



The psychology of social dilemmas: A review

Paul A.M. Van Lange*, Jeff Joireman, Craig D. Parks, Eric Van Dijk

VU University Amsterdam, Department of Social and Organizational Psychology, Van der Boechorststraat 1, 1081 BT Amsterdam, The Netherlands

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ABSTRACT

Broadly defined, social dilemmas involve a conflict between immediate self-interest and longer-term collective interests. These are challenging situations because acting in one's immediate self-interest is tempting to everyone involved, even though everybody benefits from acting in the longer-term collective interest. As such, greater knowledge of social dilemmas should help us understand not only the theoretical puzzles of why people cooperate (or not) but also the ways in which cooperation in groups and organizations can be maintained or promoted. This article reviews different types of social dilemmas, highlights recent developments in the field (especially within psychology), and suggests some new avenues for future research. We illustrate that the field of social dilemma is growing and flourishing in terms of theory, interdisciplinary collaboration, and applicability, producing insights that are novel, replicable, and applicable to many social situations where short-term self-interest is at odds with the long-term interests of teams, organizations, or nations.

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Introduction

Many of the world's most pressing problems represent social dilemmas, broadly defined as situations in which short-term self-interest is at odds with longer-term collective interests. Some of the most widely-recognized social dilemmas challenge society's well-being in the environmental domain, including overharvesting of fish, overgrazing of common property, overpopulation, destruction of the Brazilian rainforest, and buildup of greenhouse gasses due to overreliance on cars. The lure of short-term self-interest can also discourage people from contributing time, money, or effort toward the provision of collectively beneficial goods. For example, people may listen to National Public Radio without contributing toward its operations; community members may enjoy a public fireworks display without helping to fund it; employees may elect to never go above and beyond the call of duty, choosing instead to engage solely in activities proscribed by their formally defined job description; and citizens may decide to not exert the effort to vote, leaving the functioning of their democracy to their compatriots.

As the preceding examples illustrate, social dilemmas apply to a wide range of real-world problems; they exist within dyads, small groups, and society at large; and they deal with issues relevant to a large number of disciplines, including anthropology, biology, eco-

nomics, mathematics, psychology, political science, and sociology. Given their scope, implications, and interdisciplinary nature, social dilemmas have motivated huge literatures in each of these disciplines. Several excellent reviews of this literature exist, but many are dated or are narrowly focused on a specific variable that influences cooperation in social dilemmas. In the present paper, we build on past reviews by outlining key principles relevant to the definition of social dilemmas, summarizing past reviews, discussing recent developments in the field, and identifying future research directions with the potential to shed additional light on this important and ever-developing field.

Social dilemmas: beyond the prisoner's dilemma and immediate consequences

Social dilemmas come in many flavors. Sometimes cooperation means giving or contributing to the collective, sometimes it means not taking or consuming from a resource shared by a collective. Sometimes the time horizon is short, even as short as a single interaction, sometimes it is long-lasting, almost without an end as in ongoing relationships. There are social dilemmas involving two persons, and social dilemmas involving all people living in a country, continent, or even world. Not surprisingly, the diversity in social dilemma settings has led researchers to offer a range of different definitions for the concept. In his *Annual Review of Psychology* article, Dawes (1980) was one of the first who formally coined the term social dilemma, which he defined as a situation

* Corresponding author.

E-mail address: pam.van.lange@psy.vu.nl (P.A.M. Van Lange).

in which (a) each decision maker has a dominating strategy dictating non-cooperation (i.e., an option that produces the highest outcome, regardless of others' choices), and (b) if all choose this dominating strategy, all end up worse off than if all had cooperated (i.e., a deficient equilibrium). But as we will see, while focusing on the crux of the dilemma, this definition does not do justice to some other outcome structures (or more precisely, interdependence structures) that also captures the conflict between self-interest and collective interest, which include not only the prisoner's dilemma, but also the chicken dilemma, and the assurance dilemma (or trust dilemma). This definition also does not include the temporal or time dimension (e.g., Messick & Brewer, 1983; Van Lange & Joireman, 2008), because consequences can be immediate (short-term) or delayed (long-term). Such a more inclusive conceptualization allows us to include social traps, social fences, public good dilemmas, and resource dilemmas (see Table 1). We briefly discuss both features in turn.

Prisoner's, chicken, and assurance dilemmas

The well-known Prisoner's Dilemma has often been used as the basis for defining social dilemmas, which is also evident in Dawes' definition. We suggest that two other outcome interdependence structures can also be viewed as social dilemmas, if one relaxes the requirements for a dominating strategy and a single equilibrium. These structures include the Chicken and the Assurance (or Trust) Dilemma. In both dilemmas, the individual vs. collective conflict essential to social dilemmas is retained: there is a non-cooperative course of action that is (at times) tempting for each individual, and if all pursue this non-cooperative course of action, all end up worse off than if all had cooperated.

In the *Chicken Dilemma*, each person is tempted to behave non-cooperatively (by driving straight toward one's "opponent" in an effort to win the game), but if neither player cooperates (swerves), both parties experience the worst outcome possible (death). Clearly, Chicken does not involve a dominating strategy, as the best decision for an individually rational decision maker depends on what he or she believes the other will do; if one believes the other will cooperate (swerve), the best course of action is to behave non-cooperatively (and continue driving ahead); however, if one is convinced that the other will not cooperate (will not swerve), one's best course of action is to cooperate (swerve), because it is better to lose the game than to die. There are interesting parallels between Chicken and situations in which people are faced with the dilemma whether to maintain honor or status at nearly any risk (see Kelley et al., 2003).

The *Assurance (Trust) Dilemma* also lacks a dominating strategy, and is unique in that the highest collective and individual outcomes occur when both partners choose to cooperate. This correspondence of joint and own outcomes might suggest that the solution is simple, and there is no dilemma. However, if one party considers beating the other party to be more important than

obtaining high outcomes for the self and others, or is convinced the other will behave competitively, the best course of action is to not cooperate. Thus, like the Chicken Dilemma, the Assurance Dilemma is a situation in which there is a non-cooperative course of action that can (at times) be tempting for each individual, and if all pursue this non-cooperative course of action, all are worse off than if all had cooperated.

The temporal dimension

We often see that the consequences for self can be immediate or delayed, just as the consequences for the collective can be immediate or delayed. This temporal dimension is exemplified in *social traps*, or situations in which a course of action that offers positive outcomes for the self leads to negative outcomes for the collective. Examples of delayed social traps include the buildup of pollution due to overreliance on cars, and the eventual collapse of a common fishing ground as a result of sustained overharvesting. Given their emphasis on "consuming" or "taking" a positive outcome for the self, social traps are often called *take some dilemmas*, a classic example of which is the *commons (or resource) dilemma*.

