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Incomplete Information in Social Interactions

Joel Vuolevi

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Incomplete Information in Social Interactions

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Chapter 1

Introduction

The most elementary form of a decision is a choice between two alternatives. You walk to your living room and there is one apple and one orange in a bowl. You want to have something for a snack, and you choose either the apple or the orange. Classic economics theory, along with common sense, proposes that you make a rational choice that maximizes your utility. That is, you choose the fruit that, for whatever reason at that particular moment, you prefer the most.

This simple example becomes a lot more difficult if you enter the living room with your friend, and you are both hungry. One of you gets the apple, the other one the orange. But how would you decide which one gets which fruit? If one person prefers the apple and the other one the orange, the decision is easy. But if both prefer either the apple or the orange, the decision is more difficult. You may take the preferred fruit and leave the second best alternative to your friend, or you may let your friend have the favorite fruit.

The above example highlights three key aspects of social decision-making, and this Introduction is organized in subchapters accordingly. In the first subchapter I will describe how social decisions influence other people's outcomes, with a particular focus on situations in which self-interest and other-interest are at odds (e.g., both prefer the same fruit). I will also demonstrate how cooperation can sometimes emerge in such situation, even if people are assumed to pursue their self-interest. Second, I will review empirical evidence on people's tendencies to pursue self-interest versus other-interest (e.g., the favorite fruit to you or your friend) and demonstrate how preferences that differ from self-interest influence social interactions. Third, I will discuss how incomplete information influences cooperation. Sometimes people do not know their partner's exact preference (e.g., which fruit is the favorite) and the same behavior can interpreted in multiple ways (e.g., did my friend choose apple because he likes it better or because he thinks that I like orange better). I will discuss in detail how incompleteness of information influences perceived cooperation as well as general evaluations of the partner—both of which may influence cooperation in return.

Basic Principles in Social Interactions

To start with, I will introduce situations that are characterized with conflict of interest and define cooperation in this context. Second, I will introduce some basics of game theory—a framework for formal understanding of decisions in situations in which more than one person is involved. Third, I will review interpersonal strategies that people adopt in such situations and present some simulation-based as well as experimental

evidence to show that human cooperation is conditional: People cooperate with others who cooperate with them, and noncooperate with those who do not cooperate.

The Conflict Between Self-interest and Other-interest

In the living room example the most elementary question is whether you and your friend prefer the same fruit or not. If you prefer different fruits, the situation is characterized by correspondence of interest. Human life is full of situations in which people's interests align and the key question is about coordination: What should we do so that we both can obtain the best outcomes (e.g., ask your friend's favorite fruit and get an honest answer). But if you prefer the same fruit, such perfect-for-everybody solution is impossible to obtain. These situations—also notably present in everyday life—are characterized by a conflict of interest and the key question is about cooperation: Should I pursue my self-interest (e.g., take the favorite fruit) or should I pursue another person's interest (e.g., offer the favorite fruit to the friend).

Behaviors that benefit another person or a collective, but are costly to the self, are defined here as cooperation. Thus, the concept of cooperation is only meaningful in the context of conflict of interest, because cooperation cannot be separated from self-interest if self-interest and other-interest align. The second important aspect of this definition is that cooperation refers to specific behaviors alone. For example, if you give the favorite fruit to your friend with an idea that you can ask a favor later, your behavior is still defined as cooperation. This is where a distinction can be made between cooperation and altruism. The former refers to specific behaviors whereas the latter, at least in its strictest sense, refers to underlying motives and ultimate goals of behaviors (see Sober & Wilson, 1998). Following terminology in Van Lange (2008), I use altruism somewhat more loosely and define it as an other-regarding motive that may underlie cooperative behaviors. The difference to the strictest definition is that altruism in this dissertation does not necessarily mean that a person would forfeit self-interest in all possible respects (e.g., donating money to a charity is still altruistic even one could argue it is self-interested if one feels good about it). The question whether all behaviors can be accounted for by self-interest is beyond the scope of this dissertation, but interested readers may refer to previous discussions (e.g., Batson, 1991; Cialdini & Fultz, 1990; Dovidio, 1984).

Game Theory

Game theory is a framework for understanding social decision-making (Luce & Raiffa, 1957; Von Neumann & Morgenstern, 1944). It captures the decision options for each player and describes the way in which different combinations of behaviors influence outcomes for each player. In a dyadic case, this is often represented as a matrix where each row represents one behavioral option for Player 1 and each column represents one behavioral option for Player 2. Each cell consist of two values—outcomes for each

player that correspond with that particular behavior combination. Game theory can describe all possible ways in which two or more individuals can be interdependent (e.g., independence versus interdependence, corresponding versus conflicting interest, joint control of outcomes versus partner control of outcomes).

Table 1.1 presents an example of the best known dyadic game—the prisoner’s dilemma (Rapoport & Chammah, 1965; Tucker, 1950). In this game, both players have the same two options—either to cooperate or to defect. If both players cooperate, they receive the best possible collective outcomes (e.g., 4 points each, 8 points in total). However, if one player defects while the other one cooperates, the defector receives much higher outcomes (e.g., 6 points) than the cooperator (e.g., 0 points). If both players defect, they receive lower outcomes than they would by mutual cooperation (e.g., 2 points).

Table 1.1: The prisoner’s dilemma.

		Player 2	
		Cooperate	Defect
Player 1	Cooperate	4 / 4	6 / 0
	Defect	0 / 6	2 / 2

The prisoner’s dilemma is a widely used paradigm in social sciences, because it captures the conflict between self-interest and collective interest. Defection is the rational strategy, because it leads to higher outcomes than cooperation regardless what the other player does. At the same time, cooperation is the best collective strategy, because it leads to the best overall outcomes. But do people pursue self-interest or collective interest in the prisoner’s dilemma? What interpersonal strategies people apply and should apply in such mixed-motive situations?

Conditional Cooperation and the Emergence of Tit-for-tat

According to game theory, players would always defect in the prisoner’s dilemma. Game theory is based on the assumptions that all players pursue their self-interest and that all players can assume that all other players pursue their self-interest, too. Defection is indeed the rational strategy that cannot be exploited by any other strategy (i.e., no strategy can gain a relative advantage over a defector). But defection is by no

means the perfect strategy in terms of utilizing the best collective outcomes provided by the situation. Two cooperators would gain twice as high outcomes as two defectors playing with each other. But at the same time, unilateral cooperation would be exploited by a defective partner.

To compare different interpersonal strategies, Robert Axelrod (1984) organized a computer tournament in which different strategies played the prisoner's dilemma game against each other. The game was iterated and the agents had complete information on their opponents past behavior, which allows more complex strategies than unconditional cooperation or unconditional defection. Leading experts in the world submitted numerous strategies, but the results emerged surprisingly simple: The best strategy, submitted by Anatol Rapoport, was tit-for-tat—strategy that makes the cooperative choice in the first trial and simply copies the partner's previous behavior for the next round (i.e., previous cooperation is responded with cooperation and previous noncooperation with noncooperation).

Population dynamics simulations provided further evidence for the effectiveness of tit-for-tat. A subpopulation of tit-for-tat agents can obtain cooperation with each other and sustain even among selfish agents (Axelrod, 1984). Tit-for-tat can also evolve from completely random strategies (Axelrod, 1997). Tit-for-tat is an evolutionally stable strategy (along with the self-interest strategy), which supports Trivers' (1971) original argument that cooperation can emerge through a reciprocal altruism (i.e., going beyond self-interest given that the partner does the same). Experimental findings also provide evidence for tit-for-tat. While some people use selfish strategies—idea that is consistent with population dynamics simulations showing that defectors also sustain—most people adopt a version of tit-for-tat in their interactions (Klapwijk & Van Lange, 2009; Komorita, Hilty, & Parks, 1991; Komorita & Parks, 1995; Parks & Rumble, 2001; Sheldon, 1999; Van Lange, 1999).

Tit-for-tat is an example of a conditional strategy and human cooperation is inherently conditional. As Axelrod has demonstrated (1984, 1997), conditional cooperation provides good outcomes with those who want to cooperate, but also a good protection against defectors. Some previous literatures refer to conditional cooperation by reciprocal altruism (Trivers, 1971) or reciprocity (e.g., Kollock, 1993; Nowak & Sigmund, 1992; Van Lange, Ouwerkerk, & Tazelaar, 2002). To avoid confusions with different definitions in social exchange theory (e.g., Homans, 1961) and self-disclosure, here I use conditional cooperation to refer to the general principle that people adjust their cooperation according to the partner.

The human brain is suited for conditional cooperation and social exchange in particular (e.g., trading money for goods, favors for other types of favors). Social exchange involves conditional logic (e.g., if P then Q) and people perform quite poorly at detecting flaws in such conditional statements in general. By contrast, when conditional statements are about social exchange (e.g., if you borrow my car, then you

must fill the tank with gas), people perform very well (Cosmides, Tooby, Fiddick, & Bryant, 2005; Ermer, Cosmides, & Tooby, 2007). This indicates that people's logical reasoning is suited for detecting social cheaters and identifying defectors from tit-for-taters.

Social Interactions Beyond Self-interest

Empirical Evidence and Models for Social Preferences

Game theory is a normative approach to rational social behavior and explains what people should do—given that they pursue their self-interest. However, even in a single-shot prisoner's dilemma with perfect strangers, some people cooperate (for a review, see Caporael, Dawes, Orbell, & Van de Kragt, 1989). This behavior cannot be explained by evolutionary fitness of tit-for-tat, because conditional strategies cannot be applied in single-shot games where players do not have any information on their partner's previous behaviors, nor can they distinguish defectors from tit-for-taters a priori.

Perhaps even a clearer evidence of violation of the self-interest assumption comes from experiments on *the dictator game*—game that creates a conflict between self-interest and equality. In this game, the first person (i.e., the dictator) can freely divide a fixed outcome (e.g., units of money) between the self and another person. Rational self-interest would suggest that the first person keeps all the outcomes, but most people actually allocate part of it, up to the 50-50 split, to the second person (Bolton, Katok, & Zwick, 1998; Bolton & Ockenfels, 2000; Camerer & Thaler, 1995; for a recent developmental evidence, see Fehr, Bernhard, & Rockenbach, 2008). These findings are typically interpreted as evidence for egalitarianism. Self-interest allocations would create a high degree of inequality, and people sacrifice their self-interest to obtain a smaller difference in outcomes between the self and another person (e.g., the inequality aversion model; Fehr & Schmidt, 1999; see also Deutsch, 1975; Güth & Tiez, 1990; Roth, 1995).

However, the egalitarianism explanation can not explain cooperation in a single-shot prisoner's dilemma, because, without knowing what the partner would do, the cooperative choice is not a better choice than noncooperation in terms of equality in outcomes (i.e., outcomes are equal if both players make the same choice, and equally unequal if one player cooperates while the other one does not). To understand this behavior, some researchers have argued that people tend to be somewhat altruistic, in a sense that other people's outcomes have a positive weight and that people are willing to sacrifice, to some extent, their own outcomes for another person (e.g., Batson, 1991; Van Lange, 2008). This alternative explanation would also explain behavior in the dictator game. If people care about the second player's outcomes, they indeed would allocate some outcomes to that person.

The ring measure of social values is a variant of the dictator game, in which people make 24 binary choices between two outcome distributions for self and another person (Liebrand, Jansen, Rijken, & Suhre, 1986). These outcome distributions are sampled in such a way that self-interest, egalitarianism and altruism motives can be distinguished from each other. The findings provide clear evidence that self-interest is the main motive, but also that both egalitarianism and altruism influence social behavior (Van Lange, 1999).

First and foremost, these behavioral experiments show that classic economics and game theory, relying on the self-interest assumption, make quite a reasonable assumption that self-interest is indeed the strongest single motive in interpersonal behavior. At the same time, the self-interest assumption fails to capture some important aspects of social decision-making. The egalitarianism motive has been incorporated in virtually all modern social decision-making models (e.g., Fehr & Schmidt, 1999; Loewenstein, Thompson, & Bazerman, 1989). The integrative model of social values also includes the altruism component (Van Lange, 1999).

The Interdependence Approach to Social Interactions

In the previous section I discussed social preferences—outcome distributions that people prefer between self and others. I provided evidence that preferences often deviate from self-interest, but social preferences are not the only determinant of behavior in social interactions. Preferences are, literally, just preferences, and actual outcome distributions are also importantly shaped by the interaction partner's behavior as well as the structure of the social situation.

In this section I provide a framework that captures interdependence the same way as game theory does, but which is not limited to self-interest social preferences. This framework is called interdependence theory, which, similar to game theory, uses a matrix (or a similar representation) that describes outcomes as functions of interaction partners' possible behaviors (Kelley & Thibaut, 1978; for an overview, see Rusbult & Van Lange, 2003). Unlike game theory, interdependence theory does not make the assumption that people would make their decisions based on the game theoretical matrix alone.

Interdependence theory posits that people *transform* their motives from immediate self-interest (i.e., the game theoretical, given situation) to the effective situation, which incorporates motives broader than immediate self-interest. Transformations occur for many different reasons including long-term considerations, norms, and equality (for an overview, see Rusbult & Van Lange, 2003). Here, I focus on explaining how different social preferences are related to transformations, and provide a few case examples how transformations change the game theoretical situation. To illustrate, I will use the integrative model of social value orientation to explain how social decisions can be influenced by self-interest, altruism and egalitarianism motives (Van Lange, 1999).

Table 1.2: The prisoner's dilemma before and after altruism transformations. Numbers after the arrow sign are transformed outcomes.

		Player 2 = $0.5S + 0.5O$	
		Cooperate	Defect
Player 1 = $0.5S + 0.5O$	Cooperate	4 4	$6 \rightarrow 3$ $0 \rightarrow 3$
	Defect	$0 \rightarrow 3$ $6 \rightarrow 3$	2 2

Table 1.2 represents the prisoner's dilemma before (i.e., the given situation) and after altruism transformations (i.e., the effective situation, after the arrow signs). In this example, both players put the same weight on their own as well as the partner's outcomes (i.e., $0.5 \times \text{Self} + 0.5 \times \text{Other}$). Outcomes within each cell are now identical, because equal preferences for self and other corresponds with the idea that both players prefer the highest possible combined outcomes, regardless how much each player gets. Now, cooperation gives one point more independent of what the partner does. Thus, if both transform their motives like this, mutual cooperation occurs.

Table 1.3: The prisoner's dilemma before and after egalitarianism transformations. Numbers after the arrow sign are transformed outcomes.

		Player 2 = $0.5S + 0.5E$	
		Cooperate	Defect
Player 1 = $0.5S + 0.5E$	Cooperate	4 4	$6 \rightarrow 3$ 0
	Defect	0 $6 \rightarrow 3$	2 2

Table 1.3 presents the prisoner's dilemma before (i.e., the given situation) and after egalitarianism transformations (i.e., the effective situation, after the arrow signs). In this example, both players weight their own outcomes and equality in outcomes to the same extent (e.g., $0.5 \times \text{Self} + 0.5 \times \text{Equality}$). Outcomes in diagonal cells (i.e.,

mutual cooperation or defection) do not change to the given situation. Even though both weight their own outcomes less than in the given situation (i.e., $S=1$), those two cells provide the perfect equality in outcomes, which increase their values back to the original numbers. However, the combination of cooperation and defection is particularly poor in terms of equality. For the cooperator this situation is bad in two respects: The outcomes are the lowest (e.g., 0) and the inequality is the greatest (e.g., 6 vs. 0). But also for the defector the situation is not ideal: The outcomes for self are good (e.g., 6) but because that person also weighs equality, and this combination of behaviors is very bad in terms of equality, the effective outcomes are lower (e.g., 3).

Both altruism and egalitarianism transformations change the prisoner's dilemma's outcome matrix similarly. The transformed outcomes are not identical, but similar enough that both transformations can explain why some people cooperate. Thus, transformations can explain the empirical fact that some people cooperate in the prisoner's dilemma, but one game theoretical situation is not enough to obtain information on specific transformations (see Weibull & Salomonsson, 2006).

Specific transformations can be derived by measuring behavior across different social situations. Previous experiments have manipulated the outcome structure of the prisoner's dilemma and revealed that people may defect for two distinct reasons. People may defect because they are greedy and want to obtain the best possible outcomes, or because they are fearful that the other player may defect (Coombs, 1973; Rapoport, 1967; Van Lange, Liebrand, & Kuhlman, 1990; Yamagishi & Sato, 1986). Using a similar approach, Simpson (2003) demonstrated that males are more likely to defect for greed and females for fear.

To summarize, interdependence theory posits that behavior in social interactions is a product of the situation and its characteristics (e.g., conflicting vs. corresponding interest) as well as transformations, which can account for individuals' different outcome preferences between self and others. This is an important addition to game theory and social decision-making models, because the former focuses only on the situation and the latter only on general and person-specific outcome preferences. In a way, interdependence theory is a formalization of Kurt Lewin's (1936) original idea that behavior (B) is a product of the person (P) and the environment (E). Even though Lewin presented this idea as an equation (i.e., $B = f(P, E)$), interdependence theory is the only theory that actually describes the relationship between person variables, situational variables, and the interaction between the two, as illustrated in this section.

Incomplete Information in Social Interactions

Conditional cooperation clearly has its benefits as partners can protect themselves against noncooperation and still benefit from mutual cooperation with those who want to cooperate. But this benefit comes with a cost: Compared to unconditional

cooperation or unconditional noncooperation, conditional strategies require information on the partner's previous behavior.

The assumption that people have complete information on their partner's past behavior has been a prevailing, and often unquestioned, assumption in both theory and practice. Experimental research has a long tradition of representing games as matrixes that reveal complete outcome information. Such experiments also provide complete information on past behaviors (i.e., one particular choice option was chosen over the others). Thus, in vast majority of experiments of cooperation—which conclude that people use tit-for-tat—partners' have complete information on each other's previous cooperation.

In this section, I will first distinguish three ways in which information in social interactions can be incomplete (Kelley et al, 2003). Second, I will review previous literature that suggests how people might perceive their partners' cooperation when information is incomplete. Finally, I will discuss how incompleteness of information may influence both perceived cooperation and perceived transformations. I will also demonstrate how misperception of the partner's transformations may have a long-lasting influence on mutual cooperation.

Incomplete Information about Cooperation and Transformations

Incomplete behavioral information refers to uncertainty about the partner's exact behavior. People may know what the partner could do (i.e., the choice options), but they do not know for sure which one of these possible behaviors was chosen or will be chosen. The most extreme case of incomplete behavioral information is no information at all. For example in a single-shot prisoner's dilemma, players have no information on each other's behaviors. The second example of incomplete behavioral information is probabilistic information: One may know the probability of the partner's cooperation (e.g., 80%), but does not know whether a particular behavior was cooperation or noncooperation. Third, information regarding a specific behavior can be erroneous: People may receive information on cooperation whereas the actual behavior was noncooperation or vice versa (e.g., erroneous second-hand information). In this case, incompleteness of behavioral information is related to unreliability of information.

Table 1.4 illustrates a simple situation in which Person A can either cooperate or noncooperate, and Person B can interpret this behavior either as cooperation or noncooperation. The two diagonal cells represent the correct perception: Cooperation is correctly perceived as cooperation or noncooperation is correctly perceived as noncooperation. These are the two possible scenarios when information about Person A's behavior is complete—no errors in the perception of behavior is possible if information is explicit and deterministic.

Table 1.4: Illustration of incomplete behavioral information

		Person B's perception of Person A's behavior	
		Cooperation	Noncooperation
Person A's behavior	Cooperation	Cooperation correctly detected	Noncooperation incorrectly detected
	Noncooperation	Cooperation incorrectly detected	Noncooperation correctly detected

The two other possibilities are that Person A had not cooperated but Person B actually perceived this noncooperation as cooperation (i.e., cooperation incorrectly perceived), or that Person A had cooperated but Person B actually perceived this cooperation as noncooperation (i.e., noncooperation incorrectly perceived). These possibilities may occur only when people have incomplete information on their partner's behaviors. Perhaps more realistically, many behaviors are not binary choices between cooperation and noncooperation, but people may cooperate to a different degree (e.g., between 0 and 10). In this case, people may not know the exact level of cooperation (e.g., 5), but they may know the range (e.g., between 4 and 6). Thus, incomplete behavioral information may also refer to distributional information regarding the partner's behavior.

Incomplete situational information refers to missing outcome information. Often people know the value of the partner's behavior for themselves (e.g., a colleague commenting a manuscript), but they do not necessarily know the cost or benefits to the person who helped them (e.g., how much time it took). Also, people may not know all the behavioral options for the partner which makes it difficult to judge the cooperativeness of a specific behavior.

Table 1.5 illustrates this example. Person B has complete behavioral information by knowing whether the partner gave comments on the manuscript or not (i.e., misperception of behavior is not possible). Also, person B probably knows the benefits of receiving valuable feedback from a colleague (i.e., complete situational information with outcomes associated to the self). However, Person B can probably only estimate the costs and benefits of commenting or not commenting the manuscript that incurred for Person A (e.g., did the colleague intrinsically enjoyed reading the manuscript or how much time it took). Person B is probably also quite unaware of alternative behaviors and their outcomes for Person A (e.g., whether the colleague would have been busy with self-interest goals or not).

Table 1.5: Illustration of incomplete situational information

		Person B's perception of Person A's behavior	
		Commented the manuscript	Did not comment the manuscript
Person A's behavior	Commented the manuscript	Received feedback Took time? Enjoyed the paper?	
	Did not comment the manuscript		Did not receive feedback Busy for a good reason?

Incompleteness of transformational information refers to uncertainty about the partner's general cooperative versus noncooperative tendencies across different social situations. Different individuals put different weights on self-interest, egalitarianism, and altruism, and therefore exhibit a wide range of behaviors ranging from competition to cooperation (e.g., social value orientation; Balliet, Parks, & Joireman, 2009; Van Lange, 1999; Van Lange, De Cremer, Van Dijk, & Van Vugt, 2007). People may know their own transformations (e.g., egalitarianism preference), but information about others' transformations is almost always incomplete. This is because motives and intentions that underlie others' behaviors cannot be directly accessed, but they must be inferred from behavior (for an overview, see Pronin, 2008; see also Ross & Sicoly, 1979). As I have discussed, even with complete information people may make mistakes in inferring their partner's transformations. With incomplete behavioral or situational information, the underlying transformations are even more difficult to attain.

Perceived Cooperation Under Incompleteness of Information

How people perceive their partners' level of cooperation under incompleteness of information? Incomplete information often sets some boundaries (e.g., behavior cannot be extremely noncooperative or cooperative), but the exact level of cooperation must be inferred. This is a special feature of incomplete information: The missing pieces of information must be filled in.

Previous research suggests that inferences might be driven by the assumption of other people's self-interest. Research on the "norm of self-interest" reveals that global judgments about unknown others are guided by a belief in self-interest (see Miller & Ratner, 1996, 1998). For instance, people overestimate the impact of financial rewards

on their peers' willingness to donate blood. People also attribute responsibility in a self-serving way. For example, people think that their spouses are more responsible for negative than for positive events in their relationships, whereas people think of themselves being responsible for both positive and negative events (Kruger & Gilovich, 1999). Further evidence shows that these cynical theories about other people are more pronounced and lead to more selfish behavior when people are encouraged to think more about others' thoughts (e.g., Epley, Caruso, & Bazerman, 2006; Vorauer & Sasaki, 2009).

