

Boudon Reexamined

Nuts and Bolts for Contemporary Sociological Science

Gianluca Manzo (Ed.)



Boudon Reexamined presents a selection of short essays by leading scholars from several generations who critically engage and enter into dialogue with the work of Raymond Boudon. Each chapter focuses on a specific topic from his extensive writings. Readers will follow this intellectual trajectory through analyses of early correspondence with Lazarsfeld and Merton, his typology of sociological styles, and his contributions to contemporary analytical sociology, including the notion of middle-range theory. In addition to already well-discussed aspects of Boudon's work, namely his understanding of methodological individualism and the theory of ordinary rationality, the book also explores less frequently discussed topics, including his early interest in formal modeling in sociology and his understanding of the link between interdependence structures and social change. Included in the following pages are new assessments of Boudon's well-known analyses of the inequality of educational opportunity and intergenerational social mobility, as well as his lesser-known substantive contributions to the study of relative deprivation and his early dialogue with game theory. The book also outlines Boudon's study of classical authors, especially Tocqueville, before two final chapters conclude by examining how Boudon's works can be used to teach sociology at the undergraduate and master's levels. Our hope is that *Boudon Reexamined* provides readers with a fresh assessment of his legacy – how his work can be applied to conduct theoretical and empirical research in contemporary sociology, as well as to promote high-quality scientific standards for new generations.

Gianluca Manzo is Professor of Sociology at Sorbonne University and a Fellow of the European Academy of Sociology. His research applies computational models and social network analysis to the study of social stratification and diffusion dynamics. He is the author of *La Spirale des inégalités* (PUPS, 2009) and of *Agent-based Models and Causal Inference* (Wiley, 2022). He also edited *Analytical Sociology: Actions and Networks* (Wiley, 2014) and the *Research Handbook on Analytical Sociology* (Edward Elgar, 2021). More information is available on his webpage: www.gemass.fr/member/manzo-gianluca/.



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Chapter 11

The Logic of Relative Frustration. Experimental Tests of Raymond Boudon's Mobility Model

**Joël Berger, Andreas Diekmann
and Stefan Wehrli**

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L'intelligence
du social

**Book series directed
by Pierre Demeulenaere**

The great books of the sociological tradition are either works of theory and epistemology or empirical studies structured by a profound theoretical or epistemological reflection. Émile Durkheim's first three books, *The Division of Labour in Society*, *The Rules of Sociological Method*, and *Suicide*, each fall into one of these three categories. This heritage represents an impressive growing legacy of authors and works that foster an understanding of social life through the formation of new concepts, models, and interpretations, thereby providing a pathway to deciphering the thickness and chaotic nature of human societies.

Gianluca Manzo (Ed.)

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for Contemporary Sociological Science

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THE LOGIC OF RELATIVE FRUSTRATION.
EXPERIMENTAL TESTS OF
RAYMOND BOUDON'S MOBILITY MODEL

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Alexis de Tocqueville's assertion, derived from the French Revolution, that societal progress can incite frustration and conflict has been a topic of enduring interest (Goldhammer and Elster 2011). A comprehensive analysis of historical data suggests that an increase in educational opportunities and a consequent oversupply on the labor market can promote social conflict (Turchin 2012; Turchin and Korotayev 2020). A related phenomenon was observed in a study on social mobility in the US Army (Stouffer et al. 1950). Promotion opportunities were evaluated as worst in those branches that offered the highest objective chances for promotion: a cross-sectional equivalent to the effect of improving conditions coinciding with growing frustration over time.

Whereas the accuracy of Tocqueville's historical narrative is not the focus of this discussion, the proposition that social advancement can foster frustration has become a cornerstone concept of broad interest within the social sciences. The recent rise in right-wing populism has been examined from this perspective

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(Goodwin 2014; Inglehart and Norris 2017; Rydgren 2012; Smith 1995). Globalization and digitalization, while driving economic growth and creating job opportunities, are also believed to have exacerbated social inequality. Since the 1970s, labor market polarization has increased, with job opportunities rising at the top of the income distribution but stagnating and even decreasing in the middle (Agénor and Aizenman 1997; Alderson and Nielsen 2002; Autor et al. 2006; Frey and Osborne 2017; Oesch 2015; Van Reenen 2011). Progress for some and stagnation, if it does not decline, for others may foster frustration among those “left behind” (Goodwin 2014; Smith 1995; Steiner et al. 2023; Swank 2003). Populist movements leverage the frustration of the left behind to gain power (Cutts et al. 2019; Ford and Goodwin 2014; Gidron and Hall 2017; Goodwin 2014; Meuleman et al. 2020; Rico et al. 2017; Rodrik 2018; Rydgren 2012; Smith 1995).

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The frustration of those left behind is elucidated by relative deprivation (Meuleman et al. 2020; Tutić and von Hermann 2018). Relative deprivation pertains to an individual’s sense of disadvantage in comparison to others, a perception often accompanied by feelings of resentment and entitlement (Smith et al. 2012). Such perceptions can erode social trust (Dunn et al. 2012; Freeman et al. 2014) and may incite antisocial behavior or a desire for retaliation against those viewed as oppressors (Gurr 2015; Marx 2020; Skarlicki and Folger 1997).

However, the established theory of relative deprivation concentrates primarily on individuals. Explaining the phenomenon of escalating frustration amidst improving conditions requires a theory that can reconcile social structure with the widespread occurrence of frustration. One such theory is Boudon’s game-theoretical model (Boudon 1977). This model links the prevalence of relative deprivation to the opportunities for upward mobility within a social system, such as a society or an organization. In essence, the model predicts, under certain assumptions, an inverted U-shaped trajectory of relative deprivation and consequent frustration over time as mobility improves.

In Section 2, we provide a brief overview of the research to date on Boudon’s model. Section 3 of this paper outlines the model and our hypotheses. Section 4 details the experiment. Section 5 presents the results, and Section 6 concludes with a discussion.

PREVIOUS RESEARCH

Despite its potential significance to social sciences, research applying Boudon’s model remains sparse. We begin our short review with research on mathematical investigations of the model and agent-based simulation models.

Initial research has mathematically demonstrated that the primary implications of the model remain stable when the underlying micro-assumptions are varied (Kosaka 1986; Raub 1984). Boudon formulated his model in terms of game theory. However, his predictions were generally not consistent with the Nash equilibrium. Instead, he proposed the relationship between winning and losing events as a tacit coordination mechanism, which he called “quasi-solidarity” (Boudon 1982 [1977]: 114). Rationality theory would predict the mixed Nash equilibrium derived by Raub (1984).

