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The usefulness of game theory as a method for policy evaluation

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Abstract
Most of today's public policies are formulated and implemented in multi-actor networks. Game theory has long been around as a method that supports a careful analysis of interaction processes among actors. So far, it has not been widely applied in the evaluation field. Hence, questions regarding the usefulness of game theory as an evaluation method remain pertinent. This article addresses these questions, based on a review of literature on evaluations and game theory, and a case where game theory was used in an evaluation of coastal policy implementation in the Netherlands. The results suggest that game theory can help to open up the 'black-box' of policy implementation, when implementation depends on the actions of several interdependent actors. This potential lies not so much in 'hard' mathematical uses, but in the use of game theory as a formal modeling approach that adds structure and rigour to the study of social processes.

Keywords
coastal management, evaluation methods, game theory, implementation, multi-actor systems

Introduction

In a networked society, policy formulation and implementation are shaped by the interaction between multiple actors. This multi-actor dimension is not new, neither for implementation

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(e.g. Bardach, 1977) nor for policy formulation (e.g. Rittel and Webber, 1973). However, the visibility and importance of these networked characteristics are growing. How does the evaluation profession respond to this rise of the networked society and the multi-actor dimension of modern governance? One can address this question by assessing *existing* evaluation methods and concepts for their usefulness in evaluating network governance interventions (Hertting and Vedung, 2012). One can also look at the development and adoption of *new* methods in evaluation of network governance interventions. In the development of new methods and approaches, two types of developments are visible: a process-oriented response, and an analytical response.

The emergence of the process response led to the development of a constructivist evaluation approach as described by Guba and Lincoln in 1989. This process response resulted in the increased incorporation of participation, dialogue, interaction and similar activities in evaluation. An analytical response, however, has been less well-developed. In part, the process response formulated by Guba and Lincoln was accompanied by a particular constructivist paradigm and methodology. Within this paradigm, there is a growing toolkit that offers analytical support for facilitating participatory processes of joint sense-making (e.g. Moret-Hartman et al., 2011; Hermans et al., 2012). Besides support for participatory constructivist processes, also analytical tools and methods are available that help to understand processes among multiple actors.

There are a good many of such methods that combine analytical rigour with practical feasibility, as explored for situations of ex-ante policy analysis (Hermans, 2008). Examples in evaluation include applications of social network analysis to evaluate platforms and advocacy groups (Drew et al., 2011), stakeholder analysis to support evaluation design (Bryson et al., 2011), and game theory (Langbein, 1994; Niklasson, 1996). Despite these examples, attention for this type of analytical support appears to lag behind other areas of methodology development in evaluation.

Therefore, the focus here is on one of these analytical approaches: game theory. Game theory is of interest as it offers 'a theory of behavior in strategic situations' (Greif, 2006: 18). It is connected to the groundbreaking work of Von Neumann and Morgenstern and John Nash in the 1940s and early 1950s. Game theory thus has long been around and it is commonly used in economics and political science. Yet, in evaluation literature few applications are reported to date. This article explores if game theory would be a useful part of the analytical toolbox in this regard. This issue is addressed through a review of relevant literature to establish why and in what situations game theory could be useful, how it has been used for evaluations in the (recent) past, what some of its key limitations are, and to arrive at some preliminary conclusions about the potential use of game theory in policy evaluations. This review is complemented by a case that illustrates the use of game theory to evaluate implementation of coastal policy in the Netherlands. Based on the review and case experiences, the article ends with a discussion and conclusions on the usefulness of game theory to evaluators.

Reviewing the potential of game theory

Game theory as actor analysis: Why and when could it be useful?

Network governance is characterized by the presence of multiple actors and connections that shape policies and their implementation, and hence co-determine outcomes. Evaluation of network governance policies and programs requires appropriate methods. There is not just one method or approach that will suffice, but part of the toolbox will need to consist of analytical methods and techniques that help understand multi-actor processes.

Most evaluations of public policies and programs today follow a theory-of-change approach, in one format or another (see e.g. Mayne, 2012). They use causality, often causal chains, to establish whether or not an intervention worked. In many cases, actors are part of the presumed theories, results chains or causal packages. For instance, both Mayne (2012) in his introduction to contribution analysis, and an impact evaluation guide published by the World Bank (Gertler et al., 2010) use an example in education to illustrate the use of causal packages and results chains. In both cases various actors feature in the causal model: teachers, students (girls, in Mayne's example), parents, schools, the Ministry of Education and municipalities. All these actors play a part in producing outputs and outcomes of educational interventions. The mainstream evaluation approaches clearly offer ways to observe what different actors in a results chain are contributing to the realization of desired outcomes. However, they do not offer tools to understand why actors are (not) contributing, or how disappointing outcomes may result from interactions between actors that are all well-intentioned and generally supportive of policy goals and objectives.

