Article

Paradigm Shift in Game Theory: Sociological Re-Conceptualization of Human Agency, Social Structure, and Agents' Cognitive-Normative Frameworks and Action Determination Modalities

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Abstract: This article aims to present some of the initial work of developing a social science grounded game theory—as a clear alternative to classical game theory. Two distinct independent initiatives in Sociology are presented: One, a systems approach, social systems game theory (SGT), and the other, Erving Goffman's interactionist approach (IGT). These approaches are presented and contrasted with classical theory. They focus on the social rules, norms, roles, role relationships, and institutional arrangements, which structure and regulate human behavior. While strategic judgment and instrumental rationality play an important part in the sociological approaches, they are not a universal or dominant modality of social action determination. Rule following is considered, generally speaking, more characteristic and more general. Sociological approaches, such as those outlined in this article provide a language and conceptual tools to more adequately and effectively than the classical theory describe, model, and analyze the diversity and complexity of human interaction conditions and processes: (1) complex cognitive rule based models of the interaction situation with which actors understand and analyze their situations; (2) value complex(es) with which actors operate, often with multiple values and norms applying in interaction situations; (3) action repertoires (rule complexes) with simple and complex action alternatives—plans, programs, established (sometimes highly elaborated) algorithms, and rituals; (4) a rule complex of action determination modalities for actors to generate and/or select actions in game situations; three action modalities are considered here; each modality consists of one or more procedures or algorithms for action determination: (I) following or implementing a rule or rule complex, norm, role, ritual, or social relation; (II) selecting or choosing among given or institutionalized alternatives according to a rule or principle; and (III) constructing or adopting one or more alternatives according to a value, guideline, or set of criteria. Such determinations are often carried out collectively. The paper identifies and illustrates in a concluding table several of the key differences between classical theory and the sociological approaches on a number of dimensions relating to human agency; social structure, norms, institutions, and cultural forms; patterns of game interaction and outcomes, the conditions of cooperation and conflict, game restructuring and transformation, and empirical relevance. Sociologically based game theory, such as the contributions outlined in this article suggest a language and conceptual tools to more adequately and effectively than the classical theory describe, model, and analyze the diversity, complexity, and dynamics of human interaction conditions and processes and, therefore, promises greater empirical relevance and scientific power. An Appendix provides an elaboration of SGT, concluding that one of SGT's major contributions is the rule based conceptualization of games as socially embedded with agents in social roles and role relationships and subject to cognitive-normative and agential regulation. SGT rules and rule complexes are based on contemporary developments relating to granular computing and Artificial Intelligence in general.

1. Introduction

Game theory in its several variants can be viewed as an important contribution to multi-agent modeling, with widespread applications in economics and the other social sciences as well as in engineering, management, and biology. This paper presents briefly classical game theory together with two distinct approaches *to socializing—extending*—classical game theory: One, a systems approach, social systems game theory (SGT), and the other, Erving Goffman's interactionist approach (IGT). After a short presentation of classical game theory (Section 2), Goffman's IGT is presented, followed by a presentation of SGT (both in Section 3). In Section 4, these approaches are compared and contrasted with the classical theory. The two sociological theories take up such issues as communication, negotiation, solidarity based cooperation, deception and fabrication, and much else of social-psychological and sociological significance which were all-too-neglected or ignored by classical game theory (although some of these issues have been addressed in later work (such as that of Thomas Schelling (1960); Colman (2003); Elster (1989); Gintis (2009, 2010); Grossi et al. (2012); among others). However, these issues did not (and still do not) fit naturally into the language and conceptualization of classical theory. On another level, SGT and IGT reject assumptions of super-rationality and one-dimensional utility and recognize the extraordinary knowledgeability of human agents about their institutions, roles, and norms and other rules; they recognize also their mixed-motive and multi-value orientations. Section 5 provides a table comparing and contrasting on a number of key dimensions, SGT and IGT, on the one hand, and classical game theory, on the other hand. The dimensions relate to human agency, social structure, norms and other rules, and patterns of game interaction and outcomes as well as such concerns as trust, conditions of cooperation and conflict, game restructuring and transformation, and empirical relevance, etc. In Appendix A, more formal elaborated features of SGT are presented. Social science inspired game theory, such as the contributions outlined in this article suggest a language and conceptual tools to more adequately and effectively than the classical theory describe, model, and analyze the diversity and complexity of human interaction conditions and processes; it promises, therefore, greater empirical relevance, as we argue and illustrate in this article.

2. Classical Game Theory

Game theory is oriented to modelling strategic interactions between two or more players in a situation defined by fixed rules, and given action alternatives and outcomes (Harsanyi and Selten 1972, 1988; Luce and Raiffa 1957; Nash 1950, 1951, 1953; Von Neumann and Oscar 1944). The players are interdependent in their actions and the outcomes. The theory and its numerous derivatives are relatively widespread in the social sciences and also in engineering and management. It is highly institutionalized—with very substantial funding supporting courses/educational programs, textbooks, journals, research programs, policy applications, etc.

A few terms and conceptions commonly used in game theory are as follows:

(1) **Game:** A game consists of a set of players (decision makers) who are governed by a set of rules or constraints and whose actions and action outcomes are interdependent. Otherwise, *games and their players are socio-culturally and institutionally context free.*

(2) **Players: Strategic decision makers within the context of the game.** Each player is assumed to be *an anomic, self-interested egoist* who at the same time acts as a strategist, taking into account how other(s) might respond to her and whether or not her own choice of action is the "best response" to others' expected actions.

They are presumed to be universal super-rational, anomic agents (that is, without social ties) who implicitly or explicitly lack morality (as well as creative and transformative capabilities).

In other words, each player is not only alien to others with whom she interacts but a supreme egoist who tries to gain the most or to make the best choice for herself, showing no morality, concern or empathy for others ine the game situation. In other words, she merely searches in her action space that particular action which is the best response for herself to "the best choices of other(s)".

(3) **Super-capabilities of individual cognition, judgment, and choice** are assumed according to fixed axioms of rationality. Consistency and coherence are taken to be universal.

(4) Perfect or minimally imperfect information is assumed for game players about the game, its players, their options, payoffs, and preference structures or utilities (that is, crisp information, strategies, decisions).

(5) **Game structure is assumed fixed or given.** Game transformation—or transformation of any kind including that of the material and socio-cultural context—was never conceived in classical game theory. Consistent with the notion of fixed or given game structures, classical games are "closed" (in principle, not transformable except by the game theorist herself; in time, game theorizing developed concepts and illustrations of dynamic and evolutionary games (Axelrod 1984; Gintis 2004; Hardin 1995; Hofbauer and Sigmund 1988; Skyrms 1996; Smith 1982; among others).

(6) **Strategy**: Each actor has a set of possible instrumental strategies. Each strategy is a complete plan of action a player may take, given the set of circumstances that obtain in the game situation. Typically, actors have multiple strategies, among which they make choices in pursuit of net gains or increased utility. (Many types of action such as ritual and ceremonial action do not make sense in a purely rational instrumental perspective. Moreover, innovative and creative activities are not part of classical repertoires).

(7) **Payoff:** There is a mapping from a set of strategies to a set of payoffs, one such mapping for each player. The payoff a player receives from a particular outcome can be in any quantifiable form, whether concrete dollars or *abstract utility*.

(8) **Utility function or preference ordering over outcomes** (payoffs) is given and exogenous to the game—it is usually seen as one-dimensional in character.

(9) **Singular decision modality**: As in economics generally, there is the assumption of rationality. Instrumental rationality or "rational choice"—maximization of payoffs or expected utility—is the universal choice and action principle. The "maximum expected utility principle" states that a rational agent should choose an action that maximizes her expected utility in her current action/interaction situation (see Appendix A). The multiple actors (two or more) all follow this principle, consistent with the assumption of game symmetry. Each actor is assumed motivated to be an instrumental rational strategist, taking into account the interdependency of her actions with those of others, and judging how other(s) are likely to respond to her and whether or not her own choice or action is the "best response" to others' expected actions (see below).

(10) **Equilibrium**. The point in a game where both players have made their decisions and an outcome is reached. An equilibrium is the "*solution*" to the game, for instance, the Nash equilibrium in non-cooperative games—without communication or binding agreement. The "Nash Equilibrium (NE)" is the outcome of a game where no player has an incentive to unilaterally deviate from his chosen strategy after considering opponents' choices. A set of strategies form a NE if, for player i, the strategy chosen by i maximises i's payoff, given the strategies chosen by all other players in the game.

We take up later in the discussion empirical and conceptual considerations, pointing out several of the limitations of and challenges to classical game theory and the many openings for sociological game theorizing as an alternative (also, see Table 1).

3. Sociological Theories of Games and Interaction

The sociological approaches to game theorizing—and formulating an alternative—are empirically grounded as well as informed by established social science knowledge.[1] As would be expected, they emphasize the importance of taking into account and analyzing such factors as the social context, and the social relationships, roles, and norms of the players or "actors"—which contribute to defining many if not most of the "rules of the game." In this perspective, games or interaction situations are "socially contextualized or embedded" (Burns et al. 1985; Granovetter 1985). We briefly outline the two sociological approaches, IGT and SGT.

3.1. Goffman's Interaction Game Theory (IGT)

Goffman's interactionist approach (Goffman 1961, 1969; Manning 1992) to extending classical game theory derives, in part, from his knowledge of the sociological theory of symbolic interactionism (Blumer 1937).[2]

(1) Goffman focuses as does SGT on multi-agent interaction situations where there are interdependencies among two or more agents.

(2) He makes use of sociological concepts such as rules, norms, roles, and social relationships in his analyses as does SGT.

(3) IGT puts a great deal of stress on communication among actors, the categories and symbol systems the actors use, the shared framing and definitions of their interaction situations.

(4) Goffman applies the concepts of game and strategic action to a variety of social interaction situations, for instance, impression management games; in such games, actors try to manipulate the impressions they give in interactions so as to influence others' orientations and judgments of them.

(5) As would be expected from the author of "the presentation of self in everyday life" (Goffman 1959), he emphasizes the forms and strategies of self-expression in interaction situations.

(6) IGT considers how actors combine ritual and strategic modalities, often drawing on rich culturally established traditions, in the process producing complex patterns of interaction (Zelizer 2012).

(7) Especially important for Goffman was the empirical investigation and analysis of concealment, fabrication, and seduction in games, for instance, in his consideration of the "con-artist" (confidence man) who tricks others to put up money in a scheme which enables the con-artist to steal the money using deceptive methods.

(8) Of particular importance in Goffman's work is his attention to, and elaboration of, social psychological aspects of game "players": their technical knowledge and competences, their gamemanship, their capabilities of assessing situations, other agents, and themselves. Drawing on psychology and social psychology, Goffman distinguished such aspects or characteristics of players as gameworthiness (ability to set aside personal feelings and emotions—"impulsive inclinations"—in assembling the situation and in following a course of action). The varying capabilities of actors to assess their own situations as well as assess the other player(s)' situation; the capability of assessing the expressions and communications of others, their trustworthiness. Such capabilities, Goffman suggests, are important to game performance and success.

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[1] Some like Peterson (1994), but also Swedberg (2001), claim that Game Theory has proved only sporadically useful to sociologists, while Abell (2000) argues it ought to have a greater influence in sociology, and Edling (2002) claims that it has mostly affected mathematical sociology, but that its core—yet most basic principle " . . . that social actors interact, and are affected by game outcomes, albeit in different ways, by that interaction" is basic sociology.While Swedberg (2001) long ago pondered the possibility of developing a distinctively sociological game theory approach without acknowledging earlier initiatives such as IGT and SGT, he mostly saw and partially articulated the idea of game theory in order to theorize "counterfactuals." But, of course, given its empirical limitations, it would be a very poor tool for generating 'counterfactuals'.

[2] Goffman studied at the University of Chicago, a major centre for symbolic interactionism.

(9) IGT, like SGT, recognizes the role of nature and/or third parties in structuring games and regulating patterns of interactions and outcomes.

3.2. Social Systems Game Theory (SGT)

In SGT games consist of (1) participating, mutually aware agents whose actions are interdependent; (2) the SGT agents/participants are typically role and normatively directed and constrained; they are, in part, strategic, that is, "rational" but with limited ("bounded") rationality at the same time that they are innovative and creative as well as transformative beings. (3) rule regimes (cultural and institutional systems) structure and regulate role relationships, games, and interactions; in other words, games are embedded in social institutions and cultural formations (social rule systems as well as material conditions (Burns and Flam 1987; Burns and Hall 2012). and (4) resources (technologies, material conditions) play a substantial part in the actions and interactions. The SGT formulation derives from Actors-Systems-Dynamics, a meta-theory which provides a language, modelling and analytic tools on which investigations of rule systems, cultural formations, institutional arrangements, and social interaction patterns are based (Baumgartner et al. 2014; Burns 2008; Burns et al. 1985; Burns and Flam 1987; Burns and Meeker 1974).

SGT in a nutshell:

(1) SGT theory is applied to **multi-agent interaction situations** where there are interdependencies among two or more agents (as in classical game theory and IGT) (see footnote 1).

(2) **A SGT game** consists of a set of actors in diverse roles who interact in complex socio-cultural and psychological contexts, subject to particular rule regimes (institutions, cultural formations (see Figure A1)) as well as material and technological conditions. That is, games are socially embedded—normative, relational, and institutional contexts are identified and taken into account in their influence on interaction conditions and the participating actors' frames, perceptions, judgments, and actions. Interaction and group behaviour, its outputs and consequences are patterned in large part through actors performing their roles and adhering to norms; at the same time, they may make strategic choices, and take strategic actions to better achieve a goal or to realize a role or norm.

(3) SGT provides then a **cultural/institutional basis** for the conceptualization and analysis of games in their social context, showing precisely the ways in which social norms and rule complexes of social relationships, values, institutions, and social relationships come into play in shaping and regulating game agents and their interactions. It stresses action and interaction based on social rule systems—typically implementing norms, roles, and institutional arrangements.[3]

(4) SGT games may be **symmetrical or asymmetrical**—this is an empirical question relating to the social structure and population of agents involved in the games. For instance, status and power differences correspond to asymmetries in game and rule architecture.

(5) **Bounded capabilities of actors**. The SGT approach to game theorizing rejects assumptions of super-rationality and maximization of one-dimensional utility. Instead, individuals as well as collective agents are seen as having multiple value and *bounded capabilities of cognition, judgment, and choice*. Contradiction, incoherence and dilemmas, arise because of multiple values and norms which are not always assumed compatible in any given game situation. *Degrees of consistency and coherence are socially structured and regulated, that is, there is an empirical issue not an axiomatic one.*

(6) **Rules governing communicative actions**. Communication conditions and forms are specified by the rules defining action opportunities and repertoires in any given game situation. In whatever ways the norms and institutional arrangements are established and maintained, the SGT approach provides a language and analytic tools to describe and analyze *a wide variety of communication situations*

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[3]　SGT, in addition to its empirical grounding, provides the conceptual and mathematical foundations of rules and rule systems (Burns and Gomolinska 1998, 1999, 2000; Gomolinska 2002, 2004, 2005)—*ironically, classical theory defined games as systems of rules but never developed a conceptualization and mathematics of rules and rule systems (see Appendix A).*

distinguishable by their particular norms and institutional arrangements. SGT readily articulates the rules of "communication among players" and the making of binding agreements—which are the bases of what are referred to in classical game theory as "cooperative games." But there is much greater variety and complexity in human communicative activity than the simple but limited distinction (at least seen from a social rule system perspective) between cooperative and non-cooperative games would suggest.

(7) **Extraordinary social knowledge.** While SGT readily and systematically incorporates the principle that human actors have bounded factual knowledge and computational capability, *it emphasizes their extraordinary socio-cultural and institutional knowledge and competencies*: in particular, their knowledge of diverse cultural forms and institutions such as in those of family, market, government, business or work organization, hospitals, and educational systems, among others, knowledge which they bring to bear in framing and engaging in their role relationships and game interactions.

(8) **Evaluative judgment of actions and outcomes**. Strategies and outcomes have properties which are evaluated according to relevant norms and values (the value complex) of actors' roles as well as the particular game situation itself. Typically, some or many properties of interactions and outcomes are unknown—unanticipated and unintended outcomes of actions and interactions are an inherent part of the SGT conceptualization.

(9) **Game closure and openness.** SGT distinguishes between *open and closed games*. The rule regime of a closed game is fixed. In open games, actors have the capacity ("meta-power" (Burns and Hall 2012) to structure, restructure, and transform game components such as the role components or the general "rules of the game". Even external agents ("third parties") may have such power to structure and transform games (hence, "the prisoners' dilemma game has been analysed in SGT as a three-person game" with the district attorney (DA) structuring the 2-person game (Buckley and Burns 1974).[4]

(10) **Role conditions in closed and open games. Each player has one or more roles in a game.** In closed games an actor in any given role has a set of available strategies. In open games, she may develop or adopt strategies as the interactions among players evolve. She may change her role(s) or adopt a new role (or roles). In general, actors may to a greater or lesser extent change their strategies or options as well as the rules, roles, norms, players, context, etc.).

(11) **Game transformation**. Game re-structuring and transformation is conceptualized in SGT through constructive actions of game agents and/or external agents. *It is based on the innovative or creative capabilities of game participants*. Exogenous agents also engage in shaping and reshaping games. In "open games", the players may restructure and transform the game, its norms, their roles, and role relationships and, thereby, the conditions of further actions and interactions.

