Boudon Reexamined

Nuts and Bolts for Contemporary Sociological Science

Gianluca Manzo (Ed.)

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L'intelligence du social

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 10

Coleman's Problem and Boudon's Solution: Rational Choice Theory as a Tool for Sociology

Werner Raub

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L'intelligence du social

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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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SUP
Maison de la Recherche
Sorbonne Université
28, rue Serpente
75006 Paris - France

Phone: 33 (0)1 53 10 57 60

sup@sorbonne-universite.fr
< sup.sorbonne-universite.fr >

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COLEMAN'S PROBLEM AND BOUDON'S SOLUTION: RATIONAL CHOICE THEORY AS A TOOL FOR SOCIOLOGY

Werner Raub
Department of Sociology/ICS , Utrecht University, Netherlands

Raymond Boudon and James S. Coleman have stimulated modern sociological science through theoretical and empirical work in diverse domains of the discipline. Programmatically, they envisaged sociology as a problem- and theory-guided discipline, with theory construction accounting not only for the behavior and properties of individual actors at the micro-level but also, and specifically, aiming at the explanation of phenomena and regularities at the macro-level of social systems. They likewise envisaged methodological individualism as a key feature of theory construction: macro-level phenomena and regularities are explained by also employing micro-level assumptions, namely, assumptions on individual actors. Hence, theory construction requires linking macro- and micro-levels of analysis, clarifying how system characteristics affect actors and their behavior as well as, conversely, how micro-level behavior leads to macro-level consequences. Furthermore, both Coleman and Boudon advocated for closely aligning theory construction with research designs, empirical research, and statistical modeling. In this way, they pioneered sociology as a science – "rigorous sociology" – currently employed by a family of research programs and developments in the discipline (see Raub, de Graaf and Gërxhani 2022 for a sketch of rigorous sociology; Goldthorpe 2021, ch. 9 is specifically on Boudon and Coleman as pioneers of the approach, including brief biographical sketches and a discussion of common features of their contributions as well as different emphases).

Comments by Vincent Buskens, Hartmut Esser, Rainer Hegselmann, Gianluca Manzo, Jörg Stolz, and participants of the GEMASS Symposium "Engaging with Boudon: Insights for Contemporary Sociological Science" (Paris, June 2024) are gratefully acknowledged.

I will argue that Boudon offers a solution to a problem that Coleman considered as crucial for sociology along these lines. Boudon's solution is broadly in line with applications of rational choice theory in sociology. An important feature of his solution is highlighting that rational choice theory in general and game theory in particular are tools for sociology, not only in the sense of providing assumptions on regularities of individual behavior, such as (expected) utility maximization or game-theoretic equilibrium behavior, but also as tools for tackling the problem that Coleman posed.[1]

COLEMAN'S PROBLEM

Concerning the macro-level, Coleman (for example, 1990, ch. 1) considers social systems such as families, cities, organizations, schools, and markets. In addition, we could consider "populations" in the sense of Goldthorpe (2016).

Coleman outlines how to explain macro-level phenomena and macro-level regularities. Explanations include, first, assumptions on macro-conditions, that is, assumptions on social systems, including Goldthorpe's populations. Second, assumptions are needed on how macro-conditions affect micro-level conditions for individuals and their behavior. Such "bridge assumptions" (Wippler and Lindenberg 1987) make macro-to-micro links explicit and clarify the "logic of the situation" (Esser 1993, p. 94). Third, additional assumptions on micro-level conditions are needed, such as assumptions on actors' preferences and beliefs. Fourth, explanations require clarification of the "logic of selection" (Esser 1993, pp. 94-96), namely, assumptions on micro-level behavioral regularities, specifying how actors behave under given conditions. Fifth, there are assumptions on how macro-level outcomes depend on actors' behavior. These are "transformation rules" (Wippler and Lindenberg 1987) that make micro-to-macro links explicit, thus clarifying the "logic of aggregation" (Esser 1993, pp. 96-98). One can then derive implications concerning actors' behavior – micro-outcomes – from the assumptions on macro-conditions, bridge-assumptions, additional micro-conditions, and assumptions on behavioral regularities. Also, and particularly, implications for macro-outcomes and for macro-level regularities in the sense of statistical associations between macro-conditions and macro-outcomes follow from an explanans comprising all five kinds of assumptions. Coleman's macro-micro-