As a result, many evaluations have difficulties to explain what happened during project or policy implementation; they stumble upon a 'black-box' of implementation that makes it impossible to distinguish design failures from implementation failures (Bamberger et al., 2010). In many cases, understanding implementation failures is helped by looking into the role of different implementing actors. Research in the field of public administration aptly illustrates this (e.g. Bardach, 1977; De Bruijn, 2007; Pressman and Wildavksy, 1984; Wilson, 1989). During implementation, different actors need to collaborate, but they also face different constraints, pressures and have different priorities. Also, during implementation, specific choices need to be made, requiring professional judgment of implementing agents. If policies or programs have a longer time-span, implementation is likely to feature repetitive actions and patterns of interaction. This enables actors with a role in implementation to learn how to game the system, adding further challenges to understanding outcomes based on initial policy designs.

Hence, in cases where one is interested in the outcomes that result from decisions of more than one actor, a closer analysis of the actor interactions is warranted. Methods that help to understand actor interactions can be labeled actor analysis methods, and game theory is one of those (Hermans and Van der Lei, 2012). Other methods include social network analysis, discourse analysis, comparative cognitive mapping, agent-based models and Q-methodology. Roughly speaking, these different methods are suitable for different situations (Hermans and Van der Lei, 2012). For instance, different methods focus on different aspects to explain outcomes of actor interactions; some focus on the discourse and debate among (coalitions of) actors in policy and implementation debates, some focus on the perceptions and mental models used by actors to act on a problem situation, others focus on the structure of relations among a larger number of actors that co-determines their action space. Game theory and similar methods focus on the power and interests of actors, and how these combine into a space of possible outcomes in a particular setting.

Background and basic concepts in game theory

Before further exploring its potential for evaluations, it is useful to shortly explain the assumptions and basic concepts used in game theory. Game theory formalizes a game metaphor to study the strategic interactions among actors. In these situations, actors have to coordinate their behavior with that of others, and actors anticipate on the behavior of others to decide on their own strategies. Game theory offers a method to develop formal models of such situations, whereby a limited number of actors, or coalitions of actors, is taken into account. Game theory works from the assumption that the outcomes of interactions can be explained from rational choices by individual participants. Basic concepts in game theory models are (Schelling, 2010; Straffin, 1993):

- Players: the players in a game can include people, governments, organizations. We will also use 'actors' as a synonym for 'players.'
- Actions and strategies: players in a game each have a number of possible moves or actions to consider. The sequence of actions that players decide on are their strategies. Often, strategies are selected anticipating the decisions of other players.
- Outcomes: the combined strategies chosen by players determine the outcome of the game.
- Preferences and payoffs: players have different preferences among the possible outcomes. Payoffs are often used to represent the value of these outcomes to different players.
- Rules: games are governed by rules that prescribe actions and strategies that are permitted, required or prohibited (see Ostrom, 2005). Game theory is not concerned with the study of these rules or their evolution, which is the domain of institutional analysis. However, because game theory takes rules as a key context factor for its models, game theory offers a useful method to understand how different rules can lead to different outcomes.

Game theory is used in policy and institutional analysis and in social science more generally. It is used to study how certain rules and contextual factors shape incentives for behavior, as well as how the evolution of institutions over time can be explained from actors that seek cooperative solutions for social dilemmas (e.g. Greif, 2006; Ostrom, 2005; Scharpf, 1997; Schelling, 2010). Desk-studies also suggest that formal game theory models can simulate a range of real-world games quite accurately, and that they can be used to analyze questions of allocation and fairness in the distribution of values among actors (e.g. Greif, 2006; Obeidi et al., 2002).

Reported applications of game theory in evaluation research

Despite the potential usefulness of game theory, few applications of game theory in evaluations have been reported to date. At least, a literature search on game theory in four leading evaluation journals (*American Journal of Evaluation; Evaluation; Evaluation & Program Planning; Evaluation Review*) yields only a handful of articles, shown in Table 1. Of course, the use of game theory in literature is not the same as the use of game theory in practice, but it may act as a proxy indicator. It seems reasonable to assume that a significant use of game theory in practice will be visible in literature as well – at least to a certain extent.