(12) **Normative equilibria and solution concepts**. SGT re-conceptualizes the notion of "equilibrium" as well as "game solution." In SGT, games and interaction processes result in the production and manipulation of institutions, social relationships, roles, norms—and these serve, in general, *as equilibria—normative equilibria* (right actions, distributive justice (Burns et al. 2014)), which is the basis of much social regulation and order. In SGT "solutions" are defined in a particular framework or model of one or more players—or possibly a group or organization. "Solutions" envisioned or proposed by actors operating with different frameworks and interests are likely to be contradictory or incompatible. Under some conditions, however, actors may arrive at "common solutions" or find such "solutions" imposed by external agents, which in both cases are part of the patterning of interaction and game equilibria.

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4   Open games—with their opportunities for creativity and innovation—are obviously less predictable in their interaction and outcome patterns than closed games with fixed action repertoires and given outcomes. Even in many closed games the actors vary to a greater or lesser extent in their interpretations, adjustments, and enactments of the norms and algorithms associated with their roles, introducing variation in the situation (for instance, in superordinate-subordinate interactions, in peer group interactions, or in gender interactions).

(13) Action determination rule complex: Modalities for determination of action (as a distinct contrasting alternative to maximization of utility which, in any case, is a special case of DET-II modality). The universal motivational factor in SGT is the human drive to realize multiple appropriate rules, norms and values through their actions and interactions in particular contexts. An action determination rule complex DET is utilized by each and every actor to organize the selection and enactment of actions in relation to other agents in any interaction situation (Burns and Roszkowska 2005). The concept of action determination refers here to three analytically distinct bases or modalities on which actors determine what they do: for instance, following a rule or algorithm (which prescribes social actions and interactions), making choices among given alternative actions, and constructing and enacting new actions.[5]

These modalities are briefly explicated below.[6]

A. DET-I: This modality entails following or implementing an appropriate or prescribed rule, rule complex, norm, ritual, role, institutional arrangement (with multiple participants), that is, one or more rule complexes or algorithms are implemented. In the activation and effort to realize the rule or rule complex, the performer compares and "matches" the experience or perception of the act with the qualities or details specified by the rule or rule complex (see Appendix A).

Most social action and interaction are routinized, ritualistic; performance or enactment is matched with a specified rule, norm, procedures in a given interaction situation S and game G, with actors i, j, k, . . . , m. The roles and role relationships as well as general norms and rules are those applying to the particular situation. For instance, two actors, A and B, in a 2-person game have established paired rule complexes to implement, and the interaction is likely to be highly routine, predictable. Even if content changes—within some limits—the interaction is likely to be produced in routine and predictable ways. (Whole production systems operate more or less in this way: organ transplantation model (Machado 1998), hydro-power planning and decision-making model (Burns and Flam 1987); bank-wiring production room (Homans 1950)).

B. DET-II: This modality entails assessing and choosing among established or given multiple courses of action, according to a rule or principle. An agent or group of agents is faced with a "crossroad", alternative actions, multiple strategies, or modalities of action determination. For instance, the agent is faced with a choice between two or more action alternatives; or a choice has to be made between an action of normative realization or an action promising instrumental gain (possibly illegal). Or the agent chooses between an extreme emotional expression (emotional modality) and an instrumental one (constraining her emotional expression for the purpose of gaining something desirable from another agent such as an employer. Because of a blockage of an established activity, or its failure to do what it is supposed to do, the actor is driven to construct or generate one or more action alternatives. In other words, the agent(s) is (are) engaged in creative and innovative efforts.

Following a rule, procedure or algorithm, the actor selects the alternative from among the possible options. One variant of this entails "matching"—the actor selects the option most similar to a relevant norm or value; in other words, the actor compares the various alternatives to the relevant norm and value complex in the situation, and the degree of similarity is assessed. The actors choose the most similar alternative—or the one that is ranked highest in terms of similarity with the relevant norms and values.

C. DET-III: This modality entails finding or constructing one or more action alternatives in an initial phase, according to a guideline, principle, or set of criteria. Phase 2 entails the decision

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[5]   The notion of *action determination replaces the single, much more limited notion of "decision-making" in classical game theory;* even the game theoretic maximization principle can be understood as one of several "rationality" norms or rules for determining action.

[6]   Action determination encompasses additional modalities as well such as making a choice among alternatives, or constructing or adopting alternatives on the basis of the *emotional qualities of the action* ("feel good theory"); or the *expressive or symbolic qualities of the action* (action oriented to communication and the reaction of others as in "dramaturgy theory").

to approve or accept as well as perform the constructed or derived actions. In case of alternative options, the agent(s) makes an assessment and choice among those alternatives (that is, applies a DET-II modality).

Note that the "action determinations of DET-II and DET-III" are ultimately finalized through DET-I processes of rule following or enactment.

In sum, the action determination concept replaces the more limited notion of "rational decision-making" in classical game theory. It entails, as indicated above, either following or implementing a rule or rule complex such as an algorithm, selecting or choosing among alternatives, and constructing or adopting new rules—such determinations are often realized according to collective specifications and collective performances (see Table A1 in Appendix A).

The sociological approaches of SGT and IGT promise effective description, analysis, and explanation of a wide variety of social interactions and game situations—and specifying as well as explaining interaction patterns and outcomes beyond the capabilities of classical game theory. *The sociological toolbox provides a systematic basis to describe, analyze, understand and explain patterns of interaction, their stability and transformation. In some cases, predictions of interaction patterns and outcomes are possible, particularly when institutional arrangements and normative orders are stable; they operate as elaborate social algorithms providing stability, predictability, and the experience of social order among participants.* Moreover, interaction contexts and conditions can be distinguished and analysed which are likely to lead to stable patterns of interaction, on the one hand, or to unstable patterns and disorder, on the other hand.

The sociological approaches cover many types of games (in some cases games not ever envisioned or envision-able in classical theory and also, arguably, in its many direct descendants). For instance, SGT researchers have conducted studies of a variety of exchange interactions, conflict and negotiation interactions, organizational relationships such as supervisor-supervisee, and policy games in diverse fields and sectors (Baumgartner et al. 1975, 1977; Buckley et al. 1974; Burns and Flam 1987; Burns 2008; Burns and Roszkowska 2005, 2007). Goffman conducted studies and analyses of gambling casinos, community life, and everyday life interactions: expression-of-self games, games of opposition, games of coordination, negotiation, and contingency, observer-subject games, and interrogation games as well as a variety of games of secrecy, deception and fabrication (Goffman 1969, 1961).

4. Discussion: Applications and Illustrations

This section provides examples and illustrations of the sociological approaches and suggesting contrasts to classical theory. The emphases are on social rules, multiple values, multiple roles, the great variety of games and interaction situations, the patterning of interaction and games as a function of actors' social relationships and the social context.

4.1. Social Rules and Rule Systems and Their Influence on Behavior

Multiple Norms and Institutional Factors

Norms and norm complexes (rule regimes) are the "bread and butter" materials of much sociological research. It is not surprising that in his work on game theory, Goffman identified *a variety of norms* operating in any game process. For instance, the norms *prior* to any game being played as well as those *applied in the multiple phases* of an interaction process (Goffman 1969, p. 114), for instance: (1) directives (i.e., constraints) to play the game as part of a normative, institutional context as well as to participate in and perform of particular roles in the interaction situation; in other words, participation and role performance in the game interaction situations is expected, even demanded; (2) norms structuring actors choices and payoffs in the interaction situation; (3) norms supporting commitment to actors' previous moves or promises; (4) norms providing intrinsic payoffs to players, not just the ostensible outcome payoffs. In general, a game or interaction situation is "socially embedded" in, and constrained by, multiple complexes of appropriate rules (Burns et al. 1985; Granovetter 1985).

In general, in the perspectives of SGT and IGT, social norms and institutional factors must be an integral part of the description and analysis of game situations and interaction behaviour and provide a reliable basis for explaining and predicting many behavioural patterns (Baumgartner et al. 1975, 1977; Burns and Gomolinska 2000; Burns and Roszkowska 2005). The conceptualizations and analyses in the sociological approaches stress that actors' group membership and group social relationships play a substantial part in how they act and interact in relation to one another. In general, meaningful other agents and groups influence the thinking, judgment, and behavior of individual players involved in interaction situations and games. Normative and institutional factors are axiomatic in any sociological approach to conceptualizing interaction and game processes. Such factors are largely missing from classical theory, although more recently there have been initiatives to introduce such social factors (see later discussion and footnote 8). In general, in the sociological approaches, social institutional and normative factors are an integral part of the description and analysis of any and all game situations (Baumgartner et al. 1977; Buckley et al. 1974; Burns and Gomolinska 2000; Burns and Meeker 1974).

The sociological approaches to game theory not only distinguishes social rules from other constraints (such as material and technological constraints),[7] they broaden and elaborate the conceptions of and distinctions among rules: norms, regulations, institutional arrangements, rituals, traditions, habits of all sorts, among others. Social rules are an underlying code to human behaviour. Goffman emphasized, in particular, ceremonial rules including gestures which guide conduct; often these are viewed by game and rational decision theorists as secondary or even of no significance in their own right (Manning 1992, pp. 53–54). However, the social fabric of sentiments and trust among people is made up of these ceremonial threads (see later discussion about "trust" in social life).

While Sociological approaches readily recognizes informal norms and relations among actors as sources of constraint, it stresses at the same time the importance of formal institutional and legal constraints and regulations on game behaviour Goffman (1969, p. 125) writes: "Under law, a whole range of verbal threats and promises become moves for which actor A can be made liable . . . . The uttering of self-disbelieved statement under oath is a punishable offense. So also are verbal discourtesies directed at the courts "(or, in many instances, authorities in general). In this way, even words have weights in legally regulated institutional contexts . . . ".[8]

4.2. Multiple Values Versus Uni-Dimensional Utility

Actors' behavior is typically motivated and constrained by multiple values and rationales, motives and factors that go well beyond wanting to maximize the outcome of actions on a single dimension (or "utility". For instance, they may have to fulfill a specific and complex role such as that of a student, parent, teacher, apprentice, husband, or collaborator in relation to their counterparts. And while engaging in these role based interactions, they may not even try to maximize their own particular payoffs, *but instead work to produce or maintain a norm complex, a social relationship or a fragile social order (which may be conceptualized as a particular complex outcome), or they try to accomplish several goals at the same time or in sequence.* A world of multiple values results in mixed motive games and decision dilemmas for participants, for instance between instrumental gain, on the one hand, and realization of counter-norm, on the other hand, or conflict between different norms, or between divergent instrumentalities.

In such multiple value contexts, actors experience dilemmas, for instance, between doing the "rational thing" (making particular economic or political gains) versus doing "the right thing" (that is, acting in a normatively appropriate way in the interaction situation) whether that entails applying an appropriate norm or enacting a ritual. In general, human agents are moral beings, much of the

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7   The social rules are often *conflated* with the "rules" of material and ecological constraints.

8   An office or social body of officials specialized for this purpose maintain standards of conduct and regulate behavior in interaction situations. They make final judgments and institute payoffs. In whatever ways the norms and institutional arrangements are established and maintained, sociological approaches provide language and analytic tools to describe and analyze a wide variety of interaction situations distinguishable by their norms and institutional arrangements.

time subject to normative and institutional contexts and role relationships—arrangements in large part alien to game theory.

Empathy and Caring for Others

Given that humans are social animals, they display "caring-for-other" behavior, concern with others, putting "others ahead of oneself" (Goffman 1969, p. 92), serving a community, or abstract ideals, such as "the Law," or "God." Some or many of their values concern then taking other matters (than themselves) into account and making sacrifices for these others. Certain values belong to a sacred core, grounded in identity, role(s) and role relationships, and institutions to which agents may be strongly committed. Under these conditions, "not everything is negotiable" or "replaceable." *In other words, instrumental, self-interest rationality does not apply universally.*

But because of normative dilemmas, "temptations and pressures," and powerful social and material contextual factors, deviation from institutional arrangements occurs, for instance, in the performance of particular roles and role relationships, as well as norms in general. Under some' conditions such as revolutionary change, deviation and disruption becomes widespread. There is social disorder; group actors tend to struggle to establish order or possibly a new order.

4.3. Multiple Roles and Shifts in Roles

Goffman pointed out the variety of roles a player can have in many games: a "party", a "pawn", "token", "informant", "spy". A "party", for example can be an individual or group as a player, pawn, token, etc. (Goffman 1969). A given game may be embedded in other games, making for variation in actions and outcomes. Thus, a sexual game with sexually defined roles may be embedded in a business negotiation game with business roles, just as a business game may be embedded in a sexual game.

Asymmetry and Heterogeneity in Roles and Role Relationships

Typically, actors' roles in a given interaction situation or game differ; they may be differences in positions of status and power; there is also diversity in the role components: value, model, action repertoires, judgment/modality, action determination, etc. (see Appendix A). The actors participating in the same game may operate in different social and psychological contexts—violating one another's expectations or predictions.

In general, capabilities (endowments, knowledge, cognitive and judgment capabilities) are very unevenly distributed in most groups, organizations, or communities—and all games being played in these contexts will be characterized by varying asymmetries in actor capabilities, knowledge, behavioral inclinations, and performances. This concerns not only expert knowledge and judgment versus the knowledge and judgment capabilities of lay persons. Con-men vis-à-vis their victims have informational, knowledge, and strategic advantages.

4.4. Variety of Interactions and Games

The sociological approaches cover many types of games (in some cases games difficult to envision or to elaborate in classical theory as well as its many direct adaptations). For instance, Goffman conducted studies and analyses of gambling casinos, community life, everyday life interactions such as expression-of-self games, games of coordination and opposition, negotiation games, observer-subject games, and interrogation games as well as a variety of games of secrecy, deception and fabrication (Goffman 1969, 1961). SGT researchers have conducted studies of factory conflict, varieties of exchange interactions, organizational relationships such as that of supervisor-supervisee, and policy games in diverse fields and sectors (Baumgartner et al. 1977, 2014; Burns and Flam 1987; Carson et al. 2009).

4.4.1. Ritual and Ceremonial Types of Interactions

Ritual and ceremonial type of interactions have been particularly emphasized by sociologists; but SGT and IGT in their reformulation of classical game theory recognize and analyze strategic ("rational") forms of action and interaction combined with rituals and symbolic expressions. In other words, rule following—implementing norms, roles, and institutional arrangements may be *combinable with* strategic action considerations (but in ways of implementing multiple rules such as "satisficing", not "maximizing"). Social agents/beings, with their roles, role relationships, obligations as well as rights, and normative context replace "players" as anomic agents, without social relations and normative context (not socially embedded). (See footnote 7 about complex "dances" combining rational/instrumental action together with ritual and normative forms).

The *diverse forms of communication* and their uses or functions affect game processes and outcomes: for instance, to provide information or to influence the beliefs and judgments of others. Communication also may entail deception and fabrication. Actors "creatively" manipulate information and its interpretation—there are "information wars", "confidence and other fabrication games." This is part and parcel of the communication processes among actors. Information exchange and communications among actors may become *unintentionally* distorted or misunderstood. Research has shown, for instance, that particular technical or complex information provided by physicians to patients is often misunderstood by patients. The impact on behaviour of different degrees of communicative misunderstanding is an empirical question: Actors may or may not use available opportunities in the interaction situation to communicate with one another, as they are assumed able to do in classical "cooperative games" or to follow the rules equally or to the same degree (there are varying degrees of deviance and, in general, these are empirical questions).

4.4.2. Rule and Ritual Based Behavior as Contrasted with Instrumental Rationality

In most interaction situations, actors "follow" rules and rule complexes such as roles, algorithms, and institutional arrangements. People do **not** universally or even typically try to "maximize" or pursue the best action for a particular value but rather aim for normatively appropriate action or "good enough" or "satisficing" ones. Herbert Simon (1955, 1979) formulated the concept of "bounded rationality", which is readily and easily incorporated into the social science multi-value and bounded rationality approach to game theory. *Even satisficing presumes more rationality than is likely in many social action and interaction situations.*

In sum, while instrumental "rationality" has a place in sociological approaches, it shares applicability with other modalities of action driving or motiving human action and interaction. In other words, self-interested rationality, while important in human affairs, plays some role but not in all contexts and at all times. The norms and pressures for such behaviour are role and institutionally dependent.

4.5. The Concepts of Open and Closed Games

As "problem-solvers", actors/players innovate changing their game structure, its rule regimes, and resources as well as themselves. The action possibilities and outcomes in open games are not all specified or determined—and participants and/or third party or external agents may introduce new options (or eliminate existing options), or change the structure of payoffs or, in general, the "rules of the game" and, thus, the form and character of the game itself. Participants as well, possibly, as external agents may open up or close down a game or game complex. Such processes relate to the high potential creativity of agents. Actors and groups, through their transformative capabilities, adapt and transform rule complexes, taking into account new social, value, or technical considerations as well as excluding older established values and norms. Thus, game actors as well as possibly external actors with sufficient powers can restructure or transform a game, for instance, changing a zero-sum game into a coordination game, or a coordination game into a competitive or zero-sum game. In

such terms SGT treated the PDG as a 3-person game with the DA forming the game structure (PD action possibilities of the agents as well as their payoffs) (Buckley and Burns 1974; Buckley et al. 1974). In general, actors—internal and/or external to a given game—may maintain to a greater or lesser extent a closed game.