1 Boudon's (e.g., 1998, 2003) further contributions concerning applications of rational choice theory in sociology include his attempts to develop an alternative to what he considered as standard rational choice assumptions and his attempts to "endogenize" preferences and beliefs. These contributions are less pertinent for my present purposes.

macro diagram (for example, 1990, Figures 1.2 and 1.3) is a meanwhile well-known visualization of such explanations. Coleman's sketch largely falls in line with Boudon's programmatic outline of sociological explanations in his textbook-like monograph (1981, chs. 5-6). Boudon (1981, pp. 95-98), by the way, offers a visualization that is remarkably similar to Coleman's diagram (see Raub and Voss 2017, pp. 26-27 for further discussion).

Given this approach to theory construction and explanation in sociology, Coleman (see 1987a for a concise discussion) argues that making transformation rules explicit becomes a key task for sociology. Later, he adds that making bridge assumptions explicit is a complementary key task (Coleman 1993, p. 63; see, for example, Swedberg 1990, pp. 49-50 for an interview with Coleman that includes suggestions on why he addressed macro-to-micro links only later in his programmatic work). Moreover, he argues that much of sociology fails to adequately tackle the specification of micro-to-macro and macro-to-micro links. It should be clear by now that "*Coleman's problem*" refers to including explicit bridge assumptions and transformation rules in theory construction and explanation.

By far not all, but quite a bit, of Coleman's programmatic discussion of linking macro- and micro-levels of analysis is limited to highlighting shortcomings of "classic" contributions. Coleman often focuses on shortcomings of two examples, namely, Max Weber's arguments on the relation between Protestantism and economic organization and on what Coleman calls the "frustration theory of revolution" (Coleman 1990, ch. 1 is the prime source for his treatment of these examples; closely related are 1986a, pp. 1320-1323, and 1987b, pp. 154-157). Coleman's discussion of the Weber thesis has been critically examined by Cherkaoui (2005). In the following, I will show how Boudon's solution for Coleman's problem sheds light, among other things, on the frustration theory of revolution.[2] We will see that Boudon's solution, in various respects, builds upon an intuition of Coleman's, namely, that interdependence is key. As Coleman (1990, p. 21) put it: "several forms of interdependence of actions show the wide variety of ways in which the micro-to-macro transition occurs. The macro-to-micro transition is in some of these cases implicitly contained in the interdependence of actions."

2 I will focus on theory construction. When it comes to empirical research, the specification of bridge assumptions and transformation rules also involves issues related to research designs, operationalizations, and the like. Such issues are beyond the scope of this contribution.

BOUDON'S SOLUTION

Boudon often relies on examples of sociological analyses to support his programmatic approach to theory construction. In a sense, he offers "case studies" on research questions that have been addressed in classical or modern contributions to the discipline, sometimes including a "rational reconstruction" of explanatory sketches in classical or modern work (see Boudon 1981 and 1982 for case studies from various research fields). Boudon frames quite a few of his examples as stylized games. Since games and game theory are about interdependence between actors and the effects of interdependence on micro-level behavior as well as macro-outcomes of behavior, the relation to Coleman's intuition comes already in sight. I will now attempt to show that these stylized games suggest a useful and more generally applicable tool for solving Coleman's problem.

BOUDON'S COMPETITION MODEL

One of Boudon's games is the key element of his competition model (Boudon 1982, ch. 5; 1979b). The model allows for an analysis of an at-first-sight counterintuitive phenomenon: improved opportunities at the macro-level of a social system are sometimes associated with an increase in (indicators of) macro-level frustration. This contradicts the naïve idea of a throughout negative association at the macro-level between opportunities and frustration (see also Coleman 1990, p. 10; Coleman 1993, p. 63). Classical contributions concerning the phenomenon include Alexis de Tocqueville's (1856) suggestion that political reforms and increasing welfare were associated with increasing societal level frustration in the decades preceding the French Revolution. This suggestion is related to Coleman's discussion of the frustration theory of revolution. Émile Durkheim (1897) notes increasing suicide rates in times of economic growth. Samuel A. Stouffer et al. (1949) report lower satisfaction with the promotion system of an organization, the US Army, for branches with objectively better promotion opportunities.[3] Against this background, the competition model can be seen as an example of Boudon's middle-range theories (see Esser's chapter in this book).