Of the seven articles shown in Table 1, five articles merely mention game theory, but do not specifically address or report about the usefulness of game theoretic methods for evaluations (Feller, 2002; Peters et al., 1986; Scriven, 1996; Sharkey and Sharples, 2008; Windle and

Table 1. Overview of articles that refer to game theory in leading evaluation journals.

Articles (by publication year)	Extent of use of game theory	How game theory is used or mentioned
Windle and Neigher (1978)	suggest use	Study ethical problems in evaluations and suggest game theory as one of the systematic approaches to develop a better understanding of those.
Peters et al. (1986)	illustrate an argument	Point out limits of technocratic notion of rationality as 'epitomized in game theory'.
Langbein (1994)	use	Game theory is used to study enforcement and compliance in regulatory programs
Niklasson (1996)	use and reflect	Game theory is used to support interpretation of evaluation data on university reform policies
Scriven (1996)	illustrate an argument	Discusses gap between theory and practice in evaluation as a young discipline: 'the payoffs from theory to practice, when we fill the gaps, are sometimes very large. Psychology, probability theory, game theory and computer science are other examples of this phenomenon from our era.'
Feller (2002)	illustrate an argument	Illustrate difficulties of performance measurement for science agencies; Impact of game theory was not predicted or visible in early years
Sharkey and Sharples (2008)	indirect use, foundational	Look into role of negotiation skills in community evaluations. Game theory is mentioned as one of the traditions involved in negotiation literature.

Neigher, 1978). Two articles are more interesting here: Langbein (1994) and Niklasson (1996). Both use game theory to evaluate a situation of program implementation in which actors interact repeatedly and with significant freedom to choose their strategies.

Langbein (1994) uses game theory in an evaluation of the enforcement of regulatory programs. She shows that a view of enforcement and compliance as a repeated game of simultaneous play is more in line with empirical evidence than classic linear models based on deterrence theory. Langbein reports this application of game theory as part of a larger argument about the gap between evaluators and political scientists, which she argues is consequential when it comes to the evaluation of regulatory programs.

Niklasson (1996) reports an application of game theory to evaluate the implementation of university reform policies in Sweden. Game theory is used as part of a rational choice class of approaches. The article reminds readers of a key limitation of rational choice approaches, considering actors as maximizers of their utilities or gains, an assumption that does not always hold and that is difficult to operationalize; measuring utility is often nearly impossible. Game theory is used to explain the observed outcomes as a logical consequence of behavior between more and less willing persons, and as a logical outcome of a game between university management and academic staff. The game theory models themselves are 'beyond the empirical data,' but 'provided a tool for interpreting the situation that can guide the further analysis of these issues' (Niklasson, 1996: 292).

The articles by Langbein and Niklasson both conclude that game theory methods bring useful benefits. However, these studies have not been followed up since their publication in the mid-1990s.

Limitations of game theory – in theory and practice

Classical game theory has important limitations. Looking into those limitations may help to understand its limited use so far for evaluations.

In game theory literature, most attention has gone to the assumptions that underlie classic game theory: a *limited number* of fully *rational* actors, involved in an *isolated* game, while a game theory modeler further needs to have *complete information* on the game and the rules of the game, as well as on *preferences and utility* functions. This has led to some specific branches of game theory that further develop one or more of these limiting assumptions. As a result, modern game theory is not a single method or tool, but actually 'a bag of analytical tools designed to help us understand the phenomena that we observe when decision-makers interact' (Osborne and Rubinstein, 1994).

For instance, metagame theory (Howard, 1971) addresses the use of cardinal preferences to deal with difficulties in estimating ratio-scaled preferences. Hypergame analysis (Bennett 1977) addresses the differences in information that actors may have concerning the games they are playing. More recent work also addresses games of incomplete information, uncertainty and asymmetric information between players (Rasmusen, 2007). Other branches address the original limits imposed by isolated games, such as the work on games that include evolutionary dynamics (Weibull, 1995) and learning (Fudenberg and Levine, 1998) and multi-level games within organizations (Bolton and Dewatripoint, 2005) or across nations (Putnam, 1988). Although most of the game theory applications use non-cooperative game theory, there is a small but significant strand of work inspired by cooperative game theory. It looks at the creation of value by individuals, groups and coalitions, rather than the potential outcomes of conflicts based on specified actions by players in the game.

