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GENERALIZED GAME THEORY: ASSUMPTIONS, PRINCIPLES, AND ELABORATIONS GROUNDED IN SOCIAL THEORY

Abstract. Game theory in its several variants can be viewed as a major contribution to multi-agent modeling. One development of classical game theory, Generalized Game Theory (GGT), entails its extension and generalization through the formulation of **the mathematical theory of rules and rule complexes** and a systematic grounding in **contemporary social science**. Social theory concepts such as norm, value, belief, role, social relationship, and institution as well as game can be defined in a uniform way in terms of such rules and rule complexes.

The paper presents several of the key assumptions, principles, and applications of GGT, among others: (1) GGT provides a cultural/institutional basis for the conceptualization and analysis of games in their social context. Game is reconceptualized as a **social form**, showing precisely the ways in which the rule complexes of social relationships come into play in shaping and regulating game processes. (2) GGT formulates a general theory of judgment on the basis of which actors either construct their actions or make choices among alternative actions through making comparisons and judging similarity (or dissimilarity) between the option or options considered in the game and their salient norms and values in the situation. (3) GGT distinguishes between open and closed games. The structure of a closed game is fixed. Open games are those in which the agents have the capacity to transform game components, either the individual role components of one or more players, or the general "rules of the game". Rule formation and re-formation is, therefore, a function of interaction processes. (4) GGT reconceptualizes the notion of "game solution", stressing above all that any "solution" is from a particular standpoint or perspective, for instance, the perspectives of particular players. Therefore, some "solutions" envisioned or proposed by players with different frameworks and interests are likely to be contradictory or incompatible. Under some conditions, however, players may arrive at "common solutions" which are the basis of game equilibria. (5) GGT reconceptualizes game equilibria, distinguishing different types of game equilibria. Among these is a sociologically important type of equilibrium, namely normative equilibrium, which is the basis of much social order. (6) While the theory readily and systematically incorporates the principle that human actors have bounded factual knowledge and computational capability (Simon, 1969), it emphasizes their extraordinary social knowledge ability and competence: in particular, their knowledge of diverse cultural forms and institutions such as family, market, government, business or work organization, and hospitals, among others, which they bring to bear in their social relationships and game interactions.

The paper concludes with a comparison and contrast between GGT and classical game theory on a number of central theoretical dimensions.

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PART ONE: OVERVIEW

1. Introduction

Game theory in its several variants can be viewed as a major contribution to multi-agent modeling. In their classic work, Von Neumann and Morgenstern (1944:49) defined a game as simply the totality of the rules which describe it. They did not, however, elaborate a theory of rules. Other limitations derive from the relatively unrealistic cognitive and social psychological assumptions of the theory and to matters of the weak empirical relevance and applicability of the theory to the analysis of concrete social phenomena. The cumulative critique has been massive and its summary would require a book. Our purpose here is more constructive.

One relevant development of classical game theory, Generalized Game Theory (GGT), entails an extension and generalization, addressing several of the most serious limitations. While critical of the classical approach, the point of departure of GGT has been to explore fruitful ways to extend and develop it (and also rational choice theory). In general, GGT has entailed extending social and cognitive-judgmental as well as mathematical aspects of game theory.

(1) In GGT, games are conceptualized in a uniform and general way as rule complexes in which the rules may be imprecise, possibly inconsistent, and open to a greater or lesser extent to modification and transformation by the participants (Burns and Gomolińska, 1998; 2000, 2001, Burns et al, 2001; Gomolińska, 1999, 2002, 2004, 2005). Rules and rule configurations are mathematical objects (the mathematics is based on contemporary developments at the interface of mathematics, logic, and computer science). GGT has developed the theory of combining, revising, replacing, and transforming rules and rule complexes.

Informally speaking, a rule complex is a set consisting of rules and/or other rule complexes[1]. The notion of rule complex was introduced as a ge-

[1] 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.

neralization 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, 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.

(2) Classical game theory assumes a social structure where the actors are completely "autonomous" or independent from one another. Each actor judges the situation in terms of her own desires or values. There is no concern with others as such. This is illustrated by the classical rational agent who assigns values or preferences to outcomes and the patterns of interactions in terms of their implications for herself – and only herself – and tries to maximize her own gain or utility.

This extremely narrow conception of social relationships will not do. Actors are not only interdependent in action terms but in social relational, institutional, and cultural-moral terms. Hence, the importance of taking into account and analyzing such factors as the social context of games – which contribute to defining many if not most of the "rules of the game."

GGT can be characterized as a cultural institutional approach to game conceptualization and analysis (Baumgartner et al, 1975a, 1975b; Burns, 1990; Burns, 1994; Burns and Buckley, 1974; Burns et al, 1985; also see Ostrom, 1990; Ostrom et al, 1994; Scharpf, 1997)[2]. A well-specified game in the context or situation S_t at time t, $G(t)$, is an interaction situation where the participating actors typically have defined roles and role relationships (see Figure 1). A social role is a particular rule complex, operating as the basis of the incumbent's values, perceptions,

[2] Rules and rule systems are key concepts in the new institutionalism (Burns and Flam, 1987; Hodgson, 2002; March and Olsen, 1984; North, 1990; Ostrom, 1990; Powell and DiMaggio, 1991; Scott, 1995), evolutionary sociology (Aldrich, 1979; Burns and Dietz, 1992, 2001; Schmid and Wuketits, 1987), 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, 1980, 1986; 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.

judgments and actions in relation to other actors in their particular roles in the defined game. In general, actors play a number of different roles and are involved in several social relationships and institutional domains.

An actor's role is specified in GGT in terms of a few basic cognitive and normative components (formalized as mathematical objects in (Burns and Gomolińska, 1998, 2000a, 2000b, Burns et al., 2001; Gomolińska, 1999, 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 to do and what not to do and what is good or bad; repertoires of strategies, programs, and routines; and a judgment complex to organize the determination of decisions and actions in the game. GGT has identified and analyzed several types of judgment modalities, for instance: routine or habitual, normative, and instrumental modalities. The rule complex(es) of a game in a particular social context guide and regulate the participants in their actions and interactions at the same time that in "open games" the players may restructure and transform the game and, thereby, the conditions of their actions and interactions.

(3) Game theory makes heroic and largely unrealistic assumptions about actors: complete, shared, and valid knowledge of the game. Also, unrealistic assumptions are made about the abilities of players to compute (for example, payoffs and the maximization of payoffs) and about the consistency of their preferences or utilities. The player is an egoist who at the same time tries to be a strategist, taking into account how other(s) might respond to her and whether or not her own choice or action is the "best response" to others' expected actions (see below). She "takes into account" the other in order to make a best choice for self. Each actor searches through her action space (as in the 2-person game) and finds that action which is the best response to "the best of other(s)".

In GGT, players' knowledge may be only partial, possibly even invalid to varying degrees. It may also differ from player to player. Cognitive and computational capabilities are strictly bounded and, at the same time 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 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. They operate with models of the situation. These constructions may contain incomplete and imperfect information (and possibly even false information) (Burns and Gomolińska, 2001; Burns and Roszkowska, 2001b). Also, communication pro-

cesses among players may entail persuasion and deception which influence in game processes beliefs, evaluations, and judgments. GGT thus starts to approach the complexity and peculiarities of actual social games.

