The Handbook of Rationality

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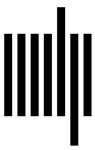

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10.4 Rational Choice Theory in the Social Sciences

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Summary

This chapter is on *applications* of rational choice theory in the social sciences rather than on rational choice theory as such, with a focus on social sciences other than economics and, more specifically, on sociology. These applications employ variants of rational choice theory as outlined in the chapters on individual rationality and decision making as well as those on game theory in this handbook (chapters 9.1–9.4). The applications aim at theories in the sense of more or less formalized models yielding explanations and testable predictions. Assumptions on rational choice are important elements of such models but not the only ones. The chapter sketches selected features of applications, including methodological individualism and model building relating micro- and macro-levels of analysis, as well as strategic interdependence and unintended consequences as core ingredients of applications. Some remarks on empirical research and suggestions for further reading conclude the chapter.

1. Applications of Rational Choice Theory in Various Social Science Disciplines

Applications of rational choice theory in the social sciences are not at all restricted to economics. They meanwhile abound, too, in disciplines such as political science and sociology. Economists have applied rational choice theory outside typical domains of economics. Becker's (1976) "economic approach to human behavior" is a prime example. Arrow (1963), Buchanan and Tullock (1962), Downs (1957), and Olson (1971) have been influential in establishing rational choice approaches in political science. An early textbook by political scientists has been Riker and Ordeshook (1973). Ostrom's study on governing the commons (1990 and subsequent contributions) is an example of work by a political scientist who won the Nobel Prize in Economic Sciences. In sociology, rational choice theory and its applications are often associated with Coleman (1990). He built on earlier work (see Coleman, 1994), including behavioral sociology (Homans, 1961) and social exchange theory (Blau, 1964; Homans, 1958) as well as contributions, starting in the 1970s, by European sociologists such as Boudon, Esser, Lindenberg, Opp, and Wippler, often labeled "structural individualism" or "explanatory sociology" (Wippler & Lindenberg, 1987). Meanwhile, applications of rational choice theory are an established approach in sociology (Wittek, Snijders, & Nee, 2013).

2. RCT, Methodological Individualism, Micro–Macro Models, and an Example

We use "RCT" for, roughly, "theories in the social sciences that include, but are not restricted to, assumptions from rational choice theory" such as standard axioms for rational behavior under certainty, risk, and uncertainty in the sense of Harsanyi (1977) and the corresponding implications on utility maximization, or game-theoretic equilibrium assumptions (see chapter 8.2 by Peterson and chapter 9.1 by Albert & Kliemt, both in this handbook).[1] RCT employs methodological individualism (Udehn, 2001) as an approach to theory construction, accounting not only for the behavior of individual actors but also, and particularly, for phenomena and processes at the level of social systems[2] made up by those actors. Therefore, RCT includes two levels, namely, the level of actors, often referred to as the "micro-level," and the system level, often referred to as the "macro-level." Moreover, and particularly, RCT focuses on how both levels are related.

2.1. Coleman's Diagram

Coleman (1986, 1990) has suggested a popular diagram (figure 10.4.1) summarizing the "logic" of micro–macro models in the social sciences and of RCT explanations (for related earlier work, see Raub & Voss, 2017).

With "macro," Coleman refers to systems, such as a family, a city, a business firm, a school, or a market. "Micro" refers to the actors making up the system. The macro-level

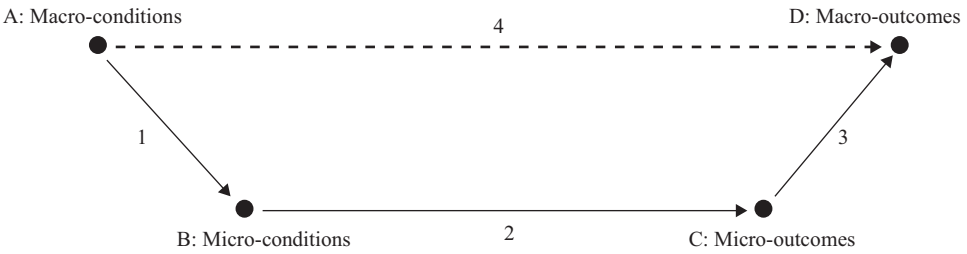

Figure 10.4.1
Coleman's micro–macro diagram.

thus relates to collective phenomena described by concepts referring to properties of social systems, for example, the size of a group. In terms of the number of actors involved, there are large as well as small social systems like dyads, triads, or small groups. The micro-level relates to properties of actors, for example, their preferences, beliefs, and behavior. Typically, the actors making up the system are individuals. However, depending on the application and simplifying assumptions deemed acceptable, the micro-level may include "corporate actors" (Coleman, 1990). For example, in theories of intraorganizational processes, a firm may constitute the system level, with individual employees and managers as actors on the micro-level. Conversely, in theories of interorganizational networks, a set of firms may constitute the system level, with individual firms as corporate actors on the micro-level. Or consider a market model with individual consumers and firms as producers on the micro-level, firms again being conceived as "unitary actors."