Even with these theoretical responses and the resulting 'bag of tools,' practical applications of game theory remain hindered by various manifestations of bounded rationality and irrational behavior. Games may be assumed to exist as a theoretical construct, but observing these games, and measuring their parameters in practice, is difficult. Clearly, assessing pay-off structures for real-world actors is difficult – a problem known also in the larger field of economics, for instance, related to the importance of stated versus revealed preferences. Furthermore, strategic games involve strategic behavior. Participants are not likely to be open about this, and may not be willing to share information with evaluators. Also, given that social actors are capable of adapting and learning, capturing social processes fully in formal (game theoretic) models is nearly impossible. Finally, game theory helps to illuminate social dilemmas, but does not provide solutions to cope with them (Schelling, 2010).

What can and cannot be expected from game theory

The limitations of game theory have some important consequences for evaluators. Specifically, they help to identify what can and cannot be expected from game theory.

Game theory can help to structure information that is available and accessible about actor decision making. Game theory cannot fully open-up the black-box of implementation. It cannot render a full and complete account of all the events, the emotions, personality clashes, covert ambitions, private family influences, organizational histories etcetera, that combined to produce specific outcomes. Policy and planning debates have a front-stage and a backstage (De Bruijn and Ten Heuvelhof, 2008). They are debated in public based on rational merits

– even if behind the curtains personality clashes influence the outcome of decision making. It does not require a full account of the emotions and clashes at the backstage to make a fruitful contribution to the more rational frontstage debates. Making explicit what is known and applying logical structures to make use of the information that *is* available, is widely accepted as better than simply groping in the dark. The popularity of logic-models in project evaluations is a point in case.

Game theory can help to limit the space of possible outcomes (Rapoport, 1970). Game theory cannot offer detailed accurate predictions of what will happen and, likewise, it cannot explain the necessity of past events. Game theory cannot explain why observed outcomes were the only possible result of policy implementation, but it may be able to explain that, in an observed constellation of policies and institutions, certain desired outcomes were *not* possible. Game theory helps to distinguish 'Stories that Might be True' from 'Stories That Can't Be True' (Rasmusen, 2007: 3). This may help evaluators to explain why certain desirable outcomes have *not* been observed, and could *not* be expected, in a given setting of actors and policy prescriptions. Such an exploration of counter-factuals would seem useful also for evaluations, as a means to explore things that did not and could never happen because the actors would not allow it.

Game theory can help to clarify social dilemmas that actors are facing in implementation situations. Game theory can support an analytical exploration of possible solutions by use of different 'solution concepts,' by applying certain principles for distributive fairness in cooperative game theory (see, for instance, the case application in this article). However, these analytical explorations fall far short of offering practical solutions for these observed social dilemmas (Schelling, 2010).

At this point, it is useful to make a distinction between a soft and a hard definition of game theory (Schelling, 2010). The hard definition stresses the use of mathematical models. The soft definition sees game theory as the study of how two or more actors 'make choices among actions in situations where the outcomes depend on the choices both or all of them make' (Schelling, 2010: 28). Based on this soft definition, even a simple two-player game model can help to elucidate, for instance, the scope of commitment, promise or threat in social interactions. Think, for instance, of the prisoner's dilemma, a simple 2-by-2 matrix that is arguably game theory's most known contribution to social science.[1] Game theory models, from simple 2-by-2 matrices to more advanced multi-player models, thus can help to formulate key questions and elucidate the choices and dilemmas that actors face. Its contribution is in specifying and clarifying key questions, not answers: these need to be found elsewhere – for instance, in thinking about possible changes of the rules of the game that make desirable outcomes – or equitable sharing – more likely.

In summary: Potential use of game theory in evaluations

What can we conclude from this review? It is always difficult to be exact about when and when not to use a method; often, boundaries between typical situations are blurred in practice and methods can be used in multiple ways. Still, it is possible now to say what we can see as one set of possible uses of game theory in evaluations. Game theory seems useful when one is interested in actor interactions, and when these interactions are sufficiently complicated and important to warrant the use of specific analyses. In network governance evaluations, when we rely on different (human) actors for the implementation of policies, game theory can help to address the 'black-box' problem. Game theory can be useful to open up this black-box, by capturing essential actor interactions in formal models that illuminate the choices and dilemmas that actors face, as well as the range of possible outcomes.

Game theory models seem primarily useful to address 'why' questions in evaluations aimed at learning. Why were outcomes of policy or program implementation disappointing in a given situation, despite the presence of capable actors with generally good intentions? Or: how were successes achieved in a situation with multiple actors with potentially conflicting interests? Game theory offers a formal modeling approach that forces users to strip descriptions of social interactions down to their bare essentials, so as to elucidate the basic mechanisms that help to explain observed outcomes (Rasmusen, 2007; Schelling, 2010). It needs to be complemented with other tools and methods to ensure empirical grounding of game theory models, and to move from problems and dilemmas towards possible solutions or improvements.