More than two decades later, Manzo (2009) picked up the thread again with an agent-based simulation of the model. Manzo (2009) was able to show that Boudon’s prediction of a reverse U-shaped mobility-frustration function is corroborated by simulation results if certain assumptions of the parameter space are met. Further research using agent-based modelling has extended the theory, suggesting that local network social comparisons (Manzo 2011) and low entry costs into status competition (Otten 2020) both amplify the effect of improving mobility on relative deprivation.

Berger and Diekmann (2015) conducted the first experimental assessment of the model and observed either static or reduced frustration as opportunities improved. This result contradicts the prediction of the model, which assumes an inverted U-shaped curve of relative deprivation, provided that certain restrictions on the parameters that were met in the experiment are assumed. However, the findings are crucially dependent on the measurement of frustration. Inequity aversion, which may reduce competitiveness in Boudon’s model, offers a partial explanation for this inconsistency (Otten 2022). Moreover, an inverted U-shaped curve was observed in pairwise comparisons of results corresponding to the Gini coefficient as a measure of frustration (Berger and Diekmann 2015).

Previous experimental studies primarily used student samples and were conducted in small groups of six. Additionally, relative deprivation and the accompanying frustration were gauged from participant self-reports or were simply assumed to be present in the losers of competition without incorporating behavioral measures for validation (Berger and Diekmann 2015; Otten 2022).

To address these limitations, we conducted an online experiment on Amazon Mechanical Turk (MTurk) to test the model’s prediction of a reverse U-shaped path of relative deprivation with improving mobility with a large, diverse sample of US citizens ($N = 2,114$). Participants competed for status positions within groups that offered varying numbers of such positions, resulting in three distinct mobility levels: low, intermediate, and high. We also varied group size for robustness. Following the competition, we employed three metrics: a structural measure assessing the relative frequency of losers within

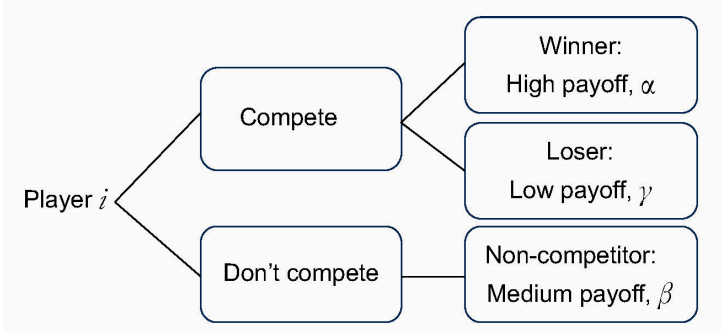
a group (termed “prevalence of relative deprivation”), a subjective measure of relative deprivation gauged using a Likert-type scale (referred to as “subjective frustration”), and a behavioral measure derived from the joy-of-destruction game (named “behavioral hostility”). In this game, participants have the opportunity to decrease the earnings of other group members, albeit at a personal expense (Abbink and Sadrieh 2009). This measure is relevant because variation in antisocial behavior within the game has been correlated with the intensity of competition for limited resources in everyday life (Prediger et al. 2014).

THE MODEL

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The model starts with a group of N players who simultaneously decide whether to compete for one of k prizes or status positions.¹ These positions are limited. There are more players than positions ($N > k$). Entering the competition requires an investment fee (C), akin to obtaining an academic degree as a prerequisite for applying for a well-paid position in the labor market. The competition game assigns each player a status position: high, low, or intermediate. Successful competitors, the winners, secure the desired position and receive a high payoff, calculated as the value of the prize minus the investment fee ($B - C = \alpha$). These winners hold a higher social status than their group members. Those who are outcompeted, the losers, have paid their investment fee but receive nothing in return, resulting in a low payoff (γ) and corresponding status position. Last, those who opt out of competition, the non-competitors, receive an intermediate payoff (β) and hold an intermediate status (Figure 1).

Figure 1: Individual Decision Situation



Note: Each player has the option to compete or abstain from competition. Successful competitors, or winners, receive a high payoff (α). Unsuccessful competitors, or losers, receive a low payoff (γ). Players who choose not to compete, or non-competitors, receive a medium payoff (β). The likelihood of success for those entering the competition is contingent on the number of positions available and the total number of competitors. This figure is a modification of the original presented in Berger and Diekmann’s (2015) study.

Boudon's model crucially assumes that only the losers experience relative deprivation (Boudon 1982 [1977]). This is because the losers, having invested the same fee as the winners, consider the winners as their reference group. However, unlike the winners, they receive nothing in return for their investment, leading to a state of relative deprivation. An example would be university graduates who fail to secure suitable employment, an outcome that has been linked to relative deprivation and subsequent frustration (Peiró et al. 2010; Turchin 2010). In contrast, the non-competitors, who have not paid an investment fee, do not consider the winners as their reference group, and therefore do not experience relative deprivation.

The model's central implication is that, in specific conditions, an increase in relative deprivation prevalence with improving social mobility emerges as the unintended consequence of individuals' strategic decisions. Increasing mobility, represented in the model by a growing number of positions (k), increases the expected benefit of entering competition. Consequently, additional positions tempt additional players to compete. When the number of additional competitors grows faster than the number of additional positions, the number of relatively deprived losers increases. Thus, increasing mobility boosts the relative deprivation prevalence.

The following discussion details how the effect of increasing relative deprivation with increasing social mobility derives from the model. The starting point is the following question: When should rational actors enter the competition, and when should they stay out? Intuitively, when the number of competitors matches or undershoots the number of positions, it is best to compete. Unfortunately, before the decisions are made, none of the N players knows how many of the others will enter the competition. However, given the high payoff (α), the low payoff (γ), and the number of positions (k), a rational actor can derive the expected utility of competing for a given number of competitors (n) with equation (1). The payoff of the other strategy, not competing, is β , no matter how many actors enter competition. With this information, a payoff matrix can be constructed from the perspective of a focal player (i) for a given number of positions (k) (Figure 2).

Equation 1:

$$E(k, n) = \begin{cases} \frac{k}{n}\alpha + \frac{n-k}{n}\gamma & \text{for } k < n \\ \alpha & \text{for } k \geq n. \end{cases}$$

Figure 2: Payoff Matrix from the Perspective of Focal Player i

		Number of other competitors ($n - 1$)				
		0	1	2	...	$N-1$
Player i	Compete	$E(K, 0)$	$E(K, 1)$	$E(K, 2)$	...	$E(K, n - 1)$
	Don't compete	β	β	β	...	β

Note: The expectation of competing depends on the total number of competitors and is given by equation (1). The payoff of not competing is β , no matter how many group members enter the competition. This figure is a modification of the original presented in Berger and Diekmann's (2015) study.