4.6. Rule-Based Patterns of Interaction and Outcomes

In general, SGT and IGT consider a rich variety of relationships: friendship, mutual hostility, indifferent or neutral relationships, superior-subordinate relationships institutionalized in groups and organizations such as those entailing leadership. Given that games are socio-culturally embedded, one expects diverse patterns in interaction situations since the norms and roles structuring and regulating game behavior vary.

SGT has focused, among other relations, on solidary relationships, which call attention to cooperative norms and norms of distribution (such as forms of "altruism"). Thus, close friends play a prisoners' dilemma game and more or less readily choose the "cooperative pattern" and avoid the asymmetrical choices as well as the outcome of mutual failure. On the other hand, most status relationships result in asymmetrical patterns of interaction and payoffs. Persons in a status or authority relationship would find appropriate and acceptable the asymmetrical interaction and outcome patterns in the PD or other games with asymmetrical outcomes—in that the patterns are normatively prescribed and expected (of course, disagreements, resentments, and anger may emerge because of differences of interpretation or deviation in one or both actors' performances) (see Appendix A).

To illustrate how games are played in a social science perspective, consider the role relationship {ROLE(A), ROLE(B)} of actors A and B, respectively, in their positions in an institutionalized relationship in game G(i,t) under conditions t. Such role relationships typically consist of *shared as well as interlocked rule complexes*. The concept of *interlocked complementary rule complexes* means that given a particular rule in one actor's role complex concerning his or her behavior toward the other, there is a corresponding, complementary rule in the other's actor's complex. For instance, in the case of a superordinate-subordinate role relationship (Burns and Flam 1987), a subcomplex k(A) in ROLE(A) specifies that actor A has the right to query actor B certain questions, or to make particular evaluations, or to direct B's actions and to sanction B. In B's role complex there is a corresponding subcomplexe m(B), obligating B to recognize and respond appropriately to actor A asking questions, making particular evaluations and directing certain actions as well as sanctioning actor B. The couplet (k(A), m(B)) consists of interlocked complementary rule (and role) complexes.

A subordinate B may be ordered by his superior A to come up with an innovation—a new product or process, which A will decide to accept or reject after assessing it, judging whether or not it does what it is supposed to do. This is a particular social order, predictable to a greater or lesser extent based on knowledge of the rule regime structuring and regulating the A-B relationship. Or, consider a similar case but with meritocracy norms prevailing. Rather than A making inquiries, deciding whether to accept or reject B's innovation, they (and possibly others) engage in a "negotiation" whether or not to accept B's innovation or either to adapt/modify it or to reject it altogether.

In sum, in a sociologically grounded game theory, actions, interactions, and outcomes are to a great extent a function of the roles and relationships among the actors, which is a particular normatively grounded social order. "Cooperation" and "non-cooperation" are relationally or institutionally contextualized. Actors define, assess, and decide actions and interactions, in large part from the perspective of their particular roles and role relationship. Thus, non-cooperation in a prisoners' dilemma game (PD) or other interaction situation would in all likelihood be defined and judged as "betrayal" by friends or members of a solidarity group. In general, in groups and organizations with well-defined solidary role relationships, participants in "zero-sum" or PD type situations tend to act cooperatively (and predictably) circumventing the so-called rational pattern of interaction and outcome (mutually destructive) resulting from each choosing the pure self-interest option. On the other hand, in the case of enemies, such behavior would be expected and considered "natural". In the

case of an hierarchical relationship (status/authority), actor A is oriented to and expects to B to behave cooperatively, something B may not want to do, for example carry out a particular loathsome tasks or to make other kinds of sacrifice. Cooperation for the subordinate actor means "compliance" with or acceptance of the superordinate's directives and the resulting asymmetric outcomes. Even if A's directive can be understood as a "violation" (in relation to B's inclinations). Subordinates comply with and make sacrifices for their superiors so that interaction patterns and outcomes are made more or less congruent with their defined hierarchical role relationship, the established social order, and typically they tend to feel good and are recognized and rewarded for their compliance (or, at least, avoid penalties). If there are no options congruent with their role relationship, they are likely to try to restructure or transform the situation. Into one facilitating more congruent patterns; or they try to avoid such interaction situations altogether. In open game situations, actors have opportunities to individually and/or collectively construct new interaction strategies and patterns. In general, actors in solidary relationships will tend to collaborate in solving problems-in-common and work toward mutually satisfying patterns. On the other hand, actors in enmity relations are not likely to collaborate and to work out mutually satisfying patterns under a wide range of circumstances. (See Appendix A for more detailed discussion of these and other interaction patterns).

In making assessments of actions and outcomes, actors do so largely from the perspective of their roles and role relationships; that is, the value complex and action repertoire of the role typically takes precedence over other value complexes. Outcomes may be defined and classified in terms of particular aspects and whether these relate to self, other, or both, or the collective as a whole. This points up the extent to which participants may engage in complex cognitive and modelling activities.

Whyte in his *Street Corner Society* (Whyte 1943) reports on ways that group lower status members were psychologically and socially driven *to lose* at bowling when playing with higher status members—regardless of being in some cases unmistakably more capable. These patterns contributed to safeguarding the group's social structure and ultimately the group's very existence by consistently acting in ways to maintain the particular social relationships and the group social order. Established status ritual and discourses typically play an important part in such social structuring.

Additionally, social actors with solidarity relationships such as, for example, friendship, as well as for those involving status or authority hierarchies as in the example above from *Street Corner Society* tend to purposefully avoid situations involving conflicts such as zero-sum situations because those outcomes could entail unacceptable results for self and/or others as well as the group as a whole.

In superordinate-subordinate interactions, we find, in general, the use of multiple rituals: Superordinates generate ritual displays to mark their higher status vis-a-vis subordinates: they carry themselves straight and exude confidence, project high energy without appearing nervous or anxious (they project "coolness"). Subordinates utilize established status interaction rituals to show their awareness of their subordinate position; these rituals express deference and the apparent acceptance of the status quo; at the same time they mayuse deception to conceal feelings of unfairness and humiliation.

When a subordinate commits a faux pau—for instance, overstepping herself vis-à-vis a superior—there are rituals of apology and reemphasis of subordination (for instance, "I'm sorry, I am having my period" or "I am on medication" or there's been a "death in my family." On the other hand, if a superior gets carried away and behaves improperly/unacceptably (especially) in a democratic society, they may apologize as well. These rituals of partial apology may be similar to those of a subordinate in relation to her superior, righting a wrong and restoring proper social order again (that is, normative equilibrium).

However, in democratic societies, where equality is a powerful principle, everyone is embarrassed when a subordinate shows excessive obsequiousness. So, the expression of subordination need to be "sufficient enough" to re-assure superiors and to properly maintain the hierarchical order. In these "presentations of self" (communicative acts, constructing gender in the case above, or status difference in a workplace hierarchy) we find *identity scripts or algorithms about performing" properly and effectively*.

Mistakes may be corrected; or, failure at accomplishing this may lead to rupture of the relationship. Maintenance of superordination-subordination in a democratic context requires a delicate balancing, a social skill not necessary in an unabashed authoritarian culture.

This case helps us see how much complexity is involved in many forms of interaction which classical game theory lacks the language and the conceptual tools to effectively describe and analyze.[9]

4.7. Cooperation, Trust

Trust in social relationships and social institutions has been investigated and analysed in both SGT and IGT. SGT focused on trust in banking and financial situations, established and maintained through particular policies and institutional arrangements to operate instrumentally and ritualistically to reinforce judgments of trust in particular systems, for instance, concerning trust in money or financial systems (Burns and DeVille 2003; Burns and Gomolinska 2001). Goffman (1969, pp. 126ff), on the other hand, focused particularly on situations of *interpersonal trust* and the role of *interpersonal rituals* that are utilized in establishing and maintaining trust. He writes (Goffman 1969, p. 130), "In the last analysis, we cannot build another into our plans unless we can rely on him to give his work and keep it and to exude valid expression . . . . And such trust is based on a social fabric of ceremonial thread. Only through an 'acceptance' of the communication of the other (one another) is maximum coordination and collaboration possible, and hence a maximally effective effort"—acting as two members of the same team, or having a common project.

5. Key Points and Conclusions

We have outlined in this article two overlapping sociological initiatives to develop and extend game theory—with an emphasis on social contexts, rules including norms and institutional arrangements, a wide repertoire of actions including diverse forms of cooperation and conflict, communication possibilities, the making of binding agreements, and strategic as well as ritualistic forms of action and interaction. Classical game theory entails a substantially different paradigm (see Table 1).

Among the points we have tried to articulate here, we would like to emphasize the following:

(1) Classical game theory is widespread in the social sciences and also in engineering and management. It is highly institutionalized—with very substantial funding supporting research programs, courses, textbooks, journals, policy applications, etc. Yet, at the same time, it is widely recognized that it is not a genuine empirically based social science theory; it fails to make use of—and to a great extent lacks the language and conceptualizing capacity to make substantial use of—the considerable knowledge available in psychology, social psychology, political science, sociology, anthropology, history, etc. And, therefore, it is unable to adequately describe and analyze systematically the extraordinary variety of human social relations and interaction situations or to consider the rich normative and moral aspects, which are central in all social life. These subjects are given more substantial and proper attention in the sociological approaches grounded in rule based behavior, institutions, and cultural formations.

The limitations of the classical theory are numerous:

(A) *Empirical irrelevance.* One of the sustained, major criticisms of classical game theory has been its limited empirical irrelevance, the inability to relate it to much of real social life phenomena

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9   Examples of complex games are found in Ugo Corte's ethnographic work on the social world of surfing and big wave surfing in particular (forthcoming book). The scarce resources of surfers are waves. Surfers compete with one another, and also collaborate, to catch as many of the best waves during a specific time period without letting any major waves go by un-ridden and thus wasted. Surfing entails a subtle and complex social game—with strategic as well as rule following and ritual behavior—in a natural context of waves that are to be utilized in surfing performances; but in some instances they involve danger and risk, partly derived from the activity itself, partly derived from the complex of social norms surfers try to apply.

(Burns 1994, 1990; DiCicco-Bloom and Gibson 2010; Elster 1989; Peterson 1994; Swedberg 2001; among others). In general, game theory makes such unrealistic, overly simplified assumptions about human actors and their interactions that it substantially risks in most applications wrongly conceptualizing and analyzing such interaction.

In general, it lacks an elaborated language and conceptual framework to deal with the varieties of social agents, their roles, role relationships and complex interactions and outcomes. There is a great variety of interaction situations and games neither describable nor analyzable in the classical framework such as interactions of love and romance, interactions of hate and revenge, ritual and ceremonial interactions not characterizable by unidimensional maximizing behavior (as discussed later). In general, a wide variety of empirical phenomena cannot be addressed: for example, the players have a low level of knowledge about or possibly a highly delusional view of the game situation, its participants, the action alternatives and outcomes; in some cases players in a game may not know what game they are in or what role(s) they play vis-à-vis others. Under such conditions, they are likely to be uncertain about their own motives and potential moves, or unable to estimate the likelihood of the various outcomes or the value to be placed on each of them. Even when one knows about her own position, she may be unclear as precisely who she is playing against, and what are the possible implications of playing and of her particular actions. Even knowing her own possible moves, she may be quite unable to make any estimate of the likelihoods of various outcomes or the value to be placed on each of them. Of course, these various difficulties can be dealt with by approximating the possible outcomes along with the value and likelihood of each, and casting the result in a game matrix; but while this is justified as an exercise, the approximations may have (and are often seen to have), woefully little relation to real conditions (Goffman 1969, pp. 149–50).

There are two more or less widely recognized empirical areas of failure from a sociological and social science perspective concern: first, the lack of capability to describe and take into account social relations and social structure and, more generally, the socio-culltural and institutional conditions of games; second, the unrealistic assumptions about game participants' knowledge, computational and judgment capabilities ("bounded rationality" (Simon 1955, 1979)).

(B) Classical game theory assumes default or very simple social relations where the actors are completely "autonomous" or independent from one another, and the social context is unspecified or ignored. Each actor judges the situation simply in terms of her own desires or values. There is no concern with other actors as such (e.g., empathy). This is illustrated by the classical rational agent who assigns values or preferences to outcomes and the patterns of interactions in terms of their positive implications for herself and tries to maximize her own gain or utility, only taking into account others in order to calculate how best to respond to them and to maximize her own gains.

Players do not have meaningful social relations and do not explicitly experience the constraints that such relations would entail. *Rather, they are anomic beings, "strangers, aliens"—with neither roles or role relationships nor explicitly subject to influence of normative and institutional context.* This is a very far from what is essential in basic social science theorizing.[10]

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[10] After years of criticism from many social scientists that game theory had little or no place for norms, morality, and institutions—and, therefore, was inappropriate for genuine empirical research on human beings, thei interactions, and groups (Burns 1990, 1994; Burns and Roszkowska 2006, 2008), the rational choice and game theorist Jon Elster "discovered" norms, arguing eventually that they did not fit or conform to rationality conceptions (Elster 1989), including, of course, those of game theory. Later game theory developers took up norms and suggested ways they altered the structure of a game and the behavior of participants (Colman 2003; Gintis 2009, 2010; Grossi et al. 2012; Lanzi 2013; Ostrom 1998; among others); other extensions of game theory include greater attention to communication among agents, social and collective preferences, bounded rationality. These "extensions" so some of what IGT and SGT do—however, they have much of an ad hoc character; a game is not a cultural or institutional object. Its rules are not mathematical objects in the Artificial Intelligence sense as in Burns and Gomolinska (2000) (Gomolinska 2002, 2004, 2005) In the extensions, the most of the researchers have typically ignored the more than 100 years of intensive social science research on norms, culture, and institutions, including the IGT and SGT research of the past 40+ years. Sociology and the social sciences arguably do not fit very easily into the classical game theory paradigm with its highly standardized and limited discourses (see "Concluding Remarks" in Appendix A).

Such an extremely narrow conception of social relationships will not do. Actors are not only interdependent in action terms—as recognized in classical game theory—but in social relational, institutional, and cultural-moral terms. Norms, roles, role relationships, institutional arrangements, and cultural formations all play a role in enabling, constraining, and regulating social action and behavior .in a wide range of interaction situations. Such concepts must not only be a part of a social science oriented game theory but must be distinguishable from the constraints of material and technological structures, infrastructures, and built environments. It is important to point out that game theorists have increasingly recognized and tried to take into account the socio-cultural context (norms/institutions in particular) (see footnote 8), but they tend to conflate these in the "game structure" along with material and technology structures as "game constraints." Sociologists find it necessary to distinguish social rule constraints which actors may or may not choose to comply with—from material constraints, which often may be fixed or given at least in the medium to short run.

There is a clear and present challenge to possess a rich set of distinctions relating to human agency, rule systems, social structure generally, change mechanisms, and drivers of action and interaction.

(C) Game theory makes heroic and *largely unrealistic assumptions about actors*: for instance, that they possess complete, shared, and valid knowledge of the game. Also, unrealistic assumptions are made about the abilities of players to compute (for example, assessing payoffs and the maximization of payoffs) and about the consistency of their preferences or utilities. At the same time, *it has little or nothing to say about humans as moral beings*—participating in moral communities; there is none of the morality that is carried and in many instances practiced by individuals and group. Finally, it lacks a language and concepts to address human creativity and innovative capacity.

Indeed, although mathematically interesting and engaging, it is, speaking generally, poor social science. In the final analysis, it is arguably a social science dead-end, in large part because it lacks an adequate conceptual language and analytic tools essential for the empirical description and analysis of game social structures, a great variety of social agents, and diverse social interactions. Norms, roles, role relationships, institutional arrangements, cultural formations, social power, and transformation, all refer to significant social phenomena. Moreover, it lacks a language and concepts to address the extraordinary human capacities of innovation, creativity, and transformation with respect to themselves and their systems. Finally, classical game theory has also little or nothing to say about humans as moral beings—participating in moral communities.

(2) The presentation here of SGT and IGT has stressed the importance of rules, norms, institutions, social relations and cultural forms such as rituals as well as social and technical algorithms, in theorizing and investigating human interaction behavior. Human behavior is conceptualized as based in large part on enacting or implementing social rule systems: rules, norms, algorithms, roles, institutional arrangements. Our presentation suggested also the rich variety of interaction forms and games as well as games characteristic of particiular institutional settings of, for instance, families, friendship networks, markets, administrative bodies, and policy systems; also, games of secrecy and deception, fabrication and lying, which have been central in IGT's analyses are neither adequately present-able nor analyzable in the classical approach.

Moreover, the sociological approaches specify a number of special social relational and institutional forms—neglected by classical game theory—such as relations of intimacy and close friendship, solidarity as well as enmity, gender relations, hierarchy, market, and state-citizen relations. In the case of gender relations, many informal gender interactions are typically highly codified, and do not involve a maximization of outcome results, but instead entail the use of cultural scripts and rituals to maintain a particular social order (often underlying the preservation of hegemony by one type of group over the other).[11]

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[11] Concerning gender, women express or emphasize in many of their interactions their identity-as feminine—utilizing makeup, "feminine" or even "sexy" clothes (especially, lipstick and other face makeup, special bras, high-heel shoes, dresses). In the face of constructing and reproducing their female identities, men may misinterpret this behavior as an 'invitation,'

(3) Sociology approaches such as that of IGT and SGT elaborate the concepts of agency, and role concepts as part and parcel of interaction and game descriptions and analyses. Most conceptual tools of sociology and the social sciences are readily and easily incorporated into the sociological game approaches and can be applied empirically and policy-wise in fruitful ways.