Another line of research demonstrated that dispositional attributions are also guided by self-interest. Research on interpersonal biases reveals a stable trait bias in that people think of others as more selfish and less fair than they think of themselves (Alicke, Dunning, & Kruger, 2005; Allison, Messick, & Goethals, 1989; Dunning & Cohen, 1992; Messick, Bloom, Boldizar, & Samuelson, 1985; Van Lange & Sedikides, 1998). Interestingly, this research reveals that in comparison to many other attributes (e.g., those linked to competence) such better-than-average (i.e., superiority) effects tend to be most pronounced for attributes that are strongly linked to social qualities (e.g., morality, honesty).

Thus, the way in which people interpret missing information may be influenced by the belief in other people's self-interest. If this is indeed true, people would systematically underestimate their partners' cooperation. Because beliefs can influence perceived cooperation only when incomplete information is present, the mere incompleteness of information can reduce cooperation.

Assuming that perceived cooperation is influenced by the partner's actual cooperation and pre-existing beliefs (e.g., self-interest), incompleteness of information might have somewhat different effects on those who behave in a generous vs. stingy manner. Given the assumption that people tend to rely on beliefs of people's self-interest, the observation of generous behavior is more conflicting with the observer's *a priori* beliefs than the observation of stingy behavior. With increasing incompleteness of information, people should become more doubtful of another's generosity than another's selfishness. People might fill in the blanks (i.e., the lacking information) with self-interest, and people need more instances of generous behaviors to believe that the other is indeed a generous person than stingy behaviors to believe that the other is indeed a stingy person. Thus, whereas all kinds of behaviors can be communicated under complete information, generous behaviors might be more difficult to communicate under incompleteness of information.

Perceived Transformations Under Incompleteness of Information

The way in which people perceive their partner's cooperation under incompleteness of information may quite directly influence perceived transformations. People tend to make dispositional attributions (e.g., a nice person) on other people's behaviors (e.g.,

cooperative behavior) in a too straightforward manner, while largely neglecting situational factors (see fundamental attribution error; Ross 1977; correspondence bias; Jones, 1990). If people perceive that their partner cooperates less under incompleteness of information, they may make inferences that the partner is generally less cooperative (i.e., perceive more self-interested transformations than is warranted). Such dispositional inferences may be particularly harmful, because they may reduce cooperation in future interactions. If the partner is perceived as less cooperative, the willingness to cooperate may drop. Equally important, the partner who is initially judged as noncooperative may be interpreted as such—especially under incompleteness of information—even if the partner started cooperating more.

Table 1.6: The prisoner’s dilemma with asymmetric egalitarianism transformations. Numbers after the arrow sign are transformed outcomes.

		Player 2 = $0.8S + 0.2E$	
		Cooperate	Defect
Player 1 = $0.5S + 0.5E$	Cooperate	4 / 4	6 → 5 / 0
	Defect	0 / 6 → 3	2 / 2

Misperception of transformational information can have a crucial impact on social interactions. Table 1.6 describes the prisoner’s dilemma game with egalitarianism transformations, similar to Table 1.3. Both players engage in strong egalitarianism transformations (e.g., $0.5S + 0.5E$), which would suggest that both players cooperate—given that they know that their partners have these transformations. Table 1.6 is drawn from Player 1’s perspective. Player 1 knows the transformation for the self, but underestimates the egalitarianism transformation for Player 2 (e.g., $0.8S + 0.2E$).

Mutual cooperation would be the preferred option for Player 1, but at the same time, Player 1 can reasonably—albeit erroneously—expect Player 2 to defect (i.e., defection yields better perceived outcomes for Player 2). Now, given that Player 2 is expected to defect, Player 1 should also defect, because it yields better transformed outcomes than cooperation. This initial misperception and defection may have a long-term impact on mutual cooperation. If Player 2 correctly perceived Player 1’s high level of egalitarianism, Player 2 would cooperate in the first round. But Player 2 would

probably use tit-for-tat and retaliate Player 1's defection in the second round—a cycle that may lead to mutual defection even though both players' initial preferences were cooperative.

The Present Dissertation

In the next four chapters, I will present nine experiments that aim to test four key premises: First, people systematically underestimate others' unselfish motives and attribute too much self-interest to others' imagined behavior (Experiments 2.1 & 2.2) as well as others' overt behavior with incomplete information (Experiments 3.1, 3.2, & 3.3). Second, the more incompleteness of information is present the more self-interest beliefs reduce cooperation (Experiments 4.1, 4.2, 5.1, & 5.2). Third, the detrimental effects of incomplete information are more pronounced for generous rather than stingy partners (Experiment 5.1 & 5.2). And finally fourth, incompleteness of information influences perceived transformations (Experiment 5.1 & 5.2). Each chapter represents an independent research article that has been published or is under review for publication. The following overview aims to convey the key contributions of each chapter.

The first empirical chapter (Chapter 2) examines motives that people attribute to other people, and compares these motives to those that people display in their own social behavior. Using a behavioral paradigm that yields relative weights for self-interest, altruism, and egalitarianism motives, Experiment 2.1 reveals that people think that egalitarianism has a smaller impact on other people's social decisions than it has on people's own social decisions. Using an evaluation paradigm in which people rate other's outcome allocations, Experiment 2.2 reveals that people expect other people to rate equal allocations as less positive than people themselves rate equal allocations. Hence, Chapter 2 indicates that in the absence of any information, people systematically underestimate the role of egalitarianism in others' social behavior.

The second empirical chapter (Chapter 3) examines interpretations that people make on others' overt behaviors when they lack some pieces of information. Using a new method—the dice-rolling paradigm—Experiments 3.1 and 3.3 provide evidence that people “fill in the blanks” with self-interest. That is, when people are given only partial information about their partner's behavior, they tend to use their self-interest beliefs to fill in the part of information that is not given. As a result, people tend to overestimate the role of self-interest not only in the imagined behavior of others (see Chapter 2), but overt behavior of others is also filtered and attributed through self-interest beliefs. Additionally, Experiment 3.2 compares people's actual behavior and predictions regarding other people's behaviors, and shows that people expect more self-interest from other people than people exhibit themselves. Hence, Chapter 3

indicates that behavior with incomplete information is filtered through the belief in other people's self-interest.

The third empirical chapter (Chapter 4) examines the influence of incomplete information on cooperation in dyadic interactions. Building on previous findings showing that people hold self-interest beliefs about other people (Chapter 2), and that such beliefs influence behavioral attributions (Chapter 3), Experiments 4.1 and 4.2 test the idea that incompleteness of information reduce cooperation. Using a new method—the coin paradigm—the results revealed that incompleteness of information undermines both expectations about another person's cooperation as well as one's own cooperation. Moreover, the detrimental effects of incompleteness of information on cooperation were mediated by expectations of other's cooperation. Hence, Chapter 4 indicates that the belief in self-interest serves to fill in the blanks when information is incomplete, which undermines expectations of other's cooperation as well as one's own cooperative behavior.

The fourth empirical chapter (Chapter 5) examines how generous versus stingy behaviors can be communicated under incompleteness of information. Incompleteness of information indeed undermines cooperation (Chapter 4), but it is not clear whether this tendency still holds when partners differ in their level of generosity versus stinginess. Experiments 5.1 and 5.2 reveal that the detrimental effects of incomplete information are more pronounced for generous than stingy partners. Second, the chapter examines dispositional attributions (i.e., perceived transformations) that people make under incompleteness of information. Both experiments reveal that under incompleteness of information, people judge the partner as less benign—the effect that is more pronounced for generous partners. Finally, the analysis suggests that such beliefs might help account for these effects on cooperation. Hence, Chapter 5 indicates that the more generosity one seeks to communicate, the more incompleteness of information undermines cooperation and perceptions regarding benign intentions of the partner.

Chapter 2

Self-Other Differences in Outcome Allocations: We Think that Others Are Less Fair¹

Imagine that a colleague asks you a favor when you are leaving for your favorite hobby. How would you respond to this request? Perhaps you think if you were asking him or her that very question, you would be helped. Or perhaps you think the colleague would find a polite way to leave and not help. Expectations about other people's interpersonal behavior may be quite important as they may help determine whether we help others or not. But what are the beliefs that people have about other people's social motives? Are others equally fair and nice as we are ourselves? Or are others considered less nice and less fair?

Past research has revealed that people tend to believe that self-interest is a powerful motive in other people. For example, people overestimate the impact of financial rewards on their peers' willingness to donate blood (see Miller & Ratner, 1996, 1998; Miller, 1999). Second, specific judgments about another person's overt behavior are also guided by the same principle: When people have only incomplete information about their partner's behavior, they tend to fill in missing pieces with self-interest (Vuolevi & Van Lange, 2010). Third, research on self-other judgments in personality descriptions has revealed that people think of themselves as better and not as bad as other people (e.g., more honest, less unfair; Alicke, Dunning, & Kruger, 2005; Dunning & Cohen, 1992; Messick, Bloom, Boldizar, & Samuelson, 1985; Van Lange & Sedikides, 1998).

We examine three different social motives that may underlie social behavior (Van Lange, 1999). First, social behavior is importantly guided by the preference to enhance outcomes for self (i.e., self-interest). This social motive has been well-acknowledged in social sciences, including classic economics (Smith, 1776), game theory (Luce & Raiffa, 1957; Von Neuman & Morgenstern, 1944), and psychology (Fehr & Schmidt, 1999; Loewenstein, Thompson, & Bazerman, 1989; Van Lange, 1999). Second, people are also concerned with enhancing outcomes for others (i.e., altruism). In many social situations, people choose behaviors that provide good outcomes for others but potentially bad outcomes for the self (for a review, see Caporael, Dawes, Orbell, & Van de Kragt, 1989). And third, people are also oriented toward equality in outcomes (i.e., egalitarianism). People tend to be aversive to inequality, which is an important motive underlying a variety of behaviors (e.g., the inequality aversion model; Fehr & Schmidt, 1999; see also Bolton & Ockenfels, 2000; Camerer & Thaler, 1995; Deutsch,

¹ This chapter is based on Vuolevi and Van Lange (2011a)

1975; Güth & Tiez, 1990; Roth, 1995, for a recent developmental evidence, see Fehr, Bernhard, & Rockenbach, 2008).

We conducted two experiments to assess social motives that people attribute to other people, and compared these motives to those that they exhibit themselves. Building on previous research showing that people tend to overestimate self-interest in others, we expected people to think that others' behaviors are more strongly influenced by selfish motives than own behaviors, and less strongly influenced by unselfish motives, such as altruism and egalitarianism.

Experiment 2.1

Method

Participants and design. The participants of the computerized, laboratory experiment were 63 VU University students in the Netherlands (28 women, 35 men, $M_{AGE} = 21.8$, $SD = 4.18$) who were randomly assigned to the behavior condition or the expectation condition. After completing the experiment, the participants were debriefed and paid €2.5.

Procedure. *The ring measure of social values* consists of 24 decomposed games, each of them displaying a choice between two alternatives that represent different combinations outcomes for the self and another person (Liebrand, Jansen, Rijken, & Suhre, 1986). The outcomes for self and other are sampled from a circle in the own-other outcome plane, which represent orthogonal dimensions for the self and the other. In the current experiment, the centre of the circle was set to 200 points for the self and 200 points for the other, and the radius was set to 150 points (Van Lange, 1999). Each item involved a choice between two equidistant own-other outcome distributions that were located next to each other on the circle (i.e. 15 degrees difference in angle). An example is the choice between Alternative #1 that gives 345 points for the self and 239 points for the other, and Alternative #2 that gives 350 points for the self and 200 points for the other.

Three orthogonal measures were derived based on 24 choices: The weight to Self, the weight to Other, and the weight to Equality in outcomes. The weights to Self and the Other were calculated by accumulating the number of points for the self and the other across 24 choices and normalizing the value between -1 and 1. If all binary choices were made to maximize the outcome for the self, Self would be 1 (i.e., MaxOwn). If all binary choices were made on minimize the outcome for the other, Other would be -1 (i.e., MinOther). Similarly, the weight to equality in outcomes was defined as the absolute difference between the outcome to the self and the other across choices. If all choices minimized the difference in outcomes for the self and the other, Equality would be 1 (i.e., MinDiff). If all choices maximized the difference in outcomes for the self and the other, Equality would be -1 (i.e., MaxDiff).

In contrast to the original measure, the two partners involved in the task were labelled as Person A and Person B. Participants in the own behavior condition were told that Person B is another participant in the same experiment. When each choice was presented, participants were asked to choose the option that they would choose as Person A. Participants in the expected behavior condition were told that Person A and Person B are other participants in the same experiment. When each choice was presented, participants were asked to choose the option that they would think that Person A would choose. Thus, participants in both conditions faced the same binary choices, but they either answered on their own behalf, or on behalf of another participant.

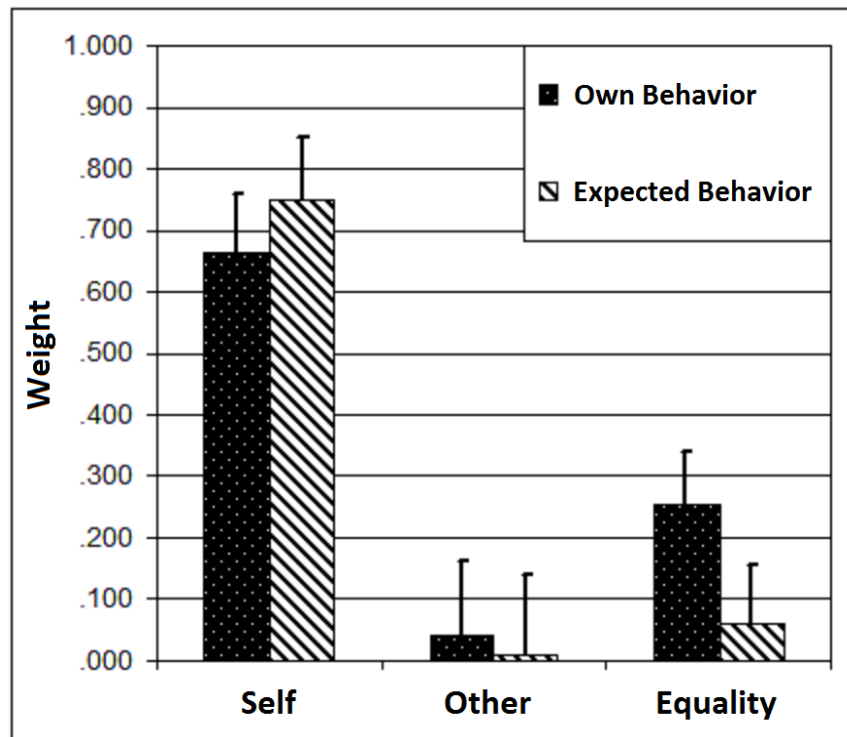
Results

Three independent sample t-tests compared the weights to Self, Other, and Equality in the own behavior and the expected behavior conditions. The analysis revealed that the equality weight is lower in the expected behavior condition ($M = 0.06$, $SD = 0.22$) than in the own behavior condition ($M = 0.25$, $SD = 0.28$), $t(61) = -2.99$, $p = .004$, $\eta^2 = .128$, supporting that idea that people expect less equalitarianism from others than they exhibit themselves. Thus, while equalitarianism affects people's own social behavior, they believe that it hardly affects other people's behavior.

By contrast, the weight to Other in the expected behavior condition ($M = 0.01$, $SD = 0.32$) did not differ from the one in the own behavior condition ($M = 0.04$, $SD = 0.37$), $t(61) = -0.36$, $p = .718$. Also, the weight to Self in the expected behavior condition ($M = 0.75$, $SD = 0.27$) did not differ from the one in the own behavior condition ($M = 0.66$, $SD = 0.29$), $t(61) = 1.20$, $p = .236$.

Finally, to test the idea that the self-other difference is greater for egalitarianism than for altruism, we conducted a 2 (behavior vs. expectation) \times 2 (Equality vs. Other) mixed-model ANOVA. The analysis revealed a two-way interaction, $F(1,61) = 4.59$, $p = .036$, indicating that the difference in unselfish motives between self and other is more pronounced for egalitarianism than for altruism (see Figure 2.1).

Figure 2.1: Weight people assign to self-interest (i.e., Self), altruism (i.e., Other), and egalitarianism (i.e., Equality) in the own behavior and in the expected behavior conditions, in Experiment 2.1. 95% confidence intervals are presented in line-graphs.



Experiment 2.2

Experiment 2.1 used own allocation behavior as a benchmark and revealed that people underestimate egalitarianism in other people. Interestingly, such self-other differences were not found for self-interest or altruism, and in fact, altruism was not found for self either. This indicates that while the model for own behavior includes self-interest and egalitarianism (and no altruism), the model for the expected behavior of others is even more straightforward: It includes only the self-interest component and virtually no egalitarianism or altruism.

Experiment 2.2 focused on the conflict between self-interest and equality, using a modified version of the dictator game (see Bolton, Katok, & Zwick 1998). Instead of acting as allocators (i.e., dictators), participants either evaluated the allocator's behavior, or indicated how they think that other people would evaluate the allocator's behavior. We predicted that the more equal allocations the allocator made (i.e., closer

to the 50-50 split), the more people would think that others evaluate the allocations as less positive than the self.

Method

Participants and design. The participants of the computerized, laboratory experiment were 81 VU University students in the Netherlands (52 women, 29 men, $M_{AGE} = 21.23$, $SD = 4.15$) who were randomly assigned to the own evaluation or the expected evaluation condition. After completing the experiment, the participants were debriefed and paid €2.

Procedure. The participants completed a dyadic outcome allocation and evaluation task with another person, Person A, who was described as another participant, but whose behavior was controlled by a computer. Person A always acted as the allocator and the participant always acted as the evaluator. The participants were told that they and Person A had a common resource of 8 coins, but Person A could freely divide the resource between the two. Across 7 trials that appeared in a random order, Person A allocated between 1 and 7 coins to the participant. After each allocation was presented graphically on the screen, participants were asked to evaluate Person A's allocation on a scale ranging from 1 ("Very Negative") to 13 ("Very Positive").

After each allocation, participants in the own evaluation condition were asked the question "How would you evaluate this allocation?" Participants in the expected evaluation condition were instructed that they would make evaluations on behalf of another person, Person B, who was also described as another participant. They were asked the question "How would Person B evaluate this allocation?" Thus, participants in the expected evaluation condition were asked to imagine how another participant would evaluate Person A's outcome allocations.

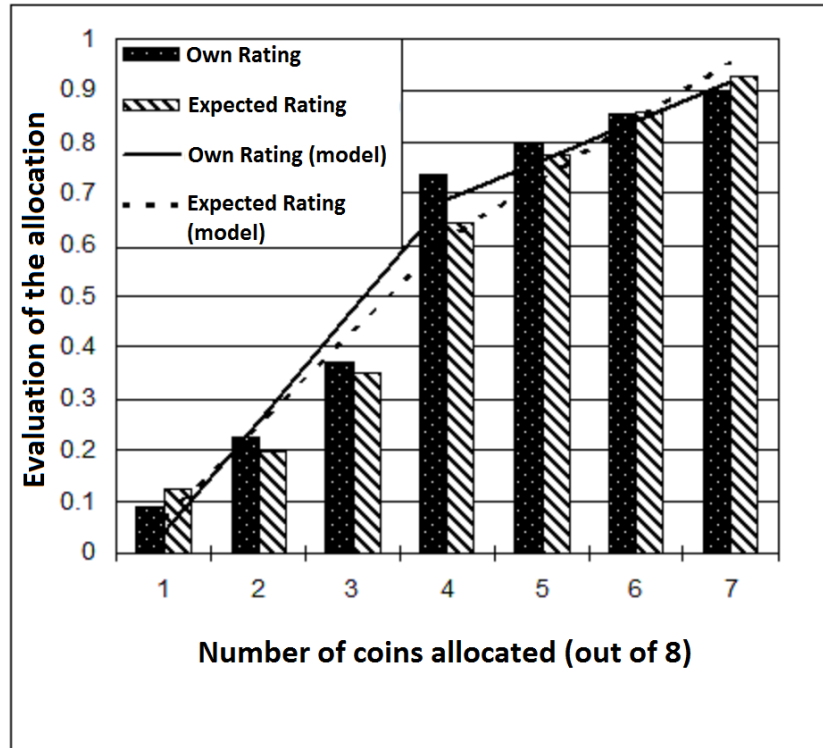
Results

We normalized participants' evaluations between 0 and 1 and predicted them based on seven allocations that Person A made. We computed separate utility functions for each participant, which consisted of Self and Equality (i.e., self-interest and egalitarianism). We could not compute Other component, because the resource size was fixed (i.e., 8 coins) and Other was not independent of Self component.

We ran a series of t-test to compare model parameters in the expected and the own evaluation conditions. We found that participants in the expected evaluation condition ($M = 0.09$, $SD = 0.17$) put less weight on equality than participants in the own evaluation condition ($M = 0.21$, $SD = 0.19$), $t(79) = -2.74$, $p = .008$, $\eta^2 = .087$ (see Figure 2.2). This supports the hypothesis that the more equal allocations the allocator made, the more people would think that others evaluate the allocations as less positive than the self. We also found that participants in the expected evaluation condition ($M =$

0.61, $SD = 0.14$) rated the allocations as less positive than participants in the own evaluation condition ($M = 0.69$, $SD = 0.17$), $t(79) = -2.29$, $p = .025$. Finally, the weight to Self did not differ between the expected evaluation ($M = 0.45$, $SD = 0.10$) and the own evaluation conditions ($M = 0.44$, $SD = 0.09$), $t(79) = 0.29$, $p = .772$.

Figure 2.2: Own and expected evaluations, in Experiment 2.2. The best fitted models are presented in line-graphs.



General Discussion

In the present research we assessed social motives that people attribute to other people, and compared these motives to those that people display in their own social behavior. Experiment 2.1 revealed that people expect that equality has a smaller impact on others' social decisions than it has on their own social decisions. Experiment 2.2 demonstrated that people expect others to rate equal or nearly equal allocations as less positive than they rate such allocations themselves. Hence, our research indicates that when people make social decisions (Experiment 2.1), or when they evaluate others'

social decisions (Experiment 2.2), people tend to underestimate egalitarianism in other people.

As previous research has also demonstrated, egalitarianism is a key factor in people's own behavior (see also Deutsch, 1975; Fehr & Schmidt, 1999; Van Lange, 1999), but it is notably absent in the expected behavior of others. People do not think that others would exhibit much egalitarianism or altruism. This conclusion is consistent with previous literature showing that people tend to overestimate self-interest in other people (Miller & Ratner, 1996, 1998; Miller, 1999; Epley, Caruso, & Bazerman, 2006; Vorauer & Sasaki, 2009; Vuolevi & Van Lange, 2010), but it also extends these findings by demonstrating the underestimation of egalitarianism. Because motives beyond self-interest are present in people's own behavior but notably absent in the expected behavior of others, elaborate models such as the integrative model of social value orientation (Van Lange, 1999) are needed for explaining people's own behavior, but quite simplistic self-interest models can be applied for explaining people's ideas about other people's behaviors.