From a game-theoretical perspective, the competition game outlined here can give rise to two distinct strategic situations. If the expectation of competing exceeds β , even if every actor enters competition, competing becomes the dominant strategy. A rational actor will always compete in this case, which implies that every single group member enters the competition. Consequently, the entire group ends relatively deprived, except those obtaining positions. That is, the relative deprivation prevalence simply amounts to $1 - k/N$.

When no dominant strategy exists, things become more complicated. This is the case when the expectation of competing exceeds β , up to a certain threshold of competitors, n^* and undershoots β thereafter. In principle, it would then be best to reach an agreement about which n^* members of a group should compete and which $N - n^*$ should not. However, assuming homogeneous players and the absence of communication or other means of coordination, such a solution, called an asymmetric Nash equilibrium in pure strategies, cannot be realized. Another possibility is a mixed strategy solution, which, according to Harsanyi and Selten's (1988) axioms, is the rational choice in a symmetrical game. That is, each player chooses to compete with an optimal probability, p^* , and stays out of competition with probability $1 - p^*$. To derive p^* , the overall expected utility of competing for a given number of positions, k , and all possible permutations of competitors, is equated with the payoff of not competing, β . Solving for p in equation (2) yields the optimal probability, p^* .

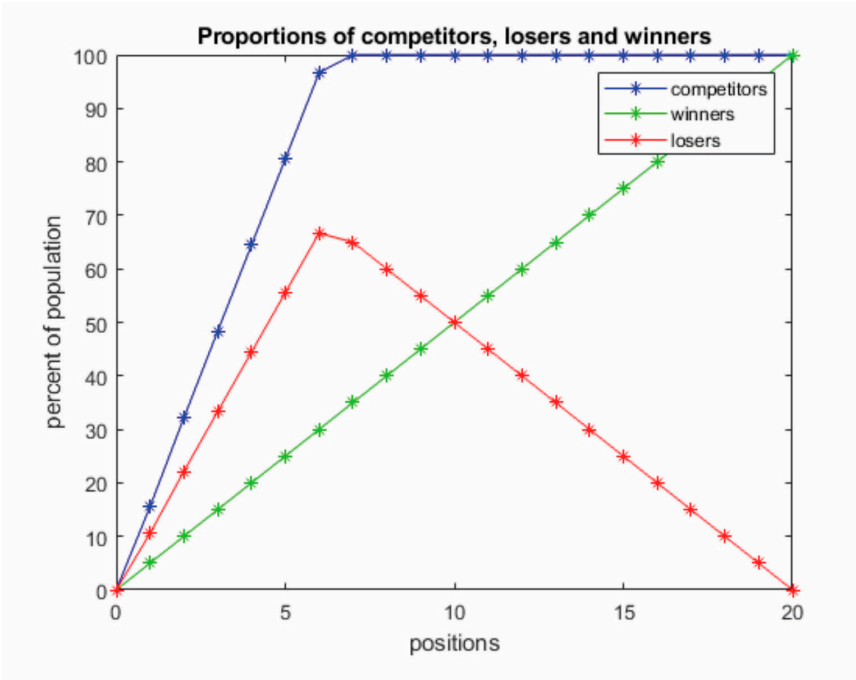
Equation 2:

$$E(\text{Compete}) = \sum_{n=1}^N \binom{N-1}{n-1} p^{n-1} (1-p)^{N-n} E(k, n) = \beta$$

This probability also equals the expected proportion of individuals entering competition. That means that the relative deprivation prevalence amounts to $p^* - \frac{k}{N}$.

Figure 3 summarizes the model predictions for groups of 20 and the payoffs $\alpha = 2, \beta = 1$, and $\gamma = 0.55$. With one position available, 15 percent of the group (or three individuals) are expected to enter the competition, resulting in a relative deprivation prevalence of 10 percent (two losers). As the number of status positions grows, the number of competitors grows even faster. For this reason, relative deprivation increases with the number of positions up to a certain point. As soon as competing becomes a dominant strategy ($k = 7$), and everyone enters the competition, additional positions can only diminish relative deprivation. From that point onward, relative deprivation decreases monotonically, approximating zero when virtually everyone gains a status position. From these predictions, we derive our main hypothesis: The association between the relative deprivation prevalence and mobility takes the form of an inverted U: the inverted U hypothesis.

Figure 3: Point Predictions for Groups of 20



Note: the payoffs $\alpha = 2, \beta = 1$, and $\gamma = 0.55$. Predicted share of competitors, winners, and losers per group, depending on the number of positions k .

It is worth noting that the association between mobility and relative deprivation does not necessarily take this form but depends strongly on the exact model parameters. Conditions that favor increasing deprivation with

increasing number of positions include a low entry fee into the competition and a large differential between the winners' and losers' payoffs. For a systematic analysis of those conditions, see Raub (1984). We provide the Matlab code used to derive our predictions in part 1 of the online supplementary materials (OSM).

METHODS

EXPERIMENTAL TREATMENTS AND DESIGN

We conducted an online experiment using MTurk, a platform previously used for social science research (Arechar et al. 2018). Online lab-style experiments offer advantages over conventional physical labs by allowing larger, more diverse samples and potentially reducing social desirability bias due to the lack of in-person experimenter presence (Belot et al. 2015; Krupnikov and Levine 2014). The study took place in the summer of 2020.

Our experiment incorporated two treatment dimensions: mobility and group size. Depending on the mobility treatment condition, the competition offered either a low, intermediate, or high number of positions (Table 1). Group size was either small groups of six participants or large groups of 20.

Table 1: Experimental Treatments Including Model Predictions (percent, set in italics)

	Small groups (6 individuals)			Large groups (20 individuals)		
	Positions	Competitors	Losers	Positions	Competitors	Losers
Low mobility	1	<i>53.1</i>	<i>36.5</i>	1	<i>15.6</i>	<i>10.6</i>
Intermediate mobility	2	<i>100</i>	<i>66.7</i>	7	<i>100</i>	<i>65.0</i>
High mobility	5	<i>100</i>	<i>16.7</i>	15	<i>100</i>	<i>25.0</i>

Notes: High payoff: USD 2, medium payoff: USD 1, low payoff: USD 0.55.