These social trap situations may be contrasted with *social fences*, or situations in which an action that results in negative consequences for the self would, if performed by enough people, lead to positive consequences for the collective. Examples of delayed social fences include the eventual deterioration of a company's positive culture due to employees' unwillingness to engage in extra-role (or organizational citizenship) behaviors, such as being a good sport and helping new employees adjust, and the gradual deterioration of an education system due to taxpayers' unwillingness to fund school levies. Given their emphasis on "giving" something of the self (such as time, money, or effort), social fences are often called *give some dilemmas*, a classic example of which is the *public goods dilemma*, which have been extensively studied by economists in particular.

Definition and history

We define social dilemmas as situations in which a non-cooperative course of action is (at times) tempting for each individual in that it yields superior (often short-term) outcomes for self, and if all pursue this non-cooperative course of action, all are (often in the longer-term) worse off than if all had cooperated. This definition is inclusive of the well-known prisoner's dilemma, as well as the Chicken Dilemma and the Assurance (or Trust) Dilemma, and it includes the "correlation" with time, such that consequences for self are often immediate or short-term, while the consequences for the collective often unfold over longer periods of time. We suggest that this provides a fairly comprehensive definition of social dilemmas. At the same time, we acknowledge that other important distinctions are not included. One such distinction is the difference between *first order dilemma*, which represents the initial dilemma,

Table 1
Classification of social dilemmas (after Messick and Brewer (1983)).

	Collective consequences	
	Immediate	Delayed
Social traps		
• Take some dilemmas	Commuting by car (vs. public transportation, or carpooling) leads to daily traffic congestion and stress	Harvesting as many fish as one can from a common resource eventually leads to the collapse of the resource
• Commons/resource dilemmas		
Social fences		
• Give some dilemmas	Electing to not contribute to a community-funded fireworks show results in cancellation of the show	Choosing to not engage in extra-role behaviors that benefit one's company eventually leads to a deterioration of the company's positive culture
• Public goods dilemmas		

and a *second order dilemma*, which represents the dilemma that one might face when deciding whether to contribute to a costly system that might promote cooperation in the first order dilemma (e.g., a system that sanctions free-riders, Yamagishi, 1986a). Cooperation in the first order dilemma is known as *elementary cooperation*, while cooperation in the second order dilemma is known as *instrumental cooperation*. As we will see in this article, a good deal of contemporary research on social dilemmas has been devoted to this very problem, providing strong evidence that many (but not all) people are quite willing to engage in costly behavior to reward other group members who have cooperated and punish those who have not cooperated (e.g., Fehr & Gächter, 2002).

It is interesting to note that the definitions of social dilemmas are marked by several important conceptual reviews of social dilemmas. In one of the earliest reviews, Pruitt and Kimmel (1977) summarized 20 years of research on experimental games, concluding that cooperation requires both the goal of cooperating and the expectation that others will cooperate, the well-known *goal-expectation theory*. Three years later, Dawes (1980) published his review of research on the n-person prisoner's dilemma in which he introduced, among others, the terms “give some” and “take some” games. Building on Hardin's (1968) analysis of the “Tragedy of the Commons,” Messick and Brewer (1983) subsequently discussed the notion of social traps and fences, and identified two categories of solutions to social dilemmas, including *individual solutions* and *structural solutions*.

In more recent reviews, Komorita and Parks (1995) and Kollock (1998) reiterated many of the same themes, and discussed how reciprocal strategies (e.g., tit-for-tat) and sanctions encourage cooperation, which was inspired by Yamagishi's (1986a) earlier work on first-order and second-order social dilemmas (or elementary cooperation and instrumental cooperation). And then over the past decade, Fehr and Gächter (2002) conceptualized and studied the potential for reward and punishment, generally showing pronounced increases in cooperation in situations in which participants were able (vs. were not able) to punish or reward one another.

A recent meta-analysis provides strong support for the power of reward and punishment, and also suggests that they may be even more effective when administered by fellow members facing the social dilemma, rather than authorities (for a recent review, see Balliet, Mulder, & Van Lange, 2011). Interestingly, some of these insights were already recognized by Elinor Ostrom in 1990, Nobel prize laureate in 2009, who suggested that institutes could play a very important role in regulating the management of natural resources and avoiding ecosystem collapses. She emphasized the importance of sanctioning and reward, preferably at local levels, and the use of local monitoring, and conflict resolution that are inexpensive and of easy access. She was a strong believer in local arrangements, by self-determination of the community by higher level authorities. And she believed in internal mechanisms such as effective communication, internal trust and reciprocity among the people who literally face the social dilemma.

Looking back, these historical developments reveal several noteworthy trends. First, various scientific disciplines clearly have grown “toward each other” such that there is much greater exchange of knowledge, and tools (such as research paradigms), that are very important to further progress in the science of human cooperation. Second, we witness that theory (or science) and reality (or application) go hand in hand. These are issues that are immediately apparent in several edited volumes (e.g., Foddy, Smithson, Schneider, & Hogg, 1999; Schroeder, 1995; Suleiman, Budescu, Fischer, & Messick, 2004), to recent overviews (e.g., Van Lange, Balliet, Parks, & Van Vugt, 2013), and to meta-analytic reviews on basic issues such as trust (Balliet & Van Lange, in press-a). Indeed, in the past several years, a plea for interdisciplinary research (Gintis, 2007), translation from basic theory to societal

application (e.g., Parks, Joireman, & Van Lange, in press), and issues of generalization to different samples and societies (Herrmann et al., 2008; see also Balliet & Van Lange, in press-b) underscore exactly the point we are trying to make. And the further link with neuroscience, genetics, and culture makes it all the more interesting (Glimcher, Camerer, Fehr, & Poldrack, 2008; Henrich et al., 2001). Indeed, these are truly exciting times for research and theorists of human cooperation. As such, it makes sense to focus our attention to recent developments, while acknowledging the classics, which is what follows next.

Recent developments

Our review is organized around calls in the literature for the development of theory, more interdisciplinary and applied research, and three broad categories of factors that influence cooperation in social dilemmas (structural, psychological, and dynamic influences). Our review focuses largely on developments in the social psychological literature, though we also address growing literatures in a number of related fields of study. Moreover, in light of space, our goal is not to exhaustively catalogue the many factors that drive choice behavior in social dilemmas, but rather, to highlight several important and exciting developments in the field. Ultimately, our goal is to use this discussion of recent developments as a bridge between classic research on social dilemmas and future directions with the potential to contribute new insights to this important and growing field. In particular, we will discuss broad developments in (a) theoretical frameworks in psychology, (b) interdisciplinary approaches to social dilemmas, and (c) ecological validity, or trends from “games to real life.”