What could be the mechanisms that account for the systematic underestimation of egalitarianism in other people? One general mechanism may be that people's beliefs are rooted in the norm of self-interest, which applies to others but not to the self. Such a straightforward and simple model, which does not recognize egalitarianism (or altruism) may serve as a powerful heuristic for understanding other's actions (Miller & Ratner, 1996, 1998; Miller, 1999). Other contributing mechanisms are that people have greater access to their own intentions (and social motives, such as egalitarianism) than to others' intentions, which typically need to be inferred from behavior (for an overview, see Pronin, 2008; see also Ross & Sicoly, 1979). Further, violations of equality by others may be more salient and memorable than violations of altruism, because the equality is often more normative (e.g., the fairness heuristic) than altruism.

Our findings have important implications for social interactions. Often cooperation would be mutually beneficial (e.g., dividing tasks according to expertise), but it may also require that both partners can rely on each other's egalitarianism (e.g., that each divides tasks in a fair manner). Human cooperation tend to be conditional (e.g., Axelrod, 1984; see also Komorita & Parks, 1995; Trivers, 1971), so people who question their partner's egalitarianism may decide not to cooperate (e.g., they choose to perform the task individually in a more laborious way). Because people tend to underestimate others' egalitarianism, as our research has demonstrated, cooperation may fail solely based on the inaccurate assumption that others do not adhere to equality.

To conclude, the present research identified a new phenomenon—the underestimation of egalitarianism in others—that is potentially important to many interdependent situations, including trust situations, negotiation, social dilemmas, either as tasks in the lab or as tasks in everyday life. One key challenge is to understand

how to overcome this systematic underestimation, because it may often hinder the potential for the development of interpersonal trust, integrative solutions, and human cooperation.

Chapter 3

Beyond the Information Given: The Power of a Belief in Self-Interest²

It is an inevitable fact from social life that our well-being is often influenced by other people's decisions. A boss can give a salary raise or not. And a friend can help you solve a math problem or not. When we encounter a situation where our well-being is influenced by others, we usually ask: Why? Why didn't she give me a raise? Why did she help me? Indeed, as humans, we try to understand other people's intentions and motives to make sense of our social environment. However, we may often reach such judgments under circumstances in which we lack information that is needed to understand others' decisions. For example, a boss can decline a raise because the company truly lacks resources. A friend may not be able to help because she has to help another friend with a more urgent need. Without such information, one could think that my boss must be concerned with her own salary only, or that my friend is so kind now that she devoted her time for my problem.

The central question here is how people fill in the blanks in incomplete information situations—that is, situations in which there is incomplete information about different behavioral options and the outcomes they produce (see Kelley et al., 2003). Do we give others the benefit of the doubt, believing that they behave in a fair or generous manner? Or do we fill in the blanks with self-interest? Or in terms of Bruner's (1957) well-known question: "How do people go beyond the information given?" Previous research provides answers for these questions only in the extreme case of incompleteness of information—in situations without any specific information at all.

Research on the "norm of self-interest" reveals that global judgments about unknown others are guided by a belief in self-interest (see Miller & Ratner, 1996, 1998; Miller 1999). For instance, people overestimate the impact of financial rewards on their peers' willingness to donate blood. Also, people think of others as more selfish and less fair than they think of themselves (Allison, Messick, & Goethals, 1989; Van Lange & Sedikides, 1998). Thus, without having any specific information, people rely on a general belief that other people's behavior is driven by self-interest. By contrast, when information is complete, people are very adaptive to socially relevant information and the idea of reciprocity—that people respond cooperatively to others' cooperative behaviors and noncooperatively to others' noncooperative behaviors—clearly illustrates this point (Axelrod, 1984; Gouldner, 1960; Trivers, 1971, for empirical evidence, see Van Lange, 1999; Klapwijk & Van Lange, 2009). However, in most

² This chapter is based on Vuolevi and Van Lange (2010)

studies on cooperation and reciprocity, information about others' behaviors is explicitly given (e.g., the other allocated 5 coins out of 10 to you). Such situations of complete information tend to "dictate" our beliefs and expectations, leaving little room for our judgments to be influenced by a broader "psychology" of assumptions, beliefs, norms and expectations. Yet it is this psychology that is important when we need to interpret missing information, and "fill in the blanks."

Present Research: Dice-rolling Paradigm and Hypotheses

In the present research, we investigated social judgments in incomplete information situations in which (1) information does exist, so that people can reconsider, revise, and update their beliefs, but in which (2) information does not dictate beliefs, so that there is enough room for multiple interpretations. We sought to demonstrate that in such incomplete information situations, people tend to rely on their global beliefs and fill in missing information with a self-interest frame of mind—even when there is incomplete evidence that behavior might not be self-interested.

We designed a new paradigm for examining social judgments under incomplete information. In this paradigm, which we refer to as *the dice-rolling paradigm*, participants received incomplete information about another person's rolling of two dice. In particular, the other allocated one die to himself or herself, and one die to the participant, and the allocated dice values produced outcomes for both the participant and the other. The situation contained incomplete information in that participants were shown the value of their own die (outcome for self), but not the value of the other's die (outcome for other). As the main dependent variable, participants were asked to estimate the value of the other's die.

Participants in the intentionality condition were led to believe that the other had control over allocating the dice outcomes, whereas participants in the unintentionality condition were led to believe that the other had no control over allocating the outcomes. Because we also sought to validate the paradigm itself, the central hypothesis was relatively straightforward. If individuals believe that other people intend to pursue their self-interest, participants should systematically overestimate the value of the dice the other allocates to himself or herself. Such overestimation should be less pronounced—or ideally absent—for unintentional allocations where the other's intentions and allocation decisions have no influence on outcomes.

Experiment 3.1

Method

Participants and design. The participants were 52 VU University students in the Netherlands (32 women, 20 men) with an average age of 20.5 years ($SD = 2.05$). The computerized, laboratory experiment was a 2 (intentionality vs. unintentionality) \times 2

(incentive: points vs. money) \times 12 (blocks of trials) design with the latter being a within-participant variable. After completing the experiment, the participants were debriefed and paid €3.5.

Procedure. The dice rolling paradigm consisted of 12 rollings of two dice, each six-sided with values ranging from 1 through 6. Participants were told that another person, who was described as another participant in this study, would roll two dice and allocate one of them to himself or herself, and another one to the participant. After each rolling, participants would see the value of the die that the other allocated to the participant, but would not see the value of the die that the other allocated to himself or herself. We controlled the actual rollings, so that all dice values (1...6) were presented twice. Thus, participants received their fair share of 3.5 points on average, suggesting that the other allocated 3.5 points to himself or herself also, given that the sum of two dice is 7 on average. After each roll, participants estimated the value of the die the other allocated to himself or herself. Because fair allocations provided an objective baseline, estimations higher than 3.5 would provide clear evidence that participants assume self-interest from the other. Participants did not receive any information about the other's die during the task or any information about possible future interactions with the other.

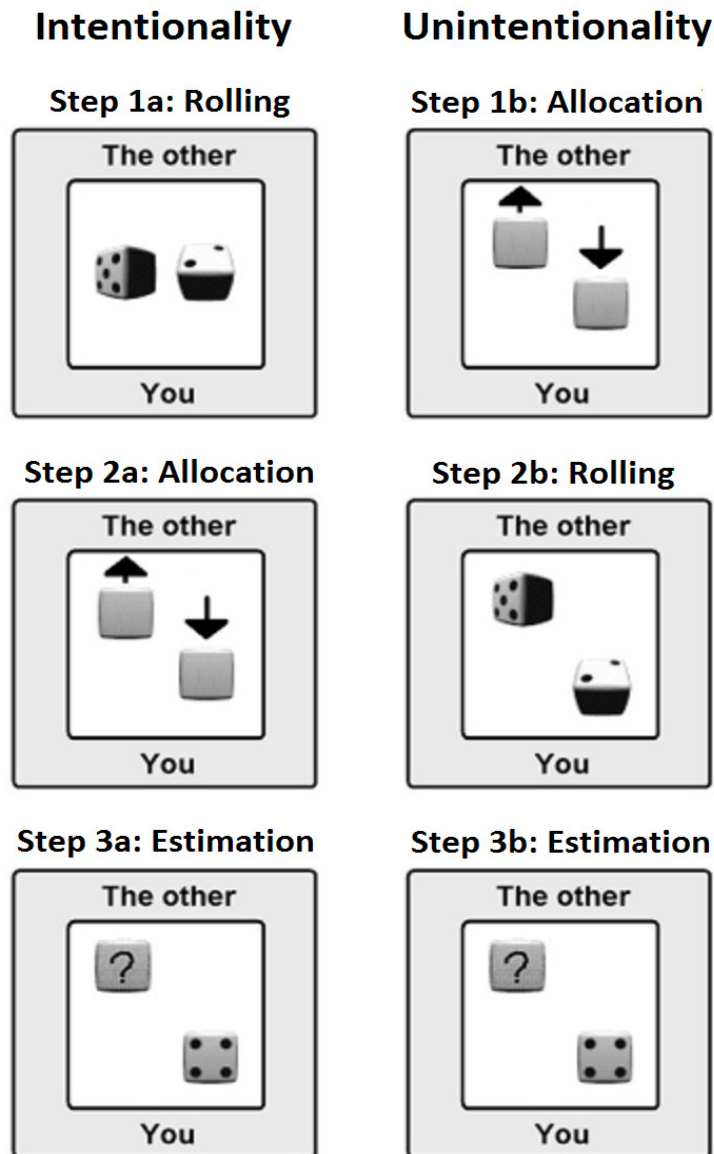
Intentionality was manipulated by reversing the order of dice rolling and allocation (see Figure 3.1 for the sequence in both conditions). In the intentionality condition the other first rolled two dice (Step 1a). After the dice had settled, their values were told to be shown to the other but were not displayed to the participant. Second, the other allocated one die to the participant and another die to himself or herself (Step 2a). Third, the participant's die was revealed and the participant estimated the value of the other's die (Step 3a). In the unintentionality condition the other first allocated the dice (Step 1b), and then rolled them (Step 2b). After the dice had settled, the participant's die was revealed and the participant estimated the value of the other's die (Step 3b). Thus, as the dice were allocated before their values were known the dice outcomes were not logically influenced by the other's decision in the unintentionality condition.

We also explored differences between "hypothetical incentives" and "actual incentives". In the point condition, participants were instructed that every point has value, in that the more points the participant accumulates the better for him or her, and the more points the other accumulates the better for the other. In the money condition, participants received money on the basis of the other's allocations, and they were told that they had a chance to earn between €2 and €5 in total. As the allocations were fair all participant received €3.5.

Figure 3.1: Graphical representation of the dice-rolling paradigm in the intentionality (Steps 1a, 2a and 3a) and unintentionality (Steps 1b, 2b and 3b) conditions, respectively. The following two links illustrate the dice rolling paradigm in both conditions:

<http://webresearch.psy.vu.nl/ejspdemo/intentionality.htm>

<http://webresearch.psy.vu.nl/ejspdemo/unintentionality.htm>



Results and Discussion

Estimated values of the dice outcomes were analyzed in a 2 (intentionality vs. unintentionality) \times 2 (incentive: points vs. money) \times 12 (blocks of trials) analysis of variance, in which the latter was a within-participant variable. The analysis revealed a main effect of intentionality, indicating that, consistent with our hypothesis, participants in the intentionality condition estimated higher dice values for the other ($M = 4.37$, $SD = 0.64$) than participants in the unintentionality condition ($M = 3.54$, $SD = 0.47$), $F(1, 51) = 27.07$, $p < .001$, $\eta^2 = .361$. Two separate one-sample t-tests revealed that participants indeed overestimated the other's dice values above the chance level ($=3.5$) in the intentionality condition, $t(26) = 7.05$, $p < .001$, but not in the unintentionality condition $t(24) < 1$.

The main effect of intentionality generalized across various conditions. First, we did not find a main effect of the incentive manipulation, $F < 1$, or an interaction between the intentionality and incentive manipulations, $F < 1$. Thus, the results did not support the idea that the magnitude of assumed self-interest would depend on whether the outcomes were hypothetical points or real money. As we did not find a main effect of blocks of trials or any interactions with manipulated variables, $F_s < 1$, the data did not support the idea that participants would have adjusted their estimations as more information about the other's behavior becomes available in later trials. Thus, Experiment 3.1 provides good initial support for the idea that a belief in self-interest influences judgments of overt behavior in the dice-rolling task.

Experiment 3.2

Experiment 3.1 demonstrated that even when participants receive their fair share, they maintain their belief that the other favors oneself. But do individuals also overestimate self-regarding behavior with a real other person, who may actually behave in a somewhat self-regarding manner? To address this issue, we conducted an experiment in which actual dice allocations were compared with estimated dice allocations.

Method

Participants, design and procedure. The participants were 43 VU University students (31 women, 12 men) with an average age of 20.6 years ($SD = 1.93$). The computerized, laboratory experiment was a 2 (allocation vs. estimation) \times 12 (blocks of trials) design with the latter being a within-participant variable. Participants in the allocation condition made 12 resource allocations by rolling two dice and allocating one of them to themselves, and another one to the other—thereby facing the same allocation decisions than the other supposedly did in the intentionality condition in Experiment 3.1. Participants in the estimation condition estimated the other's dice allocations—identical to the intentionality condition in Experiment 3.1.

Results and Discussion

One-sample t-test revealed that the average value of the die participants allocated to themselves in the allocation condition ($M = 4.01$, $SD = 0.34$) was higher than 3.50, $t(20) = 6.82$, $p < .001$, indicating that participants indeed exhibited self-interest in their allocations. But more important, independent sample t-test revealed that the dice outcomes participants allocated to themselves were less self-regarding than dice outcomes participants estimated the other to allocate to oneself in the estimation condition ($M = 4.40$, $SD = 0.46$), $t(41) = 3.15$, $p = .003$. Thus, these findings indicate that although people are somewhat self-interested in their allocations, the amount of self-interest they assume from others is still significantly greater.

Experiment 3.3

Experiment 3.3 extended Experiment 3.1 in three important respects. First, we tested the prediction that instead of just overestimating the other's outcomes, participants may also underestimate their own outcomes when only the other's dice are shown. Second, we included another factor in which a computer was said to allocate the dice. Given that the assumption of self-interest is relevant to motivations of "other people", participants should not expect the computer to benefit the other more than it benefits the participant (or some other specific mechanism relevant to the dice-situation: e.g., "I have always bad luck with chance games"). Hence, the computer condition served as another baseline for demonstrating that self-interest is only assumed from other people's intentional behaviors. Third, we tested the prediction that participants would recall the dice values after the task the same way they estimated them during the task. That is, participants in the intentionality-and-human condition would underestimate their own dice values and overestimate the other's dice values, compared to the base level of 3.5. Recalled dice values in other three conditions, by contrast, should not differ from 3.5.

Method

Participants, design and procedure. The participants were 149 North American students (63 women, 86 men) with an average age of 24.5 years ($SD = 8.14$). The experiment was administrated over the internet and all materials were displayed on participants' web-browsers. The experiment was a 2 (intentionality vs. unintentionality) \times 2 (type of information provided: participant's die vs. the other's die shown) \times 2 (the decision-maker: human vs. computer) \times 12 (blocks of trials) design with the latter being a within-participant variable. Because the type of incentive did not impact the findings in Experiment 3.1, we only used points as incentives. Also, we manipulated human vs. computer as the decision-maker. In the computer condition the dice were said to be rolled and allocated by a computer, whereas in the human condition, similar

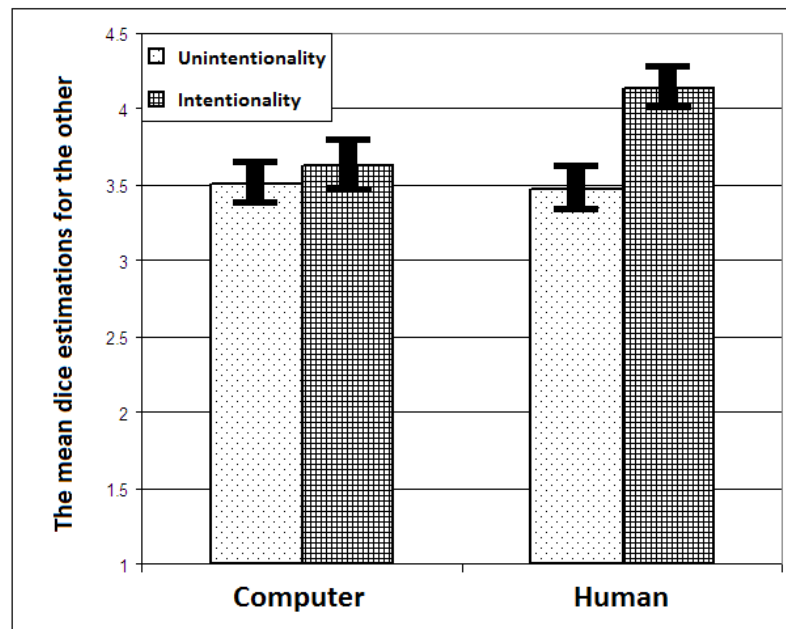
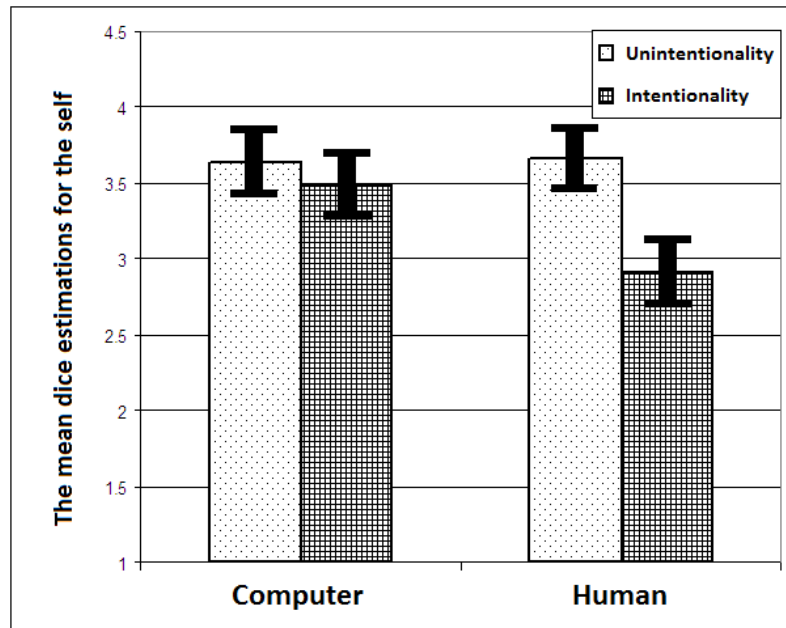
to Experiment 3.1, the other was said to roll and allocate the dice. We also manipulated the type of information provided. In the own die shown condition participants were given the value of their own die (identical to Experiment 3.1) and were asked to estimate the other's die. In the other's die shown condition participants were given the value of the other's die and were asked to estimate their own die. Finally, participants were asked to recall the average dice value they and the other had received during the dice task. Participants answered these two questions, presented in a random order, by selecting an answer from a pull-down menu in which the choices ranged from 1.0 to 6.0.

Results and Discussion

Dice estimations during the dice task. Estimated values of the dice outcomes were analyzed in a 2 (intentionality) \times 2 (type of information: self vs. other) \times 2 (decision-maker: human vs. computer) \times 12 (blocks of trials) analysis of variance, in which the latter was a within-participant variable. The analysis revealed a three-way interaction between the intentionality, the type of information, and the decision-maker manipulations, $F(1, 148) = 16.30, p < .001, \eta^2 = .104$ ³. One-sample t-test revealed, consistent with our hypothesis, that participants in the intentionality-and-human condition who were given information on their own dice values, overestimated the other's dice values ($M = 4.14, SD = 0.53$), $t(18) = 5.26, p < .001$. Also consistent with our hypothesis, participants in the intentionality-and-human condition who were given information on the other's dice values, underestimated their own dice values ($M = 2.91, SD = 0.57$), $t(17) = -4.42, p < .001$. By contrast, when allocations were unintentional or when they were made by a computer, participants estimated the dice values close to 3.5 (M s were between 3.47 and 3.66 and SD s were between 0.21 and 0.48). One-sample t-tests did not reveal that these values were different from 3.5, except that in the computer-and-intentionality condition participants slightly overestimated the dice values the computer allocated to the other ($M = 3.63, SD = 0.21$), $t(16) = 2.45, p = .027$. The means across all 8 experimental conditions are presented in Figure 3.2.

³ We found a main effect of the type of information manipulation $F(1, 148) = 13.94, p < .001, \eta^2 = .090$, indicating that participants estimated higher dice values for the other than they estimated for themselves. We also found a two-way interaction between the type of information and decision maker manipulations $F(1, 148) = 13.49, p < .001, \eta^2 = .090$, and another two-way interaction between the type of information and intentionality manipulations $F(1, 148) = 36.12, p < .001, \eta^2 = .204$. These effects are mainly caused by differences in means in the intentionality-human conditions, as one-sample t-tests show. Similar to Experiment 3.1, we did not find a main effect of block of trials or any interactions between manipulated variables F s < 1 .

Figure 3.2: The mean estimated dice values allocated to the self and the other, in Experiment 3.3. The 95% confidence intervals are presented in line-graphs.



Dice recall after the dice task. We performed another series of one-sample t-tests to examine whether or not the dice value recalls differed from the baseline of 3.5. Almost identical results compared to on-going dice estimations were found. Consistent with the hypothesis, participants in the intentionality-and-human condition underestimated their own dice values ($M = 3.16$), $t(36) = -2.89$, $p = .007$ and overestimated the other's dice values ($M = 3.80$), $t(36) = 2.79$, $p = .008$. We also found that participants in the unintentionality-and-computer condition overestimated their own dice values ($M = 3.73$), $t(36) = 2.89$, $p = .006$. Because the remaining five comparisons did not statistically differ from 3.5, our analysis concluded that dice recalls can be explained by our hypothesis in 7 out of 8 possible comparisons. Interestingly, we also found that the way in which participants assumed self-interest in the recall task was influenced by the type of information they were provided with. Independent sample t-test revealed that participants who were shown their own die did not underestimate its value ($M = 3.41$) as much as participants who were shown the other's die ($M = 2.89$), $t(35) = 2.25$, $p = .026$. This supports the idea that an underestimation of one's own dice values is attributable to the tendency "to fill in the blanks" with a belief of self-interest. By contrast, such underestimation is absent when participants were given information about their dice and thus did not need to fill in the blanks.