In the GGT approach, a well-specified game is a particular **multi-agent interaction structure** in which the participating players have defined roles and role relationships. The general game structure can be represented by a rule complex G (Burns and Gomolińska, 1998; Gomolińska, 1999, 2002, 2004). Such a rule complex may be imprecise, possibly inconsistent, and open to a greater or lesser extent to modification and transformation by the participants[3]. 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 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 in the situation S (and time t).

Suppose that a group or population $I = \{1, \ldots, m\}$ 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 $t \in T$ (we drop the "G" indexing of the role)[4]:

$$ROLE(i, t) \subseteq_g G(t), \text{ where } t \in T \tag{1}$$

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

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

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 GGT in terms of a few basic cognitive and normative components, that is rule subcomplexes (see Figure 1): (1) the complex of beliefs, ***MODEL(i,t)***, frames and defines the situational reality, key interaction conditions, causal mechanisms, and possible scenarios of the interaction situation; (2) there is a complex of values,

[3] Not all games are necessarily well-defined with, for instance, clearly specified and consistent roles and role relationships. Many such situations can be described and analyzed in "open game" terms (Burns, Gomolińska, and Meeker, 2001).

[4] $A \subseteq_g B$ represents that A is a subcomplex of B.

VALUE(i,t), including values and norms relating, respectively, to what is good or bad and what should and should not be done in the situation; (3) there are defined repertoires of possible strategies, programs, and routines in the situation, ***ACT(i,t)***; (4) a judgment complex or function, ***J(i,t)***, is utilized by actor i to organize the determination of decisions and actions in relation to other agents in situation S_t (Burns and Roszkowska, 2005b). 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. 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.

In general, $MODEL(i,t)$, $VALUE(i,t)$, $ACT(i,t)$, and $J(i,t)$ are the complexes of rules which are activated in situation S and at moment of time $t \in T$ respectively in complexes $MODEL(i)$, $VALUE(i)$, $ACT(i)$, $J(i)$.

2. The Principle of Action Determination: A Type of Judgment

Judgment is a core concept in GGT (Burns and Gomolińska, 2000, 2002; Burns, Gomolińska, and Meeker, 2001; Burns and Roszkowska, 2004; Burns et al, 2005a). The major basis of judgment is a process of comparing and determining similarity, as stressed earlier. 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, and judgment 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 (Sun, 1995).

Several types of judgments are distinguished in GGT, for instance, value judgments, factual judgments, action judgments, among others. For our purposes here, we concentrate on judgments about action.

The action judgment process could 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". In multiple option judgments, the actors generate preferences over their options.

Let B be a set of possible action alternatives. In making their judgments and decisions about an action b from B, the players activate relevant or appropriate values, norms, and commitments from their value complexes. 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 B 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.

The principle of action determination states: Given the interaction situation S_t and game $G(t)$, an actor i in Role (i,t) oriented to the value v (or a vector of values) specifying dimensions and standards $Q(v)$, then i tries to construct, or to find and select, an action pattern or option b where $b \in B$, and b is characterized by dimensions and levels $Q(b)$, which satisfy the following rough or approximate equation[5],

$$J(i,t)(Q(b),Q(v)) = \text{sufficiently similar} \tag{3}$$

Such an action b is a realizer or satisfier of v. The equation implies that the actor i should "enact b" (in other words, the conclusion of the judgment process is to "do b" since $Q(b)$ is judged to sufficiently satisfy $Q(v)$. Or, in the case that there are several options, $Q(b)$ is judged more similar to $Q(v)$ than other options in B).

Action judgment is based then on a comparison of the expected qualia of an action a, $Q(a)$, with the consequences specified by a relevant value or norm v_i, $Q(v_i)$. Each and every actor $i \in I$ in a game $G(t)$ oriented to a specific value or norm v_i tries to construct or find in her repertoire $ACT(i,t)$ an action a^* that satisfies equation (3): thus, $J(i,t)(Q(a^*),Q(v_i)) =$ sufficiently similar. She would enact such an action (expecting to realize or satisfy v_i). Whether the actor is successful or not depends, of course, on the interaction conditions and what others do (the principle of interdependency).

[5] Elsewhere (Burns and Roszkowska, 2004; Roszkowska and Burns, 2002) we have elaborated this model using a fuzzy set conceptualization. The general formulation of equation (3) relates to the notion of "satisficing" introduced by Simon (1969).

For $ACT(i,t) = \{a_1, a_2, \ldots, a_p\}$ let the results of judgment of similarity be some expression describing 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).

$$J(i,t)(Q(a_k), Q(v_i)) = d_j, \text{ where } a_k \in ACT(i,t). \tag{4}$$

We simplify expression (4): $J(i,t)(Q(a_k), Q(v_i)) = J(i,t)(a_k) = d_j$ 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 $J(i,t)(a_k) = d_j$ better realizes (or, at least not worse in realizing) v_i than does a_s, where $J(i,t)(a_s) = d_r$. She would then prefer a_k to a_s if and only if $J(i,t)(a_k) > J(i,t)(a_s)$ (in the case $J(i,t)(a_k) = J(i,t)(a_s)$ the judgment of the two actors is one of indifference in terms of realizing appropriate values). She would chose to enact a_k rather than a_s (or there is no basis for her to make a choice in the case $J(i,t)(a_k) = J(i,t)(a_s)$. More generally[6], given a repertoire of actions, players are able to rank order (at least, a subset of them) with respect to the capacity of actions to realize the value or norm v_i:

$$J(i,t)(a_{k_1}) > \ldots > \ldots > J(i,t)(a_{k_i}) > \ldots > J(i,t)(a_{k_p}), \tag{5}$$

where $a_{k_i} \in ACT(i,t)$

Given an action repertoire $ACT(i,t)$, the action determination judgment entails finding that action which best fits ("goodness of fit") or is most consonant with v_i. 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 the norm. Formally, Actor i selects the action a^* ($a^* \in ACT(i,t)$) for which[7]

$$J(i,t)(a^*) = \text{Max}[J(i,t)(a_k)] \text{ for all } a_k \in ACT(i,t) \tag{6}$$

[6] An action a_k may be cognitively formulated in a complex manner where the qualia associated with a_k, $Q(a_k)$, include such "consequences" as the responses of other agents. Thus, the players in making their judgments may consider and weigh combinations of actions such as cooperation (CC) or non-cooperation ($-C-C$) as well as other patterns in the game, for example, the PD game (see later).

[7] This may be formulated as maximizing goodness of fit (Burns and Gomolińska, 2000).