In Coleman's diagram, nodes A and D represent propositions describing macro-conditions and macro-outcomes, respectively. Arrow 4 represents propositions about empirical regularities at the macro-level, say, a statistical association between macro-conditions and macro-outcomes. Macro-outcomes (node D) as well as empirical regularities (arrow 4) represent explananda at the macro-level. Node B represents propositions describing micro-conditions. These propositions refer to "independent variables" in assumptions about regularities of actors' behavior, in our case, rational choice theory. Arrow 1 represents "bridge assumptions" (Wippler & Lindenberg, 1987) on how social conditions affect these variables. For example, social conditions such as networks or institutions, but also prices, can be conceived as opportunities or, conversely, constraints affecting the feasible alternatives between which actors can choose. Social conditions likewise shape incentives associated with feasible alternatives and actors' information. Node C represents micro-outcomes and the explanandum on the micro-level, namely, descriptions of actors' behavior. Rational choice assumptions are represented by arrow 2. Thus, arrow 2 represents a micro-theory. Finally, arrow 3 represents assumptions on how actors' behavior generates macro-outcomes. We use "transformation rules" (Wippler & Lindenberg, 1987) as a label for such assumptions on micro-to-macro relations. It is evident from the diagram that the explanandum at the micro-level, descriptions of individual behavior, follows from an explanans comprising assumptions on rational behavior and "initial conditions" on, for example, actors' preferences and beliefs (arrow 2, node B), macro-conditions (node A), and bridge assumptions (arrow 1). The explananda at the macro-level, namely, descriptions of macro-outcomes (node D) and macro-regularities (arrow 4), follow from an explanans comprising rational choice assumptions (node B, arrow 2), macro-conditions (node A), bridge assumptions (arrow 1), and transformation rules (arrow 3).

2.2. An Example: Collective Good Production and the Volunteer's Dilemma

As an illustration, consider the production of collective goods and the empirical regularity at the macro-level that group size is often negatively related to the production of collective goods (Olson, 1971). The core feature of a collective good is that actors who did not contribute to its production cannot be excluded from its consumption. Hence, when costs of individual contribution are high compared to marginal effects of the contribution on individual benefits from the good, actors face incentives not to contribute—the free-rider problem. Assume furthermore that there are no "selective incentives" and, hence, no additional individual benefits that depend on individual contributions to the production of the collective good. Then, Olson argued, collective good production will be negatively related to group size. However, the relationship between group size and collective good production should not be considered a simple macro-law. Rather, the relationship depends on a number of specific conditions such as the absence of selective incentives, the production function for the collective good, and others. Diekmann's (1985) Volunteer's

Dilemma (VOD) is a formal model of a set of conditions that imply the group size effect.

The well-known bystander intervention and diffusion of responsibility problem is a social situation for which VOD is a reasonable model: actors witness an accident or a crime. Everybody would feel relieved if at least one actor would help the victim by calling the police. However, providing help is costly, and each actor might be inclined to abstain from helping, hoping that someone else will help. VOD captures these features in a noncooperative game with N actors. Actors have binary choices. They decide simultaneously and independently whether or not to contribute to the collective good, that is, to provide help. The good is costly and will be provided if at least one actor—a "volunteer"—decides to contribute. Contributions by more than one actor are feasible, and then each actor pays the full costs of providing the good, but contributions of more than one actor do not further improve the utility level of any actor. A core feature of VOD is that the costs K of contributing to the collective good are *smaller* than the gains U from the good. The matrix in table 10.4.1 summarizes the normal form of the game, with rows representing an actor's strategies, namely, to contribute (CONTR) or not to contribute (DON'T), columns indicating the number of other actors who contribute, and cells representing an actor's payoff as a function of his[3] own strategy and the number of other actors who contribute.

In terms of Coleman's diagram (figure 10.4.2), both being a noncooperative game and group size N are macro-conditions (node A). The macro-outcome of interest (node D) is the probability that the collective good will be provided. Arrow 4 now represents the relation between group size and this macro-level probability. Node B represents the micro-conditions (a) that each actor can choose between CONTR and DON'T; (b) actors' information, namely, that actors, when choosing, are not aware of the other actors' choices;[4] and (c) actors' preferences as represented by their payoffs. Note that the normal form of the game includes bridge assumptions (arrow 1) on macro–micro transitions. Namely, the normal form specifies how an actor's payoff depends on his own choices as well as those of all other actors—that is, the normal form specifies the structure of the actors' interdependence.

Table 10.4.1
The Volunteer's Dilemma ($U > K > 0$; $N \geq 2$)

	Number of other actors choosing CONTR				
	0	1	2	. . .	$N-1$
CONTR	$U-K$	$U-K$	$U-K$	. . .	$U-K$
DON'T	0	U	U	. . .	U

