they would not be affected by the policy, in contrast, were influenced regardless of poll size.

Sample size, luck, and personal control

The findings of *Darke et al. (1998)* suggest that people may be sensitive to variations in sample size when the potential for large chance fluctuation harbors potential relevance, either real or hypothetical, for them. To test this hypothesis, we asked people to imagine themselves in a situation in which their grade in a college course was contingent on their score on the final exam. Under the LLN, their “true average” (their past average on all previous exams in this course) is more likely to be reflected by a final of 100 questions than by a final of only 10 questions. To assess their understanding of the implications of this principle, we asked them to suppose that they had an average of 90% on prior exams in a course, entitling them to a grade of A in the class, but that under the grading policy of the instructor only students who answered at least 80% of the questions correctly on the final would receive an A. Given the research on personal relevance, we expected people to recognize the applicability of the LLN and the greater hazard to their grade that was presented by the less reliable short exam. Accordingly, we predicted that they would prefer the 100 question final, which involved less chance of a score substantially lower than their “true average.”

But what would people choose if the short exam entailed no potential negative consequences, but only the greater likelihood of a substantial benefit? In another scenario, we asked participants to imagine that their average grade on prior exams was 80%, entitling them to a B, but also to suppose that the instructor, in a burst of end-of-term generosity, promised an A to everyone who received a score of at least 90% on the final. In addition, we instructed them to assume that, having taken all prior exams in the class, they had the option of simply dropping the grade on the final exam if less than 90% of their answers were correct. Accordingly, they were guaranteed at least a B in the course, regardless of the score on the last exam. In this way, we changed the circumstances so that chance was no longer a potential “spoiler”, but a potentially useful ally. Presented with this scenario, would most people realize that the short exam offered the greater opportunity for “lucking out” (by attaining a score that exceeded their past average) and choose it instead of the longer version?

We believed there were reasons for proposing an asymmetry in participants’ recognition of chance effects. If people recognize that a score on a long exam is less subject to chance fluctuation, they will also tend to believe that it is more under their control—e.g., more likely to be affected by their preparation for, and effort on, the exam. Past research demonstrates that people generally prefer to be in control (*Inglehart & Weizel, 2005; Langer & Rodin, 1976*), and this motivation may contribute to a consistent preference for the long exam.

Relatedly, preference for a long exam may also be influenced by a biased perception about chance outcomes—a belief that may underlie the desire for control. Although people undoubtedly value freedom of choice and dislike the unpredictability of arbitrary events, research suggests that their preference for control may also be rooted in a belief that random events are not really random. People, that is, may tend to associate chance with bad outcomes more than with good.

This bias is suggested by attribution research, which demonstrates that people take personal credit for positive outcomes, but tend to ascribe negative outcomes to bad luck (e.g., *Langer & Roth, 1975*).

Similarly, *Gilovich and Douglas (1986)* report that participants recognize the role of fluke events in producing their losses, but do not credit fluke events for their wins. More recently, *Risen and Gilovich (2007)* complement this research by demonstrating a negativity bias in estimations of the likelihood of some specific chance-determined events. Their participants believed that it was less likely that their own ticket would win the lottery than that the lottery would be won by a person who had acquired the winning ticket from the participant. Particularly aversive chance outcomes (e.g., a disliked person winning the lottery with the exchanged ticket) were seen as especially likely. Finally, *Risen and Gilovich (2008)* also demonstrate that people believe that it is bad luck to tempt fate—i.e., people assume that taking risks that expose oneself to chance makes negative outcomes more likely than positive ones.

These studies hint at a general proposition: People may be reluctant to surrender their control to a universe that they believe is not only capricious, but somewhat malicious to boot. Accordingly, they may forego the potential benefits of chance.

In these studies we extend research by examining recognition of the risks and benefits of chance fluctuation. Study 1 investigated exam preference in each of the above described scenarios. Because a short exam poses greater possibility of a chance-related loss (an atypically low score), we predicted that participants would prefer a long exam when a low score would decrease their grade. Because they might be less cognizant of the benefits of chance, however, we also predicted that they would fail to choose the short exam in a situation that presented substantial gain from an atypically high score and no potential detriment from a low one. Study 2 compared probability estimations and preferences in the exam context, in which ability and effort are important determinants of the outcome, with probability estimations in a ball-drawing context, in which the outcome was entirely chance-determined. Study 3 examined participants’ responses when they believed that they would be rewarded for correct answers. Finally, Studies 2 and 3 also examined participants’ beliefs about good luck, bad luck, and personal control, as well as the relation between these measures and sample choice.

Study 1

Method

Participants

Participants were 136 undergraduates (110 women and 26 men) at the University of California, Davis.¹

Design, procedure, and dependent measures

In a within-participant design, participants were asked to imagine themselves in each of two scenarios, described on separate pages. Order of scenarios was counterbalanced between participants.

(Potential Loss Scenario) You have worked hard in a particular course, and at the end of the quarter you have an average of 90% on the exams. This would entitle you to a grade of “A”. Under the grading policy of the instructor, however, you will receive a final grade of “A” in the class only if you answer at least 80% of the questions correctly on the final. Assume that achieving an “A” is very important to you, and also assume that questions on each of two exams have been randomly selected from the same pool of 1000 questions. Although these questions vary in their level of difficulty, on average they are neither easier nor more difficult than previous exam questions in the course.

¹ In all studies described in this article, participants were randomly assigned to the between-participant conditions. All participants were undergraduates at the University of California, Davis, and received credit in a psychology course for their participation.

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