3. Game Processes: Interaction Patterns and Outcomes

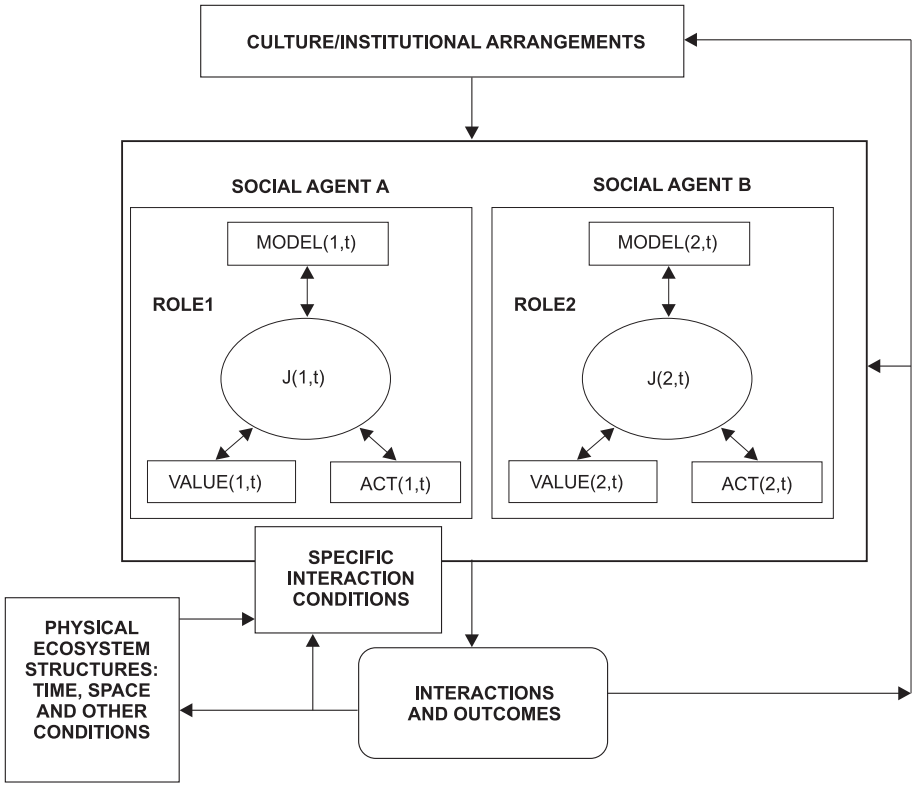
GGT investigates and models multi-agent social systems in which the agents have different roles and role relationships. Most modern social systems of interest can be characterized in this way. That is, there is already a pre-existing social structure or institutional arrangement which defines the general game structure G and shape and regulate interaction among the players (see Figure 1). The G 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 some 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 (and time t).

Interactions or games taking place under well-defined conditions entail then the *application and implementation of relevant rules and rule complexes* of game complex $G(t)$. This is usually *not* a mechanical process. Actors conduct situational analyses; they find that rules have to be interpreted, filled in, and adapted to the specific circumstances[8]. Some interaction processes may be interrupted or blocked because of application problems: contradictions among rules, situational constraints, social pressures from actors within $G(t)$ and also pressures originating from agents outside the game situation, that is in the larger social context. In general, not only do human agents apply relevant values and norms specified in their roles vis-a-vis one another in situation S, but they bring to their roles values and norms from other social relationships. For example, their roles as parents may come into play and affect performance in work roles (or vice versa). They also develop personal "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 compliance and willfully deviate, for reasons of ideals or even particular interests. Finally, agents may misinterpret, mis-analyze, and, in general, make mistakes in applying

[8] More generally, GGT stresses the process of following or applying a rule in a certain sense (Burns and Gomolińska, 2000a). This may not be a trivial matter, as Wittgenstein (1956) and Winch (1958) pointed out. We limit ourselves to the following observations. Some of the actors in I may allege a violation of the norm. 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 the common norm, introduce different (and possibly incompatible) rules of other sorts, potentially affecting the scope of a norm and the equilibrium in the situation.

Figure 1

Two Role Model of Interaction Embedded in Cultural-Institutional and Natural Context



and performing rules. In general, role behavior is not fully predictable or reliable.

Given a multi-agent social system, the agents have different roles and role relationships and operate according to the action determination principle (3). Within an already pre-existing institutional arrangement or social structure, agents in two or more roles $(1, 2, 3, \ldots, m)$ vis-à-vis one another interact (or conduct games) generating interaction patterns, outcomes, and developments.To illustrate how games are played, let us consider the role relationship $\{ROLE(1), ROLE(2), R\}$ of players 1 and 2, respectively, in their positions in an institutionalized relationship in which they play a game $G(i, t)$ in the situation 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 rule in the other's actor's complex. For instance, in the case of a superordinate-subordinate role relationship (Burns and Flam, 1987), a rule k in $ROLE(1)$ specifies that actor 1 has the right to ask actor 2 certain questions, or to make particular evaluations, or to direct actions and to sanction 2. In 2's complex there is a rule m, obligating 2 to recognize and respond appropriately to actor 1 asking questions, making particular evaluations, directing certain actions, and sanctioning actor 2.

Human action is determined by means of one or more modalities. A modality may focus on, for instance: (i) the outcomes of the action ("consequentialism" or "instrumental rationality"); (ii) compliance with a norm or law prescribing particular action(s) ("duty theory"); (iii) the emotional qualities of the action ("feel good theory"); (iv) the expressive qualities of the action (action oriented to communication and the reaction of others as in "dramaturgy" theory); (v) or combinations of these. Role incumbents focus on specific qualia in particular contexts, because, among others, (1) such behavior is prescribed by their roles as the "right thing to do", (2) such behavior is institutionalized in the form of routines, (3) the actors lack time, sufficient information, or computational capability to deal with other dimensions (qualia).

Thus, games may be played out in different ways, as actors operate within opportunity structures and constraints and determine their choices and actions (Burns and Roszkowska, 2004, Roszkowska and Burns, 2002; Burns et al, 2005a):

- *routine interactions*, that is, the actors utilize habitual modalities (bureaucratic routines, standard operating procedures (s.o.p.'s), etc.) in their interaction.
- *consequentialist-oriented interactions.* Actors pay attention to the outcomes of their actions, apply values in determining their choices and behavior on the basis of outcomes realizing values.
- *normativist-oriented interactions.* Actors pay attention to, and judge on the basis of norms the qualities or attributes of action and interaction, applying general as well as role specific norms in determining what are right and proper actions.
- *emotional interactions.*
- *symbolic communication and rituals.*

There may be combinations of these, including such mixtures as when some actors orient to outcomes interact with other actors who are oriented instead to qualities of the action. Or, some, following a routine, interact with others who operate according to a "feel good" principle, etc.

4. Applications to the PD and Other Games: Judgment Calculi, Interaction Patterns, and Social Equilibria

For illustrative purposes, let us consider games where the players' social relationships vary. We consider several of the most common social relationships: status or authority relations (hierarchy), solidary relations, rivalry and antagonistic relationships. The values which the players apply and their action determinations in any given interaction situation, for instance, the prisoners' dilemma game, will differ as a function of their established social relationship.

In a symmetrical, solidary relationship, there is a normative order orienting the players to cooperating with one another and assigning high value to mutually satisfying interactions and outcomes. In, for instance, the prisoners' dilemma (PD) game, this action would be one of mutual cooperation. Consider the standard PD game:

Table 1

Outcome Matrix for 2-Actor PD Game[9]

		ACTOR 2	
		Cooperate (C)	Not Cooperate ($-C$)
ACTOR 1	Cooperate (C)	$5, 5$	$-10, 10$
	Not Cooperate ($-C$)	$10, -10$	$-5, -5$

An action a_k may be formulated in a cognitively complex manner where the qualia associated with a_k, $Q(a_k)$, include such "consequences" as the responses of one or more other agents. Thus, the players in making their judgments may consider and weigh combinations of actions such as cooperation (CC) or non-cooperation ($-C - C$) as well as other patterns in the PD game.