In practical terms, game theory works best when there are a limited number of actors, and when there is at least some access to information about games and plays. A minimum condition would be the ability to communicate with key informants, knowledgeable about the options and preferences of different actors.

Case: Implementing coastline management in the Netherlands

The review above suggests that game theory can be useful, in certain situations and under certain conditions. For an applied field as evaluation, the proof of the pudding is in the eating. Therefore, a case application is presented to further explore the usefulness of game theory for policy evaluation. The case concerns the implementation of coastline management in the Netherlands. The starting point was a policy that was formulated in 1990, which has been by and large in place unchanged since then, but which is currently being reconsidered. This section contains a concise description of the case, the details of which can be found in a working paper (Hermans et al., 2011). Rather than including numerous references to case materials and sources here, the interested reader is referred to this more elaborate working paper for underlying sources.

Dutch coastal policy and the implementation of coastline management

The Dutch are internationally renowned for their efforts to keep dry feet and protect their low-lying lands against flooding. The Delta works are well known. Less visible are the soft sandy infrastructures that protect the Dutch coasts. The majority of the Dutch coastline consists of sandy beaches and dunes. For centuries, this coastline has been subject to gradual erosion and inland movement. Since the early 1990s, however, an official coastal policy came into working that was to halt coastal erosion and maintain the Dutch coastline at its 1990-reference position. Implementation of this policy was done through annual sand nourishment programs. Every year, six to 12 million m^3 of sand were to be distributed along the sandy coast, at places where this was considered necessary in order to maintain the coastline.

The distribution of this sand was to be decided through an annual procedure in which national government (by means of *Rijkswaterstaat*, the Dutch Department for Public Works and Water Management), provincial government, municipalities, water boards and nature organizations were represented. They discussed annual sand nourishment programs in so-called 'Provincial Consultative Bodies.' Consultation of these regional bodies, which were chaired by the provinces, was required by law. This procedure was designed by experts from

Table 2. Actors and their interests in the Provincial Consultative Bodies.

	Actor	Interest
M	Municipality	Local economy, tourism, recreation
N	Nature	Nature conservation and ecological rehabilitation
R	Rijkswaterstaat	National coast safety, 'delta safety'
W	Water board	Local management: safety
P	Province	Process: acceptable outcome for coastal zone

Rijkswaterstaat, partly to ensure sufficient support for the annual sand nourishment programs, and partly to improve the fit of these annual programs with regional needs and priorities.

Formalizing actors and interest in games in the Provincial Consultative Bodies

One can summarize the discussions and decisions in the Provincial Consultative Bodies as a game. In this game, five actors with distinct interests can be identified, as summarized in Table 2. The play of this game was regulated through official procedures. *Rijkswaterstaat* was a first mover in these games, as it proposed an annual nourishment program. This proposal was based on technical calculation rules, filled with annual monitoring data about the actual position of the coastline.

In game theory, players are assumed to act rationally, meaning that they are assumed to take those actions that are likely to maximize the expected utility of the outcomes. Therefore, a game theoretic analysis requires an estimation of the utility of different outcomes for different players. For this utility modeling, three lines of evidence were used. There was engineering evidence of the utility of the players based on physical system monitoring data and models. Interviews with key players were used for the face validation of the game. Expert opinion was used as basis for value elicitation.

The cooperative game theory approach attempts to explore the fundaments of collective action. The approach uses as atomic units of analysis the creation of value by individuals, groups and coalitions. Consequently, the elicitation of value requires many hypotheticals – what would happen if two coalitions could align their interests?

An important part of this explication of utility and value involves action on the part of the other coalitions. In this work we adopted the maximin aggregation method. This means to review for each coalition: how much value can this coalition generate assuming a hostile response from the other parties? Value, in this particular game, was assessed by reasoning primarily from safety interests. This means that the game was analyzed from a particular angle. This was warranted by the observation that all players in the game acknowledged safety as the first and foremost concern in coastline maintenance; basic safety should not be traded-off against recreational or nature interests.