3 Boudon typically focuses on rational reconstruction rather than an exegetic exercise aiming at answering the question of "What did the author really mean?", quite in line with Merton's (1968, ch. 1) distinction between the "history" and "systematics" of sociological theory, including preference for a focus on the latter.

Employing his competition model, Boudon tries to specify conditions for the emergence of the counterintuitive phenomenon. Raub (1982; 1984, ch. 4) provides a rigorous game-theoretic analysis of the model. For quite some time, the competition model did not receive much attention. Kosaka (1986) and Yamaguchi (1998) are exceptions that study variants of the model. More recently, the model has encoutered a kind of renaissance. This includes implementations as an agent-based model, likewise allowing for a theoretical analysis of various extensions (Manzo 2009; 2011). The model has also been used in experimental work testing implications of the model and of variants of the model (Berger and Diekmann 2015; Berger, Diekmann and Wehrli 2024; Otten 2020, 2023).

While this has been largely overlooked in the literature on educational and social inequality, the competition model likewise yields theoretical foundations for Boudon's influential work on inequality of educational and social opportunities (Boudon 1974; 1982, ch. 4; see Raub 1984, ch. 5 for further discussion). Relatedly, Boudon (1979b) has relied on his competition model for exemplifying his notion of "generating models", namely, sociological theories that imply observable statistical regularities and can thus contribute to "reconciling sociological theories and statistical analysis" (Boudon 1979b, p. 62). This notion has become influential in, for example, Coleman's (1981, ch. 1), Cox's (1992) and Goldthorpe's (e.g., 2007, ch. 9) work on how to conceive of causation in sociology and also in analytical sociology (e.g., Hedström 2005, ch. 5).

The substantive idea underlying Boudon's competition model is taken from theories of relative deprivation (Boudon refers specifically to Runciman's 1966 version). Roughly, the assumption is that actors compare themselves with other actors – their "reference group." Actors experience relative deprivation when they are disadvantaged, compared to those in their reference group, with respect to valued outcomes. More precisely, relatively deprived actors are those who could have achieved, but did not in fact achieve an outcome themselves that members of their reference group did achieve.

Formally, the competition model is a noncooperative game with $N \geq 2$ actors i ($i = 1, ..., N$).[4] The structure of the game is assumed to be common knowledge of the actors. Each actor must decide on a costly investment. For social life examples of such an investment, consider an actor's time, effort, and monetary

4 See a textbook on game theory such as Rasmusen (2007) for details on terminology, assumptions, and theorems employed in the sketch of Boudon's model. For brevity and simplicity, I sketch a simple version of the model and brush over technical details.

(opportunity) costs that are associated with following higher education, competing for promotion in one's professional career, or founding an enterprise. Each actor has two pure strategies, namely, to make the investment (INVEST) or not to make the investment (DON'T INVEST). Actors must decide independently and simultaneously in the sense that each actor, when making the decision, is not informed of the decisions of the other actors.

Payoffs are assumed to be (expected) utilities. If an actor chooses DON'T INVEST, the actor receives payoff 0 for sure, independent of the behavior of other actors. The actor's alternative strategy INVEST is associated with costs $K > 0$. INVEST is also risky. Namely, the actor may then receive a prize $B > K$ so that the final payoff is $B - K$, or the actor does not receive the prize and the final payoff is $-K$, that is, the actor loses the investment. Given our examples above and in terms of "material" outcomes, the prize could be access to an attractive job opening, promotion during a professional career, or becoming a successful entrepreneur.