Game-theoretic rationality assumptions such as the assumption of equilibrium behavior are micro-level assumptions (arrow 2). In an equilibrium, each actor's strategy maximizes his own payoffs, given the strategies of the other actors. VOD has N equilibria in pure strategies. These are strategy combinations with exactly one volunteer choosing CONTR with probability 1, while all other actors choose DON'T with probability 1. In each of these equilibria, the collective good is provided with certainty. However, the equilibria involve a bargaining problem: each actor prefers the equilibria with another actor volunteering to the equilibrium where he himself is the volunteer. Moreover, while the game is symmetric, the N equilibria in pure strategies require that actors do not choose the same strategies. It is a rather natural assumption that rational actors, in a symmetric game, play a symmetric equilibrium, that is, choose the same strategies. It can be shown that VOD has a unique symmetric equilibrium in mixed strategies. In this equilibrium, each actor chooses CONTR with probability $p^* = 1 - \left(\frac{K}{U}\right)^{\frac{1}{N-1}} < 1$. Under game-theoretic rationality assumptions, the symmetric equilibrium in mixed strategies is a plausible candidate for the "solution" of VOD (for various issues related to

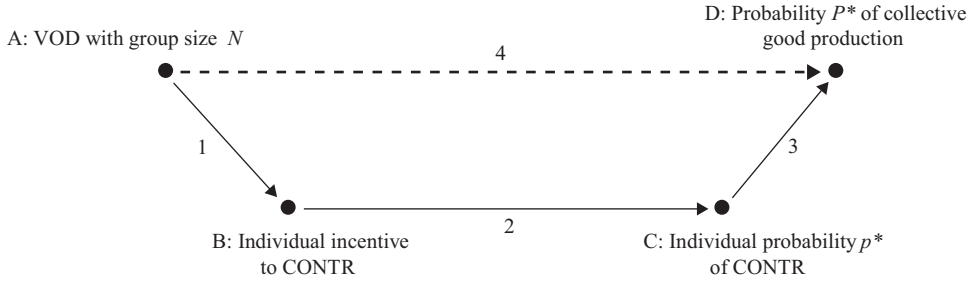

Figure 10.4.2
Micro–macro diagram for the Volunteer's Dilemma.

assuming a mixed strategy equilibrium as the solution of a game, see Camerer, 2003; Osborne & Rubinstein, 1994). Thus, p^* is represented by node C. Note that p^* is a decreasing function of N. Therefore, for VOD and under the assumption of game-theoretic rationality, a testable implication on how group size affects micro-outcomes follows: the individual probability to contribute to the collective good declines with increasing group size.

The individual probability p has to be distinguished from the macro-outcome: the probability P of collective good provision. Note that the normal form of VOD includes a transformation rule (arrow 3). Namely, the normal form specifies how the probability of collective good provision depends on each actor's individual behavior. More specifically, the normal form implies that the collective good is provided if and only if at least one actor chooses CONTR. In VOD, group size affects collective good provision through two different mechanisms. First, there is a positive effect of increasing group size, since it is sufficient that one single actor contributes and since all actors contribute with positive probability in the symmetric mixed equilibrium. After all, with increasing group size, the number of actors increases who may decide to contribute. Second, and conversely, there is a negative effect of increasing group size, since each actor's individual probability p^* to contribute decreases with increasing N. What is the total effect? For the symmetric mixed equilibrium, the probability that there is at least one volunteer and that the collective good will therefore be provided can be shown to be $p^* = 1 - \left(\frac{K}{U}\right)^{\frac{N}{N-1}}$. In Coleman's diagram, P^* is represented by node D. Obviously, $P^* < 1$, so that production of the collective good may fail. Moreover, P^* is a decreasing function of N: the negative effect of increasing group size on collective good production outweighs its positive effect. Hence, assuming game-theoretic rationality, a testable implication, represented by arrow 4, follows for how group size affects macro-outcomes in VOD: the probability that the collective good is provided decreases with increasing N.

3. RCT and Model Building

The VOD example illustrates typical features of RCT. First, VOD is a formal theoretical model. RCT has affinity with more or less formalized model building. Coleman's diagram is highly stylized. It looks simple by leaving implicit that full-fledged micro–macro models typically comprise a sizable number of possibly complex assumptions, including assumptions other than those of rational choice theory as such. The VOD example shows this. The core task in analyzing such models is to identify implications of these assumptions, more specifically implications on how micro-level behavior depends on macro- and micro-conditions as well as implications on how macro-level outcomes and macro-level regularities depend on macro- and micro-level assumptions, including assumptions linking the levels. Deriving such implications is often nontrivial. Therefore, formal model building, or at least the formalization of certain assumptions, can be helpful, if not a prerequisite, for deriving implications. In the VOD example, purely verbal reasoning suffices to see that increasing group size has two opposite effects on the probability that the collective good will be provided. However, formalization seems necessary to derive the total effect. An early version of this argument in sociology is in Coleman's (1964) discussion of "synthetic theories." These theories aim to identify the consequences of a set of assumptions and more precisely to identify consequences on the macro-level for a set of assumptions on the micro-level: "it is characteristic of many of these theories that they begin with postulates on the individual level and end with deductions on the group level" (Coleman, 1964, p. 41). Related arguments include that formalization allows for checking whether implications do follow from assumptions and for identifying assumptions that are implicitly used in merely verbal accounts (for thorough early discussions, see Hummell, 1973; Ziegler, 1972; for a recent outline, see Tirole, 2017). A major advantage of RCT is that it lends itself to formalization of core assumptions and provides analytical power by allowing for the construction of tractable models, specifically models linking macro- and micro-levels.