By varying mobility – the number of available status positions per group – we aim to examine if relative deprivation assumes an inverted U-shape with increasing mobility, as predicted. The second treatment dimension, group size, allows a robustness check of the results because the model predicts the same qualitative pattern independently of group size. Groups of six have been used in previous experiments (e.g., Berger and Diekmann 2015). Larger groups of twenty offer a broader scope for treatment effects to arise. The number of positions available per treatment was chosen strategically to optimize the likelihood of detecting an increase in losers when mobility improves. We began by selecting both the minimum ($k = 1$) and a near-maximum number of status positions ($k = 5$ for groups of six, $k = 15$ for groups of 20). For the intermediate mobility treatment, we identified the number of positions at which the model

predicts the highest number of losers. This number signifies a critical juncture at which the allure of competition becomes so pronounced that it becomes the dominant strategy, prompting the entire group to enter competition. Table 1 summarizes the design, including the predicted shares of competitors and losers per treatment.

EXPERIMENTAL PROCEDURE

The experiment consisted of two parts (Table 2). The first part involved a single round of the competition game. In the second part, participants received feedback about their status after the competition, and the relative shares of winners, losers, and non-competitors in their groups. This feedback was immediately followed by the measures of relative deprivation.

Table 2: Experimental Procedure

First part	1.	Questionnaire on sociodemographic background
	2.	Competition game (prevalence of relative deprivation)
Second part	1.	Joy-of-destruction game (behavioral hostility)
	2.	Subjective frustration (satisfaction, frustration, fairness)

In the first part of the experiment, each participant was randomly assigned to a group of either 6 or 20 members, and each group was randomly assigned to either the low, intermediate, or high mobility treatment. Participants then completed a sociodemographic background questionnaire. They were informed about the size of their group and the number of positions available in their group. They learned that the competition would result in three types of players, each with a different payoff: winners received a high payoff of USD 2, losers a low payoff of USD 0.55, and non-competitors a medium payoff of USD 1. The payoffs were expressed in money points (MP) during the experiment, with USD 1 corresponding to 100 MP. Furthermore, participants were awarded USD 0.50 for both the first and second parts.

After reading the instructions, they underwent a comprehension check. On average, participants answered 86 percent of the questions accurately, and any incorrect responses were rectified. For a detailed overview of the test, refer to the instructions in OSM2.

Subsequently, participants chose whether to participate in the competition.

The second part of the experiment began once every member of a group had made their decisions. The competitors were informed about their status as winners or losers, and all participants learned about the number of winners, losers, and non-competitors in their group. Subsequently, we measured subjective and behavioral proxies of relative deprivation. We measured

behavioral hostility using the joy-of-destruction game (Abbink and Sadrieh 2009). In this game, each participant decided whether or not to reduce the payoff of a randomly chosen participant in their group. Participants indicated the amount of money (up to 10 MP) they would be willing to pay depending on whether the randomly selected person was a winner, loser, or non-competitor. The selected person's payoff would then be reduced by five times the amount indicated. This method produces an incentive-compatible metric for antisocial behavior, contingent on the potential target's status (winner, loser, or non-competitor). We also assessed subjective indicators of relative deprivation on a Likert-type scale from 0 to 10. These indicators included frustration with the competition, satisfaction with the competition outcome, and perceived fairness of the competition.

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In finalizing our design, we opted for a survey format over a real-time interaction format. This decision was informed by the known susceptibility of real-time online experiments to substantial dropout rates, which can reach up to 18 percent (Arechar et al. 2018). To mitigate this susceptibility, we allowed participants to read instructions, make decisions, and complete questionnaires at their own pace. The participants were then disconnected immediately after completion. Once all members of a group had completed the first part, a random mechanism selected one or more winners, depending on the specific treatment. Subsequently, all group members were invited to part two by email, typically after 20 minutes.

Despite these measures, we experienced significant dropouts. The primary reason was a longer than anticipated time lag between the two parts of the experiment. In most groups, participants received an invitation to part two approximately 20 minutes after the conclusion of part one. However, in some groups, particularly those in the high-mobility treatment with a large number of winners, the waiting time was considerably longer. This led to a pronounced dropout rate in the high-mobility treatment conditions. We address the limitations arising from this dropout in the discussion section. Table SVIII in OSM₃ details the dropouts for each treatment condition.

SAMPLE

Our net sample comprised 2,114 US-American MTurk workers, 48.01 percent female and 51.99 percent male, with an average age of 39.49 years. Descriptive statistics are presented in OSM₃ Table SVI. Table 3 lists the number of groups and individuals (in parentheses) completed per treatment.

Table 3: Numbers of Groups per Treatment

	Low mobility	Intermediate mobility	High mobility	Total
Groups of 6 (individuals)	30 (180)	29 (174)	20 (120)	79 (474)
Groups of 20 (individuals)	30 (600)	30 (600)	22 (440)	82 (1640)
Total	60 (780)	59 (774)	42 (560)	161 (2,114)

Note: Numbers refer to groups (individuals in parentheses).

MEASURES

After the competition, we used three measures. First, we determined the percentage of losers in each group as a structural metric (called “prevalence of relative deprivation”). Next, we gauged participants’ behavioral hostility towards winners, losers, and non-competitors through the joy-of-destruction game (called “behavioral hostility”). Last, we evaluated “subjective frustration” by averaging scores from three scales: satisfaction with the competition outcome (reversed), frustration with the competition, and perceived fairness of the competition. Each scale ranged from 0 (not at all) to 10 (completely). We then constructed a subjective frustration index by averaging the scores from these three scales (Cronbach’s $\alpha = 0.68$; refer to OSM III Table SIV for additional details).

RESULTS

We observed significant pairwise correlations at the individual level between the three dependent measures (loser = 1, 0 otherwise, subjective frustration, and behavioral hostility) for groups of 6 and 20 participants. These correlations were statistically significant at least at the 5 percent level, as shown in Table 4. The relationships between loser status and feelings of frustration were moderate to strong, with point-biserial correlations just under 0.6. The correlations between loser status and behavioral hostility and between frustration and hostility were notably smaller, with values ranging between 0.1 and 0.2.