General Discussion

The major purpose of the present research was to examine that the belief in self-interest of other people might underlie specific social judgments in incomplete information situations. Using a new methodology, the dice-rolling paradigm, our results provide strong support for the hypothesis that under incomplete information, people assume and erroneously perceive others' behavior to stem from self-interest. Self-interest was assumed when outcomes represented money or points (Experiment 3.1), for both overestimation of outcomes allocated to the other, and underestimation of outcomes allocated to the participant (Experiment 3.3), for recall of other's past behavior (Experiment 3.3), and for judgments of present behavior (Experiments 3.1 and 3.3). Importantly, the overestimation of self-interest was observed in comparison to a baseline in which the other person needed to allocate before rolling the dice (no intention, Experiments 3.1 and 3.3) or when the computer made allocation decisions (Experiment 3.3). Moreover, Experiment 3.2 revealed that while in reality people's allocations are significantly greater than 3.5 indicating self-interest, people estimate that others exhibit even more self-interest than the level of self-interest is in actual behavior. Thus, what people conclude about other's self-interest seems to be a function of (a) what other people actually do (because there is self-interest in their allocations), and (b) incomplete information that is made "complete" by a strong belief in self-

interest. Finally, the overestimation of self-interest was observed mainly in the domain where explicit information was not provided, rather than in the domain where explicit information was provided (Experiment 3.3), supporting the idea that incomplete information is a precondition for the belief in self-interest to express itself.

The current research demonstrates that in people's attempt to make sense of the social environment, they tend to make incomplete information complete by filling in the blanks with a belief in self-interest. This extends previous research in that the belief in self-interest is not only about judgments of global beliefs about motivations of other people in general (Miller & Ratner, 1998), or about comparisons of the self with other people in general (Allison et al., 1989; Van Lange & Sedikides, 1998), but also about attributions regarding others' overt behavior. Even when people observe others and have some—though incomplete—information about their actual behavior, the belief in self-interest seems to be used to “go beyond the information given.”

It is interesting to note that cooperation and reciprocity have been studied almost exclusively in the context of complete information (for a more detailed discussion, see Nowak & Sigmund, 2005; Van Lange, Ouwerkerk, & Tazelaar, 2002). In the light of the present findings, this literature needs to be reviewed with a critical eye, as incomplete information may lead people to expect less cooperation from others, which in turn might undermine their own tendencies to behave in a cooperative manner. For example, past research has revealed that the well-known tit-for-tat strategy elicits high levels of cooperation under conditions of “complete information” but relatively low levels of cooperation when there may be unintended errors in the actions of others (i.e., incidents of noise, Klapwijk & Van Lange, 2009; Van Lange et al., 2002). Perhaps people no longer give tit-for-tat the benefit of the doubt when incompleteness of information allows multiple interpretations. Such reasoning may also be relevant to explaining why uncertainty about other's actions—social uncertainty—tend to undermine cooperation in social dilemmas involving many people (e.g., Suleiman, 1997; Van Dijk, Wit, Wilke, & Budescu, 2004; Wit & Wilke, 1998).

Before closing, we wish to outline some lines of research for future work. One interesting extension would be to examine the validity of our findings in different types of interpersonal relationships. For example, in ongoing relationships or in relationships with relatives it may not be functional to assume self-interest (e.g., in communal relationships, Clark & Mills, 1993; Rusbult & Van Lange, 2003). Conversely, the assumption of self-interest may be even stronger for groups, or representatives of groups, as people think more positively about people than about groups (e.g., Insko & Schopler, 1998; Sears, 1983). Motivational aspects of social judgments also deserve attention in future research, as we did not assess or manipulate people's motivation to make accurate judgments in the present work. It would be interesting to explore whether and how the need for accuracy might make the assumption of self-interest more or less pronounced. This could be studied simply by offering monetary rewards

for accuracy, or more indirectly by influencing the importance of being accurate or not in such social judgments—for example by adjusting the power structure of the situation, or by introducing future interaction possibilities.

We close by outlining an important implication of the present findings. In particular, we wish to note that situations of incomplete information tend to receive relatively little attention in social psychology. However, such situations are of great theoretical and societal relevance, as they form a serious threat to the development of human cooperation. When global beliefs of self-interest are translated into specific judgments (e.g., attributions, expectations, and recall), then it is likely that people act upon such specific judgments, by behaving in noncooperative ways, and eventually eliciting noncooperative behavior from others as well—indeed, a classic example of a self-fulfilling prophecy (see also Kelley & Stahelski, 1970; Miller, 1999). Therefore, to improve interactions in which cooperation may be undermined by beliefs in self-interest, we need to know more about the ways in which heuristics such as “give others the benefit of the doubt” or complementary frames of references operate, so that people are less likely to fall prey to the idea that other people are merely self-interested. This is all the more important in real life interactions in which it seems to be the rule, rather than the exception, that we have less than complete information about the actions of others.

Chapter 4

Detrimental Effects of Incomplete Information on Cooperation⁴

What would you do when your colleague asks you to read her manuscript before submission? Would you *cooperate* and spend a fair amount of your free time to help her out? Or would you *not cooperate* and spend your spare hours with your favorite hobby instead? In everyday life, we encounter many situations in which we must make a choice that either benefits the self alone (i.e., noncooperation), or that benefits another person (i.e., cooperation). What should one do in such situations to promote cooperation in one another, so that they both benefit? The basic lesson that the vast literature teaches us is quite simple: Start with making a cooperative choice, and then cooperate if the interaction partner cooperated in the previous interaction, and do not cooperate if the partner did not cooperate in the previous interaction. This strategy is called *tit-for-tat*, and computer simulations have shown that with this strategy, cooperation can emerge and sustain even among selfish agents (e.g., Axelrod, 1984; Gouldner, 1960; Trivers, 1971). Experimental work yields similar findings, and also show that most people adopt a version of tit-for-tat in their interactions (Klapwijk & Van Lange, 2009; Komorita & Parks, 1995; Van Lange, 1999).

Previous conclusions that cooperation elicits cooperation and that noncooperation elicits noncooperation are based on the assumption that people have complete information about their partner's past cooperation. However, this assumption may not be realistic. For example, how would you react if your colleague promised to read your paper, but ended up correcting just a few typos in the introduction? Would you think that your colleague was cooperative or noncooperative? How much time would you invest when your colleague needs some help in the future? This example illustrates a very common situation in everyday life: Information regarding the interaction partner's cooperation is incomplete and it is therefore subjected to interpretations. Because people need to ask themselves the question how much their interaction partner cooperated, incomplete information situations, compared to complete information situations, leave much more room for "psychology" in interpreting missing information, developing and updating beliefs, and forming impressions.

In the present work, we posit that cooperation in incomplete information situations is shaped by inferences about the partner's cooperation, and that such inferences tend to be driven by the assumption of other people's self-interest. Research on the "norm of self-interest" reveals that global judgments about unknown others are guided by a belief in self-interest (see Miller & Ratner, 1996, 1998). For instance, people

⁴ This chapter is based on Vuolevi and Van Lange (2011b)

overestimate the impact of financial rewards on their peers' willingness to donate blood. People also attribute responsibility in a self-serving way. For example, people think that their spouses are more responsible for negative than for positive events in their relationships, whereas people think of themselves being responsible for both positive and negative events (Kruger & Gilovich, 1999). Further evidence shows that these cynical theories about other people are more pronounced and lead to more selfish behavior when people are encouraged to think more about others' thoughts (e.g., Epley, Caruso, & Bazerman, 2006; Vorauer & Sasaki, 2009). Finally, research on interpersonal biases reveals the overestimation of others' self-interest is not only limited to specific interferences: There is a stable trait bias in that people think of others as more selfish and less fair than they think of themselves (Allison, Messick, & Goethals, 1989; Van Lange & Sedikides, 1998).

Present Research: Coin Paradigm and Hypotheses

In the present research, we examined whether incompleteness of information influences estimates about other's cooperation and own cooperation in a resource allocation task. Because people can no longer rely on what the other actually did, we expected that people use their global beliefs in other people's self-interest in general when making attributions about their behavior. Thus, we predicted that incompleteness of information leads people to underestimate others' cooperation. Further, we predicted that incompleteness of information undermines people's own cooperative behavior. And finally, we explored whether the predicted decline in estimated cooperation through incompleteness of information mediates the predicted decline in own cooperative behavior. Such evidence would suggest that under incompleteness of information, people cooperate less than the partner because they tend to underestimate the partner's cooperation.

Our hypotheses were tested in a newly designed research paradigm referred to as the coin paradigm, which is a dyadic allocation task in which the participant and another person take turns in allocating resources between the two. Compared to classical paradigms used widely in behavioral economics and psychology, the novel aspect of our paradigm is that each round participants are only provided with incomplete information about their interaction partner's allocation. That is, they are provided with 1, 2, 4, or 8 of a total of 16 pieces of information, each of which displays whether or not the other gave them a coin (i.e., cooperation) or kept it for himself or herself (i.e., noncooperation). Under those four conditions, we assessed participants' inferences regarding the total number of cooperative behaviors (i.e., inferred cooperation) and the number of coins the participant was willing to give to the other person (i.e., own cooperation). We predicted that with more incompleteness of information, participants would infer lower levels of cooperation from the other, and exhibit lower levels of cooperation.

Experiment 4.1

Method

Participants and design. The participants were 65 university students (53 women, 12 men) with an average age of 21.2 years ($SD = 2.56$). The computerized, laboratory experiment was a 4 (level of information provided) \times 4 (blocks of trials) design with the latter being a within-participant variable. After completing the experiment, the participants were debriefed and paid €2.5.

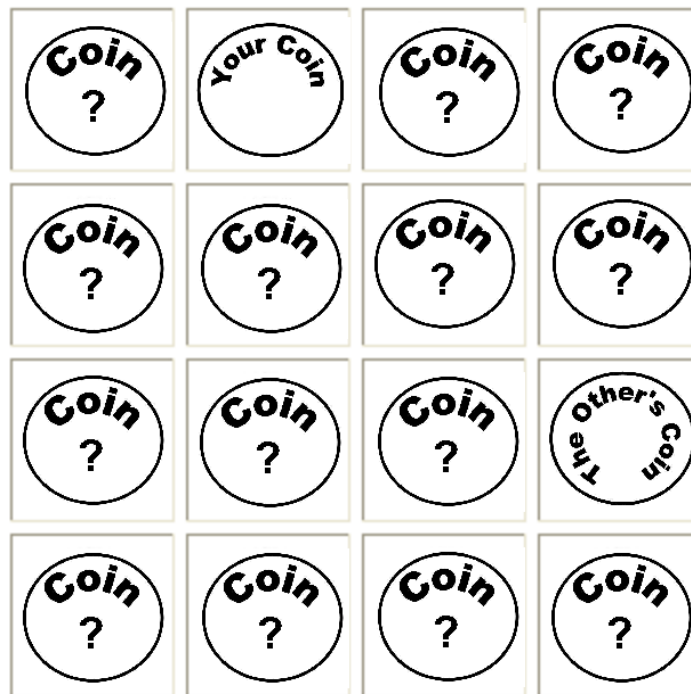
Procedure. The coin paradigm is an interaction-based, turn-taking task between the participant and another person, who is described as another participant, but whose behavior is in fact controlled by a computer. In the present experiment, the task consisted of 4 rounds of allocations of coins. In each round, first the other and then the participant allocated 16 coins between the two. Participants were informed that coins have value: "the more coins you accumulate the better for you; the more coins the other accumulates the better for him or her."⁵ Participants were first told that the other had allocated 16 coins between himself or herself and the participant, but the division of coins would not be displayed. Instead, participants were presented with 16 blank coins and they could click any coin they wanted, as illustrated in Figure 4.1. After a click the text "Your Coin" or "The Other's Coin" appeared on the coin, indicating that the other had allocated that coin either to himself or herself or to the participant. The number of coins participants were able to click was 1, 2, 4, and 8—a variable that was

⁵ The interdependence structure of the current version of the paradigm is borrowed from the dictator game in that all coins (i.e., regardless of who allocates them) are equally valuable to the participant and the other. The key difference between the single-shot dictator game (e.g., Bolton, Katok, & Zwink, 1998) and the sequential game used here (i.e., the participant and the other alternate as dictators) is that the sequential nature of the game provides opportunities for punishment and reward. Therefore, behavior is importantly shaped by the other's behavior in previous trials and the expected behavior in future trials, potentially increasing the base-rate cooperation compared to the single-shot game. Allocations that match the other's allocation would indicate that participants adhere to equality or mutual exchange of payoffs (i.e., tit-for-tat, see Experiment 4.2). Because fewer allocations than the other's allocation provide higher outcomes to the participant, this "less-than-matching" behavior would indicate that the equality principle is coupled with self-interest. Alternatively, in the case of incomplete information, less-than-matching behavior can also be caused solely by underestimation of the other's cooperation. Across both studies, we will present mediational evidence and discuss these two possible mechanisms.

manipulated between-participants. In the latter three conditions, equal number of coins was allocated to the other and the participant (i.e., the 50/50 split). In the condition where only one coin was clicked, its allocation was randomized for the first trial and alternated in subsequent trials. Thus, participants were presented with partial information that suggested fair allocations. After participants had clicked the coins, they estimated the total number of coins (out of 16) the other had allocated to the participant, and finally, allocated 16 coins in total to the other and themselves. After the participant's allocation, Round 2 started uninterruptedly with the other who, in turn, allocated 16 coins.

Figure 4.1: Display of the other's allocation after the participant has seen two coins. In this situation, the other has allocated at least one coin to the participant and one coin to himself or herself. A JavaScript demonstration of the coin paradigm can be found from:

<http://webresearch.psy.vu.nl/demo/coinparadigm.htm>

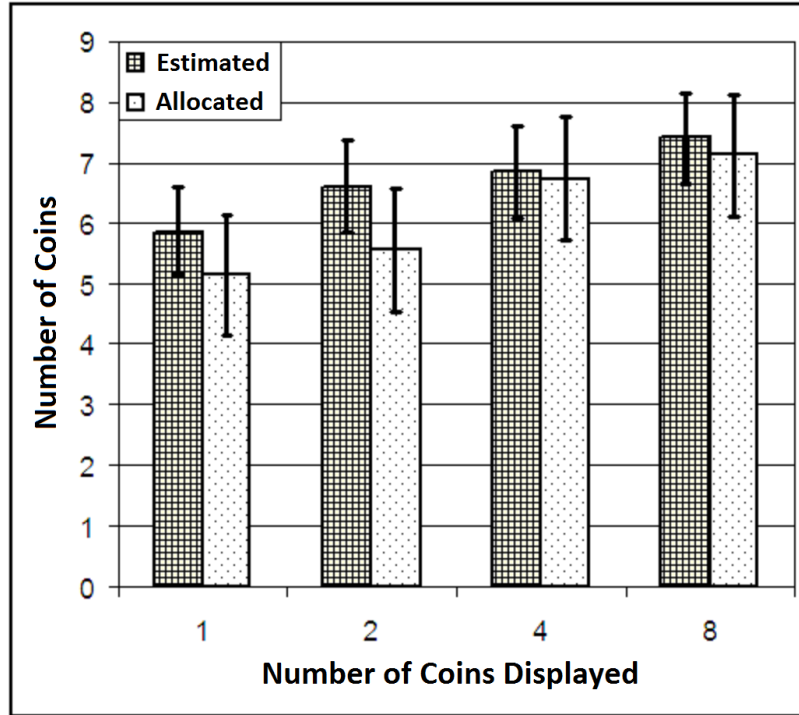


Results and Discussion

Based on four trials we calculated the mean estimated number of coins the other allocated to the participant and the mean number of coins participants actually allocated to the other, and predicted them with information availability, where 1, 2, 4 and 8 coin conditions were coded as -1, -1/3, +1/3, and +1, respectively. As predicted, a

linear regression analysis revealed that with more incompleteness of information participants inferred lower levels of cooperation from the other, $B = 0.73$, $t(64) = 2.97$, $p = .004$, $\eta^2 = .12$. The estimated numbers of coins the other allocated to the participant were 5.87 ($SD = 2.23$), 6.61 ($SD = 1.35$), 6.84 ($SD = 1.21$) and 7.41 ($SD = 0.81$) in the 1, 2, 4, and 8 coin conditions, respectively. As predicted, another linear regression analysis revealed that with more incompleteness of information participants also exhibited lower levels of cooperation, $B = 1.07$, $t(64) = 3.24$, $p = .002$, $\eta^2 = .14$. The number of coins participants allocated to the other were 5.13 ($SD = 1.94$), 5.55 ($SD = 2.60$), 6.73 ($SD = 1.78$), and 7.13 ($SD = 1.65$) in the 1, 2, 4, and 8 coin conditions, respectively. The means for estimated and actual cooperation across four experimental conditions are presented in Figure 4.2.

Figure 4.2: The estimated number of coins (out of 16) the other allocated to the participant (left bars) and the number of coins (out of 16) participants allocated to the other (right bars) as a function of information availability, in Experiment 4.1. Information availability refers to the experimental manipulation where 1, 2, 4, or 8 coins of the other's allocation were made visible to participants.



To test mediation we added coin estimations as a predictor for cooperation. The effect of the information availability manipulation on cooperation became weaker and

only marginally significant, $B = .56$, $t(64) = 1.77$, $p = .081$, and cooperation was strongly associated with coin estimations $B = .75$, $t(64) = 5.29$, $p < .001$. The Sobel test revealed the effect of information availability on cooperation was indeed mediated by coin estimations, $Z = 2.59$, $p = .010$ (two-tailed).

Consistent with our hypothesis, Experiment 4.1 revealed that incomplete information undermines inferred and actual cooperation, and that estimations regarding the other's cooperation mediate the detrimental effects of incomplete information on cooperation. This suggests that under incompleteness of information, people do not cooperate to the same extent that the other person actually did, but more to the extent that they *think* the other person cooperated.

Experiment 4.2

Experiment 4.1 provided good support for the hypothesis that incompleteness of information undermines estimations regarding the other's cooperation, as well as one's own cooperation. However, the interaction partner was programmed to pursue equality in a perfectly unconditional manner—that is, independent of the participant's own behavior. While such a partner provides a good baseline against which to assess bias in estimated allocations, one might argue that it is somewhat questionable whether many people would pursue equality in an unconditional manner.

Experiment 4.2 addressed this limitation by examining interactions with a partner who was programmed to pursue tit-for-tat, a strategy that makes exactly the same choice than the participant did in the previous trial (e.g., Axelrod, 1984; Kollock, 1993; Nowak & Sigmund, 1992; Van Lange et al, 2002). Indeed, prior research has shown that many people use a variant of tit-for-tat in their interactions in social dilemmas and related exchange situations (typically, approximately 60% of the participants tend to follow tit-for-tat; see Klapwijk & Van Lange, 2009; Van Lange, 1999). This is one of the reasons why tit-for-tat is often used as a baseline or standard for conceptualizing differences from tit-for-tat (forgiving versus retaliatory versions of tit-for-tat; tit-for-tat as the “average” strategy; see Axelrod, 1984; Parks & Rumble, 2001) or for using it as the default strategy to resemble a realistic strategy (e.g., Parks, Sanna, & Berel, 2001).

There are two further reasons for examining a tit-for-tat partner. First, numerous studies have revealed support for the effectiveness of tit-for-tat to promote cooperation. However, as far as we know, little effort has been devoted to examining the effectiveness of tit-for-tat under conditions of incompleteness of information. Second, with the exception of the first choice, tit-for-tat can be considered as providing a mirror image of the participant—and so, people are making inferences about another person who is not only very realistic but also quite similar to the self. This is also interesting because, unlike Experiment 4.1, Experiment 4.2 examined judgments of the other person's intentions. Given that people attribute too much self-interest to the other's

behavior under incompleteness of information, participants should form less benign impressions of the other in the low information condition than in the high information condition.

Method

Participants and design. The participants were 52 university students (42 women, 10 men) with an average age of 21.4 years ($SD = 6.00$). The computerized, laboratory experiment was a 2 (information provided: low vs. high) \times 8 (blocks of trials) design with the latter being a within-participant variable. After completing the experiment, the participants were debriefed and paid €2.5.

Procedure. The coin task was identical to Experiment 4.1, except that (1) it consisted of eight trials (rather than 4 trials), (2) we included only 2 and 8 coin conditions (low vs. high information), and that (3) the other followed tit-for-tat strategy (rather than fairness). The interaction started with the other's fair allocation (50-50), and in subsequent trials the other's allocation was the same as the participant's previous allocation. We controlled for the information about the other's allocation that was displayed to participants. Given that tit-for-tat strategy can only be displayed fully with complete information, participants were exposed to incomplete information that reflected tit-for-tat strategy as accurately as possible. For example, the participant who allocated 8 coins to the other (out of 16) and subsequently received 8 coins back, would find 1 coin for the self and 1 coin for the other in the 2 coin condition (low information). Likewise, the participant who made the same equal allocation (=8 coins to the other) in the 8 coin condition (high information) would find 4 coins for the self and 4 coins for the other in the next round. If the number of coins the participant was supposed to see had a fractional part, we randomly selected one of the two neighboring integers and weighted this randomization according to the fractional part. For example, after allocating 9 coins in the low information condition the participant would see $9 \times 2/16 = 1.125$ coins. In this case, the participant would find either 1 or 2 coins with probabilities of 87.5% and 12.5%, respectively. This way, we eliminated the possibility that participants could get extremely lucky or unlucky in finding their own or the other's coins while still following tit-for-tat strategy as accurately as possible.

After the coin task, we assessed participants' general impressions of benign intent of the other (Van Lange et al, 2002). Positive items were "The other was generous, nice, forgiving, kind, and trustworthy," and negative items were "The other was self-centered, greedy, competitive, stingy, vengeful, and selfish" (Cronbach's $\alpha = .83$). Participants indicated how much they agreed or disagreed with these statements on a scale ranging from 1 (*completely disagree*) to 7 (*completely agree*).