Theoretical frameworks

Despite the wealth of empirical studies on social dilemmas, the field has often been criticized for lacking a coherent, macro-level theoretical framework. This is not to say that dilemma research has been atheoretical, but rather, that the theories and hypotheses offered have tended to focus more narrowly on a specific set of variables and/or processes (for a review, see Parks et al., in press). Several theories, however, have been advanced with the potential to bring order to the field, including classic and extended versions of interdependence theory (Kelley & Thibaut, 1978; Kelley et al., 2003; Van Lange & Rusbult, 2012), the appropriateness framework (Weber, Kopelman, & Messick, 2004), and evolutionary theorizing, such as reciprocal altruism, indirect reciprocity, and costly signaling.

Interdependence theory

One theory that has served as an integrative framework for several social interaction situations and interpersonal relations is interdependence theory (Kelley & Thibaut, 1978; Kelley et al., 2003; Van Lange & Rusbult, 2012). With its roots in game theory, interdependence theory assumes that interdependent interactions are a combined function of an interdependence structure (e.g., the prisoner's dilemma), the interacting partners (e.g., partner A and B), and interaction dynamics (e.g., the use of a tit-for-tat strategy), or SABI (structure, partners A and B, interaction). Within this framework, interdependence theory also assumes that decision makers “transform” a given structure or matrix of objective outcomes into an effective matrix of subjective outcomes that is more closely linked to behavior. The *given matrix* represents short-term, self-interested preferences determined by the situation in combination with each individual's needs, skills, etc., while the *effective matrix* emerges once decision makers take into account broader so-

cial and temporal concerns, including concern with others' outcomes and/or concern with the long-term consequences of one's actions, and/or cognitive and affective states, such as recently primed schemas and mood, as shown in Fig. 1.

While the notion of "transformations" has been recognized for some time, there have been at least two significant advances with respect to this important concept. First, in understanding social preferences (or social utilities), there have been increasing attempts to summarize the major preferences. Building on previous models (e.g., Messick & McClintock, 1968), some integrative models suggest that transformations can be understood in terms of the weights that people assign to outcomes for self, outcomes for other, and equality in outcomes (e.g., Van Lange, 1999). Apart from self-interest, such theorizing identifies altruism, collectivism, and egalitarianism as important motives that might underlie cooperation (Van Lange, De Cremer, Van Dijk, & Van Vugt, 2007) and provides a broader interdependence-based framework for understanding various programs of research focusing on particular motives (e.g., Batson, 1994). Moreover, whereas the majority of past theory and research has emphasized "motivational transformations," a good deal of recent theory and research is now focusing on the role of other "cognitive" and "affective" transformations (e.g., empathy, Van Lange, 2008).

Second, whereas early theorizing in social dilemmas, based on interdependence theory, typically stressed the importance of "social transformations" (e.g., as a result of prosocial vs. proself value orientations), more recent theory and research have been devoting increasing attention to the role of "temporal transformations" (e.g., as a result of future time orientation or a concern with future consequences; Joireman, 2005; Kelley et al., 2003; Van Lange & Joireman, 2008). These transformations are essential to understanding behavior in many social dilemmas that involve both a *social conflict* (individual vs. collective interests) and a *temporal conflict* (short-term vs. long-term interests). Indeed, an important challenge in those social dilemmas is the willingness and ability for self-control, which is often defined in terms of choosing to maximize the long-term (vs. short-term) consequences of one's actions (e.g., Joireman, Balliet, Sprott, Spangenberg, & Schultz, 2008). Within this framework, features of the person or situation that promote

self-control, and/or a concern with future consequences, have the potential to encourage cooperation (e.g., Insko et al., 1998; Joireman et al., 2008; Van Lange, Klapwijk, & Van Munster, 2011) or promote positive responses to non-cooperation such as forgiveness (Balliet, Li, & Joireman, 2011).

Appropriateness framework

Another theoretical advance in the field of social dilemmas is Weber et al.'s (2004) *appropriateness framework* (see also Dawes & Messick, 2000). The appropriateness framework assumes that decisions are driven by three basic factors including one's definition (or recognition) of a situation (e.g., is this a cooperative task or not?); one's identity (e.g., do I strongly identify with my group?); and the application of decision rules or heuristics (e.g., do unto others as you would have them do unto you). These three factors are thought to influence how decision makers answer the fundamental question, *what does a person like me do in a situation like this?* As shown in Fig. 2, Weber and colleagues' framework suggests that features of the objective situation impact the decision maker's identity and how the situation is perceived; the model also assumes that identity is driven by a decision maker's personal history (e.g., individual differences, learning). The decision maker's identity then influences how he or she interprets the situation and how perception of the situation impacts his or her choice of decision rules, which ultimately leads to one's final decision. Like Kelley and Thibaut's interdependence theory, Weber and colleagues' model stresses decision makers' construal of the situation. Moreover, complementing interdependence theory, the appropriateness framework clearly recognizes the impact of personal identity and decision heuristics, both of which have featured prominently in recent work on social dilemmas.

Evolutionary theory

Needless to say, scholars have also increasingly drawn on broad theoretical frameworks from evolutionary theory to account for altruism and cooperation in social dilemmas. In particular, four theories advanced to understand altruism include kin selection, re-

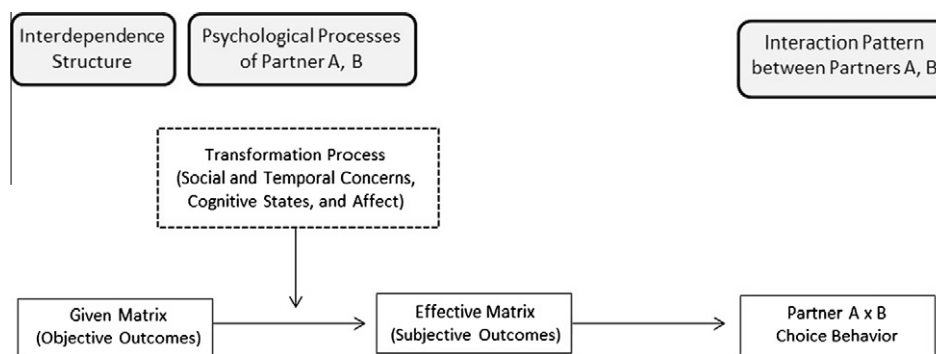


Fig. 1. Interdependence theory's structure, partners (A and B) and interaction (SABI) model illustrating transformation from given to effective matrix (Van Lange & Rusbult, 2012).

