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Abstract

Contests are situations in which agents compete by irreversibly expending costly resources in an attempt to win a prize. Due to their applications in conflict, rent-seeking, organizational incentives, sports, litigation, and political campaigns, contests are widely applied in the social sciences. In this survey we summarize some main results and recent developments of experimental studies in contest theory. We also point out their broader applications in the social sciences.

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1. Contests and contest experiments

In Economics, a ‘contest’ carries a more specific meaning than a mere competition; it is a modeling framework for analyzing costly competitions. This framework is versatile and applicable to various economic, organizational, political, and social domains where individuals expend scarce resources, such as effort, money, time, or manpower, in order to achieve a favorable outcome (Konrad, 2009), often called a ‘win’. This expenditure is irretrievable regardless of the outcome and is often referred to as ‘effort’ regardless of the nature of the resource expended. The uncertainty in the contest outcome coupled with the cost of resources present a trade-off for the contestants.

A contest success function (CSF) is a mathematical function translating a contestant's effort into their probability of success, given the expenditures of others. There are three canonical CSFs that are widely applied in the literature. In the auction CSF the contestant with the highest effort wins with certainty (Baye et al., 1996). In the rank-order tournament, the contestant with the highest performance, incorporating both effort and a non-degenerate random factor, wins with certainty (Lazear and Rosen, 1981). In the Tullock contest (Tullock, 1980) a contestant's winning probability is based on the ratio of their effective effort to the sum of all contestants' effective efforts, where effective effort is effort raised to a fixed nonnegative power. This power signifies the importance of noise in the CSF, with a higher power indicating lower noise. A power of 0 results in a completely random draw in which effort has no effect, while a power of 1, which is the most popular choice among experimenters, leads to a simple lottery. As the power increases to infinity, the Tullock contest approximates the all-pay auction.

Investigating behavior in contests is often challenging due to the unavailability of detailed field data. While economists often use sports data for such studies (Balafoutas et al., 2019), in contexts such as wars, elections, school admissions, promotional contests, patent races, and political lobbying, collecting data on effort can be impossible, with only outcomes observable. Additionally, data on costs, abilities, and other relevant variables are often proprietary. Hence, laboratory experiments, in which the researcher can control each of the above aspects, are widely employed to study behavior in contests. Controlled experiments provide a means to directly observe spending behavior, mitigate measurement errors and endogeneity issues, and analyze how contestants respond to changes in model parameters or environmental factors. Consequently, contest experiments have garnered significant attention over time (Dechenaux et al., 2015).

2. Major findings from contest experiments

Bull et al. (1987) is credited as the first study using a contest framework in a laboratory experiment, comparing a rank-order tournament with piece rate incentives. Millner and Pratt (1989) explore the impact of noise on exerted effort in the first experimental investigation of a Tullock contest, while Davis and Reilly (1998) and Potters et al. (1998) are the two earliest laboratory experiments on an all-pay auction.

There are two regular findings in the experimental contest literature employing these three CSFs. (i) Overbidding: Subjects tend to spend more than the theoretically predicted equilibrium in the Tullock lottery (Sheremeta, 2013) and in all-pay auctions with more than 2 players (Davis and Reilly, 1998) but not necessarily in rank-order tournaments (Bull et al., 1987; Schotter and Weigelt, 1992) or all-pay auctions with 2 players (Potters et al., 1998; Ernst and Thöni, 2013). Moreover, the observed overbidding levels are generally lower in rank-order tournaments compared to all-pay auctions or lottery contests (Dechenaux et al., 2015). (ii) Overspreading: Subjects spread their spending more than the theoretically predicted equilibrium in the Tullock lottery (Chowdhury et al., 2014), all-pay auction (Millner and Pratt, 1998; Davis and Reilly, 1998; Potters et al., 1998), and tournaments (Bull et al., 1987), though heterogeneity in spending behavior in tournaments is generally lower than the heterogeneity observed in other types of contests (Dechenaux et al., 2015).

Whereas in Tullock contests and rank-order tournaments efforts are distributed around the equilibrium prediction, in all-pay auctions, where equilibrium is generally in mixed strategies, effort follows a bimodal distribution, concentrating at high and low levels in the range of efforts (Potters et al., 1998; Gneezy and Smorodinsky, 2006; Ernst and Thöni, 2013).

Overbidding has been attributed to various behavioral explanations, including bounded rationality (Chowdhury et al., 2014, Lim et al., 2014), slow learning due to structural noise (Masiliūnas, 2023), mistakes, systematic biases, joy of winning, relative payoff maximization, impulsivity, and cognitive ability (Sheremeta, 2018a). The extent of overbidding is also influenced by a variety of factors, including operational details such as reward-sharing rules or cost structures (Chowdhury et al., 2014), information feedback (Fallucchi et al., 2013), framing (Masiliūnas and Nax, 2020), and features of experimental implementation (Chowdhury et al., 2020).

Overspreading is influenced by various factors, including demographic differences (Sheremeta, 2013), heterogeneous preferences for risk and losses (Chowdhury et al., 2018), social preferences such as inequality aversion (Mago et al., 2013), and heterogeneous preferences towards winning (Sheremeta, 2013). Effort variability also decreases as competitiveness decreases, for example, through an increase in the number of winners relative to contestants (Harbring and Irlenbusch, 2003), or by allowing participants to self-select into tournament schemes (Eriksson et al., 2009).