Utilizing interactions patterns in the formalism of equation (5), we obtain the following action judgments for a simple 2×2 PD game for **solidaristic players** 1 and 2:

$$J(1,t)(CC) > J(1,t)(C-C) = J(1,t)(-C-C) = J(1,t)(-CC),$$
$$J(2,t)(CC) > J(2,t)(C-C) = J(2,t)(-C-C) = J(2,t)(-CC).$$

[9] The payoff (numbers) in the matrix are for illustration. Action judgments in GGT are constructed on orderings (partial orderings).

Therefore, player 1 selects C expecting player 2 to select C. Player 2 selects C expecting player 1 to select C. The outcome CC would best satisfy their mutual value orientations in the situation. The other possible interactions, for instance, the asymmetric outcomes fail to satisfy the equality norm which usually applies in their relationship; moreover, $-C - C$ does not satisfy the norm of cooperation (see Table 2).

The players' mutual expectations characterise the relationship and are inherent in each actor's $MODEL(i, t)$ of the interaction situation under the conditions of their solidary relationship.

Actors with other types of relationships would reason and judge differently. For example, given an established **relationship of rivalry**, the players would aim for processes that result in maximum difference between outcomes for self and other(s), that is **asymetrical outcome(s) favoring self**. Each actor i has a value v_i directing him or her to find or select an action a_i^* maximizing the difference between self and other, to the advantage of self. Moreover, the "best" for player 1 is clearly not the "best" for player 2: $J(1,t)(Q(a_1^*), Q(v_1)) \neq J(2,t)(Q(a_2^*), Q(v_2))$. They would rank order the options as follows:

$$J(1,t)(-CC) > J(1,t)(-C-C) = J(1,t)(CC) > J(1,t)(C-C),$$

$$J(2,t)(C-C) > J(2,t)(-C-C) = J(2,t)(CC) > J(2,t)(-CC).$$

Aiming (hoping) for the asymmetric outcome, each would choose to enact $-C$ in the game. The likely outcome is the non-cooperative one: $-C - C$.

In an **antagonistic relationship**, the actors would value interactions or outcomes that hurt the other most (possibly at considerable cost to self, maximizing difference is not the point unless this may be interpreted or defined as maximally causing harm).

$$J(1,t)(-CC) > J(1,t)(-C-C) > J(1,t)(CC) = J(1,t)(C-C),$$

$$J(2,t)(C-C) > J(2,t)(-C-C) > J(2,t)(CC) = J(2,t)(-CC).$$

Player 1 selects $-C$ expecting player 2 to choose $-C$; player 2 selects $-C$ expecting player 1 to choose $-C$. In all case(s), $-C$ leads to the best outcome (in terms of each player's value orientation toward the other player) regardless of what the other does[10].

[10] Other norms may come into play, which modify such behavior. For instance, there may be powerful norms of civility limiting extreme actions in the case of some game situations such as this one. Restraints are imposed on the relationship and its instantiations.

Table 2
Expected Patterns of Interaction and Equilibria in a PD Game Situation as a Function of Selected Common Social Relationships

TYPE OF SOCIAL RELATIONSHIP	CHARACTERISTIC VALUE COMPLEX AND RULES: Meta-evaluation and decision rules, specifying appropriate interactions and outcomes (the latter satisfying, for instance, principle(s) of distributive justice)	APPLICATION TO THE PRISONERS' DILEMMA GAME. TYPES OF EQUILIBRIA
SOLIDARY	The actors are governed by the value of solidarity (joint gains or sharing of gains that is, **symmetric distribution**) and norms of cooperation and self-sacrifice.	The norms of the relationship are satisfied by (CC), also the symmetric outcome of (CC) are right and proper. The actors decide jointly on (CC) unless segregated from one another, in which case try to take one another into account). The (CC) pattern provides an optimal outcome, also satisfying the relationship's principle of distributive justice. (CC) is therefore a **normative equilibrium**.
RIVALRY (COMPETITIVE)	Contradictory values. Each is oriented to surpassing the other (maximizing the difference in gains between self and other). The only acceptable outcome for each would be an **asymmetric** one where self gains more (or loses less) than other. But these expectations are mutually contradictory.	($-CC$) for actor 1 and (C–C) for 2 would be judged right and proper, respectively. The likely (and situational) outcome, $-C$–C, in the game fails to satisfy the distributional rules which motivate them. **Neither normative nor situational equilibrium obtains**. The result is unstable, because each would try to transform the game.
ADVERSARY	The value orientation of each is to cause harm to the other.	The action $-C$ would be judged as right and proper, consistent with the orientation of each. Outcomes when the other suffers ($-C$–C), or ($-CC$) for player 1 or (C–C) for player 2 would satisfy the normative orientations of both players. Since the non-optimal outcome ($-C$–C) satisfies each of their values or goals vis-à-vis the other, namely to harm the other, this would be a type of **equilibrium based on parallel value orientations**.
HIERARCHY	Norm specifying appropriate interaction: player 1 has the right to take initiatives and decide and 2 has the obligation to show deference. Right and proper outcomes are also asymmetric, with 1 receiving more than 2 (which satisfies the relation's principle of **asymmetric** distributive justice).	The asymmetric interaction ($-CC$) satisfies the norm of assymetric interaction, and the unequal payoff satisfies the principle of distributive justice. ($-CC$) is therefore a **normative equilibrium**.
RATIONAL EGOISTS (INDIFFERENCE)	Each follows the principle of instrumental rationality (strategies derive value from their accomplishments for self). No interaction pattern or outcomes has collective normative force.	Rational calculation leads to the ($-C$–C) pattern of interaction, which is sub-optimal. This would be a **situational equilibrium**, but unsatisfactory and therefore unstable. Rational actors would be predisposed to work out coordinating mechanisms in order to achieve the optimum outcome, that is, a "common solution".

Actors having a **status or authority relationship** operate with a primary norm specifying **asymmetrical** interaction and payoffs. The person of superior status or authority dominates and her subordinate(s) show deference and a readiness to accept leadership or initiatives from the superior person[11]. The principle of distributive justice in the case of such a hierarchical relationship implies asymmetry. Each expects asymmetry in the interaction process and the outcomes.

$$J(1,t)(-CC) > J(1,t)(-C-C) = J(1,t)(CC) > J(1,t)(C-C),$$
$$J(2,t)(-CC) > J(2,t)(-C-C) = J(2,t)(CC) > J(2,t)(C-C).$$

Therefore, player 1 selects $-C$ expecting player 2 to choose C; player 2 selects C expecting player 1 to choose $-C$.

The expected results in other standard games are derivable in a straightforward manner (Burns, 1990). Thus, solidary players in a "zero-sum game"[12] would pursue interactions minimizing their joint losses. In any "positive sum" or coordination game, they would try to select interaction(s) maximizing their joint gains. On the other hand, rivals in a zero-sum game would each pursue options to produce maximum differences between self and other results (favoring of course self). Enemies would look to cause maximal harm to the other (but possibly within some cost limits)[13]. Solidary players in a game of "chicken would choose to avoid confrontation all together. Rational actors in the "game of chicken" would avoid the extreme and risky action to the extent that they are risk-adverse. Enemies would (and do) risk catastrophic play in a game of "chicken" (at least up to the threshold of unacceptable losses to self). Rivals might also risk such catastrophic play. In general, one can identify types of closed games that are problematic for particular social relationships. Players with solidary rela-

[11] On a personal level, the lower status person might want something else but within some limits of acceptance behaves in a way consonant with the relationship.