Table 4: Pairwise Correlations Between the Dependent Measures

	Groups of six			Groups of twenty		
	Loser	Subjective frustration	Behavioral hostility	Loser	Subjective frustration	Behavioral hostility
Loser		0.59***	0.21***		0.58***	0.16***
Subjective frustration			0.10*			0.20***

To examine the inverted-U hypothesis, we analyzed the entry into competition and the resulting prevalence of relative deprivation, represented by the share of losers per group. We employed logit models with Competing or Loser as dependent variables and three treatment dummies as predictors: intermediate mobility and high mobility, with low mobility as the reference category. We also constructed extended models with additional predictors: female (with male as reference category), age, and risk preference on a scale from 0 for risk averse, to 10 for risk seeking (Dohmen et al. 2011). All models were computed with robust standard errors and were clustered at the group level. We report only the average marginal effects (AMEs) from the restricted model here because the results from the extended model, reported in the Supplementary Online Materials (OSM3-Table SI), were closely comparable.¹

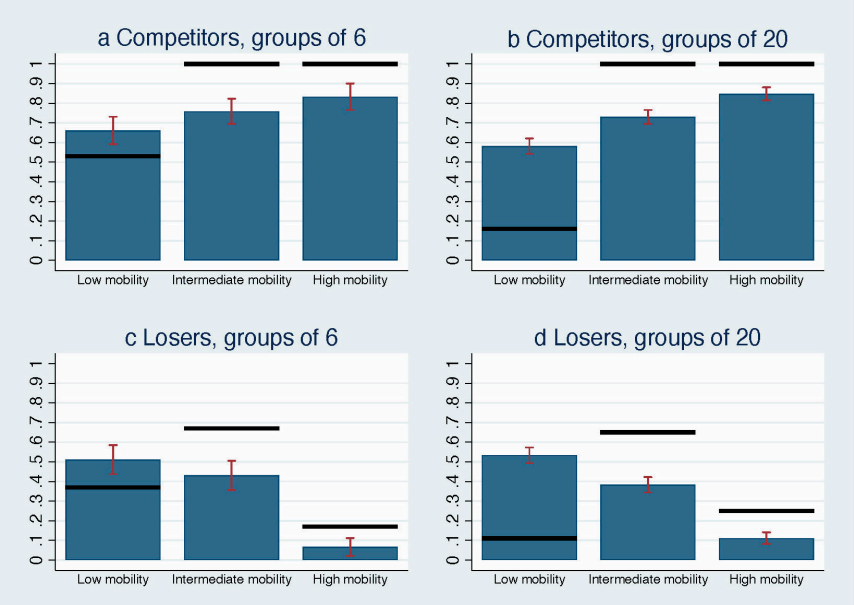
204 Figure 4 summarizes the results. The general pattern that higher numbers of winning places led to higher numbers of participants entering the competition holds for both small groups (panel a of Figure 4) and large groups (panel b of Figure 4). Using the low-mobility treatment condition as a reference, we find that for small groups with intermediate mobility, $AME = 0.098, z = 1.96, p < 0.05$; and with high mobility, $AME = .172, z = 3.50, p < 0.001$. For large groups with intermediate mobility, $AME = .148, z = 5.32, p < 0.001$; and with high mobility, $AME = 0.266, z = 9.13, p < 0.001$. The entry rates observed are indicated in the note to Figure 4.

Interestingly, we notice significant over-entry in conditions of low mobility and under-entry in conditions of intermediate or high mobility compared to rationality predictions. Under low mobility, 66.1 percent and 58.2 percent of participants enter competition, thus exceeding the predicted rates of 53.1 percent and 15.6 percent, respectively. Conversely, under intermediate mobility, the competition entry rates are 75.9 percent and 73.0 percent, falling short of the predicted 100 percent for each group.² However, note that over-entry is excluded by definition from the dominant strategy case.

1 This section draws on Berger and Diekmann (2015). For the game-theoretical model and derivations of the mixed equilibrium strategy, see Raub (1984).

2 We also computed a full model that includes the two treatment effects (number of positions and group size) with their interaction effects (refer to OSM Table SII of Berger, Diekmann, Wehrli 2024). However, in the main manuscript, we present individual regression models as opposed to the full model. This approach was chosen for two reasons. Firstly, the interaction effects were found to be statistically insignificant. Secondly, the theoretical model's predictions for large and small groups are distinct. Conducting separate analyses simplifies the comparison of predicted results with observed outcomes.

Figure 4: Shares of Competitors and Losers as a Function of Upward Social Mobility



Note: Red lines represent 95 percent confidence intervals, and black horizontal lines indicate predictions. **a** Shares of competitors per group in groups of six. Low mobility, 0.66 (predicted, 0.53); intermediate mobility, 0.76 (predicted, 1.0); high mobility, 0.83 (predicted, 1.0). **b** Shares of competitors per group in groups of 20. Low mobility, 0.58 (predicted, 0.16); intermediate mobility, 0.73 (predicted, 1.0); high mobility, 0.84 (predicted, 1.0). **c** Shares of losers per group in groups of six. Low mobility, 0.51 (predicted, 0.37); intermediate mobility, 0.43 (predicted, 0.67); high mobility, 0.07 (predicted, 0.17). **d** Shares of losers per group in groups of 20. Low mobility, 0.53 (predicted, 0.11); intermediate mobility, 0.38 (predicted, 0.65); high mobility, 0.11 (predicted, 0.25). The sample sizes are $n = 474$ for groups of six and $n = 1640$ for groups of 20.

Due to the discrepancy between predicted and actual competitiveness, the shares of losers in the groups do not peak as expected in the intermediate-mobility treatment. Instead, the shares of losers in both small and large groups consistently decrease as mobility increases (Figure 4b and c). For small groups with intermediate mobility, $AME = -0.15$, $z = -5.30$, $p < 0.001$; and with high mobility, $AME = -0.444$, $z = -11.64$, $p < 0.001$. For large groups with intermediate mobility, $AME = -0.167$, $z = -6.33$, $p < 0.001$; and with high mobility, $AME = -0.422$, $z = -15.36$, $p < 0.001$ (SOM3-Table III).

In summary, we observed an over-entry in competition within the low-mobility treatment, juxtaposed with an under-entry in the intermediate-mobility treatment. Over-entry is particularly pronounced in the larger group with 20 actors and is less apparent in the smaller 6-person group. Consequently, the shares of losers exceed predictions in the low-mobility treatments and

fall short in the intermediate-mobility treatments. Therefore, contrary to the model’s prediction of an inverted U-shaped trend in relative deprivation prevalence, we found that the percentage of losers consistently decreases with increasing mobility.

SUBJECTIVE FRUSTRATION

We constructed ordinary least squares (OLS) regression models with subjective frustration as the dependent variable to achieve two primary objectives. First, we sought to examine a fundamental micro assumption that individuals who lose in a competition experience a higher degree of frustration than those who do not compete or those who win. Second, we sought to scrutinize the inverted-U hypothesis through a subjective proxy of relative deprivation.

206 The data strongly support the micro assumption. On a scale from 0 to 10, losers report roughly 2.7 points higher average frustration than non-competitors and roughly 3 points higher frustration than winners. These effects are statistically significant with $p < 0.001$ (Table 5, Models 1 and 3).