Prizes are scarce. There are n^* prizes, with $0 < n^* < N$. Actors compete with each other for the prize due to the rule for allocating prizes. Namely, if $n \leq n^*$ for the number n ($n = 1,\ldots, N$) of actors choosing INVEST, each of those actors receives the prize. If $n > n^*$, so that there are more actors choosing INVEST than there are prizes, each actor who has chosen INVEST obtains the prize with probability n^*/n. Given this allocation rule, the actors are interdependent in the sense that each actor's probability of obtaining the prize depends on the actor's own behavior – to INVEST oneself is necessary but in general not sufficient for obtaining the prize – and on the behavior of the others, more specifically the number m of other actors choosing INVEST. The allocation rule implies, moreover, for $n \geq n^*$, that the probability for an actor who has chosen INVEST to obtain the prize decreases monotonically in the number of other actors who have chosen to invest. These properties of the game motivate the label "competition model". According to Boudon, these properties also reflect, in a highly stylized way, basic features of the allocation of job openings, of the allocation of promotion opportunities in organizations, and of the success rates of new enterprises.

MACRO-TO-MICRO AND MICRO-TO-MACRO LINKS IN THE COMPETITION MODEL

We can now show how Coleman's problem is solved for Boudon's competition model. To see this, consider the *normal form* of the game sketched so far. The normal form of a game is specified by providing three elements: the number of actors, the set of pure strategies for each actor, and the payoff

function for each actor, that is, each actor's payoff $EU(s)$ for each strategy combination $s = (s_1,...,s_i,...,s_N)$, with s_i as a pure or mixed strategy of actor i. For the competition model, we have N actors and two pure strategies, INVEST and DON'T INVEST, for each actor. The matrix in Table 1 summarizes the normal form (see Boudon 1979b and 1981: 10–11 for similar visualizations).[5]

Table 1: Normal Form of Boudon's Competition Model ($B > K > 0$; $N \geq 2$).

	Number m of *other* actors choosing INVEST								
	0	...	n^*-1	n^*	n^*+1	...	m	...	$N-1$
INVEST	$B-K$	...	$B-K$	$EU(n^*,n^*)$	$EU(n^*,n^*+1)$	...	$EU(n^*,m)$	...	$EU(n^*,N-1)$
DON'T INVEST	0	...	0	0	0	...	0	...	0

The rows represent the pure strategies of a focal actor and columns represent the number m of *other* actors who choose INVEST. Entries in the cells are the focal actor's (expected) payoffs depending on that actor's pure strategy and the number of other actors choosing INVEST. It is straightforward to verify that $EU(s) = 0$ for a focal actor choosing DON'T INVEST, $EU(s) = B - K$ for a focal actor choosing INVEST, while $m < n^*$ others likewise choose INVEST, and $EU(s) = EU(n^*, m)$ as the focal actor's expected payoff for $n^* \leq m$ if that actor chooses to INVEST and m others choose to INVEST, with $EU(n^*, m) = n^*B/(m+1) - K = n^*B/n - K$ for $n^* \leq m \leq N-1$.

First, consider *bridge assumptions* in Boudon's model on how macro-conditions affect micro-level conditions for actors and their behavior. It is clear that macro-level opportunities in the competition model depend on the size K of the costs of investments, the size B of the prizes, the number n^* of prizes, and the number N of actors in the social system. Opportunities improve, *ceteris paribus*, when B or n^* increase as well as when K or N decrease. Given a game-theoretic model, the relevant micro-level conditions are the actors' (expected) payoffs. Note, then, that the normal form of the game as summarized in Table 1 specifies precisely how each actor's (expected) payoff depends on the actor's own behavior, the behavior of the other actors, and on macro-level opportunities in terms of B, K, n^*, and N. Hence, the normal form of the game specifies the bridge assumptions for the competition model.

Second, consider *transformation rules* on how macro-level outcomes depend on actors' micro-level behavior. For the competition model, transformation rules are needed that specify how macro-level frustration depends on micro-level

5 Concerning notation, it is important to keep in mind the distinction between N (the number of actors), n (the number of actors choosing INVEST), m (the number of *other* actors than the focal actor choosing INVEST), and n^* (the number of prizes).