(4) The emerging sociological game paradigm suggests multiple challenges and opportunities for further development. Of course, it still needs to be developed as a theoretical, empirical, and policy alternative of the classical framework.

(5) SGT provides a rule-based mathematics (shared in common with computer science, in particular Artificial Intelligence) and is very different from the mathematics of classical game theory (which concerns optimization). Rule based mathematics provides in a natural manner formal definitions of cultural and institutional forms, games, roles and role relationships, interaction norms and algorithms, etc. (Burns and Gomolinska 2000) (see Appendix A for further specification).

(6) Classical game theory (and rational choice theory) are amoral, if not anti-moral, theories of human behavior in that they fail to stress or fully recognize that *human agents are moral beings with moral responsibilities, needs, and motivations*. Of course, game theorists (and rational choice theorists) might counter that "morals are incorporated into the preference or utility functions). But this does not make explicit that morals apply in particular special ways in a given interaction situation, often playing a substantial role in interaction behavior, even contradictory roles. Also, groups, communities, and organizations require moral systems as a foundation for their effective functioning and development.

(7) In spite of its many, irredeemable limitations, classical game theory provides a number of methodological tools that have proved useful in social science conceptualizations and model-construction: The 2-person and n-person game matrices; interaction trees, the sociologically extreme cases of agents assumed to be anomic or alienated trying to maximize their narrow, selfish uni-dimensional utility functions, etc.

(8) These sociological developments of game theory provide a robust alternative to classical, game theory with it's anomic, amoral and uncreative rational choice actors, its lack of specifiable norms and institutions, and without agential capacities in restructuring and transformation. Instead of hyper-rationality, hyper-knowledge, anomic relations, and actors without agency, the sociological variants have conceptualized and enabled the investigation and analysis of—games involving creative, interpretive, transformative, and normatively oriented agents, interacting in their diverse institutional and ritualistic contexts (Burns et al. 1985; Burns and Hall 2012).

Both sociological theories have been empirically applicable to real life situations. Goffman focused mainly on face-to-face interaction situations with a stress on ritual but also genuine strategic behavior in the classical game sense. SGT focused more on normatively and institutionally regulated interactions among parties involved in public policymaking, collaboration and exchange as well as diverse negotiation processes.

The sociological toolbox provides a systematic basis to describe, analyze, understand and explain patterns of interaction, their stability and transformation. In some cases, predictions of interaction patterns are possible because institutional arrangements and normative orders are powerful and stable. Interaction conditions can be analytically specified that are likely to lead to stable patterns, on the one hand, or to unstable patterns and disorder, on the other hand (Burns and Hall 2012).

All of the tools of sociology and the social sciences are readily and easily incorporated in the models—and ultimately in the general theories—and applied empirically and policy-wise. The emerging sociological game paradigm suggests multiple challenges and opportunities for further development.

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a "come-on", a "readiness for sex". It is not surprising that young girls may hardly understand the full meaning of what they are doing as they try to assume the identity of "women".

Table 1 below identifies and remarks several of the key differences between the paradigm of classical game theory and the suggested sociological paradigm on a number of dimensions: the socio-cultural and institutional embeddedness of games; human agency; social structure (social relations, norms and other rules); game structuring, modification and transformation, the rule complex of action determination (as opposed to simple maximization of utility); the rule and context bases of the patterning of interactions and outcomes. This substantial paradigm difference—indeed, incompatibility—is grounded in particular sociological conceptions of human agency (actors not simply following instructions or implementing a simple universal principle, but behaving complexly, creatively, and morally), in games embedded in social structure (rule based culture and institutions), and in a conception of human interaction as highly diverse, dynamic, and not fully predictable (as exemplified in the case of the human use of rule-based language).

In sum, what we are claiming here is that the sociological approaches point to *an alternative paradigm* based on very different assumptions and propositions than those of classical game theory regarding the social embeddedness of games, social structure and social relationships, human agency, complex cognitive models, multiple often contradictory values, and multiple modalities of choice and action determinations. In the case of SGT even the type of mathematics and formalization differ from that of the classical theory; it is the mathematics of rules and rule complexes and its relationship to granular computing and artificial intelligence (see Appendix A)

Table 1. Classical and Sociological Game Theories Compared and Contrasted.

Classical Game Theory	Sociological Approaches to the Theory of Games
I. Games and Game Constraints	
Game constraints ("rules") which include physical constraints. Although games are defined in classical theory as systems of rules, there is no conceptual or mathematical theory of rules and rule systems. In recent times (see footnote 10), game theorists have introduced "norms" to game theory models but these tend to be conflated with material, ecological, and technological constraints.	Games are systems of social rules and other constraints and enabling factors: the "rules of the game."[12] The "rules of the game" are in large part social rules (distinguished from material and technical constraints such as those of the natural environment as well as humanly constructed or built environments). Normative and institutional factors are axiomatic in any sociological approach to conceptualizing interaction and game processes, although such factors are largely missing from classical theory (or they are conflated with the "rules" of material and ecological constraints). In general, in SGT and Goffman's approach social norms and institutional factors are an integral part of the description and analysis of game situations. In SGT, there is an explicit game rule complex, G(t)—together with the physical and ecological constraints—that structure and regulate action and interaction (see Appendix A). There is a rich vocabulary of rules, distinct rule categories, and rule processes (Burns and Flam 1987). Goffman (1969, 1961) refers to and utilizes in his investigations the rich variety of rules identified in sociology and the social sciences.
Game structure is assumed fixed or given. Game transformation—or transformation of any kind including the material and socio-cultural context—was not conceived in the Classical theory.	Game re-structuring and transformation is possible through the actions of game and/or external agents.[13]
Games systems are closed consistent with fixed or given game structures (not transformable except by the game theorist).	Open as well as closed games[14]—the openness of games is assumed in the possibility of actors' structuring and transforming games.

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[12] All the approaches focus on the the phenomena that social actors interact, are interdependent, and are affected by (respond to) game outcomes. SGT is based on an elaborated theory of rules and rule regimes, with mathematical foundations. Games are rule systems together with agents and resources (technologies, material conditions). Rule System Theory also describes and explains social institutions and cultural foundations in which most games are embedded.

[13] The sociological approaches emphasize that actors involved in the game and/or external actors with sufficient powers can restructure and even transform a game, for instance, changing a zero-sum game into a coordination game, or a coordination game into a competitive or zero-sum game (relational control).SGT treated the PDG as a 3-person game with the DA structuring the game conditions (that is, the particular PD action possibilities of the agents as well as their payoffs) (Buckley and Burns 1974).

[14] In open games, the action possibilities and outcomes are not all specified—and participations and/or third party or external agents may propose new options (or eliminate possible options). Participants and/or external agents may open up or close down a game or game complex for purposes of introducing new options and/or eliminating existing options. Such processes relate to the potential creativity of game and contextual agents.

Table 1. *Cont.*

Classical Game Theory	Sociological Approaches to the Theory of Games
I. Games and Game Constraints	
"Equilibrium". Game equilibrium is the *solution* to the game.	In SGT there are different types of equilibria, the generalized Nash equilibrium, normative and other social equilibria including equilibria imposed by an authority or dictator. In SGT "solutions" are defined from a particular standpoint or model of one or more players—or possibly an entire group or organization. Disagreements among actors in a group or interaction situation about appropriate or satisfactory "solutions" can be expected, for instance, in negotiation about a rule change or reform, resulting in game disequilibria unless the actors reach a common "solution", that is, a particular agreement. A common or general game solution satisfies or realizes the values or goals of a group (and, possibly, many of the players in the game). This is the aim and accomplishment in many instances of negotiation in a group or organization.[15]
II. Agency and Actors' Capabilities & Endowments	
The players are anomic beings, "aliens," "strangers" or—neither with roles or role relationships nor subject to normative and institutional influences. (except as they might be incorporated and at the same time conflated in the utility function along with much else).	Actors in SGT are social agents, typically involved in particular roles and role relationships in groups, organizations, and communities.[16] Their behavior (interaction patterns and payoffs are a function of their particular roles and role relationships.[17] As game players, diverse types of actors are engaged in varying roles (in some cases shifting and even secret roles).
Perfect or minimally imperfect information about the game, its players, their options, payoffs, and preference structures or utilities. Crisp information, strategies, decisions.	Participating agents operate with more or less shared models, the MODEL complex (see Appendix A). Still there may be considerable variation among actors' models; in divided groups there are typically even differentiated models. Players' model(s) of the game situation may be based on highly incomplete, fuzzy, or even false information about the game situation as well as game structure. Imprecise (or fuzzy/rough) data as well as imprecise rules and norms, strategies, and judgment processes about the game and game situation (Burns and Roszkowska 2004; Roszkowska and Burns 2010).[18] Imprecise (or fuzzy/rough) data as well as imprecise rules and norms, strategies, and judgments are common. Reasoning processes may or may not follow standard logic. At the same time, SGT emphasizes the extraordinary knowledgeability and complexity of human agents in their institutional and normative contexts: in particular, their knowledge of diverse cultural forms and institutions such as family, market, government, business or work organization, and hospitals, among others; this knowledge they bring to bear in their social roles and roles relationships and the concrete game interactions.
Set of given strategies. Many types of action such as ritual and ceremonial action do not make sense in a purely rational instrumental perspective. Moreover, innovative and creative activities are not part of classical repertoires.	An ACT complex represents the repertoire of acts, strategies, routines, programs, rituals, and actions available to a player in her particular role and role relationships in the game situation (see Appendix A).[19] Creativity and adaptation are common action modalities as the basis of agential innovation, entrepreneurship, and change initiatives.

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[15] As Burns and Roszkowska have shown in their work on group negotiation, potential equilibria patterns are predictable but given the openness of many negotiation games, the particular equilibrium realized may one among several possibilities, and may differ to varying degrees from the normatively ideal one.

[16] The sociological approaches focus on diverse social relationships among interacting agents: cooperative, caring, sexual, conflictive, ritualistic/ceremonial, powering including forms of authority and violence, regulative; also, social relationships of solidary, which call for attention to cooperatve norms and particular norms of distribution; as well as status relationships which entail asymmetrical norms of interaction and payoffs (see Appendix A). SGT and IGT have considered such relationships as friendship, enmity, neutral relationships, superior-subordinate relationships, institutionalized in groups and organizations such as those involving leadership.

[17] Actors have different roles, different positions of status and power, different endowments; also, there is diversity in role components: value, model, act, judgment/modality, etc. The actors participating in a game may operate in different social and psychological worlds—with the likelihood of violating one another's expectations or predictions.

[18] It is well-established in the social sciences that actors' knowledge of their interaction situations is limited and variable, and there are often major asymmetries. Also, actors "creatively" manipulate information and its interpretation—there are "information wars."

[19] Normative as well as ritual and ceremonial types of actions have been particularly emphasized by sociologists, at the same time that SGT and IGT in their adaptations of classical game theory, recognize and analyze strategic ("rational") forms of action and interaction. As indicated above, game players in open games may adapt and restructure games, actors roles and relationships, their particular value, action, and judgment complexes.

Table 1. *Cont.*

Classical Game Theory	Sociological Approaches to the Theory of Games
II. Agency and Actors' Capabilities & Endowments	
Symmetry was a given assumption initially—for instance, actors' action opportunities and payoffs in their various roles and role relationships	Games may be symmetrical or asymmetrical—this is an empirical question relating to the social structure and population of agents involved in games[20]
Utility function or preference ordering is given and exogenous to the game. There is linear ordering.	In SGT, a player's value and evaluative structures, VALUE complex (see Appendix A), relate to the social context of the game (institutional setup, social relationships, and particular roles vis-a-vis one another).[21] Moreover, in SGT and IGT multiple values in the value complex are typically found in any given game context G.
Choice or decision-making modality: Instrumental rationality or "rational choice". Maximization of expected utility as a singular universal choice and action principle. The multiple "rational" players all are assumed to abide by the principle in their given game or interaction situation. Given a game, S, a set of actors I = {i,j, . . . ,n}, action repertoires of each and every member j, A = (Ai, Aj, . . . ,Ak) where Ai = (b1,b2, . . . ,bk), outomes (OUTj) for actor j, then EU(S) = MAX ∑Prob OUTj(ACTj) ∣ Enact (ACTj, S) × VAL(OUTj(ACT))	RULE COMPLEX OF Multiple modalities of action determination (DET) (see Appendix A).[22] The particular modality (modalities) applying depends on the social context, the institutional, normative, and roles applying.[23] In other words, the socially defined situation, relevant roles and role relationships and the context dependent rules—that is, social embeddedness—constrain and regulate the actions and interactions of participants. The SGT approach rejects assumptions of super-rationality and maximization of a one-dimensional utility. Instead, it stresses multiple modalities of action determination, for instance, based on acting in normatively appropriate ways, engaging in social rituals and ceremonies At the same time it accepts that in some contexts the actors are instrumental—"even rational self-oriented agents"—in their orientations (see Table A3).[24] This makes for dual and multiple drivers of actors' behavior. Actors judge the appropriateness, applicability, and adaptation of rules, roles, and institutional arrangements in socially defined games or game situations and apply them in rule-following procedures. SGT singles out three key action determination modalities—that rule complexes in DET. The social and material context for one or another action determination is the situational (for instance, conditions of time and space), normative, institutional, and cultural prescriptions. Actors' rights (defined by social rules) and the time and space as well as resource conditions impact on actors employment of one or another modality (see Appendix A).

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[20] One may also refer to homogenous versus heterogenous games and interaction situations.

[21] In the sociological perspective, there is a world of multiple values, which results in mixed motive games and decision dilemmas for participants, for instance between instrumental gain and norm realization, or between different norms, or divergent instrumentalities.Actors and groups, through their transformative capabilities, may adapt and transform value complexes, taking into account new value considerations or excluding older established values and norms.Given that humans are social animals, they display "caring-for-other" behavior, concern with others, putting "others ahead of oneself" (Goffman 1969, p. 92), serving a community, or an abstract ideal, or "the Law," or "God." Some or many of their values concern then taking other matters (than themselves) into account and sacrificing for them. Because of normative dilemmas, "temptations and pressures," contextual factors, deviation from institutional arrangements, particular roles and role relationships, and norms occurs. Under some conditions such as revolutionary change, deviation and disruption becomes widespread. There is social disorder, chaos.

> *Some values belong to a sacred core, grounded in identity, status, role(s), and institutions to which agents may be strongly committed. "Not everything is negotiable" or "adaptable".*

[22] Multiple modalities of action determination and realization include not only normative and ritual rule following, instrumental, habitual, play, but emotional modes of action determination, among others, which depend on social context and, in particular, actors' roles and relationships and the normative and institutional context generally.

[23] SGT shifts the basis of choice and action away from maximizing—or even satisficing—in most instances to "following" or enacting social rules, roles, and institutional arrangements—Or in constructing and selecting new alternatives. In the SGT perspective, people do not typically or universally "maximize" or pursue the best action for a particular value but rather normatively appropriate action or "good enough" or "satisficing" ones. Herbert Simon formulated the concept of "bounded rationality", which is readily incorporated into the multi-value approach of SGT.Interaction and group behavior is patterned, the outputs (and consequences) of behavior are patterned in large part through actors performing their roles and adhering to norms; in addition, they may make strategic choices, take strategic actions to achieve a goal or to realize a role or norm (bounded ratioinality, of course). "Rationality" or instrumental orientation has a place in the sociological approaches—but it is shared or competes with other modalities of action. It is simply one factor recognized in the sociological approaches in what drives or motives human action and interaction. Even self-interested rationality, while important, play even less of a part in many interaction situations.

[24] But this is not applied universally, as in classical game theory.

Table 1. *Cont.*

Classical Game Theory	Sociological Approaches to the Theory of Games
	II. Agency and Actors' Capabilities & Endowments
	DET-I. This is a given prescribed ("legitimized" or authorized) or even simply habitual/routine procedure or algorithm (rule complex). It may be that the action or game conditions are such that the actsor(s) do not have the time or rights (authority in rules) to make choices among alternatives (DET-II) or to construct one or more new alternatives (DET-III).
	DET-II. This type of determination involves an action situation where two or more actions are given, for instance institutionalized alternatives or an intrinsic part of the action situation. Determination here entails first following a principle, rule, procedure/algorithm in selecting or choosing an action among a set of alternatives. Once a selection is made, the actor(s) perform or enacts (according to DET-I) the selected option.
	DET-III. This modality involves a situation of high uncertainty in there is no apparent action or set of alternative actions. The agent then constructs or discovers one or more new actions (at least in her perspective) according to a design, set of criteria or other specifications. If the process ends in a singular action constructed, then the actor(s) enact or perform it in accordance with DET-I. If multiple alternatives are generated, then choice is made among the alternatives according to a DET-II rule or procedure. In any case, the ultimate action is enacted or performed according to a DET-I complex.
	The universal motivational factor in SGT is the human drive to act correctly, rightly, appropriately, as well as effectively to realize or achieve multiple appropriate values and norms through their actions and interactions in particular, appropriate contexts. See Appendix A and, in particular, Table A1 for more about the SGT formalization of action determination.
	III. Social Relations and Structures
Classical games lack explicit social structure—there is no appropriate language or conceptualization of such structure. Games are social structurally context free. In general, players do not explicitly have meaningful social relations and the influences that these entail	In the sociologically approaches, games are socially embedded—normative, relational, and institutional structures are identified and taken into account in their influence on the interaction conditions and frames and perceptions, judgments, and interactions of the participating agents. Roles and role relationships are the basis in SGT of a series of conceptualizations and analyses (Burns 1994; Burns and Flam 1987; Burns and Gomolinska 2000).
	Actors have different roles, different positions of status and power, different endowments; also, there is diversity in the major role components: value, model, act, judgment/modality, action determination complex, etc. The actors participating in a game may operate in different social and psychological contexts—increasing the likelihood of violating one another's expectations and predictions and generating tensions and conflicts.
	Actors' group membership and social roles and relationships play a significant part in how they play or perform in relation to one another. In general, meaningful other agents and groups influence the perceptions, judgments, and behavior of individual agents in games. A given game may be embedded in other games, causing action and outcome variation. Thus, a sexual game may be embedded in a business negotiation game and vice versa.
	Goffman elaborated the roles of player as a "party", a "pawn", "token", "informant", "spy". A "party", for example can be an individual or group as a player, pawn, token . . . (Goffman 1969, 1961).
	In their roles and interaction situations, actors experience dilemmas, for instance, between doing the "rational thing" (making economic or political gains) versus doing "the right thing." And as "problem-solvers", actors innovate changing the game, changing rule regimes (social structure) and resources.