Second, RCT, like model building in general, typically involves a trade-off: simplifying assumptions preserve tractability and analytical power for the derivation of implications at the cost of (some) assumptions being less realistic empirically, while more complex and realistic assumptions make it more difficult to derive implications. Therefore, RCT typically starts with a model that is as simple as possible, making simplifying assumptions explicit. Subsequently, when simplifying assumptions turn out to be problematic, one introduces more complex assumptions in a stepwise fashion. This is appropriate when implications are highly dependent on such assumptions rather than being robust, or when implications fare badly in the light of empirical evidence. The procedure is known as the "method of decreasing abstraction" (Lindenberg, 1992). For example, the VOD employs the simplifying assumption of a symmetric

game. More complex versions of VOD allow for individual heterogeneity with respect to costs of and gains from contributing (Diekmann, 1993). Also, quite a lot of experimental evidence suggests that the individual probability of contributing indeed tends to decline with increasing group size, while a decline is not found for the macro-level probability that the collective good is provided. Tutić (2014) provides a game-theoretic model accounting for this pattern by employing a solution concept other than the symmetric mixed-strategy equilibrium.

Third, deriving macro-implications from a micro–macro model is a key element of RCT. For example, the core issue in the analysis of VOD is not the individual probability p to contribute but rather the macro-level probability P of collective good production and how that macro-level probability depends on group size as a macro-condition. Tractability requires simplifications, while RCT aims at explanations of macro-outcomes and at incorporating macro-conditions in the explanation rather than at exclusively explaining individual behavior as such. Therefore, it seems advisable to keep micro-assumptions simple and parsimonious. In the VOD example, the analysis becomes feasible through employing micro-assumptions on equilibrium behavior. On the other hand, it seems reasonable to allow, as much as possible, for complexity of macro-assumptions as well as assumptions that provide links between macro- and micro-levels. In the VOD, therefore, the focus is on specifying the structure of interdependence between the actors and on how group size, given this interdependence, affects collective good production. Coleman (1987a, 1993) argues furthermore that careful specification of bridge assumptions and transformation rules is not only a core requirement for RCT but that explanations in the social sciences are often deficient precisely with respect to bridge assumptions and transformation rules. Hence, Coleman assumes that improving bridge assumptions and transformation rules will be more beneficial for theory development than improving micro-assumptions. In the VOD example, it is precisely the explicit specification of the normal form of the game that allows for clearly linking macro- and micro-levels since the normal form comprises the relevant bridge assumptions and transformation rules.

Fourth, RCT is consistent with a modest but realistic view of theory construction in social science, close to Merton's (1968) middle-range theories (Hedström & Udehn, 2009): RCT aims at explanations of macro-outcomes, including macro-regularities, while the use of similar micro-level rational choice assumptions in various models addressing different phenomena at the macro-level allows for a common theoretical core and coherence of the models as well as cumulative growth of knowledge (Diekmann & Voss, 2004). For example, VOD can be seen as one element of a family of models of social dilemmas (Raub, Buskens, & Corten, 2014). Social dilemmas are situations with strategically interdependent actors. Actors can choose between cooperation and defection. Cooperation by all actors on the micro-level implies a Pareto-optimal outcome on the macro-level and is a Pareto-improvement compared to defection by all actors: at least some actors are better off and nobody is worse off when everybody cooperates than when everybody defects. However, cooperation of all actors is typically not an equilibrium, and at least some actors have individual opportunities and incentives to exploit other actors' cooperation by defecting. Conversely, defection by all actors is an equilibrium. The Prisoner's Dilemma is a classic model of a social dilemma. Other well-known models include the Trust Game, the Investment Game, and the Public Goods Game (see also chapter 9.4 by Dhami & al-Nowaihi, chapter 10.2 by Schmid, and chapter 10.5 by Nida-Rümelin, Gutwald, & Zuber, all in this handbook).

For VOD, it follows from properties of equilibria in mixed strategies that the symmetric equilibrium is associated with expected payoffs $U - K$ for each actor. There is another combination of mixed strategies, not being an equilibrium, such that each actor contributes with probability $p^{**} = 1 - \left(\frac{K}{NU}\right)^{\frac{1}{N-1}} < 1$. One easily sees that $p^{**} > p^{*}$. The strategy combination such that each actor contributes with probability p^{**} is associated with a Pareto-optimal outcome, namely, expected payoffs $U - qK$ for each actor, with $q < 1$ and hence $U - qK > U - K$. Thus, VOD is a social dilemma with the mixed strategy of contributing with probability p^{*} as defection and the mixed strategy of contributing with probability p^{**} as cooperation.[5]

Models of social dilemmas aim to explain individual cooperation or defection at the micro-level and Pareto-optimal or Pareto-suboptimal macro-outcomes. The models differ by focusing on different macro-conditions and their effects, such as group size effects, the effects of repeated interactions and networks of relations, the effect of various institutions, and so forth. Game-theoretic rationality assumptions, or variants of such assumptions, ensure a common theoretical core and coherence across models of social dilemmas. Moreover, game-theoretic as well as other rational choice assumptions similarly ensure a common theoretical core not only for different models of social dilemmas but also across models for macro-phenomena and macro-regularities in a broad range of other research domains.