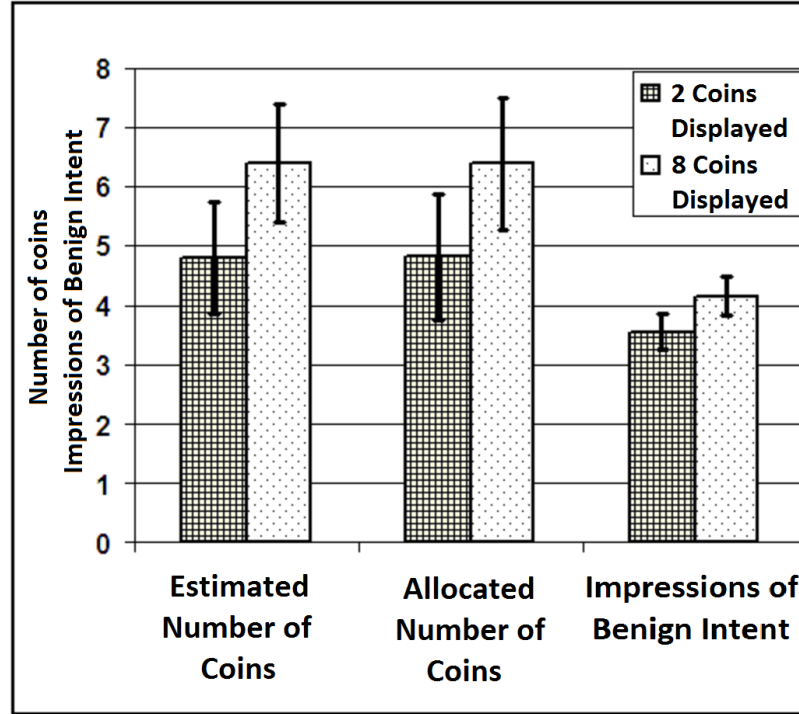
Results and Discussion

Estimation and cooperation. Based on eight trials we calculated the mean estimated number of coins the other allocated to the participant and the mean number of coins participants actually allocated to the other, and predicted them with information availability, where low (i.e., 2 coins) and high (i.e., 8 coins) information conditions were coded as -1 and +1, respectively. As predicted, a linear regression analysis revealed that with more incompleteness of information participants inferred lower levels of cooperation from the other, $B = 0.80$, $t(50) = 2.36$, $p = .022$, $\eta^2 = .10$. The estimated number of coins the other allocated to the participant were 4.79 ($SD = 2.53$), and 6.39 ($SD = 2.35$) in low and high information conditions, respectively. As predicted, another linear regression analysis revealed that with more incompleteness of information participants also exhibited lower levels of cooperation, $B = 0.79$, $t(50) = 2.05$, $p = .045$, $\eta^2 = .08$.⁶ The number of coins participants allocated to the other were 4.80 ($SD = 2.80$) and 6.38 ($SD = 2.70$) in the low and high information conditions, respectively. The means for the estimated and actual cooperation in the low and high information conditions are presented in Figure 4.3.

To test mediation we added coin estimations as a predictor for cooperation. The effect of the information availability manipulation on cooperation became nonsignificant, $B = -0.08$, $t(50) = -0.70$, $p = .486$, and cooperation was strongly associated with coin estimations $B = 1.08$, $t(50) = 23.85$, $p < .001$. The Sobel test revealed the effect of information availability on cooperation was indeed mediated by coin estimations, $Z = 2.35$, $p = .019$ (two-tailed).

⁶ We also analyzed the change in coin estimations and allocations across trials. For that analysis, we first computed the linear least squares fit across 8 trials and for each participant separately (i.e., the mean change in allocations from Trial 1 to Trial 8). We did not find an effect for coin estimations, $B = 0.35$, $t(50) = 1.25$, $p = .217$, but a linear regression analysis revealed that the change in coin allocations is different in the low and high information conditions, $B = 0.56$, $t(50) = 2.08$, $p = .043$, $\eta^2 = .080$. Across 8 trials, the allocated number of coins increased by 0.62 ($SD = 2.21$) in the high information condition, and decreased by 0.49 ($SD = 1.62$) in the low information condition. Furthermore, when analyzing the trials separately, we found the incompleteness effect, at least marginally, for the last three trials, $ps < .10$. This pattern of results indicates that the effect of incompleteness of information became more pronounced in later rounds of interaction, supporting the idea that tit-for-tat is an efficient strategy for eliciting and maintaining cooperation over repeated interactions under high rather than low information conditions.

Figure 4.3: The estimated number of coins (out of 16) the other allocated to the participant (left bars), the number of coins (out of 16) participants allocated to the other (middle bars), and impressions of benign intent (in a scale ranging from 1 to 7) participants formed about the other (right bars) in the low (=2 coins) and high (=8 coins) information conditions, respectively, in Experiment 4.2.



Benign intentions. Using the same model than in previous analyses, a linear regression analysis revealed that with more incompleteness of information participants formed less benign impressions on the other, $B = 0.30$, $t(50) = 2.67$, $p = .010$, $\eta^2 = .16$. This result indeed supports our hypothesis that participants would form less benign impressions of the other in the low information condition ($M = 3.55$, $SD = 0.87$) than in the high information condition ($M = 4.15$, $SD = 0.74$). The mean impressions of benign intent in the low and high information conditions are presented in Figure 4.3.

To conclude, consistent with our hypothesis, Experiment 4.2 revealed that incomplete information undermines inferred and actual cooperation, and that estimations regarding the other's cooperation mediate the detrimental effects of incomplete information on cooperation. What is remarkable in Experiment 4.2 is that this pattern of results emerges even when the other followed tit-for-tat. Unlike the fairness strategy examined in Experiment 4.1, tit-for-tat strategy cooperates equally as much as the participant does, and still participants cooperate less in the low information

condition. Our explanation for this finding is that tit-for-tat suffers from incomplete information because information about the other's cooperation is ambiguous. When people interact with a tit-for-tat other in complete information situations, they receive, by definition, clear information whether the other was equally cooperative or not. By contrast, when incomplete information is present, information about the other's cooperation is less clear, and the missing information may be subjected to interpretations that are rooted in participants' (implicit) theories—such as the assumption of other people's self-interest. Finally, the findings also indicate that information availability may have consequences that go beyond a specific interaction. That is, people who had less information about the other's behavior developed less benign impression about that person, and that may potentially influence cooperation in future interactions.

General Discussion

In the present research we examined the way in which incompleteness of information about the other's previous behavior influence estimated and actual cooperation in dyadic interactions. Using a new research paradigm—the *coin paradigm*—the results revealed that incompleteness of information leads to reduced estimations regarding the other's cooperation as well as lower level of own cooperation. These detrimental effects of incomplete information were found when the other was programmed to behave in a fair manner (Experiment 4.1) or when the other followed tit-for-tat strategy (Experiment 4.2). Especially the latter is a remarkable finding, because it indicates that under incompleteness of information, people fail to match the level of cooperation with a partner who is equally cooperative as the participant was in the previous trial. Complementary analyzes revealed an explanation for this effect: The participant's actual cooperation was mediated by the other's estimated cooperation, indicating that under incomplete information, people do not allocate the number of coins they have received (simply because they do not have that information), but the number of coins they *think* they have received (i.e., perceived cooperation). The implication of this mediational model that was supported in both experiments is that under incompleteness of information, responding *in kind* becomes responding *in mind*.

Our findings are consistent with previous literature showing that global judgments about unknown others are guided by a belief in self-interest (see Miller & Ratner, 1996, 1998), and that people view others as more selfish than they view themselves (Allison et al., 1988; Van Lange & Sedikides, 1998). Our work extends these literatures in that the belief in others' self-interest guides not only *global* judgments about other people's dispositions, traits, and imagined behavior (for the above-average effects in general, see Alicke, Dunning, & Kruger, 2005; Kruger & Dunning, 1999), but it also distorts *specific* judgments about overt, proximal behavior.

Most important, a novel aspect of the present work is that this overestimation of others' self-interest has strong behavioral implications on cooperation: Under higher levels of incompleteness of information, people are likely to behave less cooperatively than the other did, thereby systematically deviating from matching cooperation in a self-protective or self-enhancing manner. This finding extends previous literature on reciprocity—the idea that people would respond helpful and harmful acts in kind (e.g., Axelrod, 1984; Gouldner, 1960; Komorita & Parks, 1995; Trivers, 1971). The existing literature shows that reciprocity is a key determinant of behavior in social dilemmas and related monetary exchange situations (see Kollock, 1993; Nowak & Sigmund, 1992, 2005; Van Lange et al. 2002). However, the present work shows that when incompleteness of information is present, people tend to cooperate a bit less than the rule of reciprocity would dictate. This implies that in many real life situations that are covered by incompleteness of information by nature, such as returning favors for other types of favors, people fail to adhere to the rule of reciprocity. As a result, they perform a favor that may be a bit less other-regard than the favor they received themselves in the past. Thus, as long as favors are subjected to evaluative judgments and thereby also subjected to ego-centric biases (see also Zhang and Epley, 2009), mutual and lasting cooperation is harder to achieve than in materialistic (and easily quantifiable) exchanges with complete information.

The findings also indicate that the effects of incomplete information may go beyond a specific interaction. Experiment 4.2 revealed that participants who had less information developed less benign impressions about their interaction partner (e.g., perceived the partner as less kind, less honest, and more selfish). Thus, incompleteness of information, which is a situational feature, has strong implications how one comes to think about another person's personal qualities—finding which is consistent with classic insights of various attribution theories (e.g., Jones & Davis, 1965; Nisbett & Ross, 1980). Our finding also adds credence to the possibility that, if dispositional attributions influence cooperation in the future, mere information availability in the initial interaction may have a fairly pervasive influence on mutual cooperation over time.

Given that cooperation and incomplete information have received relatively little attention in the literature, it is important to outline some promising lines for future research. Clearly, one limitation of the current work is that all interactions examined in this chapter were interactions with strangers. It is plausible and in fact quite possible that in some other types of interpersonal relationships, such as in ongoing relationships, people do not necessarily assume self-interest from their partner (e.g., in communal relationships, Clark & Mills, 1993; Rusbult & Van Lange, 2003). Instead, people may use specific knowledge about their partner whenever incompleteness of information leaves room for multiple interpretations (e.g., she is such a nice person that she wouldn't do anything harmful to me—even though at first sight it looks like she did).

Conversely, people may assume more self-interest from groups, or from representatives of groups, as people think more positively about persons than about groups (e.g., Insko & Schopler, 1998; Sears, 1983). More generally, it would be interesting to examine beliefs as a determinant of behavior in a more systematic way by assessing or manipulating beliefs about the interaction partner, and measuring their influence on cooperation under different levels of incompleteness of information. Due to the dynamic nature of human interactions, it is very possible that small differences in initial beliefs (i.e. giving the benefit of the doubt vs. assuming self-interest) may have dramatic impact on cooperation that emerges after several rounds of interactions.

Concluding Remarks

We advanced the hypothesis that incompleteness of information undermines cooperation, and suggested that the main reason for this effect gleans from people's underestimations of others' cooperation. Under incompleteness of information, people can cooperate a little bit less than the other person did in the previous interaction and still believe that they just cooperate as much as the other person did. This pattern forms a serious threat to the development of human cooperation, because through acting upon such self-created beliefs and expectations of self-interest elicits self-interested behavior in others over the long run—indeed, a classic example of a self-fulfilling prophecy (see also Kelley & Stahelski, 1970; Miller, 1999). Therefore, to increase cooperation in interactions in which cooperation may be undermined by general beliefs in other people's self-interest, we need to understand more about how these erroneous beliefs develop and persist, and how they can be corrected. This is all the more important in real life interactions in which it seem to be the rule, rather than the exception, that we have less than complete information about the actions of others.

Chapter 5

When Generosity Is Hard to Communicate: The Asymmetric Role of Incompleteness of Information on Cooperation⁷

In everyday life people face numerous situations in which self-interest and other people's interest are in conflict. Acts of sharing (e.g., babysitting for a friend instead of going to a favorite football game) and making contributions to the group (e.g., effortful work for a group goal instead of an individual goal) are examples of cooperative behaviors in which people often act against their immediate self-interest. Some researchers have identified possible prosocial motives for cooperation such as altruism (e.g., Batson, 1991; Davis, 1996) and fairness (e.g., Deutsch, 1975; Lind & Tyler, 1988; Fehr & Schmidt, 1999). In contrast, other researchers believe that most or even all cooperative behaviors can be accounted for by self-interest (for discussions, see Batson, 1991; Cialdini & Fultz, 1990; Dovidio, 1984).

Cooperation in social interactions is importantly shaped by the partner's cooperation. Previous research shows that people exhibit a strong tendency to respond cooperatively to the partner's cooperation and noncooperatively to the partner's noncooperation (Axelrod, 1984; Gouldner, 1960; Kollock, 1993; Komorita & Parks, 1995; Nowak & Sigmund, 1992, 2005; Trivers, 1971; Van Lange, Ouwerkerk, & Tazelaar, 2002). Such reciprocal cooperation is quite effective for sustaining and promoting cooperation. A case in point is the success of the tit-for-tat strategy, which begins with a cooperative choice and subsequently reciprocates the partner's cooperative and noncooperative behavior in the next interaction (Axelrod, 1984; see also Komorita & Parks, 1995; Van Lange, 1999; Van Lange et al, 2002). In particular, this reciprocal strategy elicits cooperation with individuals who want to cooperate, but it also protects itself against noncooperative individuals.

The partner's cooperation is a powerful determinant of cooperation in social interactions, but sometimes people cooperate somewhat more or less than the partner. For example, every now and then people may behave in slightly self-serving ways by giving a little less than what they have received so that they can obtain even greater outcomes for the self. This may, for example, happen if the person does not completely trust the other person (Fetchenhauer & Dunning, 2009, 2010), or when there is a strong desire to ensure better outcomes than the partner (e.g., competitive social value orientation; Messick & McClintock, 1968; Van Lange, 1999). At other times, people may slightly differ from reciprocity in that they give a little bit more than they have received. This may, for example, happen if one seeks to restore mutual trust and

⁷ This chapter is based on Vuolevi and Van Lange (2011c)

cooperation after some fairly noncooperative interactions (Desmet, De Cremer, & Van Dijk, 2010). Or a person may act in a generous manner simply because the person thinks this may be wise: If I give even more than the other, I may receive also more the next time (Klapwijk & Van Lange, 2009; Van Lange et al, 2002). People may also be generous for reputational reasons (e.g., Iredale, Van Vugt, & Dunbar, 2008). Of course, there can also be social motives that are activated by the partner (such as generosity that is inspired by liking or empathy; Batson, 1991; Van Lange, 2008).

The major purpose of the present research is to examine cooperation under incompleteness of information. Previous research has concluded that people adjust their cooperation to the partner's level of cooperation (i.e., they follow tit-for-tat), but this baseline is not explicitly given when people have only incomplete information on their partner's cooperation. Instead, people must first infer their partner's cooperation before tit-for-tat or other conditional strategies can be applied. Incompleteness of information can influence social interactions in three distinct ways: First, people may cooperate less if they underestimate their partner's cooperation. Second, various interpersonal strategies (e.g., generous vs. stingy) might be more difficult to perceive under incompleteness of information, and some of them might be easier to communicate and to get reciprocated than some others. And third, incomplete information may influence the way in which the partner is perceived as a person: People have a tendency to attribute specific behaviors to dispositions (see fundamental attribution error; Ross 1977; correspondence bias; Jones, 1990). Therefore, any errors that people make in perceiving cooperation under incompleteness of information may influence general evaluations of the partner.

In the present research, we advance a model in which cooperation is explained by the partner's cooperation under different levels of incompleteness of information. In particular, when people have complete information about one another's behavior, they can develop cooperation through the effective use of tit-for-tat or related mechanism. When information is incomplete, by contrast, the level of cooperation is expected to decline. We advance the argument that this decline in cooperation is based on people's tendency to overestimate other people's tendencies to pursue self-interest. We refer to this phenomenon as *the incompleteness effect*, because erroneous self-interest beliefs are only possible in incomplete information situations that allow multiple interpretations. Also, we expect that incompleteness of information challenges the communication of generous strategies. Given that people apply their self-interest beliefs when they explain others' behavior, stingy behaviors are more likely to get correctly perceived as such than generous behaviors as such. This is a notable difference to complete information situations in which all kinds of behaviors, ranging from stingy to generous, are always perceived at the right level of cooperation.

An Interdependence Approach to Incompleteness of Information

Our theoretical approach to understanding incompleteness of information is rooted in the principles of interdependence theory (Kelley & Thibaut, 1978; for an overview, see Rusbult & Van Lange, 2003; Van Lange et al., 2007). Originally the theory focused on different types of outcome interdependence (e.g., covariation of interest), but more recently incompleteness of information has been added to interdependence theory as one of its basic structural properties (Kelley et al., 2003; Van Lange & Rusbult, 2011). Here, we make a distinction between three types of information and posit that every interaction can be defined in terms of situational, behavioral, and transformational (or person-specific) information.

Situational information describes the way in which the interaction partners' possible behaviors influence their own and others' outcomes. In dyadic interactions, this is often represented as a matrix, where each row represents one behavioral option for one interaction partner, and each column for the other. If situational information is incomplete, some outcome information in the matrix is missing. For example, often people know the outcomes of different behavioral options for the self (e.g., I would prefer an Italian restaurant over a Chinese one) but not necessarily for the partner (e.g., would my partner prefer an Italian or a Chinese restaurant).

Behavioral information refers to the partner's particular behavior (i.e., one row or column in the matrix) and incompleteness of behavioral information refers to uncertainty about the partner's exact choice. For example, people may know what the partner could do (i.e., complete situational information), but they do not know for sure which one of these possible behaviors was or will be chosen. Future behaviors are always characterized by incompleteness of behavioral information (e.g., even the most reliable person sometimes misses a meeting because of an unexpected traffic jam), but also past behaviors are not always known with 100% accuracy (e.g., second-hand information or probabilistic information about the partner's behavior).

A related theoretical account that describes behavioral and situational aspects of interdependence is game theory (Von Neumann & Morgenstern, 1944). Game theory would predict that people choose the behavior that provides the best personal outcomes. Interdependence theory, by contrast, posits that people do not necessarily make their decisions based on the game theoretical matrix alone, but that they *transform* their motives from immediate self-interest (i.e., the game theoretical, given situation) to broader motives that include, among others, long-term considerations, norms, equality, and reciprocity (for an overview, see Rusbult & Van Lange, 2003). For example, when self-interest and equality are at odds, people tend to choose more cooperative (i.e., fairer) behaviors that the game theoretical model would suggest (e.g., Bolton, Katok, & Zwink, 1998; Fehr & Schmidt, 1999; Deutsch, 1975; Lind & Tyler, 1988).

The fact that people do not necessarily act according to self-interest introduces the third informational aspect to social interactions, which we refer to as *transformational information*. Different individuals exhibit a wide range of behaviors from competition to cooperation (Balliet, Parks, & Joireman, 2009; see also Van Lange, 1999; Van Lange et al, 2007) and therefore people cannot rely on the assumption that their partner's pursue self-interest. Instead, people must infer their partner's transformations (e.g., interpersonal strategies) from the interactional context—based on behavior across social situations.

The way in which people infer their partner's strategies (e.g., stingy or generous variants of tit-for-tat) may have a crucial impact on social interactions. People tend to apply conditional strategies and the extensive use of tit-for-tat demonstrates this principle: People cooperate more with others who they perceive as more cooperative and less with others who they perceive as less cooperative. Thus, people's own strategy might be influenced by the perception of their partners' strategy—which may subsequently be influenced by incompleteness of information. Partners' strategies are more difficult to infer when information about the partner's behavior is incomplete. If people perceive their partners' as less cooperative under incompleteness of information—the topic that we will discuss in the next section—people may choose more self-interest strategies themselves. Thus, the mere misperception of the partner's strategy may seriously undermine cooperation—not necessarily because people intentionally choose less cooperative strategies, but because they underestimate their partners' cooperation and respond accordingly.

The effects of incompleteness of information are not limited to the way in which people perceive their partners' strategies, but they can also influence the way in which people can communicate their own strategies. When information is complete, people can try to elicit higher or lower levels of cooperation, and the partner will easily notice this behavior and presumably adapt to it. By contrast, when information is incomplete, different strategies may be more difficult to detect, thereby reducing the possibility that the partner would adapt to higher or lower level of cooperation. In particular, if people assume too much self-interest from others, generous strategies may be more difficult to communicate than stingy strategies. As a result, generous strategies may not elicit as much more cooperation as they would under complete information.

People as Self-Interest Theorists

How people interpret their partner's specific behaviors and overall strategies when important pieces of information are missing? One interesting line of research examined people's prediction about other people's behaviors in the absence of any specific information. The research on the *norm of self-interest* reveals that global judgments about unknown others are guided by a belief in self-interest (see Miller & Ratner, 1996, 1998). For instance, people overestimate the impact of financial rewards on their peers'

willingness to donate blood. Further evidence shows that these cynical theories about other people are more pronounced and lead to more selfish behavior when people are encouraged to think more about others' thoughts (e.g., Epley, Caruso, & Bazerman, 2006; Vorauer & Sasaki, 2009).

Another line of research demonstrated that dispositional attributions are also guided by self-interest. Research on interpersonal biases reveals a stable trait bias in that people think of others as more selfish and less fair than they think of themselves (Alicke, Dunning, & Kruger, 2005; Dunning & Cohen, 1992; Messick, Bloom, Boldizar, & Samuelson, 1985; Allison, Messick, & Goethals, 1989; Van Lange & Sedikides, 1998). Interestingly, this research reveals that in comparison to many other attributes (e.g., those linked to competence) such better-than-average (i.e., superiority) effects tend to be most pronounced for attributes that are strongly linked to social qualities (e.g., others are less honest, more unfair).

More recent research demonstrated that incomplete information on concrete behavior is also filtered through the belief in others' self-interest (Vuolevi & Van Lange, 2010). In the so-called dice-rolling paradigm the participant observed another person assigning outcomes by rolling two dice and allocating one of them to the participant. Participants only had information about their own die, and they were asked to estimate the value of the die the other person allocated to himself or herself. The results revealed that people indeed overestimate the value of the die the other allocates to oneself. Thus, these findings indicate that the belief in others' self-interest guides judgments of overt behavior even when there is incomplete information suggesting that the behavior is actually fair. Indeed, people do not seem to extrapolate from the given information, but seem to color their judgments based on the general belief that most other people are self-interested.

Research Overview and Hypotheses

Taken together, previous research shows that social judgments about unknown people in general (e.g., is she a nice person) and predictions about unknown people's behavior (e.g., does she donate blood only if a financial incentive is given) tend to be driven by a belief in other people's self-interest. Previous research also shows that specific judgments about unknown people's overt behavior also tend to be driven by self-interest. However, to the best of our knowledge, no research has examined whether or not these self-interest beliefs translate into self-interest behavior. Building on the idea that incompleteness of information forces people to include factors beyond strategy consideration (such as tit-for-tat) into their decision-making, such as the belief in others self-interest, we advanced the basic *incompleteness effect* hypothesis that with greater incompleteness of information, participants would cooperate less with their partner (Hypothesis 5.1).

Furthermore, we examined whether incompleteness of information might have somewhat different effects on those who behave in a generous versus stingy manner. Given our assumption that people tend to rely on beliefs in other people's self-interest, the observation of generosity is more conflicting with the observer's a priori beliefs than the observation of stinginess. People might fill in the blanks (i.e., the lacking information) with self-interest, and people need more instances of generous behaviors to believe that the other is indeed generous than they need instances of stingy behaviors to believe that the other is indeed stingy. Thus, we hypothesized that the more cooperation the partner seeks to attain, the more incompleteness of information reduces participants' cooperation (Hypothesis 5.2).

The second set of hypotheses tested the idea that general evaluations about the partner, referred to as the impressions of benign intent, are also influenced by incompleteness of information. Prior research has demonstrated that people explain other people's behavior too much by personality traits, while underestimating the role of situational variables (see fundamental attribution error; Ross 1977; correspondence bias; Jones, 1990). Therefore, people may explain partners' behavior (e.g., noncooperation) by means of their traits (e.g., a stingy person) while overlooking the possibility that behavior might be influenced merely by incompleteness of information (e.g., noncooperation triggered by the situation as much as the person). Because behavior and benign impression should be influenced by incompleteness of information in a corresponded manner, we advanced similar incompleteness effect hypotheses also for benign impressions. We predicted that with greater incompleteness of information, participants would form less benign impression of their partner (Hypothesis 5.3). And finally, we predicted that the more cooperation the partner seeks to attain, the more incompleteness of information reduces participants' impressions on their partner's benign intent (Hypothesis 5.4).