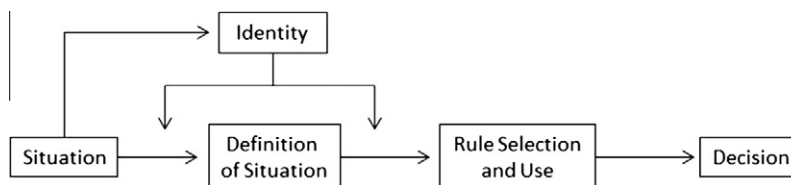


Fig. 2. Appropriateness framework (Weber et al., 2004).

reciprocal altruism (or direct reciprocity), indirect reciprocity, and costly signaling. *Kin selection* suggests that people are more likely to help those with whom they share a genetic link (Hamilton, 1964). In support of this theory, people are likely to help kin, less likely to harm kin, and are more likely to tolerate injustices from kin. Also, people are more likely to help close kin over distal kin, especially in important, life-death decisions, whereas for relatively mundane issues kinship matter somewhat less (e.g., Burnstein, Crandall, & Kitayama, 1994).

Reciprocal altruism (Trivers, 1971) is the evolutionary theoretical concept that most game theorists (and psychologists) would call reciprocity (or direct reciprocity). There is indeed considerable evidence for the idea that people's cooperative behavior is strongly influenced by the other's persons behavior. In fact, there is even evidence that 70% of the participants make a choice in a social dilemma that can be characterized as reciprocal, behaving exactly as cooperatively as they expected the other person to cooperate (Van Lange, 1999, Study 3). We return to the topic of reciprocity later in this article.

Indirect reciprocity theory assumes that people respond to information relevant to other's reputation as being cooperative (or non-cooperative) by behaving cooperatively (or non-cooperatively). Moreover, it assumes that people favor a cooperative reputation over a non-cooperative reputation, a mechanism which may account for the evolution of cooperation among strangers – with whom one is not genetically related, and with whom one does not expect future interaction (and did not have interactions in the past). There is indeed evidence revealing that, in the absence of possibilities of direct reciprocity, people respond to reputational information by giving more to others who had been cooperative in the past, and this explains how cooperation can develop and sustain when updated reputational information is available (Wedekind & Milinski, 2000).

Costly signaling theory is closely linked to indirect reciprocity theory, and assumes that humans (and other species) might engage in costly activities to signal “traits” that often are desired (selected for) by other people (e.g., Gintis, Smith, & Bowles, 2001). For example, donating large donations, when communicated to others, might signal not only generosity, but also other desirable traits that might explain why a person is able to do so. For example, generosity may signal abundance of resources and high status. Such signals may provide desirable opportunities when selected as interaction partner, including extending lucrative business, or, if one is so inclined, mating opportunities. An excellent example of costly-signaling is the escalation of cooperative behavior, in a process known as “runaway social selection” (Nesse, 2005) or “competitive altruism” (Barclay, 2004; Hardy & Van Vugt, 2006).

In summary, we suggest interdependence theory as broad theoretical framework that helps understand “what a situation is about” (interdependence structure) and “what people might make of it” (transformations). The appropriateness framework complements this approach by emphasizing the role of norms, identity concerns, and heuristics that people might use to make decisions in social dilemmas. And of course, the evolutionary theories place cooperation in a broader context of adaptation, thereby emphasizing the functional value of direct and indirect forms of reciprocity, and the role of reputation and signaling. The latter framework has made considerable progress over the past decade, and may serve as a grand theory for many more specific theories by delineating the ultimate causes of human cognition and behavior in social dilemmas.

Interdisciplinary perspectives

Beyond increased development of theory, we have witnessed increased attention to interdisciplinary research. Indeed, it has

been a bit of a paradox that social dilemma researchers working in different disciplines did not cooperate as much as they could, or perhaps should. On the one hand, of course, the various disciplines make their own unique contributions. For example, evolutionary biology focuses on ultimate distal mechanisms that support evolutionary outcomes (“fitness” or reproductive success); experimental economists frequently develop experimental games to study issues related to cooperation; mathematicians and game theorists provide a logical analysis of rational choice behavior in such experimental games; and social psychologists explore the proximate (person and situation) factors that impact choice behavior in such games. Thus, from one perspective, it is understandable that many researchers have chosen to tackle the issue of cooperation in social dilemmas from their own disciplinary perspective.

At the same time, over the past 15 years, we have seen that anthropologists, evolutionary biologists, economists, neuroscientists, political scientists, psychologists, and sociologists increasingly work together to address fundamental questions about human cooperation. For example, books and papers have appeared that outline the benefits of bridging various disciplines for the study of human cooperation and we see increasing evidence of cross-referencing among various disciplines (e.g., Gintis, 2007). Social dilemma researchers are also increasingly applying social dilemma analyses to understand a range of real-world problems, including commuting decisions (Joireman, Van Lange, & Van Vugt, 2004; Van Vugt, Meertens, & Van Lange, 1995) and organizational citizenship behaviors (e.g., Joireman, Kamdar, Daniels, & Duell, 2006; see also Balliet & Ferris, 2013).

Also, social psychologists are increasingly drawing on theories and methods in neighboring disciplines to gain a more complete picture of cooperation in social dilemmas. As an example, researchers are now using evolutionary theory to understand (self-presentation) motives for cooperating in social dilemmas (e.g., Hardy & Van Vugt, 2006; see also Griskevicius, Tybur, & van den Bergh, 2010), neuroimaging techniques to better understand altruistic punishment in social dilemmas (e.g., De Quervain et al., 2004; Singer et al., 2004), and insights from field studies to raise important basic questions about the evolution of institutions and sanctioning systems that can promote cooperation (e.g., Kollock, 1998; Yamagishi, 1986a). Indeed, as we will see, there has been an explosion of research on the effectiveness of reward and punishment in promoting cooperation, much of it revolving around the evolution of reward and punishment, the automaticity of punishment, the framing of reward and punishment, the notion of antisocial punishment (i.e., punishing cooperators rather than non-cooperators), the impact of moral appeal vs. sanctioning, the role of social norms, and the role of culture in shaping reward and punishment (e.g., Chen, Pillutla, & Yao, 2009; Egas & Riedl, 2008; Gächter & Herrmann, 2011). In sum, researchers are beginning to seriously address the call for more interdisciplinary collaboration on social dilemmas.

Ecologically valid research

In the longstanding history of social dilemmas, researchers, theorists, and critics alike have often provided the suggestion to enhance the ecological validity of their paradigms (see also Komorita & Parks, 1994). As we will see, researchers have heeded the call by developing novel social dilemma paradigms that help mirror many of the core features of real-world social dilemmas, and conducting more research in the field.

Expanded paradigms

First, complementing the classic prisoner's dilemma, commons dilemma, and public goods dilemma, researchers have begun to

use a greater variety of games to provide insight into social dilemmas, such as the ultimatum bargaining game, the dictator game, the trust game, and decomposed games. While not social dilemmas per se, these simple yet elegant games get to the heart of many issues central to decision-making in social dilemmas, including fairness (ultimatum bargaining game), giving and altruism (dictator game), willingness to trust (trust game), and various social value orientations (decomposed game).