4. Variants of RCT

Variants of RCT can be distinguished by considering how they differ from two "benchmarks." One of these comprises commonly used assumptions concerning the micro-level of actors and their behavior. A second one is related to the use of rational choice theory in micro–macro models.

4.1. Variants of RCT: The "Standard Model" and Some Alternatives

Micro-level assumptions of RCT include, but are not restricted to, rationality assumptions. In particular, empirical applications of rational choice theory require additional and substantive assumptions. By way of example, the rational choice assumption of transitive preferences requires that an actor preferring *A* over *B* and *B* over *C* also prefers *A* over *C*, but rational choice assumptions do not presuppose that *A* is preferred over *B* and *B* over *C*, nor do they comprise assumptions about those properties of *A*, *B*, and *C* due to which *A* is preferred over *B* and *B* over *C*. More specifically, rational choice theories do not assume at all that actors are exclusively interested in material consequences for themselves and are purely self-regarding in the sense of "utility = own money." Applications in the social sciences do of course require additional and substantive micro-level assumptions about actors' preferences alongside the rationality assumptions (see below). The same applies to substantive assumptions about actors' beliefs concerning the consequences of choosing a certain alternative. However, these assumptions should not be confused with the rationality assumptions themselves. It is true that rational choice assumptions are often combined with assumptions that actors are purely self-regarding and possibly also with assumptions on perfect and complete information—so much so that the combination of these types of assumptions is sometimes referred to as the "standard model" (references in the literature to the "homo oeconomicus" typically concern assumptions closely related to this standard model). This should not distract from the fact that rationality assumptions, on the one hand, and assumptions about self-regarding preferences or about perfect and complete information, on the other, are distinct assumptions of the standard model.

Some variants of RCT focus on the micro-level and offer alternatives to the assumptions of the standard model (Dhami, 2016; see chapter 9.4 by Dhami & al-Nowaihi, this handbook). Some of these variants modify the rational choice assumptions. Experiments like those by Kahneman and Tversky (2000) provided evidence on regularities of behavior ("anomalies") that are hard to reconcile with standard rational choice assumptions, and they induced the development of alternative micro-models of behavior such as prospect theory (Kahneman & Tversky, 1979; see chapter 8.3 by Glöckner, this handbook), models of bounded rationality (e.g., Rubinstein, 1998; see chapter 8.5 by Hertwig & Kozyreva, this handbook), dual-process and two-selves models (Kahneman, 2011), and a variety of models assuming myopic behavior and backward-looking learning (Macy & Flache, 2009). Meanwhile, Esser's model of frame selection (Esser & Kroneberg, 2015; Kroneberg, 2014) and Lindenberg's (2001) theory of social rationality are approaches in sociology that are inspired by such micro-models and aim at systematically developing and employing them in micro–macro models of social phenomena (Bruch & Feinberg, 2017, reviews work in the field of judgment and decision making on micro-models that can be employed in micro–macro models and are based on other than rational choice assumptions).

Coleman's diagram is neutral with respect to the specific assumptions on regularities of individual behavior represented by arrow 2. Hence, alternatives to standard rational choice assumptions such as those mentioned may, in principle, likewise serve as micro-level assumptions. Moreover, regularities of behavior hard to reconcile with standard rational choice assumptions are not only found in experiments. Rather, such regularities have been likewise documented in field research and include micro-level behavior as well as macro-level outcomes in core research fields of economics and other social sciences (Camerer, 2000). This feature has induced attention not only in psychology but also in the social sciences for new theories accounting for such evidence.

Other important variants of RCT that deviate from standard micro-level assumptions retain rational choice assumptions while replacing assumptions such as those on self-regarding behavior and likewise employing assumptions on information imperfections. Influential models combine conventional rationality assumptions with assumptions on inequity aversion or similar motives as elements of an actor's utility function (Cooper & Kagel, 2015; Fehr & Schmidt, 2006). In addition, such models assume heterogeneity between actors with respect to the strength of such motives and incomplete information of actors about other actors' utility functions. Assumptions on other-regarding preferences should be used with care since almost all behavior can be "explained" by assuming the "right" preferences and adjusting utility functions accordingly (Buskens & Raub, 2013). Stigler and Becker (1977) even recommended to

abstain from explaining variations in behavior across actors or over time by assuming variation in utility functions. Rather, they propose to assume preferences over fundamental "commodities" as similar across individuals and stable over time, while explaining variations in behavior through variations in opportunities and constraints such as prices, that is, through variations in observable macro-conditions. Lindenberg's theory of "social production functions" is a related approach in sociology (Ormel, Lindenberg, Steverink, & Verbrugge, 1999). One would prefer first of all parsimony with respect to assumptions on other-regarding preferences by adding as few new parameters as possible in micro-level assumptions. Second, assumptions on other-regarding preferences should allow for using the same set of assumptions to explain behavior in a broad range of social situations, thus avoiding "tailor-made" adaptations of assumptions for a specific explanandum that would render independent testability problematic. Third, assumptions on other-regarding preferences should not only account for well-known regularities but should also allow for deriving and testing new predictions. From this perspective, it is reassuring that models combining rational choice assumptions with assumptions on other-regarding preferences, heterogeneity between actors with respect to their preferences, and incomplete information about other actors' preferences do indeed yield implications for micro- as well as macro-outcomes in a broad range of social situations. The models, therefore, preserve tractability and testability, despite being less parsimonious than the standard models with purely self-regarding preferences. The models cover social dilemmas as well as bargaining and distribution problems such as the Ultimatum Game and the Dictator Game, and also include market games (Camerer, 2003). Moreover, these models show that the same set of assumptions implies much cooperative behavior in contexts such as social dilemmas but seemingly selfish behavior in market contexts.