[12] Games of "total conflict" are those in which what one player gains, the other loses. In a certain sense, this type of game is a **distributional game** rather than one of mutual destruction that characterize the confrontation game (or "game of chícken").

[13] In the case of actors who are hostile to one another (but this applies to rivals as well), there are likely to still be limits to their commitment to "hurt or undo the other". Under extreme conditions, they may experience the dilemma between acting in a manner consistent with their relationship (e.g. causing maximum harm to the other in an adversarial relationship) or restraining self and avoiding the risk of substantial loss to self. The strength of the desire to survive or to avoid "excessive" loss or suffering would be decisive here, but these are assessments exogenous to the logic of their relationship. Such considerations would lead to mutual deterrence. The deterrence may, of course, breakdown under some conditions – where, for instance, one or the other players goes over the limit, either through accident, miscalculation, or brinkmanship, and the other responds in kind, unleashing a process which is difficult, once underway, to curb, because of powerful pressures toward reciprocation. Thus, the conflict tends to escalate.

tionships would find problematic highly asymmetrical zero-sum games and would try to transform them (or avoid playing them)[14]. Rivals, on the other hand, would appreciate such games, and would find games with symmetric outcomes highly problematic; in general, they would want to find or construct games with real differences in outcomes, favoring of course self. Those with adversary relationships would not relish game situations lacking opportunities to cause harm-to-the other.

In an open game, where the players construct their actions and interactions, utilizing appropriate value(s) and norm(s) to guide each of them, processes such as the following would be likely to occur. Each of the players in, for instance, a solidary relationship, finds the action $a(1)^*$ and $a(2)^*$, respectively, which sufficiently realize (or comply with) v_i; these would entail cooperative or helpful type actions[15]. Equation (3) would be satisfied in that the players judge $a(1)^*a(2)^*$ as a right and proper cooperative interaction (it might entail implementing a complex of rules or a program) (recall that the judgment is based on a comparison of the expected properties or attributes of an action a, $Q(a)$, with the attributes specified by the value or norm v_i, $Q(v_i)$) for each actor i). Thus,

$$J(i,t)(Q(a(1)^*a(2)^*), Q(v_i)) = \text{sufficiently consonant} \longrightarrow$$
$$\longrightarrow \text{therefore, enact the } a(1)^*a(2)^* \text{ (“cooperative”) interaction.}$$

$$J(i,t)(Q(\text{non-cooperative}), Q(v_i)) = \text{dissonant} \longrightarrow$$
$$\longrightarrow \text{therefore, avoid such action.}$$

Constructing interactions may take place under conditions of competitive or antagonistic social relationships. Such players would generate new interactions and outcomes, possibly developing or adopting new technologies and strategies, as they strive to outdo or harm one another. While the

[14] Each player has, however, certain rough limits with respect to the “sacrifices” that she is prepared to make. For instance, actor i has a maximum value above which she is not willing to go for the sake of the relationship (or, if she does, she is intentionally or unintentionally potentially redefining the relationship (as more solidary and entailing a higher level of commitment). The other actor j may accept this limitation, acknowledging such a norm by not pressing i beyond such a threshold. Thus, the maximum value sets a limit for equilibrium interactions between i and j. Of course, the greater the value of a social relationship to the participants, the higher the limit or maximum, and the higher the level of cooperation, self-sacrifice, and commitment. In general, agents in institutionalized solidary relationships are predisposed to make sacrifices up to the value of the relationship. Failure to live up to these implicit mutual obligations or commitments would tend to undermine the relationship.

[15] For our purposes here, it is sufficient to consider a general norm such as “the principle of reciprocity” or “cooperativity” applying to both actors. Their roles are likely to prescribe role specific and differing norms for each.

game complex undergoes transformation, the competitive or antagonistic character (or identity) of the relationship – and the interaction patterns – are invariant (or reproduced). This is a type of **dynamic equilibrium** (obviously, in this case there is no normative equilibrium which the players can agree to accept or find collectively meaningful). A mediator may assist in such situations; she helps them establish a new basis for playing the game(s) (for instance, moving from total mistrust and mutual aggressivity to partial trust and cooperativity). Ultimately, a new social relationship is established through such a process.

In general, actors in institutionalized relationships are more or less predictable and understandable to one another through shared characterization and knowledge of their relationship(s). This proposition applies even to open game situations. Participants can thereby take into account in their judgments and calculations **the scope** of what they may "reasonably" request or expect from one another (Burns et al, 2001) (miscalculations and mis-judgments nevertheless occur, of course). Moreover, the knowledge of the principles or meta-rules defining limits and the scope of commitment to a particular value complex (see footnotes 14 and 15) means that the players can to a greater or lesser extent predict some of the likely consequences of adaptations and developments of their relationship.

PART TWO: SYNOPSIS OF MAJOR FEATURES OF GGT

In this part, we identify several of the key features of GGT and indicate their implications for the description and analysis of games and game processes generally.

(1) The contextualized **game structure $G(t)$, that is**, in context $t \in T$, is a rule complex whose subcomplexes are the roles that the different game agents play vis-à-vis one another. The roles are made up of subcomplexes representing key behavioral functions.
For each and every actor $i \in I = \{1, \ldots, m\}$

$$\{MODEL(i,t),\, VALUE(i,t),\, ACT(i,t),\, J(i,t)\} \subseteq_g \\ \subseteq_g ROLE(i,t) \subseteq_g ROLE(I,t) \subseteq_g G(t) \tag{7}$$

(2) GGT treats games as **socially embedded** in cultural and institutional contexts (Granovetter, 1985) (see Figure 1). The participants – in defining

and perceiving an interaction situation, assessing it and developments in it, and judging actions and consequences of actions – do so largely from the perspectives of their particular roles and social relationships in the given cultural-institutional context. The role relationships within given institutional arrangements entail contextualized rule complexes including values and norms, the modes for classifying and judging actions and for providing "internal" interpretations and meanings (Burns, 1990, 1994; Burns and Flam, 1987)[16].

(3) GGT provides a systematic theoretical basis on which to represent and analyze **symmetric as well as asymmetric games** (and the social structures in which they are embedded)[17]. Actors are distinguished by their positions and roles in society, by the asymmetries in their relationships (superordinate/subordinate, high status/low status, master/slave), by their endowments, access to resources (including special information, networks, etc.). Such variation implies different action capabilities and repertoires. Expected patterns of interaction and equilibria will vary accordingly. Also, the actors' different information and belief components in their *MODELS*, their diverse values, standards, and goals in *VALUE* complexes, the available repertoires of strategies (*ACT*), and their possibly different judgment complexes (*J*) for action determination are distinguishable and analyzable in GGT. If such variation is specified, taken into account, and analyzed in game investigations, then **empirically diverse interaction patterns and outcomes become more readily described, understandable, and predictable**.