Beyond these games, recent research has also begun to explore alternative, but related, paradigms like the give-or-take-some dilemma (McCarter et al., 2011), and the anti-commons dilemma (e.g., Vanneste, Van Hiel, Parisi, & Depoorter, 2006). The give-or-take-some dilemma represents a hybrid between the public good dilemma and the resource dilemma, modeling a situation where group members first provide the public good from which they subsequently harvest. The anti-commons dilemma, by comparison, is the mirror image of the resource dilemma and depicts situations where the problem lies in the underutilization of resources when individuals can exclude others from using a resource (see also Heller, 1998; Heller & Eisenberg, 1998). Research on these new paradigms is still scarce, but the first findings suggest that they may evoke different behaviors. The anti-commons dilemma, for example, appears to evoke much lower levels of cooperation than its mirror image, the resource dilemma (Vanneste et al., 2006).

Another topic receiving increased attention is cooperation in multiple-group settings because, in reality, people often face dilemmas in which they may belong to different groups. For example, a soldier at war is a member of his (or her) country, while fighting members of another group. Here, in-group cooperation may be quite high (fighting hard), due to a strong orientation toward one's own group (for example, patriotism), which in turn leads to greater intergroup hostility and warfare. As another example, in the context of environmental dilemmas, older generations are often asked to sacrifice for younger generations, who will eventually inherit the planet. Such settings evoke specific dynamics which have led researchers to design and study new interdependence structures like the intergroup dilemma (e.g. or team games, Bornstein, 2003; Bornstein & Ben-Yossef, 1994; Halevy, Bornstein, & Sagiv, 2008), the nested dilemma (Wit & Kerr, 2002), and the intergenerational dilemma (Wade-Benzoni, Hernandez, Medvec, & Messick, 2008; Wade-Benzoni, Tenbrunsel, & Bazerman, 1996).

The intergroup dilemma models situations in which two groups are in conflict. Individuals of each group can contribute to win from the other group, but at the same time face a social dilemma in their own group, making it more advantageous for them not to contribute. In the nested dilemma, individuals are members of subgroups which in turn are part of a superordinate group, similar to employees being members of departments within a large organization. In the intergenerational dilemma, individuals are member of a group in which they can harvest from a scarce resource knowing that at a later point in time, their group will be succeeded by a next generation. Here the issue is about the willingness to share with future generations. The introduction of multiple groups not only increases the external validity of social dilemmas, it also generates new insights, for example by showing that within-group cooperation may instigate intergroup conflict (in the intergroup dilemma), that categorization at the subgroup level may be detrimental for the collective (in a nested dilemma), and that intergenerational decisions may be subject to egocentrism.

Applied research

Complementing the development of new experimental paradigms, an increasing number of scientists is also examining social dilemmas as they occur in everyday life. For example, as already mentioned, Ostrom and her colleagues have published numerous

books and articles on how real groups of constituents arrange systems for successfully managing common pool resources. Researchers have also been actively applying social dilemma insights to understand cooperative behavior in organizations (e.g., organizational citizenship behaviors, Joireman et al., 2006), consumer behavior (e.g., Sen, Gurhan-Canli, & Morwitz, 2001), collective action, voting and political behavior (e.g., Klandermans, 1992; Van Lange, Bekkers, Chirumbolo, & Leone, 2012), proenvironmental behavior (e.g., Joireman, 2005; Kortenkamp & Moore, 2006), and commuting decisions (Joireman et al., 2004; Van Vugt et al., 1995). Applied research has also recently explored structural solutions to real-world dilemmas, such as the impact of private metering on water conservation (Van Vugt & Samuelson, 1999), reactance against the first carpool lane in Europe (Van Vugt, Van Lange, Meertens, & Joireman, 1996), and support for the development and implementation of public transportation systems (e.g., Joireman, Lasane, Bennett, Richards, & Solaimani, 2001).

In summary, over the past two decades, we have seen a strong growth in the development of new game situations that do more justice to some basic features of social dilemmas, such as the commons dilemma, the anti-commons dilemma, and dilemmas which specify interdependence among different groups of collectives (such as team games). These situations are of great theoretical interest, and also enhance opportunities for addressing key issues in society – such as the underuse of resources (sometimes resulting in waste of resources) or patterns of intergroup conflict. The growth in field studies might reinforce some of the lab-based conclusions, and often serve as powerful demonstrations of “what might happen”, or as reminders of Hardin's tragedy of the commons. And these studies serve a heuristic function for theoretical ideas, or practical obstacles that might go otherwise unnoticed – or less noticed.

Developments in structural, psychological and dynamic influences

As outlined earlier, interdependence theory assumes that choice behavior in interdependent settings is a combined function of *structural influences* (e.g., features of the decision and/or social situation), *psychological influences* (e.g., internal motives, framing, recently primed schemas, or affect), and *dynamic interaction processes* (e.g., how certain individuals respond to a tit-for-tat strategy, or whether forgiveness or retaliation will predominate when others do not cooperate). We adopt this framework for discussing some recent programs of research on social dilemmas. We first discuss structural influences by reviewing research on rewards and punishments, asymmetries between decision makers, and uncertainty over various aspects of the social dilemma decision. In subsequent sections, we review recent research on psychological influences (e.g., individual differences) and dynamic interaction processes (e.g., reciprocal strategies).

Structural influences

Rewards, punishment, and the social death penalty

It has long been known that the objective payoffs facing decision makers (i.e., the given payoff structure) can have a large impact on cooperation in social dilemmas (e.g., Komorita & Parks, 1994; Rapoport, 1967). Those payoffs, in turn, may be determined by an experimenter (e.g., by presenting relatively low or high levels of fear and greed), or by the actual outcomes afforded by the situation (e.g., the cost of contributing to a public good vs. the value of consuming the good). In terms of the situation, another factor that has a large impact on the actual (or anticipated) payoffs in a social

dilemma is the presence of rewards for cooperation and punishment for non-cooperation. Indeed, a recent meta-analysis showed that rewards and punishments both have moderate positive effects on cooperation in social dilemmas (Balliet, Li, et al., 2011; Balliet, Li, Macfarlan, et al., 2011; Balliet, Mulder, et al., 2011). Administering rewards and punishments is costly, however, and may thereby create a “second order public good.” For example, sanctions may be good for the collective, but individuals may decide not to contribute money or effort for this purpose. In his classic work, Yamagishi (1986a, 1986b, 1988b) showed that people are willing to make such contributions if they share the goal of cooperation, but do not trust others to voluntarily cooperate. More recently, Fehr and Gächter (2000) showed that people are also often willing to engage in costly punishment, and may even prefer institutions that provide the possibility of such sanctions, perhaps in part because the possibility of costly punishment can help to install a norm of cooperation (Gürerk, Irlenbusch, & Rockenbach, 2006).