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25   The diverse forms of communication and their uses or functions affect game processes and outcomes: for instance, to provide information or to influence the beliefs and judgments of others. Communication may even entail deception and fabrication. Moreover, actors may or may not use available opportunities in the interaction situation to communicate with one another or to follow the same rules (some degree of asymmetry). Information communicated among actors may become unintentionally distorted or misunderstood. Research has shown, for instance, that particular technical or complex information provided by physicians to patients is often misunderstood by patients. The impact on behavior of different degrees of such knowledge is an empirical question.From a sociological perspective, actors may or may not "cooperate" in "cooperative" games—this will depend in large part on the normative and relational structures in which they are embedded as well as strategic considerations of outcomes in their interaction situations. Even if cooperative interaction (in the sociological sense) is a major part of all human interaction, the game theory approach, while generating interesting analytic and mathematical results (Harsanyi and Selten 1972, 1988; Nash 1950, 1953) has limited relevance to the great diversity and often great complexity of human cooperation.

Table 1. *Cont.*

Classical Game Theory	Sociological Approaches to the Theory of Games
III. Social Relations and Structures	
Limited distinctions in communication conditions and constraints: No communication at all ("non-cooperative games") or communication opportunities ammong participating players ("cooperatie games"). Communication rules are axioms at the start of the game and apply to all players and plays throughout the game process. "Non-cooperative games" do not allow for communication among participating actors, while "cooperative games" allow for communication (and the making of binding agreements).	Communication as social actions in a sociological perspective. Communication conditions and forms are specified by the rules defining action opportunities and repertoires in a given game situation. There is high variability in communication according to the rule regimes applying. In whatever ways the norms and institutional arrangements are established and maintained, the sociological approaches provide a language and analytic tools to describe and analyze a wide variety of communication situations distinguishable by their particular norms and institutional arrangements.[25] SGT readily incorporates the possibilities of communication among players and the making of binding agreements—which are the bases of what are referred to as "cooperative games" in classical game theory.
Social power—Lack of power and authority relations in the early formulations.	In sociological perspectives, power and authority relations are part and parcel of the social structure of groups, organizations, and communities. A power structure is based on the rules, social relations, institutional arrangements, resource distribution that determine *the distribution of power and meta-power* among members in a group, organization, or community.
Trust is not a concept which classical game theory originally recognized or could readily incorporate—although trust, or a lack of trust, plays a major role in social relations and institutions and substantially affects actors' interactions. More recent game theory research introduces trust as an "add-on" like norm and interpersonal intimacy (Hardin 2004; King-Casas et al. 2005; Tarrant et al. 2010) (see Appendix A, Concluding Remarks).	Sociological approaches to game theory provide a language and analytic tools to specify and explain trust and trust relationships in interpersonal as well as complex organizational settings.[26]
IV. Empirical Relevance	
One of the sustained, principal criticisms of classical game theory has been its lack of much empirical relevance, the inability to relate it to much of real social life. This has been empirically demonstrated in a multitude of studies.	The sociological approach of SGT and IGT have demonstrated their effective application in describing, analyzing, and explaining a wide variety of social interactions and game situations—and specifying and explaining interaction patterns and outcomes beyond classical theory's capabilities.

Author Contributions: Tom Burns and Ewa Roszkowska are responsible for much of the conceptualization and formalization, particularly of SGT. Machado contributed also to the conceptualization as well as to the designs of Figure A1 and the Tables. Tom Burns and Ugo Corte are responsible for preparation of the material in the article on Goffman.

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[26] SGT has focused on trust in banking and financial situations, established and maintained through particular policies and institutional arrangements (Burns and DeVille 2003). On the other hand, Goffman (1969, pp. 126ff) focused particularly on situations of interpersonal trust and the role of interpersonal rituals that are utilized in establishing and maintaining trust. He writes (Goffman 1969, p. 130), "In the last analysis, we cannot build another into ouns unless we can rely on him to give his work and keep it and to exude valid expression". And such trust is based on a social fabric of ceremonial thread. "Only through an 'acceptance' of the communication of the other (one another) is maximum coordination and collaboration possible, and hence a maximally effective effort," acting as members of the same team, or sharing a common project.

Appendix A. Elaboration of SGT

Appendix A.1. Foundations

This Appendix specifies SGT further, elaborating the approach. SGT can be characterized as a cultural-institutional as well as a materialistic/technological approach to game conceptualization and analysis (Baumgartner et al. 1975; Burns 1990, 1994; Buckley and Burns 1974; Burns et al. 1985; also see (Ostrom 1990; Scharpf 1997)).[27] The contribution of SGT is in its rule-based conceptualization of games as socially embedded with agents in social roles and role relationships and subject to cognitive, normative, and agential regulation.

(1) In SGT, a well-specified game structure is conceptualized in a uniform and general way as a multi-agent interaction *rule complex or regime G* in which typically the participating players have defined roles and role relationships in a game structure in a specified situation S (Burns and Gomolinska 1998, 1999, 2000, 2001; Gomolinska 2002, 2004, 2005).The rules may be imprecise, possibly inconsistent, and open to a greater or lesser extent to modification and transformation by the participants (as well as by third parties as in the prisoners' dilemma game). Not all games are necessarily well-defined with, for instance, clearly specified and consistent norms and roles and role relationships. Many such situations can be described and analyzed in "open game" terms (Burns et al. 2017).[28]

Given an interaction situation S_t in context t (time, space, social and physical environment), some rules and subcomplexes of the general game structure G(t) are activated and implemented or realized. This G(t) complex includes then as sub-complexes of rules the players' social roles vis-à-vis one another along with other relevant norms and rules R in the situation S (and context t).

Sociological concepts such as norm, value, belief, role, social relationship, and institution as well as classical game theory concepts can be defined in a uniform way in terms of rules, rule complexes, and rule systems, which are also defined as mathematical objects (see (2) following). *These tools enable one to model social interaction taking into account economic, social psychological, and cultural aspects as well as considering games with incomplete, imprecise or even false information.*

(2) The development of SGT has entailed the formulation of a mathematical theory of rules and rule systems at the same time combining it with a systematic grounding in key concepts of contemporary social sciences (Burns and Gomolinska 2000; Burns and Roszkowska 2005, 2007). Rules and rule complexes in SGT are then mathematical objects (Burns and Gomolinska 1998, 1999, 2000, 2001; Gomolinska 2002, 2004, 2005). SGT has developed the theory of rule activation and implementation as well as the theory of combining, revising, replacing, and transforming rules and rule complexes.[29]

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[27] Rules and rule systems are key concepts in the new institutionalism (Burns and Flam 1987; March and Olsen 1989; Ostrom 1990; Powell and DiMaggio 1991; Scott 1995), evolutionary sociology (Burns and Dietz 1992), and ethnomethodology (Garfinkel 1967) and are closely related to important work in philosophy on "language games" (Wittgenstein 1953) as well as work in linguistics (Chomsky 1985, 1965; Pinker 1991). Much contemporary social science research points up that social rule systems—as constituting cultural formations, normative frames, and institutional arrangements—are ubiquitous and partially determinant of social action and interaction. There are cognitive, instrumental, social, aesthetic, and other reasons that human agents introduce, utilize, adhere to, and enforce rules (see later). Of course, some rules are more ephemeral and symbolic than others. Actors may fail (or refuse) to follow (or enforce) some of the rules.

[28] The classical game framework is treated as a special, limiting case of the more general SGT (Burns and Gomolinska 2000; Burns and Roszkowska 2005, 2007).

[29] Informally speaking, a rule complex is a set consisting of rules and/or other rule complexes.A *rule complex* is obtained according to the following formation rules: (1) Any finite set of rules is a rule complex; (2) If C_1, C_2 are rule complexes, then $C_1 \cup C_2$ and $P(C_1)$ are rule complexes; (3) If $C_1 \subseteq C_2$ and C_2 is a rule complex, then C_1 is a rule complex. In words, the class of rule complexes contains all finite sets of rules, is closed under the set-theoretical union and the power set, and preserves inclusion. For any rule complexes C_1 and C_2, $C_1 \cap C_2$, C_1–C_2 are also rule complexes. A complex B is a subcomplex of the complex A if B = A, or B may be obtained from A by deleting some rules from A and/or redundant parentheses.
The notion of rule complex was introduced as a generalization of a set of rules. The motivation behind the development of this concept has been to consider repertoires of rules in all their complexity with complex interdependencies among the rules and, hence, to *not* merely consider them as sets of rules. The organization of rules in rule complexes provides us with a powerful tool to investigate and describe various sorts of rules with respect to their functions such as values, norms,

SGT (or generalized game theory) based on the notion of a rule complex is a good example of a granular computing framework from the standpoint of Artificial Intelligence (AI). Rule complexes, and one- or multi-level structures built of rules are complex information granules. Granular computing is a computing paradigm in information processing. It is also conceived as an umbrella term for a class of theories, methodologies, and techniques making use of the notion of an information granule, introduced by Lotfi A. Zadeh. According to Zadeh's definition, an information granule is a clump of objects brought together on the basis of indistinguishability, similarity or functionality. In many cases, computing with information granules rather than with single objects forming these granules proved to be useful in the process of problem solving. In a nutshell, SGT belongs to the class of granular computing frameworks. Granular computing brings together theories, methodologies, and techniques based on the concept of an information granule. The granular computing approach is applicable in problem solving, and such problem solving is a field of Artificial Intelligence.

(3) **Game social rules** are distinguished from more material and technical constraints. In SGT, there is an explicit game rule complex, G(t)—together with the physical and ecological constraints—that structure and regulate action and interaction.

(4) **A well-specified game** in the context or situation S_t at time t, G(t), is an interaction structure in which the participating actors typically have defined roles and role relationships (see Figure A1 and, in general, are subject to the normative regulation of institutions, cultural formations, and specific social relationships.

Sociology recognizes multiple bases for actors to adhere to norms and roles as well as to other rules in their interactions: mutual long-term commitment to a group or relationship embodying the norms, intrinsic value or interest in the norms, third party (a group or specialized unit) enforcement of adherence to the norms; and a strong sense of cognitive and social order arising from rule adherence and rule-following (Burns 2008; Burns and Flam 1987; Burns and Hall 2012). Of particular interest to sociologists are the rituals and the management of rituals in interaction, to establish and maintain rule adherence. Yet, concrete game situations may see actors breaking or deviating from game rules under particular conditions.

(5) **A social role is a particular rule complex.** An actor's role complex is specified in SGT in terms of a few basic cognitive and normative components, that is rule subcomplexes, functioning as the basis of the incumbent's values, perceptions, judgments and actions in relation to other actors in their particular roles in the defined game. Typically, actors play a number of different roles and are involved in multiple social relationships and institutional domains.

An actor's role (ROLE(i,t) is specified in SGT in terms of a few basic cognitive and normative components presented and discussed below. Rule complexes and subcomplexes are formalized as mathematical objects (Burns and Gomolinska 1998, 1999, 2000, 2001; Gomolinska 2002, 2004, 2005)). The role complex includes, among other things: particular beliefs or rules that define the reality of relevant interaction situations; norms and values relating, respectively, to what is good or bad and what to do and what not to do; repertoires of strategies, programs, and routines; and a complex to determine actions as well as choices in the game. The rule complex(es) of roles in a particular game or social context guide and regulate the participants in their actions and interactions at the same time that in "open games" actors may restructure and transform the game and, thereby, the conditions of their actions and interactions.

(6) **Judgment—a core concept in SGT** (Burns and Gomolinska 2000, 2001; Burns and Roszkowska 2004; Burns et al. 2005). The major basis of judgment is a process of comparing and determining similarity. The capacity of actors to judge similarity or likeness (that is, up to some threshold, which is specified by a meta-rule or norm of stringency), plays a major part in the *construction, selection,*

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judgment rules, prescriptive rules, and meta-rules as well as more complex objects consisting of rules such as roles, routines, algorithms, models of reality as well as social relationships and institutions.

and performance of action. In this paper, the focus is on similarity of the properties of an object with the properties specified by a value or norm. But there may also be comparison-judgment processes entailing the similarity (or difference) of an actual pattern or figure with a standard or prototypical representation.

For our purposes here, we have focused on judgments about action. Other types of judgments are distinguished in SGT, for instance, value judgments, factual judgments, action judgments, among others.

The action judgment process can be connected with one option, two options, or a set of options. In case of a single option judgment, each actor i estimates the "goodness of fit" of this option in relation to her values in VALUE(i,t). In the case of two options, the actor judges which of them is better (and possibly how much better). In the case of a set of three or more options, the actor chooses one (or a few) from the set of options as "better than the others".

Let ACT be a repertoire or set of possible action alternatives. In making their judgments and decisions about an action b from ACT, the players activate relevant or appropriate values, norms, and commitments from their value complexe(s) relevant in the situation S. These are used in the assessments of options through comparison-evaluation processes. In determining or deciding a particular action b, a player(s) compares and judges the similarity between the option b from the set ACT and the appropriate, primary value or goal v which is to be realized in decisions and performances in G(t), as specified, for instance, in her role complex. More precisely, the actor judges if a finite set of expected or predicted *qualia* or attributes of option b, Q(b) are *sufficiently similar* to the set of those qualia Q(v) which the primary norm or value v (or a vector of values) prescribes.
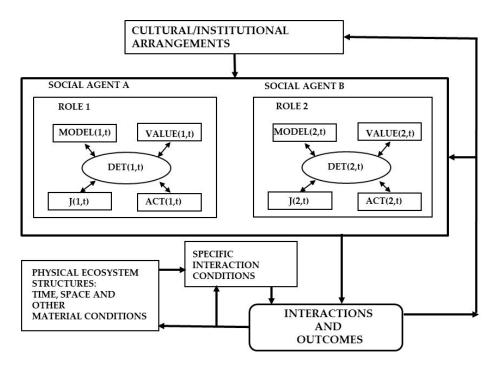

Figure A1. Two Role Model of Interaction Embedded in Cultural-Institutional and Natural Contexts.

(7) **In SGT, actors' knowledge of the interaction situation varies** and is, in general, bounded or partial; it may even be invalid to varying degrees. While cognitive and computational capabilities are strictly bounded, nevertheless, they may vary substantially among players. Judgment and action determinations are also likely to vary, for instance due to the different roles actors play and possibly their different interests and levels of knowledge in the interaction situation. Their interactions and outcomes depend in part on their beliefs as well as estimates of one another's beliefs, values, and judgement qualities. The models of the situation with which they operate may contain incomplete

and imperfect information (possibly even false information) (Burns and Gomolinska 2001). Also, communication processes among players often entail persuasion and deception which influence participants' beliefs, evaluations, and judgments in game processes. SGT thus starts to approach the complexity and uniqueness of genuine interaction situations and games.

(8) SGT General Interaction Model (see Figure A1).

Consider that a group or population I = {1, . . . ,m} of actors is involved in a situationally defined game G(t). ROLE(i,t,G) denotes actor i's role complex in G(t) at moment t ∈ T (we drop the "G" indexing of the role):[30]

$$\text{ROLE}(i,t) \subseteq {}_g G(t), \text{ where } t \in T \tag{A1}$$

The game structure G(t), in moment t ∈ T, consists then of a configuration of two or more roles together with R, that is, some general rules (and rule complexes) of the game:

$$G(t) = [\text{ROLE}(1,t), \text{ROLE}(2,t), \ldots ,\text{ROLE}(k,t); R]. \tag{A2}$$

R contains rules and rule complexes which describe and regulate the game such as the general "rules of the game", general norms, practical rules (for instance, initiation and stop rules in a procedure or algorithm) and meta-rules, indicating, for instance, how seriously or strict the roles and rules of the game are to be implemented, and also possibly rules specifying ways to adapt or to adjust the rule complexes to particular situations.