4.2. Variants of RCT: Alternatives to the Perfect Market Model of Neoclassical Economics

A second benchmark for variants of RCT is the perfect market model of neoclassical economics. Coleman (1987b) regarded that model as—in a sense—a paradigmatic example of an RCT micro–macro model. The characteristics of a perfect market (Kreps, 1990) are the relevant macro-conditions. Given rational behavior of actors—producers and consumers—macro-outcomes of individual exchange behavior can be derived, such as the existence of an equilibrium with a set of equilibrium prices for the goods, an equilibrium distribution of goods, and Pareto-optimality of the equilibrium. The model is exemplary because it is nonobvious that the macro-outcomes are implied by the assumptions. The model highlights that proving theorems, and hence showing that certain consequences follow from assumptions, is a core ingredient of applications of rational choice theory in the social sciences.

Quite a few variants of RCT that focus on the macro-level as well as on how micro- and macro-levels are related can be seen as alternatives to the perfect market model. Often, these variants retain rational choice assumptions and also other assumptions of the standard micro-model sketched above, while adapting assumptions about macro-conditions. Consequently, such variants also focus on bridge assumptions and transformation rules other than in the perfect market model. For example, Granovetter (1985) argued in his programmatic pamphlet that one should replace the assumptions of "atomized" actors on perfect markets, namely, assumptions of the perfect market model due to which strategic interdependence between actors can be neglected. Rather, Granovetter maintains, one should focus on social structures, that is, macro-conditions, that include "embeddedness" of actors. "Embeddedness" refers to ongoing relations between actors as well as networks of actors. Hence, from a rational choice perspective, Granovetter's approach focuses on macro-conditions that do imply strategic interdependence. Likewise, his approach focuses on the effects of strategic interdependence on individual behavior and on macro-effects of that behavior. Granovetter is not usually associated with rational choice approaches in the social sciences. Nevertheless, his approach is strikingly similar to Coleman's heuristic advice to combine robust assumptions on rational choice with more complex assumptions on social structure and carefully designed bridge assumptions and transformation rules. Granovetter opposes "psychological revisionism," characterizing it as "an attempt to reform economic theory by abandoning an absolute assumption of rational decision making" (1985, p. 505). Rather, he suggests maintaining the rationality assumption: "While the assumption of rational action must always be problematic, it is a good working hypothesis that should not easily be abandoned. What looks to the analyst like nonrational behavior may be quite sensible when situational constraints, especially those of embeddedness, are fully appreciated" (1985, p. 506). He argues that investments in tracing the effects of embeddedness are more promising than investments in the modification of the rationality assumption: "My claim is that however naive that psychology [of rational choice] may be,

this is not where the main difficulty lies—it is rather in the neglect of social structure" (1985, p. 506).

Variants of RCT in line with Granovetter's approach and Coleman's heuristic advice are often models for social and economic networks. Other variants focus on institutions other than perfect markets, with institutions broadly conceived as constraints for human behavior that result from human behavior itself and that structure the incentives for human behavior (North, 1990). Institutions can be of a formal or informal nature, including legal infrastructure, on the one hand, and informal conventions and codes of behavior, on the other. Still other RCT variants focus on formal and informal organizations. From a sociological perspective, Coleman suggested an analogy between RCT alternatives to the perfect market model and RCT alternatives to assumptions of the standard micro-level model: "Rational choice theory in sociology occupies a position relative to pure neoclassical economics analogous to that of behavioral economics. . . . Analogous to the psychological anomalies of behavioral economics, which show the systematic deviations from rationality that persons exhibit, the social anomalies of sociological rational choice theory show the systemic deviations from the perfect market assumption of neoclassical economies that arise in the linkage between micro and macro levels" (Coleman, 1994, p. 167).

Networks, institutions, and organizations are conceived as exogenous in some variants of RCT, while being endogenous in others. When conceived as exogenous, bridge assumptions can specify how they affect individual behavior. For example, as opportunities and constraints, they may affect actors' feasible choices. They may also affect actors' preferences and information. Networks, institutions, and organizations, assumed to be exogenous, can likewise affect how actors' behaviors "combine" to bring about macro-level outcomes and transformation rules, with transformation rules specifying this micro–macro relation. For example, electoral institutions may not only affect individual voter behavior but also affect the macro-outcomes of individual voter behavior. This includes that macro-outcomes such as the distribution of seats in parliament across political parties and, hence, coalition formation can vary considerably under different electoral institutions, even when controlling for individual voter behavior. Other variants of RCT focus on networks, institutions, and organizations as macro-outcomes themselves. Then, networks, institutions, and organizations are taken as endogenous, and the aim is to explain their emergence and dynamics as a result of actors' rational choice. Often, such models will be dynamic in the sense that they account for a social process. The burgeoning literature on strategic network formation and the coevolution of networks and behavior offers examples of work in this direction (Buskens, Corten, & Raub, 2014). From the perspective of Coleman's diagram, the macro-outcome (node D) is then simultaneously the "initial" node A of a subsequent micro–macro diagram, and so forth, leading to a sequence of "connected" diagrams as in figure 10.4.1 that account for the development of a social process over periods 1, 2, ...