(4) GGT treats the **information** available – the knowledge of the participants – as variables, whereas classical game theory makes heroic claims about the high level and accuracy of players' knowledge (more or less complete). In most interaction situations, information is far from complete,

[16] "Non-cooperation" in, for instance, a prisoners' dilemma (PD is referred to in the classical approach as "defection"). In the GGT perspective on the social contextualization of games, the action is not merely "defection" in the case that the actors are friends or relatives in a solidary relationship. Rather, it is a form of "betrayal" or "disloyalty" and subject to harsh social judgment and sanction. In the case of enemies, "defection" in the PD game would be fully expected and considered "natural" – neither shameful nor contemptible, but "right and proper" harm to one another. Clearly, it is not a matter of "defection". Such a perspective enables us to systematically identify and analyze the symbolic and moral aspects of established social relationships in particular game situations (Burns, 1994).

[17] The structure of game theory limits it to describing and analyzing more or less symmetrical games.

is usually imprecise (or fuzzy), and even contradictory (Burns and Roszkowska, 2004; Roszkowska and Burns, 2002). GGT takes into account such conditions in representing and analyzing games. Moreover, information is typically distributed unequally among players or utilized by them in diverse ways, including even ineffective ways. The level and quality of knowledge of a player i is representable in $MODEL(i,t)$. **This complex may be modified during the course of the game (see later). Some information, which classical game theory would consider essential, may be non-essential in particular GGT games**. For instance, payoffs might not be precisely specified or might be altogether unknown to one or more of the participants. The implications of these conditions differ depending on the established social relationships among the players. Those in solidarity relationships would tend to rely on their inherent **cooperative potential**; that is, they would be inclined to trust in one another's good will in dealing cooperatively with many types of problems. The latter include information problems and the risk of substantial losses. In general, information about individual payoffs would not be essential in many games where the players have strong underlying solidarity relationships, which would predispose them to "correct" ex post unfair results or developments. Such actors are predisposed to focus especially on the characteristics of the action ("cooperativeness") and interactions ("reciprocity"). Moreover, they would expect that in the face of a veil of ignorance (ex ante) or unanticipated consequences (ex post), they can together solve emergent problems (of course, there may be cases where solutions fail to materialize, or "betrayals" occur). In games where agents are alienated from one another, they experience high uncertainty and would want substantially more information not only about outcomes but also about the "character" of other players and their established ways to interpret and enact rules. In cases where such information is unavailable, players tend to rely on standard operating procedures and habitual modalities, requiring much less information, or information of another type than required for instrumental modality. Finally, in open games, there is never full information. Actors generate information as they develop strategies in the game and as the game unfolds, transforming rules and rule complexes.

(5) **The principle of action determination** – corresponding to the principle of maximizing utility in rational choice theory – subsumes several distinct modalities of action determination, each with its own "logic" (Burns and Gomolińska, 2000a, 2000b; Burns, Gomolińska, and Meeker, 2001). The theory encompasses instrumental rationality corresponding in some respects

to the rational choice approach of game theory, but allows for much more variability in the information and calculation conditions. It also encompasses additional modes of action and interaction that are fully intelligible and empirically grounded, but are not reducible to the principle of rational choice. GGT distinguishes modalities such as normatively oriented action, dramaturgical-communicative action, and "play" as well as combinations of these (see earlier). Each modality entails a logic of generating or determining action with a particular **judgment calculus, requiring as inputs specific types of data or information and generating particular evaluative, decisional and action outputs** (Burns and Gomolińska, 2000b). Each modality is a particular way of paying attention and organizing and selecting situational data in the given interaction situation S; it activates certain rule complexes and applyies particular values, norms, and routines in making judgments and determining action.

The modalities of action determination distinguish themselves in part by the prescribed consequences or dimensions, $Q(v)$, specified by the norm or value v. The actor is oriented to, attends to, and tries to regulate actual anticipated or perceived consequences, $Q(a)$ of an action a from A that she constructs or considers for choice. In an instrumental modality, for instance, the value of an action derives from judgments of **action outcomes**, whereas the value of action in the case of normative modality derives from judgments of the **intrinsic qualities of the action itself** (including possibly the intentionality of the actor). In other words, **there are operational differences in cognitive and informational terms between normative and instrumental modalities as well as other modalities**. These differences are particularly noteworthy in the case of open interaction situations where the **players construct their actions and interactions** in an ongoing process. With normative modality, the players construct an action (or actions) which entails or corresponds to prescribed intrinsic properties or qualities of the action (or actions). In the case of instrumental modality, the actors are supposed to produce an outcome or state of the world with prescribed features, that is, they must find or construct an action (or actions) that they believe produces or leads to the prescribed consequences – the properties of the action itself are not prescribed. Of particular importance is the fact that the instrumental modality requires a **model of causality** linking actions to outcomes, or enabling the specification of such linkages.

A narrow focus on outcomes as in the modality of instrumental rationality – ignoring the qualities including ethical qualities of action and interaction – implies that actors behave as if "the ends justify the means." This of

course over-simplifies judgmental computations. But the same one-sidedness and imbalance characterize those who focus only on the intrinsic qualities of actions, ignoring outcomes as in normative or procedural rationality. A narrow focus on the intrinsic properties of action considers action(s) as "right" regardless of outcomes, even catastrophic ones. However, once actors are motivated by and take into account multiple values – for instance, considering ethical qualities of actions as well as their instrumental outcomes – they are likely to be faced with dilemmas and tendencies to blocked or erratic behavior (Burns, Gomolińska, and Meeker, 2001).

(6) **Game transformation** is conceptualized in GGT in terms of the rewriting (updating and revising) as well as restructuring of rules and rule complexes: agents may modify rules, may throw some out, introduce new rules or activate (or deactivate) them; these may also consist of a combination of several such operations. Transformative operations are likely to be taken when one, several, or all players in a game find no game consequences acceptable (for instance, the non-optimal outcome of "rationally" based non-cooperation in the PD game). The game rules that have led to this outcome may be rejected by some of the players; they would try to introduce, for instance, coordination rules – that is, they would take initiatives to establish an institutional arrangement – which increases the likelihood of obtaining the optimal cooperative outcome in the PD game.

Other reasons for transforming games is to make them consistent with core societal values and norms, or with the particular social relationship(s) among the players. For instance, players transform a symmetric game into an asymmetric game more appropriate for actors with differences in status and authority. Or similarly, actors with an egalitarian or democratic type relationship would try to transform an asymmetric game (with differences in action opportunities and payoffs) into a symmetric game more compatible with their estabished social relationship. Such game transformations reflect, of course, not only the players' value orientations but their transformative capabilities and processes.

(7) **Open And Closed Games (that is, open and closed to transformation).** Classical games are closed games with specified, fixed players, fixed value (or preference) structures and judgment complexes (for instance, maxmin or other optimization procedure) as well as fixed action alternatives and outcomes. Such games are analytically distinguishable from *open game situations* (Burns, Gomolińska, and Meeker, 2001). Open and closed games are distinguishable precisely in terms of the degree of fixedness of

the players' role complexes: value, model, action, and judgment complexes for the different players belonging to I at time t in game $G(t)$. In closed game conditions, these are specified and **invariant** for each actor $i \in I$, situation S_t, and game $G(t)$. Such closure is characteristic of classical games (as well as many parlour games), whereas most real human games and interaction processes are open. In open games, the actors participating in $G(t)$ can transform one or more role components as well as the general "rules of the game" R. For instance, one or more players may re-construct or elaborate $ACT(I,t)$ in the course of their interactions. Or, they may change value complexes (including changes in their preferences or utility functions), or modify their models and judgment complexes in such open games. Thus, in a bargaining process, the actors often introduce during the course of the negotiations new options or strategies – or undergo shifts in their values and judgment complexes. In such bargaining processes, the particular social relationships among the actors involved – whether relations of solidarity, anomie, or rivalry – guide the construction of options and the patterning of interaction and outcomes. Thus, each actor i in I reconstructs her repertoire of actions, $ACT(i,t)$ or other role components in the course of her interactions. She tends to do this in accordance with the norms and values relevant to her role or the social relationship appropriate in the situation S_t at time t.