An actor's role is specified in SGT in terms of a few agential cognitive and normative components, that is rule subcomplexes (see Figure A1); MODEL(i,t), VALUE(i,t), ACT(i,t), J(i,t), and DET (i,t) are the basic rule complexes which are activated in situation S and in context and moment of time t ∈ T respectively.

$$\text{ROLE}(i,t) = [\text{MODEL}(i,t), \text{VALUE}(i,t), \text{ACT}(i,t), J(i,t), \text{DET }(i,t)] \tag{A3}$$

The five (5) role or agential components are presented briefly below.[31]

(a) **Model complex, MODEL(i,G(t)).** The complex of beliefs frames and defines the situational reality, key interaction conditions, roles and role relationships, presumed causal mechanisms, and possible scenarios of the interaction situation. Players' model(s) of the game situation may be based on highly incomplete, fuzzy, or even false information. Imprecise (or fuzzy/rough) data as well as imprecise rules and norms, strategies, and judgment processes are common (Burns and Roszkowska 2004; Roszkowska and Burns 2010). Modelling and reasoning processes typically do not follow standard logic ("bounded rationality"). SGT emphasizes at the same time the extraordinary knowledgeability and complexity of human agents in their institutional and normative contexts: in particular, their knowledge of diverse cultural forms and institutions such as family, market, government, business or work organization, and hospitals, among others; this knowledge they bring to bear in their social roles and roles relationships and the concrete game interactions.

MODEL entails knowledge (in the form of rule complexes) of the interaction conditions, the actors involve, their social relations and roles, their commitments to norms, and their action predispositions and patterns of behavior. SGT enables us to identify and analyze problematic types of MODEL: (1) There arise incoherencies and incompatibilities between VALUE rules and MODEL rules, as suggested above; similarly for the rule and rule complexes of ACT and DET. (2) Rules defining or describing the situation S are misleading. Among other things, actors might be led to focus on

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[30] A ⊆ ₉B represents that A is a subcomplex of B.

[31] Degrees of incompatibility or inconsequentiality may arise among role or agential components. For instance, the rules or the substantive actions of ACT do not fit those specified in MODEL, or they are proscribed in VALUE. Or, the action determination subcomplex DET does not fit actions in ACT, for instance, DET-II is a maximization rule or algorithm but acts or their outcomes are not characterized by cardinal values; so, an application is not possible. lFor a consideration of rule incompatibility and its consequences as well as the way it arises, for instance, as a result of reforming one rule subcomplex without adjustment or modification of other related subcomplexes; see Burns et al. (2017).

situational factors including causal mechanisms irrelevant for their values or their actions in the situation. (3) Rules about the interaction situation, the actors involved, their action predispositions and behaviour are false, contradicted by "facts".

(b) **Value complex, VALUE(i,G(t))** including values and norms relates, respectively, to what is good or bad and what should and should not be done in the game or interaction situation. In SGT, a role player's value and evaluative structures relate to the social context of the game (institutional setup, social relationships, and particular roles). Moreover, SGT emphasize multiple values, which are considered appropriate in a given group game context. The rule complex **VALUE** entails then one or more values, value orientations or goals which orient and motivate actors in their game situation(s). A single value may be quantitative or qualitative (possibly fuzzy (Burns and Roszkowska 2004; Roszkowska and Burns 2010)).

Problematic types of value complexes are identifiable and analyzable in SGT: (1) Under many interaction conditions, VALUE consists of multiple—possibly contradictory—values or goals, for instance, the value of doing right, living up to normative standards, on the one hand, and making personal or private gains at the expense of prevailing norms, on the other hand. "Mixed motive" or multiple value behavioral situations—without a meta-principle prioritization or rank ordering of the multiple values—means that *actors will be faced with dilemmas and other uncertainties*. (2) Key (or prioritized) values are not relatable (or translatable) to MODEL dimensions of the interaction situation, indicators of the state of the situation, the interaction process, and expected outcomes. Similarly there may be greater or lesser incompatibility with the rules in ACT and DET (see below)

(c) **ACT(i,G(t)):** This action **complex is actor i's** defined repertoire of possible strategies, programs, rituals, and routines in the game situation. **ACT** includes the rules defining and specifying action repertories and their pragmatics that are appropriate or normatively sanctioned in the game situations S. They would be applicable to "problem-solving" or having the means for pursuing goals or values in situation S; acts which to a greater or lesser extent are expected to realize values or goals. Once again SGT enables one to identify and analyze problematic features of ACT: (1) Actions in ACT may be irrelevant, inappropriate, or outright proscribed by norms and values in VALUE. In other words, "acceptable means do not fit ends." (2) The action complexes in ACT are not describable or understandable in MODEL. (3) The alternatives in ACT enable the realization or potential realization of only one value in a multiple value VALUUE. Or, possible none at all.

(d) **Judgment Complex J(I,G(T)):** The judgment complex consists of rules which enable the agent i to come to conclusions about truth, validity, value, or choice of strategic action(s) in a given situation, engaging in, for instance, judgment and meta-judgment giving priority among values, generating a hierarchy of values or priorities. Or making a selection among model complexes, or modifying as well as even constructing models in general, judgement is a process of operation on objects. The types of objects on which judgements can operate are: values, norms, beliefs, data, and strategies as well as other rules and rule complexes. There are also different kinds of outputs or *conclusions* of judgment operations such as evaluations, beliefs, data, programs, procedures, and other rules and rule complexes.

The SGT approach to game theory rejects assumptions of super-rationality and maximization of one-dimensional utility. Instead, it stresses judging, choosing and acting in normatively appropriate ways. At the same time it accepts that in some contexts the actors are instrumental in character—rational self-oriented agents.[32] This makes for dual drivers of actors' behavior. Actors judge the appropriateness, applicability, and adaptation of rules, roles, and institutional arrangements in socially defined games or game situations and apply them in rule-following and other action determination procedures. The socially defined situations, relevant roles and role relationships and the

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[32]   But this does not apply universally to all situations, as in classical game theory.

context dependent rules—that is, the arrangement of social embeddedness—constrain and regulate the actions and interactions of participants.

(e) **The Rule Complex of Action Determination Modalities**: **DET(i,G(t))**. An action determination modality is a procedure/rule complex/algorithm with which an actor determines the action to be taken or implemented in a given game situation S(t), for instance, her role performances or her response(s) to the actions of others in the game situation.[33]

As pointed out earlier, there are at least three (3) general modalities of action determination: First, action determination by following prescribed or designated rules or rule complex; second, action determination by making a choice among alternatives; and third, action determination by constructing an appropriate and acceptable option or options. Each type of modality encompasses a variety of procedures and algorithms of action determination having family resemblance.

A. DEF-I. Under specified conditions, the actor activates an appropriate rule or rule complex and "follows" or implements it (a procedure, a S.O.P.,[34] an algorithm generally whether recipe, blueprint, or production function, or cultural script). The action determination rule or principle is as follows:

In situation S at time t, under conditions C1,C2, . . . ,Cm, enact, perform, or execute "b*" that is, b* is expected or directed to be performed or realized in S at time t.[35, 36]

$$\text{DET-I}(Q(b^*),Q(r)) = \text{sufficiently similar} \qquad (A4)$$

Actor i in situation S(t) performs the action "b*" in such a way that the rule or rule complex r is realized or implemented in a manner "sufficiently similar" to r. This means actor i performs b* so that Q(b*), when compared and assessed with respect to the r-specified properties or qualities Q(r) is "sufficiently similar". The action performed "b*" has the character, form, qualities indicated or specified by rule or rule complex r.[37] Typically, the assessment is multi-dimensional—that is, there are multiple criteria to satisfy in the performance. If there is a complex of rules B to perform (e.g., a simple sequence), the sequence of activity is performed so as to match the criteria of "right" or correct performance specified by the complex of rules B.

In many instances, the rule complex B will entail a coordinated or integrated rule procedure or algorithm with multiple agents, for example, in a multi-agent ritual/ceremony or "production process" (assembly line, complex medical procedure such as organ transplantation, or democratic voting).

DET-I entails then following or implementing appropriate or prescribed norms, role, institutional arrangement (with multiple participants), that is, a rule complex or algorithm is implemented. Actions and interactions are routinized, ritualistic, performance or enactment matched with a specified norm or procedure. DET-I modalities entail algorithms for implementing or "following" a norm, role, role relation (collectively with others), or institutional algorithm, engaging in play and emotional or expressive modes of action determination; enacting a script in a defined or appropriate situation.

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[33] **DET** entails the rule complexes/modalities for determining actions (the three identified and specified here are following or implementing a procedure or algorithm, making a selection among two or more alternatives, construction one or more actions). Problematic situations in the case of DET may arise when actor(s) in several ways: (1) Incompatibility or incoherence between DET rule complexes and those of VALUE or MODEL; (2) situations arising where a choice among alternative alternatives need to be made or new actions constructed to realize actors' goals in the situation. But the actor or actors do not have the right/authority, capability, or desire to engage in DET-II or DET-III.

[34] The dictionary definition of a standard operating procedure (SOP) is established or prescribed rules or methods to be followed routinely for the performance of designated actions or operations in designated situations.

[35] There is always some degree of decision-making in following or implementing a rule, as the agent must make interpretations, adjustments, adaptations. In some instances, if the actual conditions are ambiguous, or contradictory, the agent will tend to engage in a DET-II process to decide on the conditions, that is, whether or not they are appropriate or right. In such cases, as discussed later, one type of modality DET-I is combined with another, DET-II.

[36] There will typically be additional rule(s) defining and specifying standards of sufficient similarity or consonance in situation S and game G(t).

[37] Often, the rule has associated "data" about its "implementation" in a defined situation S(t).

B. The DET-II type of modality applies in choosing among alternatives or producing and choosing among established or given alternatives, according to a principle, rule or algorithm. An agent or group of agents is faced with a "crossroad", alternative actions or modalities of action determination. For instance, there is a choice between two or more action alternatives; or, a choice is made between an action of normative realization or an action entailing instrumental gain. Or they choose between an extreme emotional expression (emotional modality) and an instrumental one (limiting emotional expression for purpose of gaining from another agent such as an employer).

Under specified conditions including the motivation to realize or satisfy a norm, the actor selects and performs an action located among a given set of alternatives; the selected alternative "b*" itself or its effects are judged/assessed to best realize or satisfy the contextually specified or appropriate norm or value, V of a role and/or a group. The selection is made—whether by a single or collective agent—on the basis of comparing and assessing two or more options in relation to the value or norm V.

Given a fixed repertoire of action alternatives ACT(i,t), the action determination judgment entails finding that action in ACT(i,t) which best fits ("goodness of fit") or is most consonant with complex v_i (thus, normative or role based determination entail an agent making comparisons and judging similarity (or dissimilarity) between options considered in the game and their appropriate norms and values in the situation).

The actor chooses among the given options in her fixed repertoire the action a* that maximaze d_j, the "goodness of fit" between the anticipated consequences of actions and the consequences prescribed or indicated by a norm, role Or institutionally arrangement.[38] Formally, Actor i selects the action a* (a* $\in$ ACT(i,t)) for which Equation (6) holds:[39]

$$\text{DET-II } (i,t)(a^*) = \text{Max}[J(i,t)(a_k)] \text{ for all } a_k \in \text{ACT}(i,t) \tag{A7}$$

Given an action repertoire ACT(i,t) = {b1,b2, ... ,bm}, the action determination judgment of DET-II entails finding that action which best fits ("goodness of fit") or is most consonant with v_i in the actors norm and value complex. The actor chooses among the given options in her fixed repertoire the action b* that maximaze d_j, the "goodness of fit" between the anticipated consequences of actions and the consequences prescribed or indicated by a norm, role or institutional arrangement v. Formally, Actor i selects the action a* (a* $\in$ ACT(i,t)) for which Equation (6) holds.[40] If the process results in more than one such alternative, then the actor (and/or other actors) introduces or activates additional values or procedures (such as "flipping a coin") in order to make a final determination.

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[38] For ACT(i,t) = (a_1,a_2, ... ,a_p) let the results of judgment of similarity be some expression ascertaining the degree of dissimilarity d_j (that is, the *gap* between a particular action performed or to be performed and the norm or value specifications of v_i).

$$\text{ALG}(i,t)(Q(a_k),Q(v_i)) = d_j, \text{ where } a_k \in \text{ACT}(i,t). \tag{A5}$$

We modify expression (4) to express the rule complex or algorithm(s) of comparison and assessment:ALG(i,t)(Q(a_k),Q(v_i)) = J(i,t)(a_k) =d_j where it is understood that the judgment of the action a_k is based on a comparison and assessment with respect to the given value or norm v_i. That is, the desirable qualia of an action $Q(v_i)$ are specified by v_i and are compared to the expected qualia $Q(a_k)$ of the action a_k.

The different degrees of similarity may be compared by means of > (or $\geq$). Given two (or more) alternatives, d_j, d_r, $d_j > d_r$ (or $d_j \geq d_r$) means that the actor judges that action a_k such that ALG(i,t)(a_k) = d_j better realizes (or, at least not worse in realizing) v_i than does a_s, where ALG(i,t)(a_r) = d_r. *She would then prefer a_k to a_s if and only if ALG(i,t)(a_k) > ALG(i,t)(a_s)* (in the case ALG(i,t)(a_k) = A:LG(i,t)(a_r) the judgment of the two actors is one of indifference in terms of realizing appropriate value(s)). She would chose to enact a_k rather than a_r (or there is no basis for her to make a choice in the case ALG(i,t)(a_k) = ALG(i,t)(a_r). More generally, given a repertoire of actions, players are able to rank order (at least, a subset of them) with respect to the capacity or capacities of the actions to realize the value or norm v_i:

$$\text{ALG}(i,t)(a_{k1}) > \ldots > \ldots > \text{ALG}(i,t)(a_{k1}) > \ldots > \text{ALG}(i,t)(a_{kp}), \text{ where } a_{ki} \in \text{ACT}(i,t) \tag{A6}$$

[39] This may be formulated as maximizing goodness of fit (Burns and Gomolinska 2000).
[40] This type of determination would include maximizing on a single dimension, optimizing in a multi-value case or satisficing, etc.

C. DET-III entails action determination by first discovering or constructing one or more alternatives to be followed by DET-I or DET-II processing. The DET-III determination takes place according to contextually appropriate or relevant specificiations (design, guidelines, set of criteria or specifications). That is, the principle of DET-III directs: Find or construct, then select/accept and implement an action (or several alternatives) which realizes intrinsically or produces extrinsically conditions having the character, form, or qualities satisfying or realizing the criteria specified by a norm or value complex vi in V. The actor or actors engage(s) in finding ("searching") or constructing ("creating") alternative(s) satisfying the relevant value complex in S(t); she adds to or transforms the action repertoire ACT(I, G(t)).

DET-III applies in action situations where there are no given or established/acceptable options—any that existed have been discredited or delegitimized (because of performance failure or contradictions with major norms or values). Or, because of a blockage of an established activity, or the activity's failure to do what it is expected to do. That is, the actor(s) is(are) driven to construct or generate one or more new action alternatives to enact. Engaging in such creative or innovative efforts is a major characteristic of human agency.

DET-III is a multi-phase process. Phase 1 entails constructing or finding one or more promising actions (these are two distinct types of mechanism).[41] Phase 2 involves assessing/accepting and selecting an act "b*" to be performed (in the case this entails judgments and choice among alternatives; that is, DET-II type determination would be applied. Phase 3 involves enacting or implementing "a*", that is, applying DET-I.

The performed action "a*" is intended to realize or satisfy the value and/or norm either intrinsic to the performance itself and/or in the outcome(s) produced. Action in this sense is a means for realizing values and accomplishing "goals".[42]

In the table below, the three general modalities of action determination are presented so they can be compared and contrasted. The action determination modalities are activated along with VALUE, MODEL, and ACT rule complexes as a function of the normative, institutional, and agential context (the social embeddedness of games).

Clearly, action determination replaces the more limited notion of "decision-making" in classical game theory (and rational choice theory). Its three modalities entail, as indicated above, "following or implementing a rule or subcomplex"; selecting or choosing among alternatives; and constructing or adopting new alternatives. This is often done collectively (see Table A1).

Note that the "determinations in DET-II and DET-III" are finalized through a DET-I processes of rule following or enactment. We find typically combinations of DET-I, DET-II, and DET-III in action determination processes, e.g., such complex processes in organ transplantation processes in Sweden and Europe (Machado 1998), hydro-power planning and implementation in Norway (Burns and Flam 1987), and general innovation processes as in Burns et al. (1985).

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[41] In related work on creativity and innovation, we specified several procedures and strategies actors use in constructing new entities and processes; such as adaptation, heuristics, trial and error and other approaches to creativity and innovation, for instance, taking an object or process and adapting or modifying it, possibly radically.

[42] Actors utilize one or more modalities in their action determination complex to determine decisions and actions in relation to other agents in an interaction situation S_t. Typically, the defined situation and actors' relationships and roles indicate which one or several modalities are to be employed in the situation: for instance, strategic instrumental action or ritual action or a combination of both (Burns and Roszkowska 2005).

Table A1. Action Determination Modalities, Their Conditions, and Properties.