investment decisions of each of the N actors. Motivated by relative deprivation theory, Boudon's assumption is that the reference group for actors choosing INVEST is the group of other actors who have likewise chosen INVEST, while actors choosing DON'T INVEST compare themselves with others likewise choosing DON'T INVEST. It is then in line with relative deprivation theory to assume that those actors feel relatively deprived who have chosen INVEST but do not obtain the prize B, and thus lose their investment K. Following this reasoning, Boudon defines macro-level frustration as the proportion of relatively deprived actors. The proportion of relatively deprived actors is equal to 0 if the number n of actors choosing to INVEST does not exceed the number n^* of available prizes and is otherwise equal to $(n - n^*)/N$. Given Boudon's specification of the macro-outcome, it then follows that the normal form allows one to derive the (expected) macro-level frustration for each strategy combination s, that is, for each micro-level outcome. Hence, the normal form of the game, together with Boudon's conceptualization of the macro-outcome, also specifies the transformation rule for the competition model.

The example of specifying bridge assumptions and transformation rules for Boudon's competition model illustrates the general point. The analysis of a noncooperative game requires that the actors' decision situation be exactly specified. The normal form of a game yields such a specification and, by doing so, implies how macro-conditions affect micro-conditions and how macro-outcomes depend on micro-outcomes. After all, macro-conditions are typically a key ingredient of the decision situation, and the normal form of a game also typically allows for deriving macro-consequences of actors' micro-level behavior. In light of Coleman's problem, this is an important contribution of game-theoretic modeling to theory formation and explanation in sociology – but one that has been hardly ever noticed.

THE COMPETITION MODEL AS A GENERATING MODEL FOR MACRO-LEVEL ASSOCIATIONS[6]

Of course, there is also another contribution of game theory to the toolbox of theory formation and explanation that is much better known and much more discussed. That contribution concerns the specification of assumptions on behavioral regularities in line with rational behavior. This is consistent with interpreting rational choice theory in general and game theory in particular as a "descriptive" – rather than "normative" – theory of individual behavior. For noncooperative games, assuming Nash equilibrium behavior or assuming

6 The following sketch uses material from Raub (2020, pp. 28-32, 40-41).

behavior in line with a "refined" equilibrium concept are standard examples. Rational choice assumptions on behavioral regularities allow for deriving micro-level outcomes, namely, implications on actors' strategy choices and their behavior, given the normal form of the game.

For Boudon's competition model, assumptions about behavioral regularities are needed to answer the key question in light of counterintuitive phenomena like those discussed by Tocqueville, Durkheim, and Stouffer et al.: Can improving macro-level opportunities be associated with increasing macro-level frustration? Standard assumptions on rational behavior in a noncooperative game include that actors will choose a dominant strategy if such a strategy is available and that the chosen strategies are in Nash equilibrium anyway. Moreover, it is usually assumed that rational behavior implies that actors in a symmetric game play a symmetric equilibrium, while it can be shown that a symmetric game like Boudon's competition model indeed always has a symmetric equilibrium.

These assumptions are already sufficient for tackling our key question. DON'T INVEST is never a dominant strategy. After all, the normal form of the game shows that an actor's payoff for INVEST is always larger than the payoff for DON'T INVEST as long as the number of other actors m who choose INVEST is small enough, that is, as long as $m \leq n^* - 1$. Conversely, INVEST is a dominant strategy if the (expected) payoff for INVEST exceeds the payoff for DON'T INVEST even if *all* actors choose INVEST. This is the case iff $EU(n^*, N - 1) > 0$ for a focal actor's expected payoff when the actor chooses INVEST. In this case, the game of course has a unique Nash equilibrium such that each actor chooses the dominant strategy INVEST. This equilibrium is also symmetric.

Assume now that $EU(n^*, N - 1) < 0$ for a focal actor who chooses INVEST, so that INVEST is not a dominant strategy. One can then show (Raub 1984, ch. 4) that the game has a unique symmetric equilibrium in mixed strategies: in this equilibrium, each actor chooses INVEST with probability p^*, $0 < p^* < 1$. Note that in this case the expected proportion of actors who choose INVEST must be smaller than 1.

By now, it is evident that improved macro-level opportunities can indeed be associated with increasing macro-level frustration. For example, consider a scenario with "good" macro-level opportunities, namely, $N = 10$, $K = 1$, $B = 3$, $n^* = 4$. For this scenario, INVEST is a dominant strategy since $EU(4, 9) = 0.2 > 0$. Rational behavior then implies that each actor chooses INVEST. It follows that $(N - n^*)/N = (10 - 4)/10 = 0.6$ for macro-level frustration. For a scenario with "bad" macro-level opportunities, assume $N = 10$, $K = 1$, $B = 2$, $n^* = 4$. Thus, the two scenarios differ with respect to the size of the prize B.