The hypotheses were tested in two different paradigms in which incompleteness versus completeness of information was manipulated in different ways. The first paradigm—the *dice paradigm*—is a dyadic resource allocation task in which the participant and another person (referred to as *the other*) take turns in rolling two dice and allocating them between the two (see Vuolevi & Van Lange, 2010). Participants are provided with either partial or full information about the other's dice allocations that produce points for both the participant and the other. The second paradigm—the *coin paradigm*—is a new paradigm involving an allocation task in which incompleteness of information is manipulated by providing a smaller or a larger sample of information about the other's actual allocation of coins. Thus, in the first paradigm participants have complete information about the outcomes they receive (i.e., behavior), but only incomplete information about the partner's choice options (i.e., the situation). In the second paradigm participants have complete information about the partner's choice options (i.e., the situation), but incomplete information about which of

these known options the partner had actually chosen (i.e., the behavior). Thus, the present research seeks to demonstrate that the effects of incomplete information on cooperation are quite general and largely independent of the way in which incomplete information is manipulated.

Experiment 5.1

Method

Participants and design. The participants were 280 North American students (97 men, 183 women) with an average age of 24.5 years ($SD = 7.12$). The computerized experiment was administrated over the internet and all materials were displayed on participants' web-browsers. The experiment was a 3 (partner's strategy: stingy vs. fair vs. generous) \times 3 (type of information provided: both outcomes vs. own outcome vs. vs. the other's outcome shown) \times 6 (blocks of trials) design with the latter being a within-participant variable.

Procedure. The dice rolling paradigm was an interaction-based, turn-taking task between the participant and another person—the other—who was described as another participant, but whose behavior was in fact controlled by a computer. The dice-rolling paradigm consisted of six rounds of rollings of two dice, each six-sided with values ranging from 1 to 6. The dice values produced points for both the participant and the other, and the participants were told that these points have value: "The more points you accumulate the better for you and the more points the other accumulates, the better for him or her". Participants were first displayed that the other would roll two dice and allocate one of them to himself or herself, and another one to the participant. After each allocation, the participant would only see the value of the die the other allocated to the participant, the value of the die the other allocated to himself or herself, or the values of both dice—a variable that was manipulated between-participants. After the participant was presented with either incomplete or complete information about the other's dice allocation, the participant in turn rolled and allocated the two dice—one of them to himself or herself, and another one to the other.

The interaction sequence was repeated six times. Each round the participant first observed the other's dice rollings and allocations, followed by the participant's own dice rollings and allocations. We controlled for the other's rollings and allocations in that the shown dice values averages were 2.67 (consisting of values 1, 2, 2, 3, 4 and 4), 3.5 (consisting of values 1, 2, 3, 4, 5 and 6) and 4.33 (consisting of values 3, 3, 4, 5, 5 and 6). For example, participants in the stingy-and-own information condition received the dice values of 2.67 on average (i.e., the other allocated lower outcomes to the participant), and the other in the stingy-and-other's information condition received the dice values of 4.33 on average (i.e., the other allocated higher outcomes to oneself). The dice values the other allocated to the participant and himself or herself across nine

experimental conditions are presented in Table 5.1. To make sure that all participants faced the very same allocation decisions, we also controlled for participants' own dice rollings. Six rollings produced the following pairs of dice values in a random order: 1 & 2, 1 & 3, 2 & 3, 4 & 5, 4 & 6, and 5 & 6. As a dependent measure, we calculated the mean value of the die the participant allocated to the other and normalized this value between 0 and 1. This normalized measure of cooperation gets the value of zero if the participant always allocates the lower-valued of the two dice to the other. Likewise, if the participant always allocates the higher-valued die to the other, the normalized cooperation gets the value of one.

Table 5.1: The average outcome the other allocated to the participant (Self) and oneself (Other) across nine experimental conditions, in Experiment 5.1

Information manipulation:		Both dice shown	Own dice shown	Other's dice shown
The other's strategy:	Stingy	Self: 2.67 points	Self: 2.67 points	Self: not shown
		Other: 4.33 points	Other: not shown	Other: 4.33 points
	Fair	Self: 3.5 points	Self: 3.5 points	Self: not shown
		Other: 3.5 points	Other: not shown	Other: 3.5 points
	Generous	Self: 4.33 points	Self: 4.33 points	Self: not shown
		Other: 2.67 points	Other: not shown	Other: 2.67 points

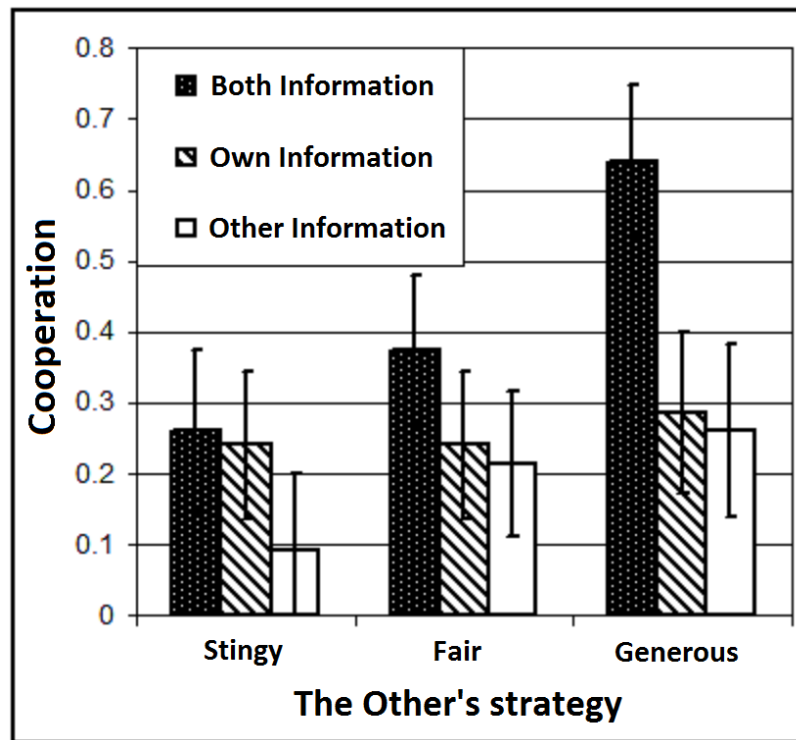
After completing the dice task, the participants filled out 10 items assessing impressions of benign intent during the dice task (Van Lange et al., 2002). Positive items were "The other was...generous, nice, forgiving, kind, trustworthy," and negative items were "The other was...self-centered, greedy, competitive, stingy, revengeful, selfish" (Cronbach's $\alpha = .883$). Participants could indicate how much they agreed with these statements on scales ranging from 1 (*not at all*) to 7 (*very much*).

Results

Cooperation. Based on six trials we calculated the mean value of the die the participant allocated to the other and normalized its value between 0 and 1. Normalized cooperation was analyzed in a 3 (the other's strategy: stingy vs. fair vs. generous) \times 3 (information: own die vs. other's die vs. both dice shown) analysis of variance. The analysis revealed a main effect of strategy, indicating that, consistent with the tit-for-tat

principle, participants who were paired with the generous interaction partner cooperated more ($M = 0.41$, $SD = 0.39$) than participants who were paired with the fair interaction partner ($M = 0.27$, $SD = 0.29$), or with the stingy interaction partner ($M = 0.20$, $SD = 0.29$), $F(2, 271) = 9.24$, $p < .001$, $\eta^2 = .064$. The analysis revealed a main effect of information, indicating that participants who were given information on their own and the other's outcomes exhibited greater cooperation ($M = 0.43$, $SD = 0.39$) than did participants who were only given information on their own outcome ($M = 0.25$, $SD = 0.29$), or the other's outcome ($M = 0.19$, $SD = 0.27$), $F(2, 271) = 14.52$, $p < .001$, $\eta^2 = .097$. This supports the incompleteness effect hypothesis predicting that with greater incompleteness of information, participants would cooperate less with their partner (Hypothesis 5.1).

Figure 5.1: Cooperation as a function of the other's strategy (stingy vs. fair vs. generous allocations) and the information manipulation (own dice shown vs. both dice shown vs. the other's dice shown), in Experiment 5.1. The 95% confidence intervals are presented in line-graphs.



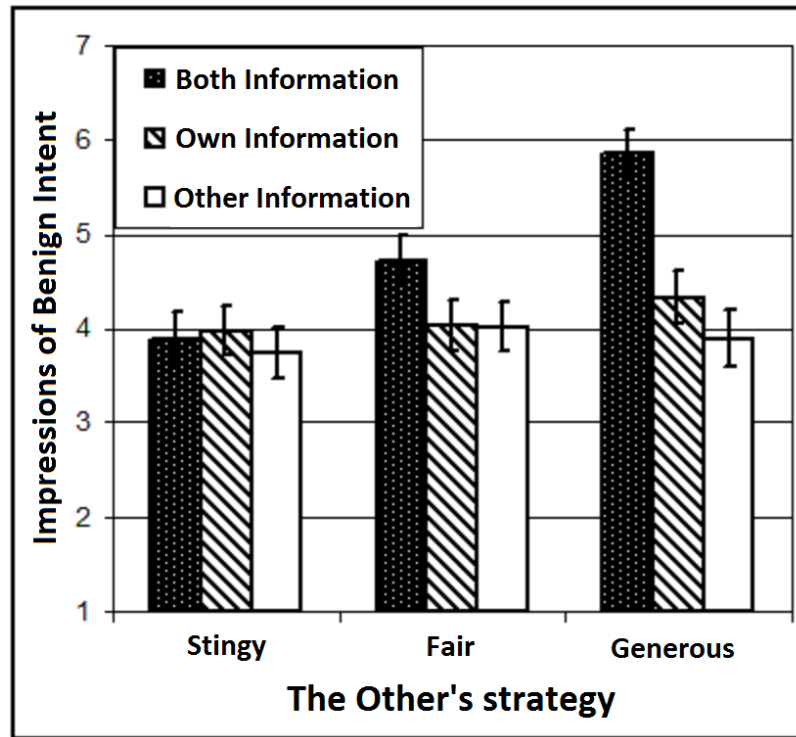
The analysis also revealed a two-way interaction between the other's strategy and the information manipulation $F(4, 271) = 2.70$, $p = .031$, $\eta^2 = .038$. The pattern

presented in Figure 5.1 reveals that the difference in cooperation between the complete information condition (i.e., both dice shown) and the incomplete information conditions (i.e., own dice shown or the other's dice shown) is greater to the degree that the partner behaves a more generous (vs. stingy) manner. This supports the hypothesis that the more cooperation the partner seeks to attain, the more incompleteness of information reduces participants' cooperation (Hypothesis 5.2).

Impressions of benign intent. Impressions of the other's benign intent were analyzed in 3 (the other's strategy: stingy vs. fair vs. generous) \times 3 (information: own die vs. other's die vs. both dice shown) analysis of variance. The analysis revealed a main effect of strategy, indicating that participants who were paired with the generous interaction partner judged their partner's intentions as more benign ($M = 4.78$, $SD = 1.17$) than participants who were paired with the fair interaction partner ($M = 4.24$, $SD = 0.70$), or with the stingy interaction partner ($M = 3.88$, $SD = 0.87$), $F(2, 271) = 24.65$, $p < .001$, $\eta^2 = .154$. The analysis revealed a main effect of information, indicating that participants who were given information about their own outcomes and other's outcomes judged their partner's intentions as more benign ($M = 4.86$, $SD = 1.13$) than participants who were only given information about their own outcome ($M = 4.10$, $SD = 0.69$) or the other's outcome ($M = 3.80$, $SD = 0.83$) $F(2, 271) = 35.78$, $p < .001$, $\eta^2 = .209$. This supports the hypothesis that with greater incompleteness of information, participants would form less benign impression of their partner (Hypothesis 5.3).

Finally, the analysis revealed a two-way interaction between the other's strategy and the information manipulation $F(4, 271) = 12.70$, $p < .001$, $\eta^2 = .158$. The pattern presented in Figure 5.2 reveals that the difference in benign impressions between the complete information condition (i.e., both dice shown) and the incomplete information condition (i.e., own dice shown or the other's dice shown) is greater the more generous versus stingy the partner really is. This supports the hypothesis that the more cooperation the partner seeks to attain, the more incompleteness of information reduces participants' impressions of their partner's benign intent (Hypothesis 5.4).

Figure 5.2: Benign impressions as a function of the other's strategy (stingy vs. fair vs. generous) and the information manipulation (own dice shown vs. both dice shown vs. the other's dice shown), in Experiment 5.1. The 95% confidence intervals are presented in line-graphs.



Mediation by benign impressions. The above analyses revealed similar main and interaction effects for cooperation and for impressions of benign intent. Moreover, we found a significant correlation between cooperation and impressions of benign intent ($r = .48, p < .001$). These findings support our goal to explore whether impressions of benign intent might plausibly serve as a mediator for the determinants of cooperation (i.e., the main effect of incompleteness of information and the interaction effect of information and the other's strategy). At the outset, we should note that this analysis can only provide preliminary evidence, because the mediator (i.e., benign impressions) was assessed after the dependent variable (i.e., cooperation).

Hence, we examined whether impressions of benign intent would reduce the effects of the strategy and information manipulations on cooperation. For this analysis, we coded the other's strategy as -1, 0, and +1 for the stingy, fair, and generous conditions, respectively. For the information manipulation we computed a contrast between complete and incomplete information. Thus, we coded the complete

information condition (in which both dice were shown) as +2, and the own dice and the other's dice conditions both as -1. We found that when benign impression were added as a predictor, the main effect of information dropped from $B = 0.067$, $t(278) = 5.13$, $p < .001$ to $B = 0.033$, $t(278) = 2.41$, $p = .017$. The main effect of strategy dropped from $B = 0.099$, $t(278) = 4.28$, $p < .001$ to $B = 0.047$, $t(278) = 1.97$, $p = .050$. Finally, the interaction effect dropped from $B = 0.046$, $t(278) = 2.85$, $p = .005$ to $B = 0.011$, $t(278) = 0.64$, *ns*. Sobel tests revealed that all these three effects were mediated by benign intentions: The main effect of information on cooperation, $Z = 5.66$, $p < .001$, the main effect of strategy on cooperation, $Z = 6.13$, $p < .001$, and their interaction on cooperation, $Z = 5.55$, $p < .001$, were mediated by benign impressions.

Experiment 5.2

Experiment 5.1 provided good support for the hypothesized incompleteness effect—that with greater incompleteness of information, individuals cooperate less with their partner (Hypothesis 5.1). We also found, consistent with Hypothesis 5.2, that the detrimental effects of incompleteness of information were most pronounced for the generous partner, followed by the tit-for-tat partner, and least pronounced for the stingy partner. Finally, the experiment demonstrated that impressions of the partners' intent were judged as less benign under incompleteness of information, and that this effect was more pronounced for partners who apply generous strategies (evidence in support of Hypotheses 5.3 and 5.4).

Experiment 5.2 extended Experiment 5.1 in several important respects. First, we designed a new paradigm (the coin paradigm) in which we could measure the effects of incomplete behavioral information. That is, in contrast to the dice-rolling paradigm, participants in Experiment 5.2 had complete information about the partner's choice options (i.e., the situation), but incomplete information about which of these known options the partner had actually chosen (i.e., the behavior). Each turn, the partner allocated between 0 and 16 coins to the participant, who only got to see a subset of the overall allocation (e.g., that the partner allocated 3 coins to the participant and 5 to the self, and 8 coins were unknown). Thus, the fewer coins the participant sees, the more the partner's overall allocation of 16 coins is characterized by incompleteness of information.

The coins the participant and the partner allocated were more valuable for the interaction partner than for the person who allocated the coins. Hence, we provided an incentive for mutual cooperation, but at the same time, noncooperation would provide better personal short-term outcomes. These characteristics—conflicting interest but high enough interdependence that mutual cooperation is promoted—are identical to the prisoner's dilemma, which is the best-known dilemma in social and behavioral sciences (Rapoport & Chammah, 1965; Tucker, 1950). In fact, the coin paradigm is a game of

16 prisoner's dilemma games played in parallel: Cooperation is the number of cooperative choices in 16 games and incompleteness of information is manipulated by means of unknown vs. known outcomes in those individual games.

Second, Experiment 5.2 used more realistic strategies for the interaction partner than did Experiment 5.1, in which the partner was programmed to pursue a stingy, fair, or a generous strategy in a perfectly unconditional manner—independent of the participant's behavior. In Experiment 5.2, the partner's behavior was anchored to the participant's behavior, and the partner was programmed to pursue a variant of tit-for-tat, a strategy that makes a little less cooperative (i.e., stingy tit-for-tat), equally cooperative (i.e., tit-for-tat), or a little more cooperative (i.e., generous tit-for-tat) choice than the participant did in the previous trial (e.g., Axelrod, 1984, Kollock, 1993; Nowak & Sigmund, 1992; Van Lange et al., 2002). Prior research has shown that many people use a variant of tit-for-tat in their interactions in social dilemmas and related exchange situations (approximately 60% of the participants tend to follow tit-for-tat; see Klapwijk & Van Lange, 2009; Van Lange, 1999). Thus, when people make inferences about the tit-for-tat partner they make inferences about another person that is not only very realistic but also quite similar to the self.

Method

Participants and design. The participants of the computerized, laboratory experiment were 116 VU University students in the Netherlands (70 women, 46 men) with an average age of 20.47 years ($SD = 2.92$). The experiment was a 3 (the other's strategy: TFT-2, TFT, TFT+2) $\times 2$ (amount of information provided: low vs. high information) $\times 16$ (blocks of trials) design with the latter being a within-participant variable. After completing the experiment, the participants were debriefed and paid €3.5.

Procedure. The coin paradigm was a dyadic coin allocation task between the participant and another person, who was described as another participant, but whose behavior was in fact controlled by a computer. In the present experiment, the task consisted of 16 rounds of allocations of coins. In each round, first the participant and then the other allocated 16 coins between the two. The coins that the other allocated were square-shaped coins that were worth of two points for the participant, but only one point for the other. The coins that the participant allocated were round-shaped coins that were worth of two points for the other, but only one point for the participant. This way, the situation supported mutual exchange of square and round coins (i.e., mutual cooperation).

Each round started with the participant's allocation of 16 coins. Following the tit-for-tat principle, the other's allocation was anchored to the participant's allocation in that round. Three different versions of TFT were used: The other allocated two coins less than the participant (TFT-2), the same number of coins than the participant (TFT),

or two coins more than the participant (TFT+2). Participants were provided with incomplete information about the partner's allocation of coins. Out of 16 coins in total the partner allocated each round, the participant was able to see a subset of 2 or 14 coins—a variable that was manipulated between-participants. After each allocation, the participants were presented with 16 blank coins, and they could click any coin they wanted. After clicking a coin the text “Your Coin” or “The Other’s Coin” appeared on the coin, indicating that the other had allocated that particular coin either to himself or herself, or to the participant. After clicking and observing the allocation of 2 or 14 coins, the interaction proceeded to the next round and to the participant's allocation.

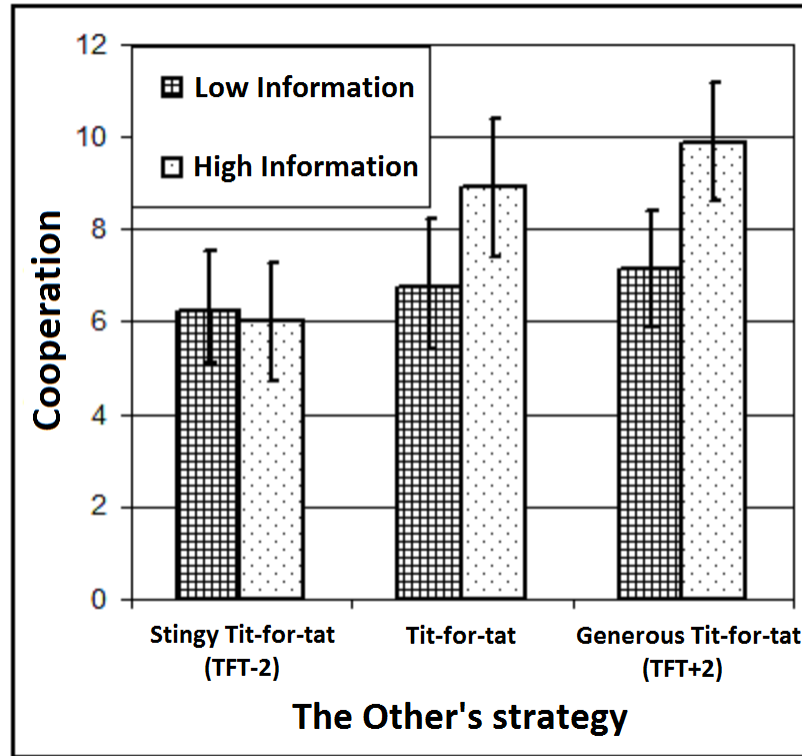
After the coin task, the participants filled out 10 items assessing the impressions of the partner's benign intent (Cronbach's $\alpha = .853$). This scale is described in detail in Experiment 5.1.

Results

Cooperation. Based on 16 trials we calculated the mean number of coins the participant allocated to the other and analyzed it in a 3 (the other's strategy: TFT-2 vs. TFT vs. TFT+2) \times 2 (amount of information provided: low vs. high information) analysis of variance. The analysis revealed a main effect of strategy, indicating that, consistent with the tit-for-tat principle, participants in the TFT+2 condition cooperated more ($M = 8.44$, $SD = 3.00$) than participants in the TFT ($M = 7.70$, $SD = 3.22$) or the TFT-2 conditions ($M = 6.13$, $SD = 2.64$), $F(2, 110) = 7.92$, $p = .001$, $\eta^2 = .126$. The analysis revealed a main effect of information, indicating that participants in the high information condition cooperated more ($M = 8.20$, $SD = 3.23$) than participants in the low information ($M = 6.68$, $SD = 2.84$), $F(1, 110) = 8.62$, $p = .004$, $\eta^2 = .073$. This supports the incompleteness effect hypothesis that with greater incompleteness of information, participants would cooperate less with their partner (Hypothesis 5.1).

Finally, the analysis revealed a two-way interaction between the other's strategy and the information manipulation $F(2, 110) = 3.31$, $p = .040$, $\eta^2 = .057$. The pattern presented in Figure 5.3 reveals that the difference in cooperation between the high information condition and the low information condition is greater the more generous (TFT+2) versus stingy (TFT-2) version of tit-for-tat the partner applies. This supports the hypothesis that the more cooperation the partner seeks to attain, the more incompleteness of information reduces participants' cooperation (Hypothesis 5.2).