DET-I Rule Following	DET-II Choice Among Given Alternatives	DET-III Construction or Adoption of "New" Action(s)
Properties of Action Determination Modalities		
Ritual/Routine/Algorithmic Rule-following including the following of cultural scripts. (see Equation (A4))	The action alternatives are given within defined action constraints bounded choice—among the given alternatives. (see Equation (A7))	Non-routine action determination in "open situations" where actors construct or discover one or more alternatives to be considered for choice and implementation (with greater or lesser constraints on their construction of options).
Collective Forms of Action Determination Modalities		
Collective coordinated rule following. A group, organization, or community perform together prescribed organized activities (or are compelled in the given game situation to do so).	Collective procedure(s) to make choices: (1) authority relations in which the group leader makes the choice; (2) a well-defined voting procedure in a group is followed to determine among established or given alternatives in action or policy; (3) Participants engage in organized negotiation about choice among given alternatives.	Collectives construct and propose options and alternative proposals in an "open" situation. They make a determination or selection among constructed alternatives through negotiation or democratic voting; or a collective authority constructs or adopts their new action, policy, or paradigm, authorizes and imposes it (possibly after consultation, negotiation, or even voting).
Conditions for Applicability		
Clear-cut rule or procedure to follow or enact in a particular "traditional" or institutioinalized action situation. Or time constraint so actor(s) does (do) not have the opportunity to utilize a DET-II selection procedure or a DET-III action construction procedure. Or social structural constraints on an actor (or actors) blocking their utilization of DET-II and/or DET-III	Actor(s) has (have) choice opportunities and motivation as well as the time to apply one or another DET-II procedure, that is, making a selection among two or more alternatives.	Actor(s) has (have) opportunity to utilize a DET-III process to construct or discovery appropriate action or actions in the situation.
Performance Features Including Phase Patterns and Termination		
There is basically a direct enactment or performance phase of DET-I.	A selection or choice phase is followed by a DET-I enactment or performance phase. In other words, a two-phase process.	DET-III process is followed by a second phase or possibly two more phases. That is, after the construction phase, there is possibly a DET-II choice phase (whenever two or more alternatives are constructed or discovered). Even when no selection among alternatives is necessary, there will be an enactment/performance phase, that is DET-I.

Appendix A.2. Game Processes: Interaction Patterns and Outcomes

SGT investigates and models multi-agent interaction patterns and outcomes as a function of the actors' roles and role relationships as well as the socio-normative and material contexts. Most modern social systems of interest can be characterized in this way. That is, there is already a pre-existing social structure or institutional arrangement which defines the general game structure G and shapes and regulates interaction among the players engaged in G (see Figure A1). The G rule structure (in large part, its social structure) is translated into a process whenever the actors defined by G are in an interaction situation S_t in context t (time, space, social and physical environment) such that the rules and subcomplexes of G, G(t), are activated and implemented or realized: $G(t) \subseteq {_g}G$, where $t \in T$. The G(t) complex includes then as sub-complexes of rules the players' particular social roles

vis-à-vis one another along with other relevant norms and rules in the situation S (at time t) (Burns and Gomolinska 2000; Burns and Roszkowska 2005).

Many social interactions or games take place under well-defined conditions and entail the *application and implementation of relevant rules and rule complexes* of game complex G(t). *This is usually not a purely mechanical process.* Actors conduct situational analyses; they find that rules have to be interpreted, complemented, and possibly adapted to the specific circumstances.[43] *Some interaction processes may be interrupted or blocked because of application problems: contradictions among rules, situational or exogenous material and/or social constraints, that is, in the larger social context, pressures from actors within G(t) and also pressures originating from agents outside the game situation.* In general, not only do human agents try more or less to apply relevant values and norms specified in their roles vis-a-vis one another in situation S, but they also bring to their interaction situations *roles values, norms, and strategies from other social relationships and contexts*. For example, their roles as parents may come into play and affect performance in work roles (or vice versa). They develop also personal (including romantic) "interests" in the course of playing their roles, and these may violate the spirit if not the letter of norms and values defining appropriate role behavior. More extremely, they may reject full compliance and willfully deviate, for reasons of ideals or even particular personal interests evoked in the interaction situation as when romantic attachments come into play in work places, political movements, or religious settings. Finally, agents may misinterpret, mis-analyze, and, in general, make mistakes in applying and performing rules—in some cases they simply lack sufficient skills and capabilities. In general, role behavior which is often highly orderly and predictable in many instantiations is not fully predictable or reliable but, as suggested earlier, it varies as a function of a number of potential factors.

Given a multi-agent social system like a concrete game, the agents have different roles and role relationships and operate according to one or more of the three action determination modalities. Within an already pre-existing institutional arrangement or social structure, agents in roles vis-à-vis one another interact (or conduct games) generating particular interaction patterns and outcomes. In the following table, behavior (interaction patterns and outcomes) in well-known classical closed games is presented. The diverse patterns and outcomes are a function of the norms applying to particular roles and social relationships; since most socialized actors know what to do and what is expected in these different relationships.

In general, the manner in which particular actors frame, cognize-judge, and play their options and produce mutual outcomes will be a function of their roles and social relations as well as of material and more general normative as well as material conditions, as we discuss below drawing on earlier SGT research—see the predicted or likely patterns in Table A3.

Appendix A.3. Selected Classical Games: Interaction Patterns and Social Equilibria

Drawing on Burns (1990, 1994); Burns and Roszkowska (2006); Scharpf (1997); Tselebis (1990), among others, we have applied SGT to several classical simple one-shot, two-by-two games: for example, "coordination," "confrontation," "prisoners' dilemma," and "battle-of-the-sexes" games (see Tables A2 and A3). The games are assumed to be initially given or structured by outside agents (or circumstances) but framed or defined, "interpreted" and responded to by the participants in terms consistent with their role relationships or the normative context. In these ideal type or standardized simple games, on may distinguish—in a highly over simplified way for purposes of

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43 More generally, SGT stresses the process of following or applying a rule in a certain sense (Burns and Gomolinska 2000). This may not be a trivial matter, as Wittgenstein (1953) and Winch (1958) pointed out. We limit ourselves to the following observations. Some of the actors in an interaction situation may allege a violation of a relevant norm in the situation. This may not entail a dispute over the norm itself, but over its application, an issue of fact. Related problems may arise: some of the actors have conflicting interpretations of the meanings of the norm or of its particular application in the situation S. Or the participants, while adhering to a common norm, introduce different (and possibly incompatible) rules of other sorts, potentially affecting the scope of a norm and normative equilibria in the situation.

illustration—between "cooperative/supportive" types of action and "non-cooperative/non-supportive types of action.

Table A2. Payoff Matrices and Definitions of Four Game Constellations.

		Actor 2	
		Collaboration/Support (C)	**Non-Collaboration/ Non-Support (-C)**
Actor 1	**Collaboration/Support (C)**	R1, R2 (symmetric gains)	S1, T2 (asymmetric outcome, unequal gains or losses)
	Not Collaboration/ Non-Support (-C)	T1, S2 (asymmetric outcome, unequal gains & losses)	P1, P2 (symmetric losses)

The values and rank orderings of the outcomes are assumed to be the following (for i = 1,2):

Coordination Game: $R_i > P_i > T_i = S_i$;
Prisoners' Dilemma Game: $T_i > R_i > P_i > S_i$; $T_i \neq S_i$;
Confrontation (Chicken) Game: $T_i > R_i > S_i > P_i$; $T_i \neq S_i$;
Battle of the Sexes Game: $T_i > S_i > P_i > R_i$; $T_i \neq S_i$.

Table A2 presents the generic payoff matrix of the given games. Each actor has a choice between two classes of action/strategy: "collaboration/support" and "non-collaboration/non-support". For example, cooperation may entail taking the wishes of the other into account, compromising, showing civility, coordinating with the other, sticking to agreed on rules or contracts, etc. Non-cooperation means, for example, refusal to coordinate, unwillingness to compromise, acting contrary to the wishes of the others, trying to gain ahead of the other, breaking a contract, causing harm to the other, etc.

The evaluation and choice of a strategy by each actor leads to a jointly determined outcome, with a particular payoff for each player and possibly for the group as a whole. For reasons of simplicity, the payoffs in all games are symbolized by the same letters (T, R, P and S) and with designations for the two actors, 1, 2. *What differs is the operative rank orderings of the options and their outomes or payoffs in each game*—which are a function of the types of social relationships (and roles) the actors have vis-à-vis one another.

The patterns of interaction and outcomes in our four standardized/idealized games are strikingly different. In games structured by an ongoing or functioning cohesive group, the actors are likely to have collective or joint preferences: For instance, given solidary relationships (kinship, friendship), the actors are motivated, other things being equal, by a more or less shared value or norm to strive for positive gains for both, and at the same time minimizing differences. In general, solidary actors prefer outcomes with symmetric gains over asymmetric gains and, of course, over collective losses. This ordering applies to the coordination, prisoners' dilemma, and confrontation games. The "battle of the sexes" confronts solidary actors with a dilemma—there is no single best collective choice, but there are two asymmetric outcomes with gains for both actors—these are competing equilibria. If the actors fail to choose one of these "two equilibria outcomes," there is a collective or mutual loss.

Table A3. Social relationships with particular roles, types of game situation, interaction patterns and social/normative equilibria.

	Type of Social Relationshp				
Type of Game	**Status/Domination Relation** (Action determination principle (ADP) is A decides, B accedes and payoffs should be asymmetric).[44]	**Solidarity Relationship** (Action determination principle is for A and B to cooperate and share more or less equally).[45]	**Competitive Relation** (Action determination principle is that each chooses separately and selects strategies or constructions options to outdo one another and gain asymmetric payoffs advantageous for self).[46]	**Adversary Relation** (Action determination principle is for each to choose separately and selects or constructs actions to cause harm to the other preferably at the same time limiting harm to self).[47]	**Indifferent/Egotistical Relation** (Action determination principle is for each to select or construct options to gain solely for oneself, with no empathy or concern for the other).[48]
Coordination Game (both gain by coordinating; both lose if one and/or both do not coordinate)	A decides, B accedes. **Normative Equilibrium** = [T1,S2] Should B oppose the unequal outcome, this would entail questioning and restructuring the relation.	A and B coordinate and share payoffs. **Normative Equilibrium** = [R1,R2]	A and B choose separately, and try to induce or trick the other into the asymmetrical outcomes. **No Normative or non-normative equilibrium.** But If CC [R1,R1] payoff large enough, A and B might decide to switch to a cooperative mode with some probability >> 0	A and B choose separately, trying to induce or trick the other into the disadvantageous asymmetrical outcome. A and B would each prefer [P1,P2] to [R1,R2] **Non-normative Equilibrium** =[P1,P2]	A and B inclined to coordinate **Non-normative Equilibrium** = [R1,R2].

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[44] SGT specifies in addition to the action determination principle (ADP) the actors' MODEL, ACT, VALUE complexes compatible or appropriate for the relationship. Here the actors would operate with MODELS which differentiate them into classes; their VALUE and ACT complexes would consist of asymmetric but complementary rule components as discussed in the main text.

[45] Corresponding to the ADP for a solidary relationship, the actors' models would define one another as friends or solidary partners with expectations of mutual predispositions to cooperate and to share gains (and losses). Values and norms in VALUE would orient the actors to cooperation and to sharing gains (and losses). Actions in ACT would appropriately be cooperative ones—and harmful or humiliating type actions would be excluded.

[46] The actors' values and action repertoire are oriented to outdoing one another and gaining asymmetric payoffs advantageous for self. Note that this pattern of DET, MODEL, VALUE, and ACT differs from a relationship of indifferent, purely egotistical agents—and the patterns of expected interactions and outcomes in Table A3 indicates this conclusion.

[47] In line with the ADPs for the actors in adversary relations, their MODELS, VALUES, and ACT complexes are structured toward valuing and strategizing harm to the other (which is likely to lead to mutual self-destruction—unless there is mutual deterrence. (Another possible scenario would be for one to triumph over the other).

[46] The actors' values and action repertoire are oriented to outdoing one another and gaining asymmetric payoffs advantageous for self. Note that this pattern of DET, MODEL, VALUE, and ACT differs from a relationship of indifferent, purely egotistical agents—and the patterns of expected interactions and outcomes in Table A3 indicates this conclusion.

[48] Empathy or caring for one another would not be part and parcel of VALUE in this relationship of indifference. Each is oriented instead to gains for self (and avoidance of losses). Options in ACT would encompass forms of non-collaboration and non-support, hence the likely interaction patterns and outcomes of mutual harm unless they choose to rationally cooperate, which would not be alien for such actors because of their neutrality—in contrast with adversaries or truly competitor actors ("rivals") where in both cases powerful emotions may be involved.

Table A3. *Cont.*

	Type of Social Relationshp				
Confrontation Game or Chicken (both lose if they both try to win. Both avoid disaster if both give in; if one of the actor accedes and the other insists, the latter gains "wins")	A decides, B accedes. **Normative Equilibrium** = [T1,S2]	A and B coordinate. and avoid the confrontation interaction. **Normative Equilibrium** = [R1,R2].	A and B choose separately. **No Normative or non-normative Equilibrium** (unless they jointly decide not to play because of risks involved).	A and B choose separately. **Non-normative Equilibrium** = [P1,P2] (unless punishment so great that refuse to play)	A and B choose individually. **Partial non-normative equilibrium** in that [R1,R2] likely—but not stable.
Battle of the Sexes or Distributive Game (both lose if both try to win as in PD or confrontation game; both lose if they both choose non-collaboration. They both win to a certain extent if one accedes)	A decides, B accedes. **Normative Equilibrium** = [R1,R2]	A and B try to coordinate. [T1,S2] and [S1,T2] are partial **Normative equlibria**, not intrinsically fully satisfactory. Actors likely to try to transform the game making new action possibilities such as a new option or introduction of a norm such as turn-taking.	A and B choose separately. **No Normative or non-normative equilibrium**	A and B choose separately. **Non-normative Equilibrium** = [P1,P2].	A and B choose individually. **No normative or non-normative equilibrium.** Actors may transform the game into one offering equilibria.
Prisoner's Dilemma Game (both lose if each tries to gain ahead of the other. Both win if each agrees to collaborate and accept a second best outcome. One gains, the other looses in the asymmetrical patterns)	A decides, B accedes. **Normative Equilibrium** = [T1,S2]	A and B coordinate and avoid the mutual loss outcome. **Normative Equilibrium** = [R1,R2]	A and B choose separately, aiming for [T1,S2] and [S1,T2], respectively, **No equilibrium**	A and B choose separately, aiming for [T1,S2] and [S1,T2], respectively. Likely **Non-normative outcome equilibrium** = [P1,P2]	A and B choose individually. No normative equilibrium. Actors are likely to try to negotiate cooperation for mutual gain or to change the game, for instance, agreeing to choose together, [R1,R2], which would be a **partial equilibrium.**

The predispositions and patterns of choice are very different in the case of actors in relations of status or authority difference. In any game involving agents with significant status or authority differences, the actors would expect and generally accept asymmetrical outcomes with gains as well as losses favoring in both cases the higher status/authority actor. In other words, such actors expect vis-à-vis one another and tend to accept differential or asymmetric payoffs, favoring the person of higher status or authority. These outcomes are expected to prevail over any symmetric outcomes (which, on the other hand, are preferred by solidary egalitarian actors).[49] Notice the contrast in evaluations, choices and interaction/outcome patterns between solidary egalitarian relations and status difference relations.

Yet, entirely different patterns would be expected in the case of competitive and hostile relationships actors in competitive relations strive for asymmetrical gains, preferring these, of course, to mutual gains as well as mutual losses. Indeed, a relationship involving rivals is characterized by a common value orientation toward *maximizing differences between self and other*. On the other hand, in the case of hostile actors, each frames and make judgments that cause negative outcomes for one another. They each prefer asymmetrical gain or loss-avoidance to mutual gain; but even mutual loss maybe preferred by such actors to mutual gain! Finally, actors who are indifferent or neutral with respect to one another would frame, evaluate, and judge in self-interested (egoistic) ways—the gains of one individual at the expense of the other is neither normatively proscribed nor prescribed. Asymmetrical as well as mutual gains are preferred to mutual loss or asymmetrical loss but mutual gain is judged superior to the mutual loss preferences of hostile actors. This is the behavior of the classical "rational actor".

In making assessments of actions and outcomes, actors do so largely from the perspective of their roles and role relationships, that is the value complex of the role take precedence over other value complexes. Outcomes may be defined and classified in terms of particular aspects and whether these relate to self, other, both, or a collective as a whole. (This points up the extent to which participants may engage in complex normative-cognitive activities). They also make use of meta-values and other meta-rules defining the relative value of right and proper interactions and outcomes.

In these ideal type games, one may distinguish—in a highly oversimplified way for the purposes of illustrating our type of analysis—between "cooperative type actions" and "non-cooperative type actions." For example, cooperation may entail taking the wishes of the other into account, compromising, showing civility, coordinating with the other, sticking to agreed on rules or contracts, etc. "Non-cooperation" means, for example, refusal to coordinate, unwillingness to compromise, acting contrary to the wishes of the others, trying to gain ahead of the other, breaking a contract, causing harm to the other, etc.

SGT provides a systematic basis to identify, analyze, and predict the interaction and equilibrium conditions for different social relationships and normative contexts generally. The rule sub-complexes of actors' roles—action determination complex (DET) as well as MODEL, VALUE, ACT—enable highly refined representation and analyses as suggested above in Table A3 and the discussions around it.

Appendix A.4. Concluding Remarks

Among SGT's unique paradigmatic contributions, one might single out four: (i) the rule-based reconceptualization of social interaction and games, drawing on granular computing and artificial intelligence in formulating a mathematics of rules and rule complexes including algorithms; (ii) the concept of rule-based action determination with multiple modalities; also the related rule-based conceptions of cognitive models, value complexes, and action repertoires (as rule complexes); (iii) role

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49   In general, the meta-rules and -valuations of a given role or role relationship transform a preference ordering, for instance, that of a personal or isolated individual, e.g. those given initially as in Table A2 (on the basis of the individual assessments). The transformation results is a re-assessment of actions and interactions as well as outcomes (Lanzi 2013).

sub-complexes including an action determination sub-complex (DET) as well as sub- complexes of models, values, and action repertoires enable highly refined representations and analyses (as suggested in Table A3 and the discussion around it) (iv) the scientific capacity to identify and predict the interaction and equilibria patterns for different social relationships (and normative contexts generally) in diverse interaction or game situations.