Table 5: Subjective Frustration

	Model 1	Model 2	Model 3	Model 4
Loser	2.709***		2.693***	
	(11.16)		(20.70)	
Winner	-0.322		-0.305**	
	(-1.37)		(-2.65)	
Intermediate mobility		0.161		-0.257
		(0.65)		(-1.76)
High mobility		-1.206***		-1.269***
		(-4.73)		(-9.46)
Constant	2.382***	3.509***	2.453***	3.767***
	(13.12)	(19.10)	(26.80)	(31.92)
N	474	474	1640	1640

Note: OLS regression models with subjective frustration (index) as dependent variable. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. t-values in parentheses. Standard errors clustered at the group level. Models 1 and 2 refer to groups of 6; Models 3 and 4 refer to groups of 20. Reference categories: non-competitor, low-mobility condition.

Contrarily, the inverted-U hypothesis does not receive any support from our findings. We observed no significant differences in frustration levels between the low- and intermediate-mobility treatments in either small or large groups. However, frustration levels were approximately 1.2 to 1.3 points lower in high-

mobility treatments than in low-mobility treatments ($p < 0.001$ for groups of both sizes). In essence, frustration remains stable as mobility increases but decreases when mobility reaches its peak (refer to Table 5, Models 2 and 4).

In conclusion, our results do not endorse the inverted-U hypothesis. However, they do affirm the micro assumption that losers experience greater frustration than winners and non-competitors.

BEHAVIORAL HOSTILITY

In our analysis of behavioral hostility within the joy-of-destruction game, we observed a distinct pattern. Approximately 40.7 percent of participants were willing to pay to reduce the payoff of a randomly selected group member. This figure aligns closely with the 39.4 percent reported in a previous study by Abbink and Sadrieh (2009).

When we break down this behavior by participant type, non-competitors fall below this baseline at 22.2 percent whereas losers exceed it at 51.8 percent. Interestingly, winners align closely with the overall average at 40.1 percent. Losers spend three times as much ($M = 2.215$) as non-competitors ($M = 0.753$), and winners spend approximately twice as much ($M = 1.74$).

However, the status of the individual on the receiving end of the hostility, the “target,” appears to have minimal impact. For instance, losers invested 2.13, 2.04, and 2.48 to reduce the payoffs of non-competitors, losers, and winners, respectively.

Consequently, our discussion will primarily focus on general interpersonal hostility, defined as the average individual spending for reduction (Cronbach’s $\alpha = .90$). This approach allows us to concentrate on the behavior of the instigator, which our data suggest plays a more significant role than the status of the target (refer to Table 6).

Table 6: Hostility Depending on the Status of a Focal Individual and a Target Individual

Target’s status	Instigator’s status		
	Loser	Winner	Non-competitor
Loser	2.04	1.65	0.72
Winner	2.48	1.89	0.91
Non-competitor	2.13	1.69	0.63

Note: The table represents the points invested by the focal participant to reduce the payoff of the target, contingent on the instigator’s and the target’s status. The conversion rate is 100 money points, equivalent to USD 1.

We analyzed behavioral hostility using OLS regression models (Table 7). Initially, we only tested for status effects in Models 1 and 4 for small and large groups, respectively. Next, we tested for treatment effects in Models 2 and 5.

Finally, we incorporated the participants' beliefs about the hostile behavior of other group members, which has been identified as a strong predictor of reducing others' payoffs in previous research (Prediger et al. 2014).

Table 7: Behavioral Hostility

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Loser	1.761*** (6.56)		0.579** (3.06)	1.384*** (8.82)		0.621*** (6.19)
Winner	1.093*** (4.86)		0.0932 (0.53)	0.970*** (5.53)		0.282** (2.78)
Intermediate mobility		0.115 (0.34)			0.0956 (0.45)	
High mobility		-0.157 (-0.49)			0.117 (0.47)	
Beliefs about losers			0.0747* (2.01)			0.136*** (6.38)
Beliefs about non-competitors			0.389*** (8.48)			0.348*** (11.39)
Beliefs about winners			0.392*** (10.64)			0.343*** (14.59)
Constant	0.515*** (4.36)	1.569*** (7.44)	-0.510*** (-4.04)	0.814*** (8.55)	1.585*** (11.60)	-0.700*** (-10.84)
N	474	474	474	1640	1640	1640

Note: OLS regression models with behavioral hostility as dependent variable. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. t-values in parentheses. Standard errors clustered at the group level. Models 1, 2, and 3 refer to groups of six participants, and models 4, 5, and 6 refer to groups of 20. Reference categories: non-competitor, low-mobility condition.

The results corroborate our initial findings. Losers consistently spend most on diminishing others' assets, followed by winners and then non-competitors. This pattern is consistent across both small and large groups (refer to Models 1 and 4 in Table 7; groups of 6: losers vs. non-competitors, $1.761, t = 6.56, p < 0.001$; winners vs. non-competitors, $1.09, t = 4.86, p < 0.001$, losers vs. winners in a test of linear combination, $F = 4.82, p < 0.05$; groups of 20: losers vs. non-competitors, $1.38, t = 8.82, p < 0.001$, winners vs. non-competitors, $.97, t = 5.53, p < 0.001$, losers vs. winners in a test of linear combination, $F = 4.45, p < 0.05$).

Treatment effects provide no support for the inverted-U hypothesis, aligning with our analysis of structural and subjective relative deprivation. No

significant differences across treatments were observed for either small or large groups (refer to Models 2 and 5 in Table 7).

In a subsequent analysis, we incorporated beliefs about the extent to which other players in the group reduced their group members' assets. This was differentiated by the categories of losers, winners, and non-competitors. The beliefs of participants in all three categories significantly predict behavioral hostility (Models 3 and 5 in Table 7). Interestingly, when accounting for beliefs, the effect of the instigator's status diminishes. In small groups, once beliefs are factored in, the disparity in hostility between winners and non-competitors almost vanishes and becomes statistically insignificant (Model 1: $1.09, t = 4.86, p < 0.001$, Model 3: $0.09, t = 0.53, p = 0.596$). In contrast, the surplus hostility of losers remains significant and substantial when adjusting for beliefs (Model 1: $1.76, t = 6.56, p < 0.001$, Model 3: $1.58, t = 3.06, p < 0.05$). A similar pattern is observed in large groups. When controlling for beliefs, hostility in winners aligns closely with that in non-competitors (Model 4: $0.97, t = 5.53, p < 0.001$, Model 6: $0.28, t = 2.787, p < 0.01$), whereas the coefficient of hostility in losers remains more than double the coefficient of hostility in winners even when adjusting for beliefs (Model 4: $1.38, t = 8.82, p < 0.01$, Model 6: $0.62, t = 6.19, p < 0.001$).