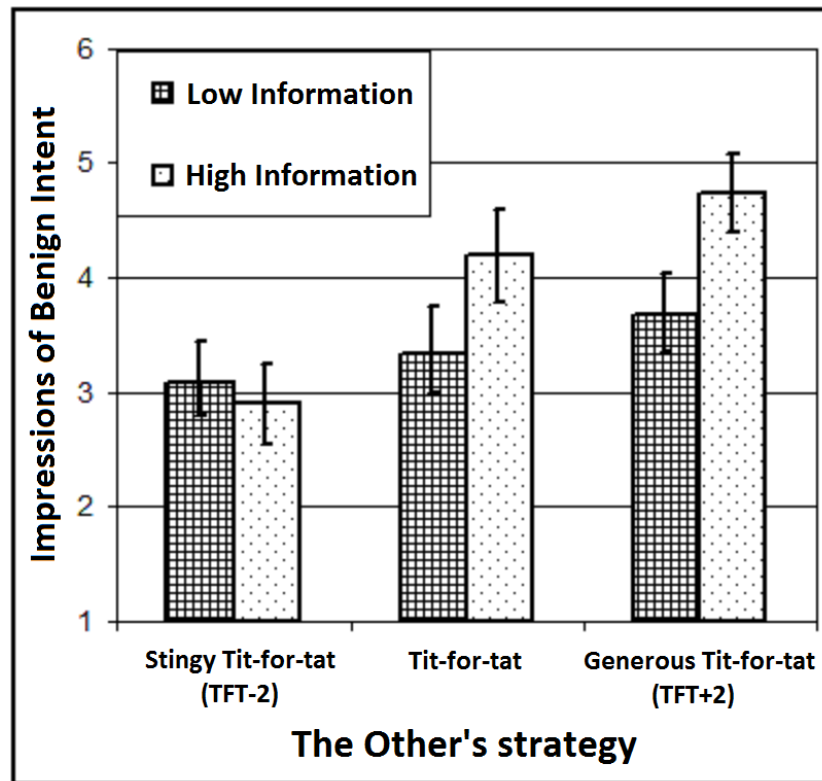
Figure 5.3: The mean number of coins (out of 16) the participant allocated to the other as a function of the other's strategy (stingy tit-for-tat vs. tit-for-tat vs. generous tit-for-tat) and the information manipulation (low vs. high information), in Experiment 5.2. The 95% confidence intervals are presented in line-graphs.



Impressions of benign intent. Impressions of the other's benign intent were analyzed in a 3 (the other's strategy: TFT-2 vs. TFT vs. TFT+2) \times 2 (amount of information provided: low vs. high) analysis of variance. The analysis revealed a main effect of strategy, indicating that participants who were paired with the TFT+2 partner judged the other's intentions as more benign ($M = 4.20$, $SD = 0.83$) than participants who were paired with the TFT partner ($M = 3.77$, $SD = 0.77$) or with the TFT-2 partner ($M = 3.00$, $SD = 0.91$), $F(2, 110) = 27.34$, $p < .001$, $\eta^2 = .332$. The analysis also revealed a main effect of information, indicating that participants in the high information condition judged the other's intentions as more benign ($M = 3.94$, $SD = 1.19$) than participants in the low information condition ($M = 3.37$, $SD = 0.67$), $F(1, 110) = 16.01$, $p < .001$, $\eta^2 = .127$. This supports the hypothesis that with greater incompleteness of information, participants would form less benign impression of their partner (Hypothesis 5.3). Finally, the analysis revealed a two-way interaction between the other's strategy and the information manipulation, $F(2, 110) = 7.93$, $p = .001$, $\eta^2 =$

.126. The pattern presented in Figure 5.4 reveals that the difference in benign impressions between the high information condition and the low information condition is greater the more generous (TFT+2) versus stingy (TFT-2) version of tit-for-tat the partner applies. This supports the hypothesis that the more cooperative the partner is the more cooperation the partner seeks to attain, the more incompleteness of information reduces participants' impressions of their partner's benign intent (Hypothesis 5.4).

Figure 5.4: Benign impressions as a function of the other's strategy (stingy tit-for-tat vs. tit-for-tat vs. generous tit-for-tat) and the information manipulation (low vs. high information), in Experiment 5.2. The 95% confidence intervals are presented in line-graphs.



Mediation by benign impressions. In the above analyses, similar main and interaction effects were observed both for cooperation and for impressions of benign intent. Moreover, we found a moderate correlation between cooperation and impressions of benign intent other ($r = .62, p < .001$). These findings support our goal to explore whether impressions of benign intent might plausibly serve as a mediator for

the determinants of cooperation (i.e., the main effect of incompleteness of information and the interaction effect of information and the other's strategy). As in Experiment 5.1, we should note that this analysis can only provide preliminary evidence, because the mediator (i.e., benign impressions) was assessed after the dependent variable (i.e., cooperation).

Hence, we examined whether impressions of benign intent would reduce the effects of the strategy and information manipulations on cooperation. For this analysis, we coded the strategy manipulation as -1, 0, and +1 for the TFT-2, TFT, and TFT+2 conditions, respectively. We coded the information manipulation as -1 and +1 for the low and high information conditions, respectively. We found that when benign impression were added as a predictor, the main effect of information dropped from $B = 0.751$, $t(114) = 2.86$, $p = .005$ to $B = 0.254$, $t(114) = 1.04$, *ns*. The main effect of strategy dropped from $B = 1.198$, $t(114) = 3.88$, $p < .001$ to $B = 0.093$, $t(114) = 0.28$, *ns*. Finally, the interaction effect dropped from $B = 0.754$, $t(114) = 2.44$, $p = .016$ to $B = 0.187$, $t(114) = 0.65$, *ns*. Sobel tests revealed that all these three effects were mediated by impressions of benign intent: The main effect of information on cooperation, $Z = 3.50$, $p < .001$, the main effect of strategy on cooperation, $Z = 5.53$, $p < .001$, and their interaction on cooperation, $Z = 3.43$, $p < .001$, were mediated by impressions of benign intent.

General Discussion

In the present research we examined cooperation in dyadic interactions. We advanced a new framework which posits that cooperation is importantly affected by incompleteness of information about the partner's previous cooperation. When people have complete information on one another's behavior, people may develop cooperation through the effective use of tit-for-tat, as previous research has demonstrated (e.g., Axelrod, 1984; Gouldner, 1960; Kollock, 1993; Komorita & Parks, 1995; Nowak & Sigmund, 1992, 2005; Trivers, 1971; Van Lange et al. 2002). When people have only incomplete information about one another's behavior, tit-for-tat becomes accompanied by the incompleteness effect. The hypothesized incompleteness effect is based on people's tendency to overestimate others' self-interest, which has been reported in various literatures (see Miller & Ratner, 1996, 1998; Allison et al., 1989; Van Lange & Sedikides, 1998; Vuolevi & Van Lange, 2010), but which behavioral implications have not yet been examined. We posited that this general overestimation of others' self-interest makes people attribute too much self-interest to partners' specific behaviors and to respond less cooperatively than the tit-for-tat principle would dictate (i.e., cooperate less than the partner actually did).

Two experiments provided good support for the incompleteness effect—that with greater incompleteness of information, participants cooperate less with their partner

(Hypotheses 5.1). We also manipulated the interaction partner's cooperation and found that the more cooperation the partner seeks to attain, the more incompleteness of information reduces participants' cooperation (Hypotheses 5.2). Thus, detrimental effects of incomplete information were not compensated by generosity. Instead, the more cooperation one tries to communicate the more that behavior is filtered through self-interest beliefs, which effectively diminish the benefits generosity in social interactions with incomplete information.

These detrimental effects of incomplete information were found across two complementary manipulations of incompleteness of information: When participants had incomplete outcome information regarding one of the two outcomes (i.e., incomplete situational information, in Experiment 5.1), and when participants had complete situational information (i.e., choice options), but incomplete information about the partner's exact behavior (incomplete behavioral information, Experiment 5.2). Moreover, these effects were found when the partner used stingy, fair, and generous strategies in an unconditional manner (Experiment 5.1), and when the partner's behavior was anchored to the participant's own behavior (stingy tit-for-tat vs. tit-for-tat vs. generous tit-for-tat, in Experiment 5.2)

Both experiments also revealed that with greater incompleteness of information, participants form less benign impression of their partner (Hypothesis 5.3). Similar to the findings observed for cooperation, the more cooperation the partner seeks to attain, the more incompleteness of information reduces participants' impressions on their partner's benign intent (Hypothesis 5.4). Supplementary analyses revealed that in both experiments, the detrimental effects of incomplete information on cooperation were mediated by benign impressions of the partner. As noted earlier, the evidence for mediation should be considered preliminary—one reason being that the presumed mediator was assessed after the presumed criterion measure. Nevertheless, these findings plausibly underscore the vulnerability of cooperation under incompleteness of information: If people erroneously perceive their partner's behavior as noncooperation, and form their impressions accordingly (e.g., she is unkind), and act upon it (e.g., I do not cooperate), the mere presence of incomplete information in the beginning may have a long lasting detrimental effect on mutual cooperation.

The mediational model suggesting that incompleteness of information reduces cooperation because people underestimate their partners' cooperation has important implications to social interactions. One could argue that the mechanism by which incompleteness of information influences cooperation is that uncertainty about the outcomes elicits self-protection motives (cf. prevention focus; see Higgins, 1997) and make people try to avoid bad outcomes rather than to obtain good ones (cf. prospect theory; see Kahneman & Tversky, 1979; see also Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001). This line of reasoning would predict lower cooperation under incompleteness of information, but no impact on benign impression of the partner. The

second mechanism—supported by our data—is that incompleteness of information indirectly influences cooperation by changing the way in which people interpret their partner’s cooperation. Because perceived cooperation and impressions that people form on their partners are presumably interrelated, this line of reasoning would predict lower cooperation as well as less benign impressions under incompleteness of information. This pattern was indeed found in both experiments, including full mediation in Experiment 5.1 and partial mediation in Experiment 5.2, which suggests that that incompleteness of information does not necessarily make people more self-interested directly, but that people become more self-interested indirectly because they overestimate their partner’s self-interest.

Our findings have important implications to interdependence theory (Kelley & Thibaut, 1978). Incompleteness of information has been recently added to one of the basic structural properties of interdependence theory (Kelley et al., 2003; Rusbult & Van Lange, 2003), but the role of incompleteness of information has not been elaborated in detail. Here, we develop these ideas in two different ways. First, we make a distinction between behavioral and situational incompleteness of information and demonstrate that they have similar negative effects on cooperation in social interactions. Second, we demonstrate the importance of transformational information—information relevant general strategies that people use across social situations. Under incomplete behavioral or situational information, people make errors in inferring their partner’s transformations (e.g., view their partner’s as more stingy). This can have a crucial impact for future interactions, because erroneously perceived transformations may influence people’s own willingness for cooperative transformations.

To the authors’ knowledge, no prior research has assessed cooperation as a function of mere information availability. One novel aspect of our work is that incompleteness of information (e.g., the extent to which incoming information is reliable) is manipulated orthogonally from the valence of information (e.g., the extent to which the partner is cooperative vs. noncooperative). In previous research the two are often operating in concert. For example, a large body of evidence shows that communication with the interaction partner increases cooperation (for a review, see Balliet, 2010). The exact underlying mechanism for this effect is not known, yet it is quite plausible to think that in such first time meetings, people are more likely to display positive rather than negative information about them. Therefore, in our view, previous communication experiments demonstrate that the combined effect of more information and positive valence increase cooperation. Our research contributes to this body of literature the notion that the mere incompleteness of information, while keeping its valence constant, is enough to undermine cooperation.

A few studies have manipulated information in a binary manner and compared complete information to no information at all. In a classic experiment by Shafir and Tversky (1992), participants played a single-shot prisoner’s dilemma game while

knowing or not knowing the partner's choice (i.e., no choice shown, vs. cooperation shown vs. defection shown). Participants cooperated more when the partner's choice was not shown, compared to the average cooperation when the partner's cooperation or defection was shown. Further research demonstrated that high cooperation without knowing the partner's behavior might be caused by illusion of control. Indeed, the original results were replicated when participants thought that the partner would make the choice in the future, but not replicated when participants were told that the partner had already made the choice (Morris, Sim, & Giretto 1998). In our experiments participants were shown part of the partner's behavior, thus it was clear that the behavior had already happened and could not be influenced. A special feature of incomplete information is that it anchors the event firmly in the past, whereas no-information allows more abstract and perhaps positively biased thought processes, such as the illusion of control. Thus, from the perspective of eliciting mutual cooperation, the condition of very little information might be more challenging than complete information or no information at all.

Our findings are related to previous work on noise, defined as the discrepancy between actual and intended outcomes (Klapwijk & Van Lange, 2009; Van Lange et al., 2002). This work has demonstrated that cooperation declines when the actual outcomes are altered from the intended ones, but also that generosity is quite effective at reducing or overcoming the detrimental effects of noise. This previous research is consistent with our research in that both noise and incomplete information undermine cooperation. However, there are intriguing differences as well. Generosity helps one to cope with noise in social interactions, but generosity is not effective as a communication tool for coping with incompleteness of information. How can we reconcile these seemingly inconsistent findings?

In the noise paradigms, participants were typically able to communicate their cooperation, and such communication was not challenged by incompleteness of information. Moreover, generosity was communicated at each interaction. These qualities serve the important function that generosity is communicated clearly and consistently (Van Lange et al., 2002; see also Rumble, Van Lange, & Parks, 2010). By contrast, the drawback of incompleteness of information, as we have seen in two experiments, is that people are not able to communicate their generosity in a persuasive manner—because there is so much missing information that people are likely to fall prey to their persistent belief in other people's self-interest. A complementary explanation is that when noise is present, one knows the exact outcomes, but does not know the partner's precise intentions. When incompleteness of information is present, one does not know the exact outcomes, or the partner's intentions. Thus, incomplete information might have a more fundamental impact on cooperation because it influences the outcomes one observes and receives (e.g., did I receive good or bad outcomes), not just the intentions (e.g., is the partner generous or stingy). The

important lesson we learned from the present research is that the belief in self-interest can drastic implications for how well good intentions can be communicated.

We propose that future research could examine in detail the way in which incomplete information versus noise influence dyadic cooperation. Our reasoning, based on tit-for-tat principle and the incompleteness effect, would also be quite easy to incorporate into the evolutionary framework, which could hopefully shed more light on the functional side of self-interest assumptions. The development of different interpersonal relationships would also provide a very interesting avenue for future research. In the present research we examined interaction with strangers, but it is quite possible that in ongoing relationships, for instance, people do not necessarily assume self-interest (e.g., in communal relationships, Clark & Mills, 1993; Rusbult & Van Lange, 2003). Conversely, even more self-interest might be assumed from groups, or from representatives of groups, as people think more positively about persons than about groups (e.g., Insko & Schopler, 1998; Sears, 1983). More generally, beliefs in different contexts (e.g., when to assume self-interest vs. when to give the benefit of the doubt), and their influence on behavior in various types of interpersonal relationships, would provide a more comprehensive picture on how beliefs and incomplete information operate in concert in dyadic interactions.

Chapter 6

General Discussion

Humans are interdependent on one another. Behaviors influence others' well-being in many interpersonal relationships (e.g., friends or romantic partners), but even perfect strangers are sometimes interdependent (e.g., asking directions; giving a seat for an elderly person in a tram). Interdependent individuals may benefit or hurt each other by their behaviors. Especially diagnostic are situations that are characterized by a conflict of interest, because individuals must decide whether to pursue self-interest or other-interest in those situations.

Often people choose to cooperate—go beyond their self-interest to benefit another person or collective. Cooperation has been a major puzzle in social sciences, because forfeiting one's self-interest does not fit very well into classic economic theories of rational behavior. From the perspective of the dyad or collective the benefits of cooperation are quite evident: Mutual cooperation gives the best combined outcomes in the prisoner's dilemma; a group of hunters might benefit from sharing their preys with one another because one hunter might not be successful for long time and big animals would get spoiled anyways; colleagues would benefit from sharing their tasks according to expertise. But from the individual perspective cooperation is always costly: Defection gives the best individual outcomes in the prisoner's dilemma regardless what the other player does; a hunter would be better off individually without sharing his pray; helping colleagues costs time and potentially reduces time available for individual goals. Thus, from the perspective of the collective everybody should cooperate whenever it is mutually beneficial, but from the perspective of the individual people should not cooperate.

Evolutionary simulations, along with experimental data, show that human cooperation is conditional (Axelrod, 1984; Gouldner, 1960; Kollock, 1993; Komorita & Parks, 1995; Nowak & Sigmund, 1992, 2005; Trivers, 1971; Van Lange et al. 2002). People cooperate, and ought to cooperate, with those who cooperate with them. Conditional cooperation is clearly the best strategy in both worlds: It provides the best combined benefits with those who want to cooperate, but it also provides a protection against those who try to obtain the best individual outcomes by not cooperating. But this benefit comes with a cost: Compared to unconditional cooperation or unconditional noncooperation, conditional strategies require information about the partner's previous behaviors.

This dissertation is rooted in the idea that conditional cooperation is not always directly applicable. When people have only incomplete information about their partner's behaviors, they can no longer rely on simple conditional rules such as tit-for-tat alone. Before conditional cooperation can be applied, people need to fill-in the

blanks in information (e.g., estimate the partner's cooperation). Thus, cooperation in interactions with incomplete information is determined by behavioral strategies (e.g., tit-for-tat) as well as psychology relevant to inferring the partner's cooperation. As such, the present dissertation connects two major literatures: The one relevant to interpersonal strategies discussed before (e.g., tit-for-tat) and the other relevant to interpersonal beliefs, expectancies, and impressions (Miller & Ratner, 1996, 1998; see also Epley, Caruso, & Bazerman, 2006; Messick, Bloom, Boldizar, & Samuelson, 1985; Vorauer & Sasaki, 2009).

The first half of this dissertation tested the idea that people use their self-interest beliefs to predict and evaluate other people's behaviors under incompleteness of information. The second half of this dissertation examined how self-interest beliefs influence cooperation and impressions in repeated interactions. The first subchapter of this general discussion summarizes the key contributions of each empirical chapter. The second one discusses general implications of the dissertation and presents a model for understanding dyadic cooperation under incompleteness of information. The third one reviews other relevant literatures and the fourth one discusses limitations and suggestions for future research. Finally, the fifth subchapter arrives to the main conclusion of this dissertation.

Summary of the Empirical Findings

Chapter 2 assessed motives that underlie other people's social behavior. Previous literature suggests that people's own social decisions are influenced by self-interest, altruism, and egalitarianism (Van Lange, 1999), but it is not clear whether people think that these motives influence others' social behavior the same way or not. Building on previous literature showing that people tend to overestimate self-interest in others (Miller & Ratner, 1996, 1998), people may underestimate unselfish motives such as altruism and egalitarianism in others' social behavior. Experiment 2.1 separated the three social motives from choice behavior and revealed that people expect that egalitarianism has a smaller impact on others' social decisions than it has on own social decisions. Experiment 2.2 demonstrated that people expect others to rate equal or nearly equal allocations as less positive than they rate such allocations themselves. Hence, Chapter 2 revealed that people make errors in predicting others in situation in which egalitarianism shapes own behavior.

Chapter 3 focused on judgments that people make on others' overt behavior. In the absence of any concrete information, people overestimate others' selfish motives and underestimate unselfish ones, in particular, egalitarianism (Chapter 2), but it is not clear whether this tendency holds when people observe and evaluate others' overt behavior. The key question is whether incomplete information on fair behavior corrects erroneous self-interest beliefs, or erroneous beliefs persist under incompleteness of

information. Experiments 3.1 and 3.3 revealed that under incompleteness of information, people use self-interest beliefs to predict the missing pieces of information. Self-interest guided judgments regarding others' present behavior (Experiments 3.1 and 3.3) and recall of past behavior (Experiment 3.3). Self-interest was assumed only for intentional behavior of other people. When people could not attribute intentionality or when allocations were made by a computer, no self-interest was assumed. Experiment 3.2 revealed that people indeed exhibit some degree of self-interest in their allocations, but the assumed level of self-interest is greater. Thus, people are somewhat accurate when they assume self-interest from others, but they overestimate the degree to which others actually behave according to self-interest.

Chapter 4 examined the role of self-interest beliefs in an interactional context. Chapter 3 demonstrated that people attribute too much self-interest to others, but it is not clear whether people respond with the same level of self-interest in return. Previous literature shows that people tend to cooperate conditionally (i.e., use tit-for-tat), but this pattern is demonstrated only when partners' have complete information on each other's behaviors. If partners have only incomplete information, they may fill-in the missing pieces of information with self-interest, and respond accordingly—in part based on their erroneous self-interest beliefs. Experiment 4.1 and 4.2 revealed that incompleteness of information leads to reduced estimations regarding the other's cooperation as well as lower levels of own cooperation. These detrimental effects of incomplete information were found when the other was programmed to behave in a fair manner (Experiment 4.1) or when the other followed tit-for-tat (Experiment 4.2). Complementary analyses revealed an explanation for this effect: Own cooperation was mediated by the partner's estimated cooperation, indicating that under incompleteness of information, people do not cooperate as much as the partner, but as much as they think that the partner has cooperated. Because perceived cooperation is less than actual cooperation, incomplete information reduces cooperation in dyadic interactions.

Chapter 5 first replicated the findings of Chapter 4. Two complementary incompleteness manipulations provided good support for the basic idea that with greater incompleteness of information, people cooperate less. Chapter 5 also extended this finding in two important ways. Experiments 5.1 and 5.2 manipulated the interaction partner's cooperation and revealed that the more cooperation the partner seeks to attain, the more incompleteness of information reduces participants' cooperation. This indicates that the detrimental effects of incomplete information cannot be compensated by generosity. Experiments 5.1 and 5.2 revealed that general impressions about the partner are also influenced by incompleteness of information: With greater incompleteness of information, participants formed less benign impression of their partner—the effect that was more pronounced for generous rather than stingy partners. Supplementary analyses revealed that the detrimental effects of incomplete information on cooperation were mediated by benign impressions of the

partner. These findings plausibly underscore the vulnerability of cooperation under incompleteness of information: If people erroneously perceive their partner's behavior as noncooperation, and form their impressions accordingly (e.g., she is unkind), and act upon it (e.g., I do not cooperate), the mere presence of incomplete information may have a long lasting detrimental effect on mutual cooperation.

Conditional Cooperation Revisited

Traditionally, experimental research on cooperation has relied on experimental games in which partners have complete information about each others' past behaviors and in which behaviors are always implemented without errors. General conclusions and existing models of cooperation reflect behavior under these conditions, but the validity of these conclusions in more realistic settings (e.g., including incompleteness of information or unintended errors) has not been addressed until the most recent research.