Given the "bad" macro-level opportunities, INVEST is no longer a dominant strategy since $EU(4, 9) = -0.2 < 0$. Rational behavior in line with the unique symmetric equilibrium in mixed strategies implies that the expected number of actors choosing INVEST is smaller than N. Then, it likewise follows that the expected macro-level of frustration is smaller than 0.6. Hence, our example shows that better macro-level opportunities can be associated with higher macro-level frustration. As Boudon (1979b) put it: the competition model can generate associations like those discussed by Tocqueville, Durkheim, and Stouffer et al.

It is important to realize that the competition model not only shows that better macro-level opportunities can be associated with higher macro-level frustration. Rather, the model also shows that improving macro-level opportunities can be associated with decreasing macro-level frustration. To see that, compare the scenario with "good" macro-level opportunities with further scenarios that reflect even better opportunities, namely, $N = 10$, $K = 1$, $B = 3$ and $n^* \geq 5$. In these scenarios, more actors can obtain the prize B, while the other parameters representing macro-level opportunities are kept constant. Clearly, INVEST remains a dominant strategy and rational behavior again implies that each actor chooses INVEST in these scenarios. It follows that the number of actors who end up relatively deprived decreases and, hence, macro-level frustration decreases in these scenarios for $n^* \geq 5$.

Concerning the competition model as a "generating model" and with an eye on empirical content and testability, it is furthermore important that the model is not only consistent with positive as well as negative associations between macro-level opportunities and macro-level frustration. Namely, the model should also allow for specifying *conditions* for either a positive or a negative association. A comprehensive game-theoretic analysis of the model is not needed here, but is available in Raub (1984, ch. 4) and Berger and Diekmann (2015). Such an analysis specifies those regions of the parameter space where better macro-level opportunities are associated with more macro-level frustration, as well as those regions where the association is inversed.[7] Raub (1984, ch. 4) and Berger and Diekmann (2015) also derive implications of alternative assumptions on regularities of behavior, such as behavior in line with asymmetric equilibria in pure strategies or in line with maximin-behavior.

7 To avoid misunderstandings, note that improving macro-level opportunities due to increasing n^* can be associated with increasing macro-level frustration if INVEST is not a dominant strategy. This can happen, because the expected number n of actors choosing INVEST may increase more rapidly than n^*.

This is a useful exercise in line with theoretical pluralism, and helps to assess the robustness of model implications to variants of rationality assumptions.[8]

REMARK

To make my point about Boudon's solution to Coleman's problem, I could and did focus on a simple version of the competition model. That simple version includes various assumptions that seem "unrealistic" from an empirical perspective. Assume one would like to replace unrealistic assumptions with more realistic ones. Would that imply that Boudon's solution would become problematic? The answer to that question is "No". Consider more complex versions of the competition model. For example, such versions could allow for heterogeneity in the sense that actors have different payoff functions. Or consider a version with actors choosing sequentially such that actors choosing later know about earlier choices by other actors. Specifying Nash equilibria and deriving game-theoretic solutions in the sense of selecting a "plausible" equilibrium would then become more difficult and perhaps even impossible with analytical methods. But Boudon's solution of Coleman's problem relies on specifying the normal form of the game and does *not* depend on being able to specify Nash equilibria, let alone on specifying Nash equilibria with analytical methods. The point is precisely that game theory offers two *different* tools for sociology: equilibrium assumptions as assumptions on regularities of behavior on the one hand *and* tools like the normal form for specifying the actors' decision situation and their interdependencies in the first place. These two tools can and must be carefully distinguished. It would be no problem in principle to precisely characterize the normal form for more complex versions of the competition model. Even the assumption of equilibrium behavior itself – the *other* tool that game theory offers – could be dropped and replaced by alternative assumptions on regularities of behavior, *given* a normal form.