Dynamic contests also exhibit a tendency for overbidding relative to the equilibrium benchmark. Moreover, in contrast to the typical decrease in overbidding observed in repeated play of static contests due to learning effects, some studies (Deck and Sheremeta, 2012 on the game of siege; Deck and Sheremeta, 2019 on tug-of-war) have reported a non-decreasing gap between expended and predicted effort over time in dynamic contest experiments.

Dechenaux et al. (2015) provide a thorough review of various comparative statics investigations in laboratory experiments, covering static contests and various dynamic forms, including sequential contests, races, elimination contests, contests with carryover, and static contests with multiple battlefields. Sheremeta (2019) provides a review of major results across static, dynamic, multidimensional, and group contests. Kimbrough et al. (2020) explore experimental applications of economists' main models of war and conflict. Literature reviews that focus on specific topics in contests also examine experimental work on these topics. These include Chowdhury et al. (2023) on heterogeneity and affirmative action in contests, Chowdhury and Gürtler (2015) and Piest and Schrek (2021) on sabotage in contests, Sheremeta (2018b) on behavior in group contests, and Chowdhury (2021) on the impact of social identity on contest behavior.

3. Broader implications of contest experiments for the social sciences

The contest framework has been applied in numerous disciplines including computer science, animal biology, management science, psychology, and education (see Kasumovic et al., 2017 for a review of the interdisciplinary perspectives on contests). This section explores recent studies that delve into various areas important to the social sciences. It underscores the significance of contestant heterogeneity in shaping incentives within contests.

When there is sufficient heterogeneity among contestants, weaker players might feel discouraged due to lower expectations of success and exert less effort. This, in turn, can also induce stronger players to exert less effort. This phenomenon is often called the ‘discouragement effect’. The discouragement effect is observed to influence the weaker contestants more heavily (Hart et al., 2015; March and Sahm, 2017; Fallucchi et al., 2021). This observation underscores the argument for implementing affirmative action policies in contests with heterogeneous participants. In a real effort tournament involving schoolchildren, Calsamiglia et al. (2013) observe that additional training through affirmative action led to improved overall performance and a more equitable representation of advantaged and disadvantaged children among winners. Various experiments (e.g., Czibor and Dominguez-Martinez, 2019; Maggian et al., 2020 on gender quotas) highlight the effort-enhancing and participation-enhancing effects of quota policies. Measures such as bid caps and favorable tie-breaking rules can also alleviate the discouragement of weaker contestants (Llorente-Saguer et al., 2023).

Dynamic contests may introduce asymmetry even among initially homogeneous contestants, as interim success creates variations in the continuation value. Mago et al. (2013) distinguish between strategic momentum and psychological momentum, finding support for strategic momentum in a best-of-three lottery contest with an intermediate prize. Overall, contest experiments provide evidence for the effort enhancing benefits of affirmative action policies in heterogeneous contests. See the survey by Chowdhury et al. (2023) for further details on both the discouragement effect and affirmative action in contests.

The well-known but uncontrolled Robbers Cave experiment (Sherif et al., 1961) is the pioneering study demonstrating that hostility can arise in conflicts between groups with artificially created group identities. Diab (1970) extends this result to show that artificially created or minimal identity can even override natural identities when it comes to igniting conflict. Chowdhury et al. (2016) present contrasting evidence from a controlled lab experiment using a group contest with no identity, real identity, and minimal identity. The results show that the salience of real identity, but not minimal identity, plays a crucial role in the initiation and intensity of conflict, as suggested by Sen (2007).

Another broadly investigated class of contests in the social sciences analyzes conflict in which two or more contestants who expend resources in multiple battlefields, with each contestant's payoff determined by their set of battlefield victories and the cost of resource allocation. This class includes the well-known Colonel Blotto game and its variants. These have applications in electoral competition, R&D competition, attack-and-defense, and multi-market resource allocation. Early experiments in this area include Avrahami and Kareev (2009) and Chowdhury et al. (2013). Both experiments broadly support the theoretical predictions of the models. Extensions in the lab and in the field include Arad and Rubinstein (2012), Kohli et al. (2013), and Chowdhury et al. (2021).

Finally, a related area where contest experiments have made a distinct mark is conflict involving attack-and-defense. Kovenock et al. (2019) is the first to run an experiment on attack-and-defense of weakest link networks. They employ both the lottery and auction CSFs and show that only the theoretical results for the auction CSF are supported in the laboratory. De Dreu et al. (2021) combine findings from various experiments on political conflicts, analyzing the tradeoff between winning and reducing collective costs. Through a series of psychometric tests, they attribute aggressive political investment to non-selfish preferences, over-optimism, and limited cognitive capacities. De Dreu and Gross (2019) distinguish between neurocognitive processes in attack-and-defense, noting that defending is a more spontaneous and successful strategy. Factors such as pro-sociality and empathy reduce attack frequency, while time pressure and intellectual challenges can increase attack intensity (De Dreu et al., 2019). These studies underscore the avoidable nature of conflict and contribute to the emerging literature on biological sources of contest behavior (e.g., Branas-Garza et al., 2023).

We have briefly addressed some of the key findings and applications of contemporary contest experiments, with emphasis on relevance to social scientists. Given the increasing popularity and rapid evolution of the field, we anticipate many more advances to come.

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