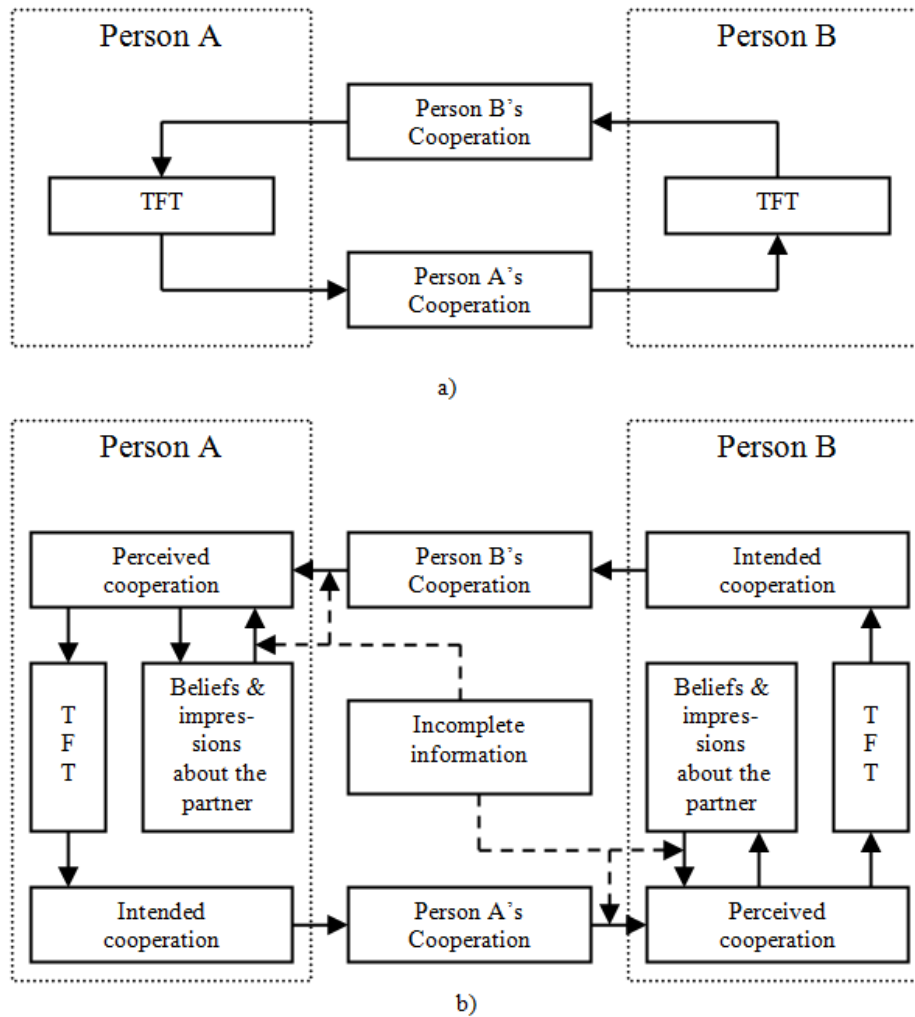
Figure 6.1a displays a dyadic interaction with two tit-for-tat partners—basic model that has been known for half of a century. Dashed boxes on left and right describe processes within two interdependent individuals: Person A and Person B. The middle part describes measurable behavior between Person A and Person B. In this model, both partners know each other's exact level of cooperation and respond accordingly (i.e., they use tit-for-tat). If Person A starts with cooperation, they will keep cooperating as long as the interaction continues.

The general implications of this dissertation do not contradict with this basic model supported in thousands of game theoretical experiments. Instead, they identify a boundary condition in which the model is valid. When people have only incomplete information on their partner's behaviors, they can no longer rely only on their partner's behavior and apply simple conditional rules such as tit-for-tat directly. Instead, beliefs and impressions about the partner also influence the way in which behaviors are evaluated and responded to.

Figure 6.1b displays the new model that explains cooperation with varying degrees of incompleteness of information. In comparison to the basic tit-for-tat model, people must first infer their partner's cooperation based on incomplete information and use their beliefs and impressions to fill-in the missing pieces of information (Chapters 2 and 3). Subsequently, people respond to others based on their inferred level of cooperation—people indeed use tit-for-tat but in the absence of complete information they rely on inferred rather than actual level of cooperation (Chapter 4). Finally, consistent with various attribution literatures (see fundamental attribution error; Ross 1977; correspondence bias; Jones, 1990), impressions about the partner are essentially determined by perceived cooperation (Chapter 5). This may have a long-lasting influence on mutual cooperation, because impressions may influence how subsequent

behaviors are perceived and responded to (e.g., behaviors of a person who is perceived as stingy might be evaluated even more self-interestingly).

Figure 6.1: The basic model for dyadic interaction with two tit-for-tat partners (a) and the corresponding model developed in this dissertation for explaining cooperation with varying degrees of incompleteness of information (b).



To conclude, the model developed in this dissertation is more general than previous models on conditional cooperation. The core aspect of the model is that the degree to which people have incomplete information about their partner's cooperation determines the extent to which behavior is based on actual information versus beliefs and impressions about the partner. This model highlights an important boundary

condition for conditional strategies: Self-interest beliefs influence perceived cooperation and own cooperation unless information is complete enough to override self-interest beliefs. Because many interactions in real life are characterized by incompleteness of information, the model is more ecologically valid and helps explaining reduced cooperation in situations in which mutual cooperation might be the preferred option.

Implications and Contributions

Besides general implications discussed before, this dissertation is connected to various lines of previous research. I will discuss these implications and contributions in this subchapter.

Noise

A closely related concept to incompleteness of information is noise—the discrepancy between intended and actual outcomes (Klapwijk & Van Lange, 2009; Van Lange et al, 2002). Sometimes behaviors do not come out as intended (e.g., arriving late to a meeting because of an unexpected traffic jam), and often people only have an access to the observed behavior, not necessarily to the intentions behind them (see Pronin, 2008). If people respond to the actual rather than intended cooperation, the level of cooperation is influenced by noise.

Noise is similar to incompleteness of information in that they both alter the link between intended and perceived cooperation. In particular, noise influences the link between intended and actual cooperation, whereas incompleteness of information alters the link between actual and perceived cooperation (see Figure 6.1b). Because of these similarities, it is not very surprising that noise reduces cooperation the same way as incompleteness of information does (Klapwijk & Van Lange, 2009; Van Lange et al, 2002).

There is also an important difference between the two constructs. When noise is present one knows the actual cooperation but does not know whether that level of cooperation was intended or not. When incompleteness of information is present one does not know the actual nor intended cooperation. Because intended cooperation cannot be accurately inferred without knowing the actual cooperation, intended cooperation is always influenced by incompleteness of information.

This difference may explain why generosity does not help for incompleteness of information, as demonstrated in this dissertation, but it does help for noise, as previous research has demonstrated (Klapwijk & Van Lange, 2009; Van Lange et al, 2002). The more generously one behaves under incompleteness of information the more self-interest beliefs reduce perceived cooperation and presumably perceived intentions as well. Noise, on the other hand, makes behaviors somewhat more or less cooperative

independently of the partner's level of cooperation. Thus, unlike incompleteness of information, incidents of noise do not intervene with communication of generous intentions and behaviors.

Interdependence Theory

Interdependence theory is a conceptual framework for understanding the basic features of social situations (Thibaut & Kelley, 1978; Rusbult & Van Lange, 1996, 2003). Originally, interdependence theory identifies four structural properties of interdependence: degree of dependence (i.e., independence vs. dependence), mutuality of dependence (i.e., equal vs. unequal dependence on one another), covariation of interest (i.e., corresponding vs. conflicting), and basis of dependence (i.e., cooperation vs. coordination). More recently, incompleteness of information has been incorporated to interdependence theory as one of its basic properties (Kelley et al, 2003).

Many ideas presented in this dissertation were initially introduced or at least inspired by Kelley et al (2003). However, the role of incomplete information, both conceptually and empirically, is examined more thoroughly in this dissertation. First, I identify that information regarding a specific social interaction can be incomplete in two distinct ways: People can have incomplete behavioral information (e.g., what did the partner exactly do) or incomplete situational information (e.g., what are my partner's outcomes associated with a particular behavior). In Chapter 5 I manipulate both types of incompleteness of information and arrive to the conclusion that they have similar detrimental effect on cooperation in social interactions.

Second, I demonstrate that people can have incomplete information about their partner's transformations (e.g., general tendencies towards cooperation vs. competition across social situations). Under incomplete behavioral or situational information, transformational information is almost always incomplete, and people have a tendency to attribute too much self-interest to others' transformations (i.e., self-interested behavioral attributions translate into self-interested dispositional attributions). This can have a long-lasting impact on cooperation, because self-interest beliefs about the partner's transformations may hamper even mutually preferred cooperation in subsequent interactions.

Trust

Trust is a psychological state comprising the intention to accept vulnerability based upon the positive expectations of the intentions or behavior of another (Rousseau, Sitkin, Burt, & Camerer, 1998). Generalized trust refers to trust in people in general and interpersonal trust refers to trust in a particular individual (Rotter, 1971).

In many ways, generalized trust and interpersonal trust are related to beliefs and impressions discussed in this dissertation. When people have no prior information, they must rely on generalized trust. Previous research has shown that people tend to

underestimate strangers' trustworthiness (Fetchenhauer & Dunning, 2009, 2010). This finding is closely related to the idea that people have self-interest beliefs about other people.

In repeated interactions people accumulate information on their partner's behavior. Now, with increasing amount of person-specific information people shift from generalized trust to interpersonal trust and cooperation is a key determinant in this process: Cooperative behaviors increase trustworthiness and vice versa (Klapwijk & Van Lange, 2009; Komorita & Parks, 1995; Van Lange et al, 2002). Previous research does not address trustworthiness evaluations under incompleteness of information, but it is quite possible that perceived cooperation is the key determinant rather than actual cooperation—similar to the finding that benign impressions are closely related to perceived rather than actual cooperation. If this is indeed the case, interpersonal trust may be difficult to build under incompleteness of information. In particular, very high levels of trust may not be possible to attain by generous behaviors.

Methodological Contributions

Paradigms used in this dissertation are either completely novel or significantly modified from existing ones. Experiment 2.1 used the ring measure of social values for disentangling self-interest, altruism and egalitarianism motives from choice behavior (Liebrand, Jansen, Rijken, & Suhre, 1986). In the present version of the paradigm participants made choices either on their own behalf, or on behalf of another person, which allowed comparing own and expected social motives.

Experiment 2.2 used the dictator game to compare own and expected social motives (Bolton, Katok, & Zwick, 1998). Instead of acting as allocators (i.e. dictators), participants evaluated the allocator's outcome allocations. This approach allowed to disentangle social motives from evaluative judgments and to compare own evaluations to the expected evaluations of others, similar to Experiment 2.1.

Experiments 3.1, 3.2, 3.3 and 5.1 used a novel paradigm—the dice rolling task—which measures expected cooperation under incompleteness of information. The core idea of the paradigm is that participants are given only partial information on the partner's behavior, and predictions regarding the missing pieces of information are conceptualized as a measure of expected cooperation. This is an indirect—albeit very straightforward—way of assessing beliefs that guide judgments of overt behavior. This paradigm can be used for studying beliefs in different interpersonal relationships (e.g., strangers vs. friends vs. relatives), organizational structures (e.g., bosses vs. subordinates), and group settings (e.g., ingroup vs. outgroup stereotyping).

Experiments 4.1, 4.2 and 5.2 used another novel paradigm—the coin task—which measures expected and actual cooperation in repeated interactions. For each trial participants are given a subset of information on their partner's cooperative vs. noncooperative behaviors. They estimate the partner's total cooperation and respond

with their own level of cooperation—the approach that allows measuring the link between estimated and actual cooperation at different levels of incompleteness of information. With this approach different partner strategies can be implemented (e.g., fairness in Experiment 4.1 and tit-for-tat in Experiments 4.2 and 5.2) and the game theoretical structure can be varied (i.e., an exchange game in Experiment 4.2 and the prisoner's dilemma in Experiment 5.2), similar to standard games used in social dilemma research. This paradigm can be used for studying cooperation in various interpersonal setting.

More broadly, incomplete information paradigms developed in this dissertation narrow the gap between traditional game theoretical paradigms and more real-life-like interactions. Game theoretical paradigms are essentially outcome transactions (e.g., money or point), but many cooperative behaviors in real life are favors. Previous research has shown that people engage in egocentric biases in favor evaluations—favor receivers focus on benefits and favor givers focus on costs (Zhang & Epley, 2009). Thus, favor-to-favor interactions are essentially interactions with situational incompleteness of information—information that is most incomplete with regard to the interaction partner's outcomes. Paradigms developed in this dissertation mimic such favor-like transactions in that they incorporate incompleteness of information while still providing, similar to game theoretical paradigms, quantifiable information on beliefs and cooperation.

Limitations and Suggestions for Future Research

Personality Variables and Different Interpersonal Relationships

Two major simplifications were made in this dissertation. First, conclusions were drawn for the average behavior without using individual difference variables as explanatory constructs. This was a deliberate choice, because the focus of this dissertation is on a situational variable (i.e., incompleteness of information) that explains human behavior in general. I suggest that future research would examine the role of individual difference variables (e.g., social value orientation, trust, regulatory focus) in incomplete information situations. Perhaps most interestingly, individual difference variables may interact with incompleteness of information. For example, people high in generalized trust may be less likely to make self-interest attributions and perhaps less likely to respond self-interestingly in return.

Second, all participants thought that they were interacting with another participant—essentially with a stranger. This was also a deliberate choice, because strangers do not have any dispositional information on one another and therefore they need to rely on their beliefs in other people in general. Future research in different types of interpersonal relationships would be particularly interesting, because people may use their past information and experiences for filling in the blanks in incomplete

information. For example in ongoing relationships people do not necessarily assume self-interest (e.g., in communal relationships, Clark & Mills, 1993; Rusbult & Van Lange, 2003). Conversely, even more self-interest might be assumed from groups, or from representatives of groups, as people think more positively about persons than about groups (e.g., Insko & Schopler, 1998; Sears, 1983). Another interesting line of future research would examine asymmetric interdependence. For example, people may attribute even more self-interest to others who have more power over their outcomes (e.g., politicians or bosses).

Functionality of Self-interest Beliefs – The Evolutionary Approach

Why people attribute too much self-interest to others behaviors? One explanation is that under incompleteness of information, people are bound to make errors in judging their partner's cooperation. Previous research has identified a strong bias called loss-aversion: People put more effort for avoiding losses than for obtaining gains of the same size (cf. prospect theory; see Kahneman & Tversky, 1979; see also Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001). Therefore, underestimation of cooperation is a safe strategy that avoids the possibility of getting exploited by the partner.

Risk-averse attitudes may ultimately be rooted in survival thresholds (for a discussion, see McDermott, Fowler, & Smirnov, 2008). As previous simulations have shown, defectors and tit-for-taters are both sustainable sub-populations. Given that a population consists of both and people make mistakes in identifying the two, it may be less harmful to identify a tit-for-tater as a defector than a defector as a tit-for-tater. This of course calls for future research, because such evolutionary-based claims are highly speculative unless their success has been demonstrated in the evolutionary simulation framework.

Information Sharing in Social Dilemmas

This dissertation identified a boundary condition for cooperation—incompleteness of information—that is quite challenging to overcome. A lot of research effort has been devoted to increasing cooperation in social dilemmas and three types of solutions have been proposed: strategic, motivational, and structural (for reviews, see Kollock, 1998; Komorita & Parks, 1994; Van Lange & De Dreu, 2001; Van Lange, Liebrand, Messick, & Wilke, 1992; Weber et al., 2004).

This dissertation revealed that strategic and motivational solutions are largely ineffective. Even generosity—strategy that is efficient for noise for instance—does not overcome the detrimental effects of incomplete information. Motivational solutions are also ineffective, because cooperative transformations depend on the perception of the partner's cooperative transformations. Because such perception is susceptible for self-interest attributions, cooperation cannot easily be elicited or maintained under incompleteness of information.

The structural solutions—aim at removing or changing the dilemma—provide an interesting avenue for future research. Our findings indicate that the power of incomplete information is quite substantial, which suggests that people might be better off communicating even somewhat selfish behaviors. To what extent people, organizations, or politicians should communicate their selfish versus unselfish behaviors is a question that future research will provide some answers. Based on the present findings, it is quite possible that in many occasions, more information and more transparency would prevent people from making erroneous self-interest attributions and therefore would yield a higher level of mutual cooperation.

Concluding Remarks

Decades of research on the prisoner's dilemma and other experimental games have arrived at the main conclusion that tit-for-tat is the strategy that people follow and should follow. Our research indicates that this conclusion does not completely hold when people have only incomplete information about their partner's behaviors. Under incompleteness of information, tit-for-tat becomes accompanied by people's general belief that most other people are self-interested, which in turn undermines cooperation. Previous research has shown that the detrimental effects of some imperfections in social interactions (e.g., noise) can be overcome by generosity, but this dissertation reveals that generosity is a largely inefficient for interactions with incomplete information: The more generosity one seeks to communicate the more incompleteness of information undermines cooperation. The strongly held belief that other people are primarily self-interested seems to function as theory for people to rely on with strangers when they do not have complete information about the other's actions. As such, the belief in self-interest may become a self-fulfilling prophecy, as people tend to respond in mind (i.e., based on what they think others did) rather than respond in kind (i.e., based on what others actually did).

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Nederlandse Samenvatting (Summary in Dutch)

In het dagelijks leven worden mensen vaak geconfronteerd met situaties waarin eigen en andermans belang met elkaar in conflict zijn. In dat geval kan men ervoor kiezen om alleen die doelen na te streven die het eigenbelang dienen (niet-coöperatief gedrag), of om over dat eigenbelang heen te stappen en de ander dan wel het collectief van dienst te zijn (coöperatief gedrag). De algemene les die uit vele duizenden experimenten en evolutiegerichte simulaties in voorgaand onderzoek kan worden getrokken is helder en duidelijk: mensen beantwoorden coöperatief gedrag met coöperatief gedrag, en niet-coöperatief gedrag met niet-coöperatief gedrag. Menselijke coöperatie wordt dus in belangrijke mate bepaald door het eerdere gedrag van de interactie-partner, en deze handelswijze (voorwaardelijke coöperatie) blijkt behoorlijk effectief in het bewerkstelligen van coöperatief gedrag in tweetallen.

In deze dissertatie wordt uitgegaan van het idee dat een dergelijke conditionele coöperatie niet altijd direct toepasbaar is, omdat mensen soms beschikken over onvolledige informatie ten aanzien van de coöperatie in vorige interacties. Voordat conditionele coöperatie kan worden toegepast, moet het coöperatieniveau van de partner vaak worden afgeleid uit informatie die geen eenduidig uitsluitsel geeft – en in de regel verschillende interpretaties toestaat. In deze dissertatie wordt daarom onderzocht of er sprake is van een systematische vertekening in de inschatting van andermans gedrag, en hoe een vertekening van invloed kan zijn op het eigen coöperatieve gedrag.

Het eerste empirische hoofdstuk (hoofdstuk 2) behandelt drie sociale motieven die sociaal gedrag beïnvloeden: eigenbelang, altruïsme en egalitarisme (gelijkheid). Uit de resultaten blijkt dat vergeleken met de mate waarin deze motieven naar voren komen in het eigen gedrag, mensen de verwachting hebben dat egalitarisme minder van invloed zal zijn op andermans sociale gedrag. In hoofdstuk 2 wordt daarom geconcludeerd dat egalitarisme weliswaar een belangrijke motivatie is bij het tot stand komen van het eigen gedrag, maar een ondergewaardeerde rol speelt bij het inschatten van het gedrag van anderen.

Het tweede empirische hoofdstuk (hoofdstuk 3) behandelt de interpretaties die mensen maken van het waarneembare gedrag van anderen. Uit de resultaten blijkt dat wanneer mensen over onvolledige informatie beschikken ten aanzien van het gedrag van een interactie-partner, ze de ontbrekende informatie invullen met de aanname van eigenbelang. De resultaten laten zien dat hoewel eigenbelang wel degelijk meespeelt in het eigen gedrag, mensen inschatten dat dit bij anderen in sterkere mate het geval is. Daarmee is de conclusie in hoofdstuk 3 dat mensen de neiging hebben om de rol van eigenbelang in het waarneembare gedrag van anderen te overschatten.

In het derde empirische hoofdstuk (hoofdstuk 4) wordt de invloed van onvolledige informatie op coöperatie in dyadische interacties onderzocht. Uit de resultaten blijkt dat

onvolledigheid van informatie zowel de verwachtingen over andermans coöperatie als de eigen coöperatie negatief beïnvloedt. Hoofdstuk 4 laat daarmee zien dat het geloof in eigenbelang wordt ingezet om de ontbrekende informatie in te kleuren, wat zowel de verwachting van andermans coöperatie als het eigen coöperatieve gedrag ondermijnt.

Het vierde empirische hoofdstuk (hoofdstuk 5) behandelt interacties tussen partners die verschillen in de mate van generositeit versus gierigheid. Uit de resultaten blijkt dat de nadelige effecten van onvolledige informatie sterker gelden wanneer de ander genereus is dan wanneer de ander gierig is. Verder laten de resultaten zien dat wanneer informatie onvolledig is, mensen hun partner als minder welwillend ervaren – ook dit effect is sterker naarmate de ander genereuzer is. Dus hoofdstuk 5 vormt een indicatie dat hoe meer generositeit men probeert te communiceren, hoe meer de coöperatie en de perceptie van andermans welwillende bedoelingen worden ondermijnd door onvolledige informatie.

In zijn geheel wijst deze dissertatie op een belangrijke voorwaarde voor menselijke coöperatie. Wanneer mensen volledige informatie over het gedrag van hun partner hebben, dan kan coöperatie relatief gemakkelijk tot stand komen met behulp van voorwaardelijk-coöperatieve strategieën. Maar wanneer men slechts over onvolledige informatie ten aanzien van het gedrag van een interactiepartner beschikt, heeft men de neiging om de ontbrekende informatie in te kleuren met eigenbelang, wat vervolgens een meer op het eigenbelang gerichte reactie in de hand werkt. Dit stelt een uitdaging aan de menselijke samenwerking. Als menselijk gedrag vooral wordt ingegeven door wat men *denkt* dat de ander heeft gedaan in plaats van wat de ander daadwerkelijk deed, dan werkt het geloof in eigenbelang een ‘self-fulfilling prophecy’ in de hand. Dit zou kunnen verklaren waarom niet-coöperatief gedrag zich soms zelfs voordoet wanneer beide interactiepartners de voorkeur zouden hebben voor een situatie waarin beide personen zich coöperatief opstellen.

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Curriculum Vitae

Joel Vuolevi was born December 31st 1975 in Oulu, Finland. He started studying electrical engineering at University of Oulu in 1994 and obtained his master's and PhD degrees in 1998 and 2001, respectively. From 1997 to 1998 he worked for Nokia as a trainee and RF-designer. From 1998 to 2002 he worked for University of Oulu as a PhD student, researcher, and acting professor. In 2002 he moved to California and joined a semiconductor design house start-up RF Integrated Corporation. In 2004 Joel returned to Finland and started pursuing his studies in social psychology. After completing undergraduate classes at University of Helsinki, he moved to Amsterdam for master studies in social psychology in 2005. He received his research master's degree from the VU University in 2007 and started pursuing his PhD soon afterwards. The present dissertation is the result of research conducted between 2007 and 2010. Currently Joel works as a post doctoral researcher at the VU University.

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