The value potential of all coalitions, measured in delivered safety, was rated on a scale from 0 to 100. Utility measurement lacks an absolute scaling, so we may arbitrarily set the value to scale between zero and one hundred. Note that this exercise does not guarantee that the grand coalition of all players delivers the most value; this is a matter for judgment and investigation on a case-by-case basis. Indeed, many serious policy issues surround coalition building processes where it is difficult or impossible to bring a coalition on-board without a global loss of value. Such situations are known as sub-additive games.

$$\nu\{\phi\} = 0$$

$\nu\{R\} = 94$ $\nu\{W\} = 8$ $\nu\{M\} = 13$ $\nu\{N\} = 19$

$\nu\{RW\} = 100$ $\nu\{RM\} = 63$ $\nu\{RN\} = 69$ $\nu\{RM\} = 38$ $\nu\{WN\} = 44$ $\nu\{MN\} = 6$

$\nu\{WMN\} = 31$ $\nu\{RMN\} = 69$ $\nu\{RWN\} = 75$ $\nu\{RWM\} = 75$

$$\nu\{RWMN\} = 81$$

Figure 1. The game as estimated, in characteristic function form.

Cooperative game theory model: Game in characteristic function form

The game as evaluated is set out in Figure 1. The operator ν{} should be read as 'the value of coalition X is.' We select four players, or idealized interest groups, to capture the key features of this game. The players are represented by the letters R, W, M and N in Table 2. P (province) was omitted, as this actor officially acted as a neutral chair. In reality, provinces sometimes were perceived to align with municipalities and their interest in the local economy and recreation.

The game as estimated by the research is given in Figure 1. Note that the point of this particular part of the analysis is not to get the exact numbers of each coalitions value right. Rather, quantification here serves to give an indication of relative values of coalitions, based on inputs from experts and informed by interviews.

Solution concepts: Core and Shapley value

The goal of cooperative game theory is to provide strategic advice concerning the play of a game. In cooperative games, we hope to describe who should cooperate with whom, and how much these parties should sacrifice in support of the common interest. However, arriving at such 'solutions' for cooperative games is not straightforward. There are multiple means for cooperation and there are different ways to assess whether cooperative outcomes are fair, sufficient or efficient. Rapoport (1970) and Straffin (1993) discuss various solution concepts for cooperative games. We adopted two particular solution concepts in our analysis. First, we used a modest proposition for examining design solutions, one which is known as the 'core.' The core considers only the space of solutions which are in the individual and group interest.

Analyzing the design space using the solution concept of the core, reveals that there is no core to the game; there is no solution that meets the needs of individual and group rationality. All players agree on the importance of safety as the main interest. They do not agree on the additional values such as those related to recreation, tourism, nature and dune preservation. Realizing the additional non-safety values put on the game by the players {M,N,W} costs additional budget. However, the available budgets are not sufficient to cater to these values. In practical terms, this was illustrated by the frequent demands for additional (small) sand nourishments by municipalities, and the standard response by *Rijkswaterstaat*: additional nourishments may be incorporated, but not on *Rijkswaterstaat*'s budget.

Another solution concept that was explored for this game was the use of the Shapley value. This is a mediation solution that attempts to reward players according to what they bring to the table. Also with this solution concept there will be dissatisfaction. For instance, the value of the game for the coalition of Water board, Municipality, and Nature v{WMN) = 31 (out of 100). If *Rijkswaterstaat* would join them, the value of the resulting grand coalition would be v{RWMN} = 81. This means that *Rijkswaterstaat* would bring 50 units of value to the table. If it was to join an existing coalition of the other three players, it could thus expect a maximum share of 50 units. However, on its own, *Rijkswaterstaat* would be able to secure v{R} = 94 units of satisfaction on its safety interests. The assumption here being that, on their own, they would not have to cater to any of the additional demands. For instance, they would not need to leave room for natural dynamics and gradual dune movements and there would be no need to allow certain buildings and structures along the beaches to facilitate tourism. *Rijkswaterstaat* has no incentive whatsoever to join any coalition other than the coalition with Water boards. The safety value of this coalition is estimated at v{R,W} = 100. What water boards bring to the table, is their specific knowledge of local and regional safety concerns, allowing for fine-tuning of sand nourishments for safety.

Implications of games repeated over time

It was not possible within the modeled game to meet all the additional non-safety values. The safety values were accepted by all players as the main values. The rules of the game gave further influence to *Rijkswaterstaat*, as both the first mover in the game, and the final decision-maker. Only within these boundaries, was there some room for individual players to have some influence.

The sand distribution games were repeated every year, for several years. As a result, some of the other players may have grown dissatisfied. Players indicated in interviews that they had an increasing feeling that the discussions were outdated rituals rather than meaningful joint decision making. Therefore, it is understandable that these players, notably municipalities, nature organizations and provinces, gradually moved the policy debate to other venues, where they expected better opportunities to realize outcomes that would be favorable for them.