5. Strategic Interdependence, Game Theory as a Tool, and Unintended Consequences as a Topic

Variants of RCT comprising alternatives to the perfect market model show that applications of rational choice theory in the social sciences often refer to social systems with strategic interdependence between actors. It is therefore not surprising, and illustrated by our VOD example, that game-theoretic tools are often employed. After all, game theory is the branch of rational choice theory that provides concepts, assumptions, and theorems allowing to specify how actors behave in interdependent situations. Game theory assumes that actors behave as if they try to realize their preferences, taking their interdependence as well as rational behavior of the other actors into account (Harsanyi, 1976). Meanwhile, applications in the social sciences employ game theory broadly, including not only "classical games" with complete information in normal form (Harsanyi, 1977) but also, for example, games in extensive form, repeated games, and games with incomplete information (Osborne & Rubinstein, 1994). With respect to RCT in sociology, interdependencies between actors and actors taking their interdependencies into account are likewise the core of Weber's definition of social action: "Sociology . . . is a science which attempts the interpretive understanding of social action in order thereby to arrive at a causal explanation of its course and effects. . . . Action is social in so far as . . . *it takes account of the behaviour of others and is thereby oriented in its course*" (Weber, 1947, p. 88, emphasis added).

Micro- as well as macro-outcomes of an actor's behavior typically depend not only on his own choices and possibly chance events but also on the behavior of other actors. Therefore, outcomes are often unintended consequences of actors' behavior: an actor's intentions need not coincide with the outcomes of his behavior. This applies, too, under rational behavior of actors (Boudon, 1977; Elster, 2007; Hayek, 1967; Merton, 1936). Applications of rational choice theory in the social sciences, certainly applications analyzing situations with strategic

interdependence, often focus on outcomes that are unintended consequences. In the VOD example, rational actors maximize their own expected payoffs, given the behavior of the other actors, thus producing a Pareto-suboptimal macro-outcome, but they are not assumed to *intentionally* produce such an outcome. An important distinction is between unintended consequences that are beneficial for the actors and unintended consequences that are unfavorable. The paradigmatic example for beneficial unintended consequences is a Pareto-optimal equilibrium on a perfect market, driven by selfish actors trying to maximizing own benefits, referred to by the "invisible hand" metaphor. The paradigmatic example for unintended consequences that are *unfavorable* for the actors involved are social dilemmas. In these dilemmas, individually rational behavior produces a Pareto-suboptimal macro-outcome. The symmetric equilibrium in mixed strategies in VOD is an illustration.

6. RCT and Empirical Research

Coleman (1986) argued that applying rational choice theory in the social sciences might contribute to a better integration of theory and empirical research. Nevertheless, RCT has for quite some time been criticized for weak links with empirical research. Focusing on rational choice approaches in political science, Green and Shapiro (1994) argued that much of this work did not induce serious empirical research and that empirical tests have been poorly conducted (the contributions in Friedman, 1996, scrutinize these claims). Meanwhile, the situation has changed. For example, Goldthorpe's (1996) arguments for an alliance involving quantitative analysis of large-scale data sets and rational action theory have been influential in sociology (Blossfeld & Prein, 1998). By now, quite a lot of work by theorists as well as empirical researchers aims at reducing the gap between theoretical models based on rational choice assumptions and empirical research in sociology. Note that empirical research need not and should not be restricted to testing RCT predictions. In addition to testing predictions, and certainly from the perspective of micro–macro models, empirical research is needed to establish macro-level regularities (arrow 4 in Coleman's diagram) that can subsequently serve as RCT explananda (for a similar perspective in demography, see Billari, 2015; Goldthorpe, 1996, 2016).

Today, systematic empirical research based on RCT is common in many fields, including but not restricted to social networks, power and inequality, education and social mobility, deviant behavior and criminology, religion and secularization, migration and immigrant assimilation, families and households, markets and organizations, collective action and collective decision making, ecological behavior, and social dilemmas (Abraham & Voss, 2004; Wittek et al., 2013). While Goldthorpe advocated the use of survey research, other research designs are meanwhile employed as well (Buskens & Raub, 2013; Gächter, 2013). Employing complementary research designs, such as lab and field experiments, surveys and other observational designs, and vignette studies for repeatedly testing the same hypotheses, can yield information on the robustness and replicability of empirical results (Buskens & Raub, 2013; Jackson & Cox, 2013). Other important contributions involve the development of statistical models that facilitate better integration of theoretical models employing rational choice assumptions and empirical research by integrating core assumptions on rational choice into the statistical model itself (McFadden, 1973; Snijders, 2013).