CONCLUSIONS

Boudon has sketched simple game models in quite some further work, such as in his discussion of how the First World War came about (1981, pp. 24-32), of international relations between the two world wars (1981, p. 109, 112), of

8 Together with the careful experimental work on the competition model that is meanwhile available (see the references above) this could also suggest adding some nuance to the perspective on applications of rational choice theory in the social sciences as a mere "glass-bead game" (Hedström 2021, p. 498).

the general idea of unintended consequences of goal-directed and incentive guided behavior (1982, pp. 14, 15, 79-80), and of collective action (1982, pp. 144-145). From the perspective of modern game theory, his analyses may not always be technically correct in all respects. Also, as far as I know, he never explicitly made the point himself that the normal form of a game can be a useful tool that allows one to cope with and solve Coleman's problem. This point has been largely neglected in other literature, too.[9] At the same time, the point is clearly an implication of Boudon's work on and with game models for sociological theory formation and explanation.

Why is it that Boudon provided a solution for Coleman's problem, rather than Coleman himself? An answer to this question must remain speculative. A hunch may be that Coleman simply did not frequently employ game theory and game-theoretic reasoning. While his interest in academic social simulation games was conducive to Coleman's path to rational choice theory (see, for example, Coleman 1996, p. 348 and various contributions in Clark 1996), he focused on his sociological version of a theory of exchange systems in analogy with neoclassical economics (for example, Coleman 1990, pt. V), rather than employing game theory as a variant of rational choice theory.[10]

The literature provides further examples of dealing with Coleman's problem by specifying the normal form of games. An instructive case is the macro-association between group size and collective good production (see Raub 2020 for discussion and references). Also, specifying the normal form of a game is not the only way of dealing with Coleman's problem – there are various alternatives. Another tool from game theory for tackling Coleman's problem is the extensive form of a game. This is the tree-like representation that specifies features explicitly that remain "hidden" in the normal form, such as the sequence in which actors make decisions in the course of a game, and the information of an actor about what happened previously in the game when the actor makes a decision. Specifying the extensive form is needed, for example, when one wishes to analyze repeated games, including repeated games in a network of actors. For examples on how specifying the extensive form allows

9 For example, general discussions of uses of game theory in sociology such as Petersen (1994) or Swedberg (2001) and more recent overviews like Breen (2009) and Przepiorka (2021) do not address the issue at all – but see Raub, Buskens, and van Assen (2011, p. 14, n. 4) for a brief remark in line with the key idea developed here.

10 Note that "game theory" is not an entry in the carefully constructed subject index of Coleman (1990). Coleman (1986b) is a rare example of work by Coleman that does employ game theory. Coleman (1987b) briefly refers to the Prisoner's Dilemma. Similar references to various game models can be found in other work by Coleman but he typically avoids explicit game-theoretic analysis.

for making bridge assumptions and transformation rules on macro-to-micro and micro-to-macro links explicit, see Buskens, Corten, and Raub (2022).

Moreover, game theory is not the only "supplier" of tools for solving Coleman's problem. Coleman (1987a, 1990) himself has pointed out that variants of rational choice theory, such as general equilibrium theory of neoclassical economics, as well as social choice theory, include explicit examples for bridge assumptions and transformation rules. Diekmann (2022) provides guidelines for applications of rational choice theory in sociology so that they include clear assumptions on macro-to-micro and micro-to-macro links. And there are other tools than those from rational choice theory. For example, Flache and de Matos Fernandes (2021) provide guidelines for agent-based computational modeling in sociology. Their guidelines suggest how such modeling might be instrumental for solving Coleman's problem – and how agent-based computational modeling is a tool that can accommodate rational choice assumptions on behavioral regularities but can also accommodate alternative assumptions on such regularities. What is always needed is an exact "protocol" for precisely characterizing actors' decision situation so that macro-conditions and macro-outcomes are accounted for. The normal form as well as the extensive form of a game are examples of such protocols, but not the only examples.[11]

To put things in perspective, it is good to realize that in many applications, the normal form of a game has to be complemented by further assumptions in order to provide adequate bridge assumptions and transformation rules (the same point holds for the extensive form). We have already seen that in our discussion of the competition model. The normal form of the game as such yields for each strategy combination the (expected) proportion of actors who invest but do not obtain the prize. For the specification of the transformation rule, the normal form has to be complemented by a definition of "macro-level frustration" in terms of that proportion. Given relative deprivation theory, this can be seen as a straightforward step. Still, it is a necessary and important one, also highlighting that rational choice assumptions proper are by far not the only important "ingredients" of sociological theory and explanation.