One of the most dramatic forms of punishment currently receiving attention is *ostracism* or *social exclusion*. Research on ostracism and social exclusion reveals that even the possibility of social exclusion is a powerful tool to increase cooperation, and that this threat might be more effective in small as opposed to large groups (e.g., Cinyabuguma, Page, & Putterman, 2005; Kerr et al., 2009; Ouwerkerk, Kerr, Gallucci, & Van Lange, 2005). Moreover, it appears that most people realize that harmful pursuit of self-interest can lead to social punishments (see Gächter, Herrmann, & Thöni, 2004). As noted by Kerr et al. (2009), in everyday life, small groups may not often go as far as to socially exclude people, but the threat is often there, especially in the form of social marginalization by paying less attention to non-cooperative members or involving them in somewhat less important group decisions.

Although punishments can be effective in promoting cooperation, some adverse effects have been documented in recent research. For example, several studies have shown that sanctions can decrease rather than increase cooperation, especially if the sanctions are relatively low (e.g., Gneezy & Rustichini, 2004; Mulder, Van Dijk, De Cremer, & Wilke, 2006; Tenbrunsel & Messick, 1999). One explanation for these adverse effects is that punishments may undermine people's internal motivation to cooperate (cf. Deci, Koestner, & Ryan, 1999). According to Tenbrunsel and Messick (1999), sanctions can also lead people to interpret the social dilemma as a business decision, as opposed to an ethical decision, thus reducing cooperation.

Researchers are now also documenting that groups may at times punish cooperators, a (somewhat counterintuitive) phenomenon known as *antisocial punishment* (Gächter & Herrmann, 2011; Herrmann, Thöni, & Gächter, 2008). In one of the most recent papers on this topic, Parks and Stone (2010) found, across several studies, that group members indicated a strong desire to expel another group member who contributed a large amount to the provision of a public good and later consumed little of the good (i.e., an unselfish member). Last but not least, there is also growing evidence suggesting that punishment might be most effective when it is administered in a decentralized manner (by fellow members) rather than in a centralized manner (by an authority) (for some tentative evidence, see Balliet, Li, et al., 2011; Balliet, Li, Macfarlan, et al., 2011; Balliet, Mulder, et al., 2011; Nosenzo & Sefton, 2013).

Asymmetries in resources, benefits, and roles

Another popular topic in social dilemmas is the role of asymmetries. In most early social dilemma studies, group members were symmetric in that they each possessed an equal number of endowments that they could contribute to a public good, and/or could each benefit equally from public goods and collective resources. Moreover, group members typically made their decisions

simultaneously (rather than sequentially), and frequently made their decision without reference to specific roles in a group (such as whether one is a leader or a follower). While such symmetries help simplify the dilemma, in real life, various types of asymmetry are more prevalent. Recognizing this, researchers are now exploring how such asymmetries impact choice behavior in social dilemmas.

For example, research has shown that those who are wealthier and those who benefit more from a well-functioning public good behave more cooperatively (e.g., Marwell & Ames, 1979; Van Dijk & Wilke, 1993, 1994; but see Rapoport, 1988). These differences partly reflect differences in the relative costs of contributing (e.g., contributing a certain amount of money may be less risky for the less wealthy), but they may also connect to feelings of fairness (e.g., people consider it fair if the wealthy contribute more than the less fortunate). Moreover, in step-level situations, asymmetries are often used as a tacit coordination device (e.g. by deciding to contribute in proportion to the number of endowments one possess), yet this only works if people (tacitly) agree on which tacit coordination rule to apply (Van Dijk, De Kwaadsteniet, & De Cremer, 2009). And, of course, group members do not always agree. Indeed, in some cases, people may have “self-serving” ideas on what would be fair or reasonable, especially when people face multiple types of asymmetry (Messick & Sentis, 1983; Wade-Benzoni et al., 1996). In short, resource asymmetries can have a large impact on cooperation in social dilemmas.

Another asymmetry that can impact cooperation in social dilemmas revolves around the role one assumes within the group. For example, De Cremer and colleagues have shown that leaders take more of a common resource than followers, in large part because leaders feel more entitled to behave selfishly (De Cremer & Van Dijk, 2005). Interestingly, the tendency for leaders to take more than followers is stronger when the leader has a proself value orientation (De Cremer & Van Dijk, 2006), and when there is a high degree of variability among group members' harvests (Stouten, De Cremer, & Van Dijk, 2005).

Uncertainty

In most social dilemma experiments, the characteristics of the dilemma have been known with certainty to all group members. For example, in resource dilemmas, participants are usually informed about the exact size of the resource, the exact replenishment rate, and the number of participants. Similarly, in public goods dilemmas, participants are often aware of the exact threshold required to provide the public good (or the function linking contributions to benefits in a continuous public good). In real life, however, such defining characteristics are not always clear, as people often face various types of environmental uncertainty (Messick, Allison, & Samuelson, 1988; Suleiman & Rapoport, 1988). This uncertainty, in turn, has been shown to reduce willingness to cooperate in various social dilemmas (e.g., Budescu, Rapoport, & Suleiman, 1990; Gustafsson, Biel, & Gärling, 1999), and several explanations have been offered to account for the detrimental effects of uncertainty. For example, uncertainty may undermine efficient coordination (De Kwaadsteniet, Van Dijk, Wit, & De Cremer, 2006; Van Dijk et al., 2009), lead people to be overly optimistic regarding the size of a resource (Gustafsson et al., 1999), and/or provide a justification for non-cooperative behavior (for a review, see Van Dijk, Wit, Wilke, & Budescu, 2004). Also, uncertainty undermines cooperation when people believe their behavior is quite critical for the realization of public goods, but when criticality is low, uncertainty matters less or may even slightly promote cooperation (Chen, Au, & Komorita, 1996). Future research may well identify other crucial moderators of this uncertainty effect.

Noise

One final structural factor that has received attention in recent years is the concept of “noise.” In many experimental social dilemmas, there is a clear connection between one’s intended level of cooperation and the actual level of cooperation communicated to one’s partner (e.g., if Partner A decides to give Partner B 6 coins, Partner B learns that Partner A gave 6 coins). However, in the real world, it is not uncommon for a decision maker’s actual level of cooperation to be (positively or negatively) impacted by factors outside of his or her control (i.e., noise). While positive noise is possible (i.e., cooperation is higher than intended), the majority of research has focused on the detrimental effects of negative noise (i.e., when cooperation is lower than intended). This research clearly has shown that negative noise reduces cooperation in give some games (Van Lange, Ouwerkerk, & Tazelaar, 2002) and willingness to manage a common resource responsibly, especially among prosocials faced with a diminishing resource (Brucks & Van Lange, 2007). Moreover, the adverse consequences of negative noise can “spill over” into subsequent dilemmas that contain no noise (Brucks & Van Lange, 2008). While noise can clearly undermine cooperation, several studies also suggest it can be overcome, for example, if the partner pursues a strategy that is slightly more generous than a strict tit-for-tat strategy (e.g., tit-for-tat + 1; Klapwijk & Van Lange, 2009; Van Lange et al., 2002), when people are given an opportunity to communicate (Tazelaar, Van Lange, & Ouwerkerk, 2004), and when people are encouraged to be empathetic (Rumble, Van Lange, & Parks, 2010).

