What are the chances of winning?

Exploring the ecology and psychology of competitions

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Many resources are distributed by using competitions in which *n* competitors are ranked on a criterion to determine which *k* are "winners" ($k < n$). Whereas competitions can be characterized by costs and benefits, we explore their ecology by modeling the probability that a potential competitor will be a winner, taking account of numbers of winners (*k*), potential competitors (*n*), and relative ability level of the individual competitor (*q*). Using simulations, we explore how agents with different profiles of skill levels should assess the chances of winning different types of competitions. Although some implications are counter-intuitive, there is an astonishingly simple result: across different situations and profiles, probabilities exhibit a U-shaped pattern, clustering at the extremes, i.e., close to 0 and 1. In contrast, when we model humans (assuming linear information aggregation) intermediate values of probabilities dominate. We therefore use the multiple-cue probability learning paradigm to test whether humans can learn to make the appropriate probability judgments. We find that humans make systematic errors and their estimates do not cluster at 0 and 1. Since the appropriate calculations require considerable computational resources, we explore the possibility of using a simple decision rule. We identify one such heuristic and demonstrate its efficacy. Finally, we discuss changes and uncertainties in the parameters of our model and how these illuminate both the ecology and psychology of competitions. We also suggest extensions to more complex forms of competition.

Keywords: competition; probabilistic judgment; heuristics; simulation

Competitions are mechanisms for allocating resources to a limited number of recipients. As examples, consider the awarding of research grants, accepting papers for journals, prizes for different activities, selection of job candidates, promotion decisions, selection of contracts, and so on. More formally, competitions are used to decide which *k* of *n* competitors are "winners" ($k < n$) based on a rank-ordering of the competitors on a criterion.

Competitions have, of course, intrigued social scientists. Economists, for example, have made extensive analyses of how the incentive structures of competitions (also called contests or tournaments) affect economic agents' motivation to compete relative to other compensation schemes (see, e.g., Prendergast, 1999). Moreover, it has been argued that due to globalization and technology, among other forces, competitions have grown greatly in importance in everyday life thereby contributing to larger inequalities in the distribution of wealth as the world moves toward a "winner-take-all-society" (Frank & Cook, 1995). That is, contrary to the past, today people buy goods from a wide variety of suppliers around the globe such that even small differences in price/quality ratios are critical.

Economists and psychologists have both conducted experiments using the market-entry paradigm where only a limited number of competitors who decide to enter a market can be successful. Here the emphasis has been on factors affecting rates of entry and particularly overconfidence in judgment as captured by so-called "excess entry," that is, the phenomenon that too many competitors enter the market (Camerer & Lovallo, 1999; Fischbacher & Thöni, 2008; Moore & Cain, 2007; Karelaia & Hogarth, 2010; Rapoport, Seale, Erev, & Sundali, 1998; Sundali, Rapoport, & Seale, 1995).

Our purpose in this paper is to explore the ecology and psychology of competitions where, by the former, we aim to illuminate the probabilistic structure of winning in competitions, and, by the latter, to shed light on aspects of how people decide whether or not to enter specific competitions. We first describe the generic nature of competitions and identify their main features. Moreover, whereas it is important to characterize competitions by payoffs and the costs of entry, we find it instructive to focus principally on the probability that entry will lead to a successful outcome.

For this, we present a model. For any number of n (potential) participants and k winners, the model calculates p, the probability of being one of the winners, as a function of q, the decision maker's relative ability level on the criterion used to rank competitors. In other words, q is the probability that a randomly selected potential competitor has an ability level less than that of the decision maker. We exploit this model in several ways. First, we demonstrate that the probability of success, p, is a complex function of q, k, and n, and that it has several subtle implications that might not be evident at first sight. Second, we conduct simulations to illustrate the distribution of success probabilities that people with varying profiles of relative ability would experience as a function of characteristics of different situations. Third, we conduct further simulations to test the effects of assumptions of our theoretical model.

In previous work (Hogarth, Mukherjee, & Soyer, 2011), we found that people were unable to estimate accurately the probabilities specified by this model. This raises at least two important questions. The first is whether there are simple cognitive strategies or "heuristics" that people could reasonably use to make appropriate estimates. To answer this question, we simulate the efficacy of several such strategies and thereby further characterize the decision making ecology of competitions.

The second question is a consequence of noting that the environments in which people learn about the chances of success in competitions are not necessarily conducive to learning from experience (Einhorn & Hogarth, 1978; Hogarth, 2001). That is, people might be confused about how changes in the parameters of situations affect the chances of success. Moreover, the feedback received after making decisions could be either missing or misleading. We therefore use the multiple-cue probability learning paradigm to conduct experiments in which people are given the chance to infer the appropriate rules for estimating probabilities after receiving clear and timely feedback. In short, given ideal conditions for learning, do people acquire appropriate rules for estimating their chances of success in competitions?

In brief, the answers to our two questions are first that probabilities of winning in competitions involve astonishingly simple patterns: across different situations and profiles, probabilities cluster at the poles, i.e., close to 0 and 1. In contrast, when we model humans (assuming linear information aggregation) probabilities cluster away from the poles. As for the second question, we find that humans make systematic errors, do not show much ability to learn to estimate success and their estimates do not cluster at 0 and 1. Since the appropriate calculations require considerable computational resources, we explore the possibility of using a simple decision rule. We identify one such heuristic and demonstrate its efficacy. Finally, we discuss changes and uncertainties in the parameters of our model and how these illuminate both the ecology and psychology of competitions. We also suggest extensions to more complex forms of competition.

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