Various issues arise related to empirical research testing predictions based on RCT (Kroneberg & Kalter, 2012). These issues include whether such tests should exclusively focus on predictions themselves or also on empirically assessing assumptions used for deriving predictions, such as assumptions on preferences and beliefs—and on how to do so. Another issue is how to cope with empirical evidence that is hard to reconcile with, or an outright refutation of, predictions based on RCT. Axioms of rational behavior under certainty, risk, and uncertainty à la, for example, Harsanyi (1977) imply that a utility function exists and that behavior in accordance with these axioms can likewise be characterized as maximizing the utility function. In a rather strict sense, an actor behaving according to the axioms behaves *as if* maximizing a utility function: one need not assume that actors consciously calculate (expected) utilities. In this sense, rational choice theory is a theory of behavior rather than of the underlying mental processes. However, behavior may turn out to be more or less systematically inconsistent with predictions based on RCT.

Harsanyi (1976, 1977) argued that although rational choice assumptions may yield empirically problematic conclusions, it is useful to employ them for establishing a "benchmark" so that empirically observed refutations become themselves explananda for more refined models. Other arguments proceed from the idea that macro- rather than micro-level implications of RCT are the core issue. From this perspective, it has been suggested (Goldthorpe, 1996) that errors in predicting individual behavior with RCT will cancel out on the macro-level. Becker (1976) has developed the argument that typical macro-outcomes of micro–macro models are robust to

replacing the rational choice micro-model by alternative micro-models. Coleman (1987a, 1990) argues in a similar direction and suggests that replacing simple rational choice assumptions by more complex micro-theories would undermine the tractability of the model because it becomes unfeasible to derive implications for macro-outcomes at all, certainly so when complex bridge assumptions and transformation rules are involved in the model. Both the "errors cancel out" argument and the argument that macro-outcomes are generically robust to varying micro-models of behavior are disputed (Raub, Buskens, & Van Assen, 2011). For example, Thaler (2018) argues that actors' deviations from what rational choice assumptions imply do not exhibit "random error." Rather, Kahneman and Tversky's work, as well as subsequent work building on Kahneman and Tversky's, shows that it is predictable how actors' empirical behavior deviates from implications of rational choice assumptions. Furthermore, Thaler (2018) presents evidence that even macro-outcomes like aggregate market behavior can deviate from what one would expect based on rational choice assumptions. This would contradict the argument of Becker and others that institutions like competitive markets with exchange and division of labor operate so that nonrational behavior of possibly even many actors will be "eliminated" and aggregate outcomes are driven by fully rational behavior of possibly only few actors who thrive on other actors' "errors" (Clement, 2002). Another controversy with respect to RCT and empirical research (Green & Shapiro, 1994; Grofman, 1993) concerns the merits and problems of empirical research that focuses on qualitative predictions of changes "at the margin" using comparative statics rather than on quantitative point predictions.

7. Concluding Remarks and Suggestions for Further Reading

This chapter has been on selected features of contemporary applications of rational choice theory in the social sciences. See Macy and Flache (1995), Hechter and Kanazawa (1997), and Abraham and Voss (2004) for earlier concise reviews of selected applications. Wittek et al. (2013) is a recent handbook on applications in many domains. Ermakoff (2017) is a general discussion of RCT in sociology complementary to this chapter. For reasons of space, we have neglected a "history of ideas" perspective on how contemporary applications relate to, say, British moral and social philosophy of the 17th and 18th centuries (Hobbes, Hume, Smith, Ferguson), the Austrian school of economics (Menger, Schumpeter, Hayek), and analytical philosophy of science (e.g., Hempel, Nagel) and critical rationalism (Popper, Lakatos). Udehn (2001) is a source with respect to history of ideas. An informative collection of interviews with key scholars in the social sciences who have been influential in promoting and discussing contemporary applications is Swedberg (1990). Wittek (2013) is a bibliography with pointers to additional references on various issues discussed in this chapter. Burgeoning research programs in the social sciences are similar to applications of rational choice theory in that they focus on micro- as well as macro-levels of analysis and try to systematically relate these levels as well as assuming variants of incentive-driven and goal-directed behavior. These research programs include behavioral and experimental game theory (Camerer, 2003), approaches employing models of learning in games and evolutionary game theory (Fudenberg & Levine, 1998; Gintis, 2009a, 2009b; see chapter 9.3 by Alexander, this handbook), analytical sociology (Hedström, 2005; Hedström & Bearman, 2009; Manzo, 2014; for discussion, see Opp, 2013), and applications of agent-based computational modeling (Macy & Flache, 2009).

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Notes

1. "RCT" is thus *not* used as an abbreviation for "rational choice theory" but refers to social science theories employing rational choice assumptions.

2. We use the label "social system" broadly, including systems of actors typically analyzed in, for example, sociology, political science, and economics.

3. Throughout, we use "he" and "his" to facilitate readability and without intending gender bias.

4. Strictly speaking, we would have to specify the extensive form, including the game tree, rather than only the normal form of VOD, to make its information structure explicit.

5. Note, by the way, that it can also be shown that the macro-level probability that the collective good will be provided increases with increasing group size if each actor contributes with individual probability p^{**} (Diekmann, 1986).

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