Why might winners' perceptions of others' hostility shape their own aggressive actions? This remains open to speculation. Winners might exhibit aggression because they anticipate potential threats from others: a kind of pre-emptive retaliation. Alternatively, their actions could stem from a desire to elevate their status. Conversely, the hostility displayed by losers seems to be rooted in frustration, as indicated in Table 4.

EXPLORATORY RESULTS

Exploiting our heterogeneous and extensive sample, we conducted a series of exploratory analyses using socioeconomic background (gender, age, education), political ideology, and psychological measures (risk preferences, social value orientation) as predictors of competition entry, subjective frustration, and behavioral hostility. Most predictors were gauged with direct survey questions (see OSM2 for details). However, social value orientation was assessed with an incentive-compatible method (Crosetto et al. 2019; Höglinger and Wehrli 2017; Murphy and Ackermann 2014).

Descriptive statistics are presented in OSM3 Table SVI, and regression outcomes from combined small and large group data are in OSM3 Table SVII. Only a few variables showed significant effects. Risk-tolerant individuals ($AME = 0.060, z = 19.35, p < 0.001$) and women ($AME = 0.074, z = 4.41,$

$p < 0.05$) were more inclined to compete, whereas those with graduate degrees were less so than were individuals with a high school education or less ($AME = 0.075, z = -2.24, p < 0.05$). Risk tolerance correlated positively with both perceived frustration ($0.044, z = 2.23, p < 0.05$) and behavioral hostility ($0.043, z = 4.75, p < 0.001$). The latter was also more pronounced among right-leaning individuals than among centrists ($0.312, z = 5.96, p < 0.001$).

DISCUSSION AND CONCLUSION

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The rise of populism has reignited scholarly interest in the paradox of societal advancement leading to frustration and social tension (Cutts et al. 2019; Ford and Goodwin 2014; Gidron and Hall 2017; Goodwin 2014; Meuleman et al. 2020; Rico et al. 2017; Rodrik 2018; Rydgren 2012; Smith 1995). However, our understanding of the specific macroconditions and micro-mechanisms that give rise to this phenomenon is still limited. A game-theoretical model proposed by Boudon (1982 [1977]) offers a promising approach to this issue. This model connects opportunities for upward social mobility within a social system to the prevalence of relative deprivation in that system. It predicts that the proportion of relatively deprived and frustrated losers in the competition for upward social mobility will follow an inverted U-shaped pattern as mobility increases.

To test this inverted U-shaped hypothesis, we designed an online experiment on MTurk with a large and diverse sample of US citizens ($N = 2,114$). We allowed participants to choose whether to compete for high-status positions with their group members. The first treatment dimension was the number of positions available per group, which created low, intermediate, or high accessibility to upward mobility. The second treatment dimension was group size: small groups of six or large groups of 20. This treatment allowed a robustness check of the results. We employed three metrics to gauge relative deprivation. First, in line with Boudon's suggestion, we used a structural measure to determine the relative frequency of losers within a group. Second, we assessed participants' subjective frustration upon discovering the competition's outcome using a Likert-type scale. Last, we measured behavioral hostility through the joy-of-destruction game (Abbink and Sadrieh 2009), which evaluates participants' inclination to decrease their group members' payoffs at a personal cost. This measure is of specific interest as it has been linked to the intensity of competition for limited resources in everyday life (Prediger et al. 2014).

We found no inverted-U-shaped relative deprivation prevalence when mobility increased but we did find falling relative deprivation – a result that was

robust to variation in group size. The pattern of decreasing relative deprivation with increasing mobility was due to a gap between behavior expected under standard rationality assumptions and observed behavior. Our findings are qualitatively consistent in both small and large groups. We observed over-entry into competition with low mobility and under-entry with intermediate mobility, with decreasing relative deprivation as a consequence. However, over-entry in a “winner takes it all” situation ($k = 1$) is particularly pronounced in the larger group with 20 actors and less noticeable in the smaller six-person group. Moreover, comparing our results with our previous experiments with six-person groups (Berger and Diekmann 2015) we did not observe over-entry in situations with one vacant position. Only in one of the three former experiments subjects invested slightly more than predicted. Hence, results are not consistent in small groups. At best, we can say that actors vastly overrate their chances of winning when the opportunity is small and the group is large.

The entire deductive sequence leading to the inverse U-type mobility-frustration relation is not confirmed by the data due to deviations from the game-theoretic predictions of the mixed equilibrium. In real-world situations, individuals typically have more time to make choices, such as completing job applications, and allocating more time to the decision-making process, potentially leading to more rational behavior.

At the same time, the discrepancy between predicted and observed entry into competition with intermediate accessibility to upward social mobility becomes even greater when actors are concerned not only with their own payoffs but also with the payoffs of others (Otten 2020; 2022). More frustration under increased chances for upward social mobility is thus unlikely to emerge under the conditions exemplified by the model. However, various factors may reinforce this phenomenon. Consider the classic finding by Stouffer et al., which suggests lower average satisfaction with promotion opportunities in those branches of the US Army offering the highest objective chances (Stouffer et al. 1950). Importantly, mid-twentieth century soldiers constitute a specific demographic group: males. It is well-established that, on average, men exhibit more competitive behavior than women, particularly when winners are selected by performance rather than by lot (Berger, Osterloh and Rost 2020; Niederle and Vesterlund 2007; 2011). Consequently, over-participation and increased frustration when mobility is relatively high may well occur in specific subpopulations with pronounced competitiveness. Behavioral contagion in networks could also encourage over-entry (Guilbeault et al. 2018; Manzo 2011).

Beyond the question of over-entry, we found an intriguing, exploratory result. Although losers exhibited higher frustration than winners and non-

competitors, as the model suggests, we found a different pattern for behavioral hostility. Not only losers but also winners showed more hostility than non-competitors. There are two potential explanations. The first is a causal effect. Winners might engage in pre-emptive retaliation due to fear of aggression from losers, or they might wish to increase their status. The second involves self-selection, suggesting that individuals drawn to competition might inherently possess more aggressive traits (Kajonius et al. 2015; Paulhus and Williams 2002; Tesi et al. 2023; Zitek and Jordan 2016). Additionally, a combined effect is plausible: Intense competition might heighten inherent tendencies toward antisocial behavior (Berger, Osterloh, Rost et al. 2020). In our study, irrespective of the exact underlying mechanisms, we can definitely exclude the idea that heightened hostility in losers stems solely from self-selection. The division into winners and losers was made at random. Nonetheless, losers consistently displayed more hostility than winners.