(8) **A Reconceptualization of "Solution".** In classical theory, the theorist or social planner specifies an equilibrium (there may be several) which is the "solution to the game." If an equilibrium is not specified, then some player could gain by changing his or her strategy to something other than what the theorist has specified for her. In the classical theory, equilibrium is a "solution" to the game. And what we refer to as a "common solution" is an equilibrium.

Earlier, we pointed out in the case of the PD game, one or more players may reject some game rules because they prove to be ineffective or to lead to suboptimal (even disastrous) outcomes. They respond to the situation by introducing, for example, particular coordination rules which increase the likelihood of obtaining the optimal (cooperative) outcome. The coordination rules are a "solution" to the "PD problem". The transformed game structure results in one or more "common acceptable solution(s)" to the PD game.

In the GGT perspective, social agents define and understand "solutions" on the basis of the institutional context, their social relationships, roles, value complexes, and cognitive-judgment frames. They have "standpoints"

from which they identify problems and propose solutions[18]. The solutions proposed may or may not converge on one or more outcome(s).

A **common or general game solution** is a multi-agent strategy or an interaction order that satisfies or realizes the relevant norm(s) or value(s) of the players, resulting in a state that is judged acceptable – or even satisfactory – by the game players. The latter consist of a population of agents or a single collective agent (for instance, a group of people who are organized to make collective decisions such as a "public policy decision"). An "acceptable solution" is the best result attainable under the circumstances; in a certain sense this makes for an "equilibrium" state, although not necessarily a normative equilibrium.

Solution proposals of the actors may diverge. In other words, there is no **common** solution, at least initially; in other words, no multi-agent strategy or outcome which is acceptable to all participants. For instance in a negotiation situation; the positions of the players might be too far apart and no agreement or settlement can be reached. An "equilibrium" in such a game is then the state of **not** bargaining or playing the game.

What is judged a solution for one agent (or several agents) from a particular perspective or perspectives may be judged as a problem from the particular perspective(s) of other players. In other words, any game may entail particular "problems" for one or more players, while others may not experience "problems" in the situation. Realizing a norm or value or achieving a goal is a "solution" to the problem of unrealized goals, values, or norms. The players may have different views on satisfactory or even acceptable "solutions". Or the differences may occur between individual and collective agents. Thus, we distinguish situations where proposed solutions are **convergent** (that multiple actors find it acceptable or even highly satisfactory) as opposed to a situation where the solutions proposed by different agents contradict one another – they are **divergent proposals**. Clearly, not every game has a **common solution** (Roszkowska and Burns, 2002).

(9) **Reconceptualizing Game Equilibrium.** An interaction or game equilibrium is a type of **common solution** where the participants find a particular interaction pattern or outcome as acceptable or even satisfactory. The key to this conception are the judgment processes whereby "problems" are "solved" or partially solved. When there is convergence in the solutions, then an equilibrium state is possible. If there is divergence,

[18] The theorist (as well as arbitrators) also have "standpoints" and can propose "solutions". Whether the players accept such solutions is another question.

however, then no equilibrium obtains (unless "solutions" are imposed, for instance, by a dictator). The players endorse or pursue different, incompatible solutions.

GGT distinguishes different types of game equilibria. One such is the Nash equilibrium. It is a game state from which no actor in the game can improve his or her individual situation by choosing an action or outcome differing from this equilibrium. Elsewhere we have generalized the Nash equilibrium in terms of our conceptualization of players' judgment complexes and their evaluative judgments:

Nash Generalization (Burns and Roszkowska, 2004): Let G be a game, $I = \{1, 2, \ldots, m\}$ set of players, S_i, set of strategies the i-player, where $i \in I$. An m-tuple of strategies $a_I = (a_1, a_2, \ldots, a_i, \ldots, a_m)$, for $a_i \in S_i$, is a Nash equilibrium state in pure strategies in a game G if the inequality below holds for each and every player i and for every strategy $b_i \in S_i$[19]

$$J(i,t)(a_1, a_2, \ldots, a_i, \ldots, a_m) \geq J(i,t)(a_1, a_2, \ldots, b_i, \ldots, a_m)$$

where $J(i,t)(x)$ represents player i's evaluative judgments of the outcomes of the m-tuple of strategies (option) x in situation S_t.

Consider that the game theorist or an arbitrator propose a Nash equilibrium as a "solution". If some reject this "solution" of the game, that is, itis not acceptable to some, many or possibly all players, then the question is whether there is another outcome solution which might be acceptable to all participants. If there is no such solution, then the players might consider the challenge of how and in which direction to change the game ("the rules of the game") or to avoid the game altogether.

Actors are often normatively or cultural interdependent in that they belong to and participate in an established social group or organization, or interact in the context of established normative controls. The agents acting collectively or in an organized way (for example, through a voting procedure or through an authority) judge game patterns and outcomes from the perspective of a common norm applied to the m-tuple, a_I, whose consequences are $Q(a_I)$. The consequences may refer to the action itself (as in performing a ritual properly) or the outcomes (the distribution of goods (or bads)), or both. The production of normatively satisfying patterns or outcomes relates to a major GGT concept, namely **normative equilibrium**. The normative equilibria associated with performances of roles,

[19] The Nash equilibrium entails m individual solutions which aggregate to a type of common solution, which is an equilibrium under some conditions.

norms, and institutional arrangements make for **social facts** and "**focal points**" [20] to which participants orient (Schelling, 1963; Burns and Gomolińska, 2000b)).

In GGT, an activity, program, outcome, condition or state of the world is in a normative equilibrium if it is judged to realize or satisfy appropriate norm(s) or value(s) v_I in the situation S for each and every participant. While the concept of normative equilibria may be applied to role performances and to individuals following a norm, we have especially utilized the concept in terms of **game normative equilibria** in a given institutional and situational context. This means that the game participants judge an m-tuple $a_I = (a_1, a_2, \ldots, a_i, \ldots, a_m)$ on the basis of whether it realizes or satisfies v_I where v_I represents a collective norm, normative procedure, or institutional arrangement. Examples of procedures to produce normative equlibria are democratic processes, adjudication, and negotiation as well as the exercise of legitimate authority; they are particularly relevant as devices to resolve conflict under conditions of contentiousness and conflict (Burns and Roszkowska, 2005).