The sociological contributions to game theorizing—such as the SGT approach elaborated in this Appendix—suggest a language and conceptual and methodological toolbox that enables researchers to describe, model, and analyze the diversity and complexity of human interaction phenomena more fully and effectively than classical game theory (including its derivatives).

Some game theorists would argue that desirable extensions could be accommodated in a classical game theoretic model that takes into account that the players respond, for example, to social preferences, social pressures, including those arising from norms and values, powering processes, emotions, etc. Although, as suggested in several instances here (see, for instance, footnote 9), a number of game theorists have paid increasing attention to "social factors" (Basu 2010; Colman 2003; Gintis 2004, 2009, 2010; Grossi et al. 2012; Grune-Yanoff 2011; King-Casas et al. 2005; Lanzi 2013; Leonard 1995; Liu 2011; Ostrom 1998; Tarrant et al. 2010), among others. Lanzi (2013), in particular, exemplifies brilliantly such a strategy of extension. He draws on Goffman's concept of socially influential framing as a sociological meta-process which structures the preferences and action repertoires of the actors involved in a game. The usual tools of game theory are then applied in determining likely patterns.

But such social factors, as is the case with other extensions of game theory, are typically exogenous to the game theory model—in other words, they are not intrinsic to the core of the model. There is nothing inherently wrong with such an approach. But, arguably, these extensions are more or less *ad hoc* adaptations of the classic paradigm in confrontation with empirical observations ("reality") and a multitude of anomalies, pointed out by numerous critics of the classical approach over many decades.

All in all, the sociological approaches to game theorizing, promise greater empirical relevance as well as scientific power. This suggests a possible paradigm shift in the future from classical game theory to a sociological or social science grounded game theory.

References

Abell, Peter. 2000. Sociological theory and rational choice theory. *The Blackwell Companion to Social Theory* 2: 223–44.

Axelrod, Robert. 1984. *The Evolution of Cooperation*. New York: Basic Books.

Basu, Kaushik. 2010. The Moral Basis of Prosperity and Oppression: Altruism, Other-Regarding Behaviour and Identity. *Economics and Philosophy* 26: 189–216. [CrossRef]

Baumgartner, Tom, Walter Buckley, and Tom R. Burns. 1975. Relational Control: The Human Structuring of Cooperation and Conflict. *Journal of Conflict Resolution* 19: 417–40. [CrossRef]

Baumgartner, Tom, Tom R. Burns, and Philippe DeVille. 1977. Conflict Resolution and Conflict Development: The Structuring and Restructuring of Games. In *Research in Social Movements, Conflict, and Change*. Edited by Louis Kriesberg. Greenwich: JAI Press.

Baumgartner, Tom, Tom R. Burns, and Philippe DeVille. 2014. *The Shaping of Socio-Economic Systems: The Application of the Theory of Actor-System Dynamics*. London: Routledge.

Blumer, Herbert. 1937. Social Psychology. In *Man and Society*. Edited by Emerson Schmidt. New York: Prentice-Hall, pp. 144–98.

Buckley, Walter, and Tom R. Burns. 1974. The Prisoners' Dilemma Game as a Systems of Social Domination. *Journal of Peace Research* 11: 221–28.

Buckley, Walter, Tom R. Burns, and David Meeker. 1974. Structural Resolutions of Collective Action Problems. *Behavioral Science* 19: 277–97. [CrossRef]

Burns, Tom R. 1990. Models of Social and Market Exchange: Toward a Sociological Theory of Games and Human Interaction. In *Structures of Power and Constraint: Essays in Honor of Peter M. Blau*. Edited by Craig Calhoun, Marshall W. Meyer and W. Richard Scott. New York: Cambridge University Press.

Burns, Tom R. 1994. Two Conceptions of Agency: Rational Choice Theory and the Social Theory of Action. In *Human Agency and the Reorientation of Social Theory*. Edited by Piotr Sztompka. Amsterdam: Gordon & Breach.

Burns, Tom R. 2008. Social Rule System Theory: An Overview. In *Rule System Theory: Applications and Explorations*. Edited by Helen Flam and Marcus Carson. Frankfurt, Oxford and New York: Peter Lang Publishers.

Burns, Tom R., and Philippe DeVille. 2003. The Three Faces of the Coin: A Socio-economic Approach to the Institution of Money. *European Journal of Economic and Social Systems* 16: 149–95.

Burns, Tom R., and Thomas Dietz. 1992. Cultural Evolution: Social Rule Systems, Selection, and Human Agency. *International Sociology* 7: 259–83. [CrossRef]

Burns, T. R., and H. Flam. 1987. *The Shaping of Social Organization*. London: Sage Publications.

Burns, Tom R., and Anna Gomolinska. 1998. Modelling Social Game Systems by Rule Complexes. In *Rough Sets and Current Tends in Computing*. Edited by Lech Polkowski and Andrzej Skowron. Berlin and Heidelberg: Springer.

Burns, Tom R., and Anna Gomolinska. 1999. A Uniform Framework for Representing Social Actions and their Interactions. Paper presented at the 11th International Congress of Logic, Methodology, and Philosophy of Sciences, Session of the Polish Society of Logic and Philosophy of Sciences, Cracow, Poland, August 20–26.

Burns, Tom R., and Anna Gomolinska. 2000. The Theory of Socially Embedded Games: The Mathematics of Social Relationships, Rule Complexes, and Action Modalities. *Quality and Quantity: International Journal of Methodology* 34: 379–406. [CrossRef]

Burns, Tom R., and Anna Gomolinska. 2001. Socio-cognitive Mechanisms of Belief Change: Applications of Generalized Game Theory to Belief Revision, Social Fabrication, and Self-Fulfilling Prophesy. *Cognitive Systems Research* 2: 39–54. [CrossRef]

Burns, Tom R., and Peter Hall. 2012. *The Meta-power Paradigm: Impacts and Transformations of Agents, Institutions, and Social Systems—Capitalism, State, and Democracy in a Global Context*. Frankfurt, New York and Oxford: Peter Lang.

Burns, Tom R., and David Meeker. 1974. Structural Properties and Resolutions of the Prisoners' Dilemma Game. In *Game Theory as a Theory of Conflict Resolution*. Edited by Anatol Rapaport. Holland: Reidel.

Burns, Tom R., and Ewa Roszkowska. 2004. Fuzzy Games and Equilibria: The Perspective of the General Theory of Games on Nash and Normative Equilibria. In *Rough-Neural Computing. Techniques for Computing with Words*. Edited by Pal S. Kumar, Lech Polkowski and Andrzej Skowron. Berlin and London: Springer, pp. 435–70.

Burns, Tom R., and Ewa Roszkowska. 2005. Generalized Game Theory: Assumptions, Principles, and Elaborations Grounded in Social Theory. *Studies in Logic, Grammar, and Rhetoric* 8: 7–40.

Burns, Tom R., and Ewa Roszkowska. 2006. Economic and Social Equilibria: The Perspective of GGT. *Optimum-Studia Ekonomiczne* 3: 16–45.

Burns, Tom R., and Ewa Roszkowska. 2007. Multi-Value Decision-Making and Games: The Perspective of Generalized Game Theory on Social and Psychological Complexity, Contradiction, and Equilibrium. In *Festskrift for Milan Zeleny*. Amsterdam: IOS Press.

Burns, Tom R., and Ewa Roszkowska. 2008. The Social Theory of Choice: From Simon and Kahneman-Tversky to GGT Modelling of Socially Contextualized Decision Situations. *Optimum-Studia Ekonomiczne* 3: 3–44.

Burns, Tom R., Thomas Baumgartner, and Philippe DeVille. 1985. *Man, Decisions, Society: The Theory of Actor-System Dynamics for Social Scientists*. London and New York: Gordon and Breach.

Burns, Tom R., Jose C. Caldas, and Ewa Roszkowska. 2005. Generalized Game Theory's Contribution to Multi-agent Modelling: Addressing Problems of Social Regulatiion, Social Order, and Effective Security. In *Monitoring, Security and Rescue Techniques in Multiagent Systems*. Edited by Barbara Dunin-Keplicz, Andrzej Jankowski, Andrzej Skowron and Marcin Szczuka. Berlin and London: Springer.

Burns, Tom R., Ewa Roszkowska, and Nora Machado. 2014. Distributive Justice: From Steinhaus, Knaster, and Banach to Elster and Rawls—The Perspective of Sociological Game Theory. *Studies in Logic, Grammar, and Rhetoric* 37: 11–38. [CrossRef]

Burns, Tom R., Ewa Roszkowska, Ugo Corte, and Nora Machado. 2017. Linking Group Theory to Social Science Game Theory: Interaction Grammars, Group Subcultures and Games for Comparative Analysis. *Social Sciences* 6: 107. [CrossRef]

Carson, Marcus, Tom R. Burns, and Dolores Gomez Calvo. 2009. *Paradigms in Public Policy: Theory and Practice of Paradigm Shifts in the EU*. Edited by Marcus Carson, Tom R. Burns and Dolores Calvo. Frankfurt am Main, New York and Oxford: Peter Lang.

Chomsky, Noam. 1985. *Syntactic Structures*. The Hague, Berlin and New York: Mouton. First published 1957.

Chomsky, Noam. 1965. *Aspects of the Theory of Syntax*. Cambridge: The MIT Press.

Colman, Andrew M. 2003. Cooperation, Psychological Game Theory, and Limitations of Rationality in Social Interaction. *Behavioral and Brain Sciences* 26: 139–53. [CrossRef] [PubMed]

DiCicco-Bloom, Benjamin, and David R. Gibson. 2010. More than a game: Sociological theory from the theories of games. *Sociological Theory* 28: 247–71. [CrossRef]

Edling, Christofer R. 2002. Mathematics in sociology. *Annual Review of Sociology* 28: 197–220. [CrossRef]

Elster, Jon. 1989. *Nuts and Bolts for the Social Sciences*. Cambridge: Cambridge University Press.

Garfinkel, Harold. 1967. *Studies in Ethnomethodology*. Englewood Cliffs: Prentice-Hall.

Gintis, Herbert. 2004. Towards the Unity of the Human Behavioral Sciences. *Philosophy, Politics and Economics* 31: 37–57. [CrossRef]

Gintis, Herbert. 2009. *The Bounds of Reason: Game Theory and the Unification of the Behavioral Sciences*. Princeton: Princeton University Press.

Gintis, H. 2010. Social Norms as Choreography. *Politics, Philosophy & Economices* 9: 251–64.

Goffman, E. 1959. *The Presentation of Everyday Life*. New York: Anchor/Doubleday.

Goffman, Erving. 1961. *Encounters*. Indianapolis: Bobbs-Merrill.

Goffman, Erving. 1969. *Strategic Interaction*. Philadelphia: University of Pennsylvania Press.

Gomolinska, Anna. 2002. Derivability of Rules from Rule Complexes. *Logic and Logical Philosophy* 10: 21–44. [CrossRef]

Gomolinska, Anna. 2004. Fundamental Mathematical Notions of the Theory of Socially Embedded Games: A Granular Computing Perspective. In *Rough-Neural Computing: Techniques for Computing with Words*. Edited by S. Kumar Pal, Lech Polkowski and Andrzej Skowron. Berlin and London: Springer, pp. 411–34.

Gomolinska, Anna. 2005. Toward Rough Applicability of Rules. In *Monitoring, Security, and Rescue Techniques in Multiagent Systems*. Edited by Barbara Dunin-Keplicz, Andrzej Jankowski, Andrzej Skowron and Marcin Szczuka. Berlin and London: Springer, pp. 203–14.

Granovetter, Mark. 1985. Economic Action and Social Structure and the Problem of Embeddedness. *American Journal of Sociology* 91: 481–510. [CrossRef]

Grossi, Davide, Luca Tummolini, and Paolo Turrini. 2012. Norms in Game Theory. In *Agreement Technologies*. Law, Governance and Technology Series; Edited by Sasha Ossowski. Dordrecht: Springer, vol. 8.

Grune-Yanoff, Till. 2011. Models as products of interdisciplinary exchange: Evidence from evolutionary game theory. *Studies in History and Philosophy of Science* 42: 386–97. [CrossRef]

Hardin, Russell. 1995. *One for All*. Princeton: Princeton University Press.

Hardin, Russell. 2004. *Trust and Trustworthiness*. New York: Russell Sage Foundation.

Harsanyi, John C., and Reinhard Selten. 1972. A Generalized Nash Solution for Two-Person Bargaining Games with Incomplete Information. *Management Science* 18: 80–106. [CrossRef]

Harsanyi, John C., and Reinhard Selten. 1988. *A General Theory of Equilibrium Selection in Games*. Cambridge: MIT Press.

Hofbauer, Josef, and Karl Sigmund. 1988. *The Theory of Evolution and Dynamical Systems*. Cambridge: Cambridge University Press.

Homans, George C. 1950. *The Human Group*. San Diego: Harcourt, Brace, and Company.

King-Casas, Brooks, Damon Tomlin, Cedric Anen, Colin F. Camerer, Steven R. Quartz, and P. Read Montague. 2005. Getting to Know You: Reputation and Trust in a Two-Person Economic Exchange. *Science* 308: 78–83. [CrossRef] [PubMed]

Lanzi, Diego. 2013. Frames and Social Games. *Journal of Socio-Economics* 45: 227–33. [CrossRef]

Leonard, Robert L. 1995. From Parlor Games to Social Science: Von Neumann, Morgenstern, and the Creation of Game Theory, 1928–1944. *Journal of Economic Literature* 33: 730–61.

Liu, Ting. 2011. Credence Goods Markets with Conscientious and Selfish Experts. *International Economic Review* 52: 227–44. [CrossRef]

Luce, R. D. Duncan, and Howard Raiffa. 1957. *Games and Decisions*. New York: Wiley.

Machado, Nora. 1998. *Using the Bodies of the Dead*. London: Darthmouth Publishers.

Manning, Philip. 1992. *Erving Goffman and Modern Sociology*. Cambridge: Policy Press.

March, James G., and Johan P. Olsen. 1989. *Rediscovering Institutions: The Organizational Basis of Politics*. New York: Free Press.

Nash, John. 1950. Equilibrium points in n-person games. *Proceedings of the National Academy of Sciences of the United States* 36: 48–49. [CrossRef]

Nash, John. 1951. Non-cooperative games. *Annals of Mathematics* 54: 286–95. [CrossRef]

Nash, John. 1953. Two-person cooperative games. *Econometrica* 21: 128–40. [CrossRef]

Ostrom, Elinor. 1990. *Governing the Commons: The Evolution of Institutions for Collective Action*. Cambridge: Cambridge University Press.

Ostrom, Elinor. 1998. A Behavioral Approach to the Rational Choice Theory of Collective Action. *American Political Science Review* 92: 1–22. [CrossRef]

Peterson, Trond. 1994. On the Promise of Game Theory in Sociology. *Contemporary Sociology* 23: 498–502. [CrossRef]

Pinker, Steven. 1991. Rules of language. *Science* 253: 530–34. [CrossRef] [PubMed]

Powell, Walter W., and Paul J. DiMaggio, eds. 1991. *The New Institutionalism in Organizational Analysis*. Chicago: University Press.

Roszkowska, Ewa, and Tom R. Burns. 2010. Fuzzy Bargaining Games: Conditions of Agreement, Satisfaction, and Equilibrium. *Group Decision and Negotiation* 19: 421–40. [CrossRef]

Scharpf, Fritz W. 1997. *Games Real Actors Play: Actor-Centered Institutionalism in Policy Research*. Boulder: Westview Press.

Schelling, Thomas. 1960. *The Strategy of Conflict*. Cambridge: Harvard University Press.

Scott, Richard W. 1995. *Institutions and Organizations*. London: Sage Publications.

Simon, Herbert A. 1955. A Behavioral Model of Rational Choice. *Quarterly Journal of Economics* 59: 99–118. [CrossRef]

Simon, Herbert A. 1979. *Models of Thought*. New Haven: Yale University Press.

Skyrms, Brian. 1996. *Evolution of the Social Contract*. Cambridge: Cambridge University Press.

Smith, Vernon. 1982. Microeconomic Systems as an Experimental Science. *American Economic Review* 72: 923–55.

Swedberg, Richard. 2001. Sociology and Game Theory: Contemporary and Historical Perspectives. *Theory and Society* 30: 301–35. [CrossRef]

Tarrant, Carolyn, Marry Dixon-Woods, Andrew M. Colman, and Tim Stokes. 2010. Continuity and Trust in Primary Care: A Qualitative Study Informed by Game Theory. *Annals of Family Medicine* 8: 440–46. [CrossRef] [PubMed]

Tselebis, George. 1990. *Nested Games: Rational Choice in Comparative Politics*. Berkeley: University of California Press.

Von Neumann, John, and Morgenstern Oscar. 1944. *Theory of Games and Economic Behaviour*. Princeton: Princeton University Press.

Whyte, William Foote. 1943. *Street Corner Society*. Chicago: University of Chicago Press.

Winch, P. 1958. *The Idea of a Social Science and Its Relation to Philosophy*. London: Routledge & Kegan Paul.

Wittgenstein, Ludwig. 1953. *Philosophical Investigations*. Oxford: Blackwell.

Zelizer, Viviana A. 2012. How I Became a Relational Economic Sociologist and What Does that Mean. *Politics & Society* 40: 145–74.