This is visible in the diminishing role in the more recent years of the Provincial Consultative Bodies. As of 2009, with a new Water Bill, the Provincial Consultative Bodies no longer have an official role in the programming of nourishments – they need to be informed, but their consent is no longer required. Annual sand nourishment programming is still being discussed at this venue, but the big decisions on coastal management are taken elsewhere.

For instance, the most visible decision in Dutch coastal management in recent years has been the construction of a so-called ‘sand motor’ in 2011. This sand-motor was a pilot project whereby an artificial appendix to the coast was created, basically a large volume of sand. This should gradually erode over a period of 20 years or more, to nourish beaches and dunes further north along the coastline. The actors responsible for safety (the Water board and *Rijkswaterstaat*), stressed that the effects of the sand motor were uncertain, and that, despite the large volume of sand, 20 million m^3, still additional sand nourishments might be necessary if the sand would not be released at the right time and locations. In the decision about the sand motor, it is clear that *Rijkswaterstaat*, which once designed the sand distribution game in a way that allowed for national control, was not in control anymore. Considerations other than flood safety and efficiency were more influential.

Usefulness of game theory in this case

Game theory has helped to show that the implementation of an earlier coastal policy resulted in a game that had no core, meaning that not all individual demands could be satisfied. *Rijkswaterstaat* was in control, while other players could not be certain about the outcomes of interest to them. This helps explain why these other players eventually lost interest and looked elsewhere for possibilities to influence coastal management. But is this useful? Does it add something to existing evaluation reports in this case?

To a certain extent, it does. Past evaluations signaled some dissatisfaction with annual procedures. Decisions regarding non-safety issues were considered opaque and it was recommended to make future decisions more transparent. However, past evaluations did not attempt to explain or analyze the reasons behind this dissatisfaction, other than by pointing out their non-transparency. A game theory lens offers some logical explanations. Also, it triggers thinking about solutions and about their possible impacts. The game theory results suggest that more transparency is not likely to resolve the lack of value in the game – transparency does not necessarily help in sharing a non-existing pie. Broadening the annual distribution games and/or linking up with other issues, to include some room and resources to cater to non-safety values, would seem a more logical fix.

As any analytical lens, game theory illuminates phenomena that would otherwise remain less clear. In this case, it also points to the strategic value of information in games. The outcomes of this decision situation are partly due to a lack of interest in non-safety issues on behalf of the dominant player in the game, and partly due to a lack of information on non-safety issues. Safety, equated with the prevention of coastline erosion, was well understood due to past monitoring efforts of *Rijkswaterstaat* backed by a community of coastal scientists. The value of stable, broad or narrow beaches for recreation and the local economy was less clear. Also the impacts of sand nourishment on nature were ill-understood. This makes payoffs on these values of interest less certain. Game theory helps to see that different players have different needs for information to operate effectively. Limiting the information base and knowledge development efforts to only one set of values, is likely to put certain players at a disadvantage. They cannot evaluate their strategies and cannot reason their case convincingly in discussions with others. Note that this insight relates to the transparency issue in earlier evaluations, but that it is slightly different. It points out that, in fact, more monitoring and knowledge development is needed related to non-safety values in order to level the playing field and enable transparent decision making.

This illustrates that game theory in this case helped to understand how the original design of the implementation procedure logically explains the observed outcome. Rather than merely signaling disappointment, such understanding enables the design of new procedures and forms for collaboration that enable more effective negotiations and that offer more possibilities to align interests. Because even if other players have moved key coastal management debates to other venues, they still remain interested in safety. And they do realize they need the expertise and resources of *Rijkswaterstaat* as part of the effort to secure safety. In the end, sidelining safety expertise is not in the interests of these other players either.

The evaluation results were presented and discussed with Dutch experts and policy-makers in three different workshops and meetings. During those meetings, the game theory models were validated. The usefulness of those models to them as experts and policy-makers was not explicitly assessed through a separate questionnaire, but workshop observations provide some pointers. The presentation of the game theory models triggered significant discussion among participants, in all three workshops. Participants easily recognized that they were part of a game. As one participant mentioned, the visualization and word use from game theory helped him to verbalize and talk about knowledge that was intuitive to him. One could say that game theory helped participants to explicate their knowledge. This may not offer great surprises, but it does offer a new perspective to think about possible improvements of problematic situations, and in this way to act upon evaluation findings. Participants discussed how they could use this way of thinking to help them think through strategic decisions that they were facing regarding future coastline management policy. A follow-up project with a TU Delft student for one of the Water boards corroborates the impression of the perceived value of game theory.