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In our exploratory analyses, we observed that risk-tolerant individuals and women were more inclined to engage in competition. However, individuals with higher education levels demonstrated a lower propensity for competitiveness. Those with a higher risk tolerance expressed higher feelings of frustration and exhibited more aggressive behavior. The pattern of increased hostility was also notable among individuals with right-leaning political views. Increased competitiveness in women is surprising at first glance, as typically, women are less competitive than men (Balafoutas et al. 2018; Niederle and Vesterlund 2007; 2011). At the same time, our competition game used a specific method of winner selection: the lot. Random selection has been reported to increase competitiveness in women (Berger, Osterloh, and Rost 2020).

A significant limitation of our study is participant dropout, which primarily occurred in the larger groups and the high-mobility treatment. As a result, the findings for this specific condition should be interpreted with caution. Nevertheless, we believe our main result – decreasing frustration as social mobility improves from low to intermediate – is reliable, because we experienced minimal dropout in the low- and intermediate-mobility treatments. Moreover, the results are quite consistent for both small groups, which were largely unaffected by dropout, and for large groups.

To summarize our main results: First, over-entry into competition was prevalent in low-mobility scenarios in large groups, whereas significant under-entry was noticeable in both intermediate and high-mobility situations. This trend led to a reduction in relative deprivation across all the conditions. Second, both winners and losers displayed higher antisocial tendencies than did non-competitors. Importantly, there was no corresponding rise at the aggregate

level as mobility increased, suggesting that self-selection at least partly explains nastiness in competitors.

Drawing on our findings, future studies of social structure and relative deprivation should focus on elements that intensify the competitive drive for upward social mobility when more opportunities arise. We assumed that subjects' decisions were governed by the strict rationality standards of game theory and by a utility function that excluded nonmonetary arguments. We also assumed risk neutrality for predictions made from expected monetary values. No learning processes were taken into account in any of the experiments discussed so far. Subjects had to make decisions in "one-shot" interactions. It is very likely that subjects will adapt their behavior if they have the opportunity to repeat interactions (with strangers). Further research may also consider relaxing the model assumptions or applying alternative decision principles from bounded rationality theory. Research should also investigate whether the pronounced hostility in winners stems from self-selection or has some causal elements. In parallel, it is worth examining whether societal advancement might amplify frustration due to a growing disparity between winners and losers, rather than focusing exclusively on the "losers of modernization," as suggested by Boudon's model.

Although the results of the few available experiments are to some extent inconsistent and the central prediction of the inverse U-shaped relationship between mobility and the extent of frustration is not in accordance with previous experimental findings, the model should by no means be abandoned prematurely. To put it in Boudon's own words: "It is worth noting, incidentally, that the model also provides the logical skeleton for a research project in experimental social psychology that would very probably lead to some very instructive results and would perhaps put one in a better position to understand phenomena like envy" (Boudon 1982 [1977], p. 123). As he also emphasizes, the basic model can be extended in various directions. For example, he suggests some variants that take into account heterogeneity with regard to resources or position goods, so that the value of a successful application decreases with the number of vacant positions (Boudon 1982 [1977], p. 122). Various alternative operationalizations are also conceivable when measuring the degree of frustration. The underlying strict rationality theory of mixed Nash equilibrium, which we employed in our study, makes very restrictive assumptions; bounded rationality principles and learning may come closer to observable behavior. In any case, the strength of the model is that precise hypotheses can be derived for different parameter constellations and different model variants, which can be tested on empirical data.

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NOTES ON THE AUTHORS

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ACCLAIMS

This remarkably well-structured volume accomplishes two feats at once. It offers a critical engagement with the multiple facets and contributions of Raymond Boudon's sociological oeuvre, for example: the modeling of relative deprivation, the generative approach to social stratification, the plea for methodological individualism, the analysis of unintended consequences and social change, the epistemology of sociological investigations, and the reflection on rationality and belief formation. Through this critical engagement – here is the second feat – this volume tackles substantive and methodological issues central to contemporary developments in the discipline of sociology, whether the focus is on formal models, simulation work, counterfactual reasoning, social mobility and its measurements, the significance of Rational Choice, or our understanding of processual dynamics.

Ivan Ermakoff, Professor of Sociology,
University of Wisconsin-Madison

Without indulging in praise, this collective volume – bringing together 18 substantial chapters – aims to shed light on the enduring legacy of Raymond Boudon's sociology. It addresses a notable gap: the lack of a detailed, multifaceted examination of the work of one of the foremost figures in both French and international sociology. The reader will find not only an assessment of Boudon's intellectual contributions but also a critical appraisal of their limitations and the avenues they open for further research into contemporary issues. The book will appeal both to specialists familiar with the evolution of Boudon's thought over time and to those wishing to discover it, explore it in greater depth, or draw upon it for teaching purposes.

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This book is a splendid tribute to Raymond Boudon, one of the most important sociologists of the second half of the 20th century. The contributions, in their appreciative and critical aspects alike, clearly bring out the intellectual depth and challenging nature of Boudon's work and its continuing relevance in the study of modern societies.

John H. Goldthorpe, Emeritus Fellow,
Nuffield College, University of Oxford

This collection of papers, expertly curated by Gianluca Manzo, is as wide-ranging and thought-provoking as Raymond Boudon himself. It is sure to stimulate interest in a now-sometimes-forgotten giant of French sociology.

Neil Gross, Charles A. Dana Professor of Sociology,
Colby College (Maine)

This Memorial Festschrift honors Raymond Boudon (1934–2013) by considering his contributions to conceptualization, theory, and empirics, as well as their associated methods, across foundational topical domains in sociology and guided by expert commentators. It is not only a superb assessment, and its value will grow in three main ways. First, like most Festschriften, it provides a portrait of the growth and trajectory of Boudon's ideas, embedded in his relations with other scholars, both teachers, peers, and students. This portrait will grow over time. Second, as the historian David Knowles wrote about the *quaestiones quodlibetales* of the medieval university (especially the University of Paris) and the debates held during Advent and Lent when anyone could ask any question of any master, Festschrift discussions are a valuable index to what is “in the air” – in this case both when Boudon was working and now. Third, Boudon believed in the promise of mathematics, and it will be possible to trace over time the progress of the $X \rightarrow Y$ relations in the book, as they travel from general functions to specific functions.

Guillermina Jasso, Professor of Sociology,
Silver Professor of Arts and Science, New York University

This book is not a hagiography. Unusually, its title truly reflects its content. Twenty-two sociologists from different countries and different generations take a fresh look at the work of Raymond Boudon. In keeping with his approach but without complacency, they highlight the theoretical and methodological contributions of his sociology, its limitations, its errors, its relevance for teaching sociology to the new generations, and the perspectives that remain open in several thematic areas.

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