In summary, structural influences center on key differences in the interdependence structure of the social dilemma, such that outcomes linked to cooperation can be improved through reward and outcomes linked to non-cooperation through punishment, with exclusion representing a strong form of punishment. The effects of structural differences often go beyond material outcomes, and elicit a rich psychology involving neuroscientific, cognitive and emotional processes. Asymmetries and roles are important determinants of behavior in social dilemma, yet understudied, especially when looking at social dilemmas in everyday life where asymmetries and roles seem the rule and not the exception. Uncertainty and noise are also omnipresent in everyday life, and they may shape the psychology in many ways, in that they may challenge trust, feelings of control, and perhaps sometimes give rise to judgments and heuristics that are predictably inaccurate, such as unrealistic optimism regarding the state of affairs (such as size of the pool) or unrealistic pessimism regarding other’s willingness to cooperate.

Psychological influences

Advances have also been made in understanding how a variety of psychological variables impact cooperation in social dilemmas. In this section, we focus on four categories of psychological variables including individual differences, decision framing, priming, and affect.

Social value orientation

A long history of social dilemma research makes clear that people differ in fundamental ways in how they approach and interact in social dilemmas. The personality variable that has received the lion’s share of the attention is social value orientation (Messick & McClintock, 1968; Van Lange, 1999). Although SVO has long been recognized as a predictor of social dilemma cognition and behavior (e.g., Kelley & Stahelski, 1970; Kuhlman & Marshello, 1975), researchers continue to gain deeper insights into its origin (e.g.,

Van Lange, Otten, De Bruin, & Joireman, 1997), measurement (e.g., Eek & Garling, 2006; Murphy, Ackerman, & Handgraaf, 2011) and influence on cognition and behavior in lab and field studies. As noted earlier, several excellent reviews of the SVO literature have recently been published (e.g., Au & Kwong, 2004; Balliet, Parks, & Joireman, 2009; Bogaert, Boone, & Declerck, 2008; Van Lange et al., 2007). Nevertheless, a number of recent advances are worth noting.

First, whereas researchers have often defined a prosocial value orientation in terms of a desire to maximize joint outcomes, it is becoming increasingly clear that prosocials are also very concerned with maximizing equality. For example, in his integrative model of social value orientation, Van Lange (1999) suggests that the desire to maximize joint gain and equality are positively correlated and that prosocials pursue both goals (cf. De Cremer & Van Lange, 2001), while individualists and competitors pursue neither. More recent evidence supports the claim that equality in outcomes is the primary concern among prosocials (Eek & Garling, 2006). Consistent with the argument that prosocials consider equality an important principle, research shows that prosocials are more likely than individualists and competitors to (a) use an “equal split is fair” rule in negotiation settings (De Dreu & Boles, 1998), (b) respond with a high degree of anger to violations of equality, regardless of how such violations impact their own outcomes, whereas individualists and competitors only respond to violations of equality when such violations harm their own outcomes (Stouten et al., 2005), and (c) show a high degree of activity in the amygdala when evaluating unequal distributions of outcomes (Haruno & Frith, 2009). Taken together, these findings suggest that a concern with equality is very strongly linked to how prosocials approach social dilemmas, how they respond to others who might violate equality, and what makes them distinctively different from individualists and competitors. It is also plausible that because of their concern with equality, prosocials might feel strongly about restoring justice in the world (e.g., Joireman & Duell, 2005), and gravitate to political parties that emphasize not only solidarity but also egalitarianism (e.g., Van Lange et al., 2012).

Second, researchers continue to find evidence for the ecological validity of SVO. As an example, research has shown that, relative to individualists and competitors, prosocials are more willing to donate to help the ill and the poor (but not the local sports club) and volunteer as participants in psychology experiments (e.g., McClintock & Allison, 1989; Van Lange, Schippers, & Balliet, 2011), exhibit citizenship behavior in organizations (Nauta, De Dreu, & Van der Vaart, 2002), engage in proenvironmental behavior (Cameron, Brown, & Chapman, 1998; Joireman et al., 2001), express stronger preferences for public transportation (Van Vugt et al., 1995), coordinate (i.e., sync) their behavior with an interaction partner (Lumsden, Miles, Richardson, Smith, & Macrae, 2012), and be perceived as cooperative based on their non-verbal behavior (Shelley, Page, Rives, Yeagley, & Kuhlman, 2010). In short, since the publication of Komorita and Parks’ (1994) book, an impressive number of studies have been published supporting the real-world impact of SVO.

Trust

Another variable closely linked to cooperation is trust. According to one of the most accepted definitions, 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, p. 395). As such, trust involves vulnerability, that is, the uncertainty and risk that comes with the control another person has over one’s outcomes and “positive expectations” which often imply a set of beliefs in the cooperative intentions or behavior of another person, or people

in general (Rotter, 1967, see also Evans & Krueger, 2010). Early work on trust in social dilemmas showed that those high in dispositional trust were more likely than those low in trust to increase cooperation in response to a partner's stated intention to cooperate (Parks, Henager, & Scamahorn, 1996), reduce consumption of a depleting common (Messick et al., 1983), and contribute to public goods (Parks, 1994; Yamagishi, 1986a).

Since these initial studies, a number of important insights regarding trust and cooperation have emerged. First, research suggests that people who are not very trusting of others are not necessarily "noncooperative" in a motivational sense. Rather, they are simply prone to believe that others will not cooperate, and that "fear" undermines their own (elementary) cooperation. However, when given the chance to contribute to a sanctioning system that punishes noncooperators, low-trusters are actually quite "cooperative." In other words, they appear quite willing to engage in instrumental cooperation by contributing to an outcome structure that makes it for everybody, including those with selfish motives, attractive to cooperate, or unattractive to not cooperate (Yamagishi, 2011; for earlier evidence, see Yamagishi, 1988a, 1988b).

Second, trust matters more when people lack information about other people's intentions or behavior, or when they are faced with considerable uncertainty (see Yamagishi, 2011). An interesting case in point is provided by Tazelaar et al. (2004) who, as mentioned earlier, found that levels of cooperation are much lower when people face a social dilemma with noise. More interesting, they found that this detrimental effect of noise was more pronounced for people with low trust than for people with high trust (Tazelaar et al., 2004, Study 2).