A more general discussion of usefulness of game theory to evaluators

The case illustrates that game theory can be useful and can add new and useful insights, beyond insights obtained from other types of evaluations. Of course, it is just one case, in which contributions were useful but not spectacular. This calls for modesty in drawing general conclusions on the usefulness of game theory for evaluators. Next to the few earlier reports, however, it does suggest that there are situations in which game theory can be useful to evaluators.

It is by now widely accepted that evaluators need tools and approaches to deal with the presence of multiple interdependent actors. Game theory offers an analytical instrument to understand actor interactions, has been around for half a century, and yet is hardly used in evaluations. One reason may be that evaluators do not know about game theory, or at least, not enough to be able to apply it in their work. Another reason may have to do with the mathematical nature of game theory that is emphasized by some. And still another reason may be the strict assumptions of rational behavior that underlie game theory. The mathematical structure and the rationality-assumptions, particularly, may have caused hesitation and doubt among evaluators who are dealing with multiple actors and social processes. Probably, many of those evaluators are willing to accept the metaphor of a game to describe program or policy implementation processes. However, assuming rational actors and attaching quantitative values to their utilities is likely to receive skepticism. The reference to game theory by Peters et al. (1986), contained in Table 1 in this article, suggests as much.

This is understandable, and seems of concern to 'mathematical' applications of game theory. If one follows a 'practitioner's approach,' even simple formal game theory models can be useful to investigate interactions among interdependent actors (Schelling, 2010). This means using game theory as an 'exemplifying theory' (Rasmusen, 2007), rather than as a mathematical model to predict the outcomes of social processes. Similarly, in the case reported here, quantification was part of the analysis, but the numbers used were crude estimates.

Other reasons for the infrequent use of game theory may have to do with the dominant evaluation practice that easily emphasizes impact and effectiveness. Game theory aids a better understanding of social dilemmas that help to explain how impacts come about, but game theory does not offer a tool to measure impact and effectiveness. It always needs to be complemented with additional analyses and results to provide sufficient empirical grounding. Commissioners do not request the use of game theory – or a related method – in their Terms of References and evaluators might be hesitant to propose a method that commissioners are not familiar with. Similar explanations for the limited use of actor analysis methods more generally have been offered in relation to ex-ante policy analysis in water management (Hermans, 2008): existing project and institutional structures do not leave much room for their use; the experts involved (commissioners as well as analysts) prefer traditional tools and approaches that they are familiar with; and they may be hesitant to be forced to reflect on their own roles in policy (implementation) processes.

These and other reasons help to explain the limited use of game theory in evaluation practice. Also, some skepticism is warranted: game theory is not a cure-all when confronted with strategic interactions among actors. However, game theory can be used to add rigour and a logical structure to the interpretation of observed social interactions and possible instances of strategic behavior. Structuring a situation as a game, in a formal model, is the main contribution of game theory in evaluations. This is where evaluators should focus on. Especially when used in combination with other methods and sources of evidence, the results from a game theoretic analysis can act as catalysts for discussions among policy-makers. Structuring information, aiding understanding and stimulating discussion are worthwhile contributions.

Conclusion

Game theory offers a lens that enables one to analyze policy implementation processes in which multiple actors are involved. As such, it can inform evaluators and evaluation users about these processes and their design. Game theory is not unique though. Other tools may offer lenses that are equally effective. A field labeled here as actor analysis contains many more of such lenses: social network analysis, argumentative models, stakeholder analysis and similar methods.

Lenses are influential. If you look for games, you will see games. If you look for networks, you will see networks. If you look for mechanisms, you will see mechanisms – and if you look for impact, you will see impact (or sometimes, the lack thereof). Therefore, this article is not a call for the application of game theory everywhere. However, it is a call for a conscious choice of analytical lenses and theoretical concepts. When interactions among multiple actors are an imported part of the policy or program that is to be evaluated, neglecting lenses that help explain such interactions and their outcomes would be a bad choice.

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Note

1. This example also helps to explain why the quantification of preferences, which is part of most game theory models, may be less disputed and less obscure than some assume. In the classical prisoner's dilemma the preference of the two prisoners for different possible outcomes, in terms of

years to be served in prison, is quite intuitive and fairly robust: most players will prefer outcomes with less years in prison over outcomes with more years in prison.

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