To see this for a more complex example, consider revolutions, one of the cases that "motivated" the competition model. Coleman (for example, 1990, p. 10; see also 1990, ch. 18) notes that many frustrated actors do not yet necessarily

11 To avoid misunderstandings, it is useful to add that one cannot exclude *a priori* that the specification of links between macro- and micro-levels of analysis is less complex and problematic in some cases than envisaged by Coleman. For example, Goldthorpe (2021 chs. 9, 10) has provided arguments in this direction, possibly with research on social mobility and sociology of education in mind.

induce a revolution. In addition, "social organization" is needed that allows for mobilization, coordinated action, and the like (Coleman 1990, pp. 21-22). It is for this reason that Coleman (1990, p. 21) suggests that "good social history" may help to link micro- and macro-levels in such a case. In particular, Coleman (1990, pp. 482-483) observes that a revolution is a public good and thus presupposes the solution of a free-rider problem. From this perspective, in addition to specifying bridge assumptions and transformation rules that help explain in the first place why improving opportunities can induce more macro-level frustration, a "second step" of theory formation is needed. In principle, this second step could build on a game-theoretic model of public good production. This would involve specifying a normal or extensive form of a game that reveals how macro-conditions, which include, but are likely not restricted to, macro-level frustration, affect individual preferences and beliefs. Also, the normal or extensive form would reveal how the macro-outcome of collective good production, or, respectively, failure of productive good production, depends on micro-level behaviors. Jointly, these two "steps" of theory formation could be conceived as specifying "nested games" (Tsebelis 1990).[12]

My take-home message is that game theory, as a branch of rational choice theory, offers at least two useful tools for theory construction and explanation in sociology. One of these is well-known, though of course much disputed. That is the specification of assumptions on rational behavior for situations with interdependent actors. In Esser's (1993) terminology: game theory – and rational choice theory more generally – provides a "logic of selection". The second contribution of game theory is much less well known: tools for specifying a situation with interdependent actors precisely in the first place, in the process allowing for a solution of Coleman's problem of making macro-to-micro as well as micro-to-macro links explicit. In Esser's (1993) terminology: game theory is also a tool for clarifying the "logic of the situation" as well as the "logic of aggregation". It should be clear that simultaneously making use of *both* contributions that game theory offers for the sociology toolbox is in line with Coleman's arguments for emphasizing the elaboration of bridge assumptions and transformation rules in theory construction and explanation, while keeping the assumptions on behavioral regularities simple and concise. In his more abstract and fundamental work on rational choice theory, Boudon does not agree in all respects with Coleman's arguments. In

12 Note that Coleman (1990, ch. 18) also sketches an alternative approach to frustration theories of revolution. His alternative does not focus on the relation "improved – opportunities – frutstration" but on the relation "improved opportunities – perceived chances of success of a revolution".

his sociological applications of game theory models for theory construction and explanation, though, Boudon does in fact employ Coleman's approach. Boudon thus highlights by way of example how Coleman's problem can be solved. Reexamining Coleman and Boudon indeed yields nuts and bolts for contemporary sociological science.

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NOTE ON THE AUTHOR

Werner Raub, Professor Emeritus of Sociology in the Interuniversity Center for Social Science Theory and Methodology (ICS) at Utrecht University, is a Fellow of the German National Academy of Sciences – Leopoldina and of the European Academy of Sociology. He recently co-authored the chapter "Rigorous sociology" in K. Gërxhani, N.D. de Graaf and W. Raub (Eds.), *Handbook of Sociological Science: Contributions to Rigorous Sociology* (Edward Elgar, 2023).

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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.

Gérald Gaglio, Professor of Sociology,
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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 Festschrifts, 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 $X -> Y$ 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.

Dominique Vidal, Professor of Sociology,
Université Paris Cité