Normative equilibria are a function of (1) the particular relationship(s) among the actors and the value or norm v_I appropriate or activated in the situation S at a given time t and (2) of the concrete situation S in which rule complexes are applied: the action possibilities found or constructed in the situation and the consequences attributed or associated with the action(s). The participants know (or believe) that others accept or are committed to these equilibria – or to the rules that produce them. This makes for a "social reality" which is more or less predictable; it provides a space for planning and developing complex, individual and collective strategies. Normatively based game equilibria are patterns or sets of consequences generated through actors realizing – or anticipating the realization of – situationally relevant values and norms (or, the collective patterns and consequences are judged in themselves to realize or satisfy shared values). Such interaction patterns and outcomes have normative force and contribute to institutional order(s).

There may also be stable game patterns which are not normative equilibria in that they lack moral force or necessary legitimacy. Game players

[20] Schelling (1963:57–58) refers also to "clues," "coordinators" that have "some kind of prominence or conspicuousness". From a conceptual point of view, his characterization is vague. For instance, "But it is a prominence that depends on time and place and who people are. Ordinary folk lost on a plane circular area may naturally go to the center to meet each other... But in the final analysis we are dealing with imagination as much as with logic... Poets may do better than logicians at this game."

might, nevertheless, accept them because they perceive them to be the best possible options under the circumstances (as in the Nash equilibrium). For instance, in closed games, there are interaction patterns which do not permit the full realization or satisfaction of important values to which participants are oriented. They may accept the patterns pragmatically or conditionally – as long as they are constrained to play the given game. But such equilibria – lacking players' commitments, and confidence or trust in them – cannot be enduring (as is the case of Nash equilibria (Burns and Roszkowska, 2004))[21]. This also applies to equilibria that are imposed, that is, collective solutions imposed, by dictators and dominant groups. Inherently, such solutions are only equilibria to the extent that the dictator or adjudicator can force the participants to comply with the imposition.

Concluding Remarks

GGT has been applied to a wide variety of phenomena: among others:

- formalization of social relationships, roles, and judgment and action modalities (Burns and Gomolińska, 2000; Burns, Gomolińska, and Meeker, 2001; Gomolińska, 1999, 2002, 2004, among others);
- reconceptualization of prisoners dilemma game and other classical games as socially embedded games (Burns, Gomolińska, and Meeker, 2001; Burns and Roszkowska, 2004);
- models of societal conflict resolution and regulation (Burns, Caldas, and Roszkowska, 2005; Burns and Roszkowska, 2005);
- rethinking the Nash equilibrium (Burns and Roszkowska, 2004);
- fuzzy games and equilibria (Burns and Roszkowska, 2004; Roszkowska and Burns, 2002);
- socio-cognitive analysis and belief revision (Burns and Gomolińska, 2001; Roszkowska and Burns, 2002);
- simulation studies in which GGT is applied, for instance, in the formulation of multi-agent simulation models of regulatory processes (Burns et al, 2005a, 2005b).

[21] An outcome that is not Pareto optimal is one where the actors, if they cooperate in restructuring their pattern – or underlying rules – can improve the payoffs for some (or all) of them without reducing the payoffs for others, namely through movement to the cooperative interaction. Pareto optimal points are stable against universal coalitions, because it is not possible to deviate from such states without hurting some players. Thus, this acts as a constraint on collective shifts (Scharpf, 1997; Tsebelis, 1990). The PD game has a Nash equilibrium for rational egoists, namely non-cooperative interaction, which, however, is not Pareto optimal.

Our generalization of classical game theory implies that there are many game theories or models reflecting or referring to different social relationships and corresponding rationalities or interaction logics. Classical game theory is, therefore, a quite general but nevertheless limited model in its scope. **It is applicable to a particular type of social relationship: namely that between unrelated or anomic agents acting and interacting in accordance with particular "rationality" rules and modalities**. The actors lack sentiments – either for or against – one another. And they are purely egoistic in their relationship. Moreover, their games are closed ones. They may not change the rules such as the number and qualities of participants, the specific action opportunity structures and outcomes, the shared modality of action, their value complexes and models of the interaction situation. The creative aspect of action, as exhibited in open games, has been acknowledged by Tsebelis (1990), but he recognizes that such problems cannot be addressed systematically within the classical game theory framework.

Table 3 identifies several key dimensions which distinguish game theory (and rational choice theory), on the one hand, and GGT, on the other. While sharing a number of common elements, GGT and game theory exhibit substantial differences in conceptualizing and modeling human action and interaction.

Table 3

Comparison of Generalized Game Theory and Classical Game Theory

THE GENERAL THEORY OF GAMES	CLASSICAL GAME THEORY
Game rule complex, *G(t)* – together with physical and ecological constraints – structure and regulate action and interaction.	**Game constraints** ("rules") which include physical constraints
Players: **Diverse types of actors in varying roles**; actors as creative, interpreting, and transforming beings	Players: **universal**, **super-rational agents lacking** creativity and transformative capabilities.
Games may be **symmetrical** or **asymmetrical** – actors have different roles, positions of status and power, endowments; also, diversity in role components: value, model, act, judgment/modality, etc. They operate in different social and psychological contexts.	**Mainly symmetry**
Game transformation based on the innovative or creative capabilities of players; exogenous agents may also engage in shaping and reshaping games	**Game structures are fixed**
Open and closed games (this follows from the preceding)	**Closed games**

***VALUE*(*i*,*G*(*t*)) complex**: A player's value and evaluative structures derive from the social context of the game (institutional setup, social relationships, and particular roles). 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"	**Utility function** or preference ordering is given and exogenous to the game.
***MODEL*(*i*,*G*(*t*)) complex.** A player's model of the game situation which 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. Reasoning processes may or may not follow standard logic.	**Perfect or minimally imperfect information** about the game, its players, their options, payoffs, and preference structures or utilities. **Crisp** information, strategies, decisions.
***ACT*(*i*,*G*) complex.** It represents the repertoire of acts, strategies, routines, programs, and actions available to player i in her particular role and role relationships in the game situation. In classical game theory, a particularly important class of actions (and constraints on action) concern communication. In GGT **communication** conditions and forms are specified by the rules defining action opportunities in a given game. 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 the other. 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 (degree of asymmetry).	**Set of possible strategies and communication conditions. Communication rules** are axioms at the start of the game and apply to all players. Non-cooperative games do not allow for communication. Cooperative games allow for communication (and the making of binding agreements).
JUDGMENT/MODALITY: *J*(*i*,*G*(*t*))-complex. Multiple modalities of action determination including instrumental, normative, habitual, play, and emotional modes of action determination, among others, which depend on context and definitions of appropriateness. The universal motivational factor is the human drive to realize or achieve particular value(s) or norm(s).	**Singular modality**: Instrumental rationality **or "rational choice". Maximization of expected utility** as a universal choice principle.
Bounded capabilities of cognition, judgment, and choice. Contradiction, incoherence and dilemmas, arise because of multiple values and norms which do not always fit together in a given situation. Consistency and coherence are socially constructed and vulnerable.	**Super-capabilities** of deliberation and choice according to fixed axioms of rationality. Hamlet syndrome is not possible.
Solution concept: "solutions" are defined from a particular standpoint or model of each player. Disagreements among actors about appropriate or satisfactory solutions is expected. A common or general game solution satisfies or realizes the values or goals of the multiple players in the game.	**An "equilibrium" is the solution to the game.**
Different types of equilibria, generalized Nash equilibrium, normative and other social equilibria including equilibria imposed by an authority or dictator.	**Mainly Nash equilibrium** (which conflates different types of socially distinct and meaningful equilibria)

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