Third, based on a recent meta-analysis, it is clear that trust matters most when there is a high degree of conflict between one's own and others' outcomes (Balliet & Van Lange, *in press-a*; cf. Parks & Hulbert, 1995). This finding makes sense, as these are the situations involving the greatest degree of vulnerability, as trusting others to act in the collective's interest can be quite costly in such situations. Indeed, as noted earlier, trust is, in many ways, about the intention to accept vulnerability based upon positive expectations of the intentions or behavior of another (Rousseau et al., 1998, see also Evans & Krueger, 2010).

Consideration of future consequences

A final trait relevant to cooperation in social dilemmas is the consideration of future consequences, defined as "the extent to which people consider the potential distant outcomes of their current behaviors and the extent to which they are influenced by these potential outcomes" (Strathman, Gleicher, Boninger, & Edwards, 1994, p. 743; cf. Joireman, Shaffer, Balliet, & Strathman, *in press*). Several studies have shown that individuals high in CFC are more likely than those low in CFC to cooperate in experimentally-created social dilemmas (e.g., Joireman, Posey, Barnes True-love, & Parks, 2009; Kortenkamp & Moore, 2006), and real-world dilemmas, for example, by engaging in proenvironmental behavior (e.g., Joireman et al., 2001; Strathman et al., 1994), commuting by public transportation (e.g., Joireman et al., 2004), and supporting structural solutions to transportation problems if the solution will reduce pollution (Joireman et al., 2001).

Other individual differences

A number of additional individual differences have received attention in recent dilemmas research. This research has shown, for example, that cooperation in social dilemmas is higher among those low in narcissism (Campbell, Bush, & Brunell, 2005), low in dispositional envy (Parks, Rumble, & Posey, 2002), low in extraversion and high in agreeableness (Koole, Jager, van den Berg, Vlek, &

Hofstee, 2001), high in intrinsic orientation (Sheldon & McGregor, 2000), high in sensation seeking and self-monitoring (Boone, Brabander, & van Witteloostuijn, 1999), and high in the need to belong, assuming the group is large (De Cremer & Leonardelli, 2003).

Decision framing

The psychological "framing" of social dilemmas has also received a fair amount of recent attention. For example, in general, emphasizing the acquisitive aspect of the dilemma ("you can gain something from the task") leads people to be less cooperative than emphasizing the supportive aspect of the dilemma ("you can contribute toward a common good") (Kramer & Brewer, 1984). Similarly, cooperation is lower when decision makers view the social dilemma as a business decision, rather than an ethical decision (Tenbrunsel & Messick, 1999) or a social decision (Lieberman, Samuels, & Ross, 2004; Pillutla & Chen, 1999). Framing the dilemma as a public goods vs. a commons can also impact cooperation, but, as De Dreu and McCusker (1997) show, the direction of such framing effects seems to depend on the instructions given and the decision maker's SVO: to summarize, cooperation rates are lower in give some than in take some dilemmas when instructions to the dilemma emphasize individual gain or decision-makers have an individualistic value orientation, whereas cooperation is higher in give some than in take some games when instructions emphasize collective outcomes or decision-makers have a prosocial value orientation. In general, group members are more concerned to distribute outcomes equally over group members in the take-some dilemma than in the give-some dilemma (Van Dijk & Wilke, 1995, 2000). Finally, research has also shown that cooperation decreases if people come to believe they have been doing better than expected, and increases if people believe they have been doing worse than expected (Parks, Sanna, & Posey, 2003).

Priming

Another question that has received some attention is whether it is possible to induce cooperation through subtle cues and suggestions. The answer is generally "yes," though the dynamics of priming cooperation are surprisingly complex, and it is not clear whether they exert very strong effects. But some effects are worth mentioning. For example, priming an interdependent mindset effectively promotes cooperation (Utz, 2004a), but if the person has a prosocial orientation, it is better to prime a self-mindset which can activate their existing prosocial values (Utz, 2004b). Similarly, prosocials show increased cooperation when encouraged to think about "smart" behavior, whereas such "smart" primes will just make prosocials more selfish (Utz, Ouwerkerk, & Van Lange, 2004).

Heuristics

Like priming, the application of decision heuristics to social dilemma choice has received relatively little attention. Yet the work on heuristics that has been done is quite revealing. A small amount of this work has looked at the value of heuristics for directing behavior in large-scale social dilemmas (Messick & Liebrand, 1995; Parks & Komorita, 1997). The primary focus, however, has been on an equality heuristic (or norm), under which people choose with an eye toward making sure everyone has the same experience. In resource-consumption-type tasks, the equality heuristic is oriented around everyone receiving the same amount of the resource. People tend to anchor on it, and then adjust their choices in a self-serving direction (Allison, McQueen, & Schaeffer, 1992; Allison & Messick, 1990; Roch, Lane, Samuelson, Allison, & Dent, 2000). When the dilemma involves contribution, "equality"

is oriented around everyone giving the same amount, though the motivator of this heuristic is not constant—sometimes equality is used to emphasize fairness, in that all should give, but at other times it is used to emphasize efficiency, in that everybody giving the same amount is the easiest way to achieve the goal (Stouten, De Cremer, & Van Dijk, 2007, 2009; Stouten et al., 2005). Further along this line, some theorists have argued that, in mixed-motive situations, most decision heuristics are employed in order to maximize the likelihood of engaging in fair behavior, on the assumption that coming across as fair conveys to others that one is trustworthy (Lind, 2001).

Affect

The influence of affect on decision-making is another topic of current prominence within the field of social dilemmas. Here, research has focused on both general mood states and specific emotions. Regarding mood, a clear pattern that emerges is that a positive mood is not necessarily beneficial for encouraging cooperation. For example, a positive mood can lead people to infer that they have been sufficiently supportive of the group and they are now at liberty to choose however they wish (e.g., Hertel & Fiedler, 1994). It may also be that a positive mood leads people to focus more on internal states, which would heighten selfishness, while negative moods lead to an external focus, which would heighten cooperation (Tan & Forgas, 2010). These findings are consistent with the emerging notion that happiness is not always a useful mood state to induce (Gruber, Mauss, & Tamir, 2011) and raises the interesting notion that it could be beneficial to make social dilemma participants feel bad in some way about the situation. Along these lines, it has been shown that those who feel badly about their choices in a social dilemma will become more cooperative in subsequent dilemmas, even if there is a considerable time lag between the initial and subsequent dilemmas (Ketelaar & Au, 2003).

This immediately raises the question of whether it would matter which specific negative emotion was induced. For example, would it be irrelevant whether a person felt mad or sad, so long as the feeling was negative? For that matter, might there be other specific emotions that come into play when choosing in a social dilemma? In fact, there is evidence that cooperation is connected with a range of negative emotions including envy (Parks et al., 2002), guilt (e.g., Nelissen et al., 2007), shame (e.g., De Hooge, Breugelmans, & Zeelenberg, 2008), regret (Martinez, Zeelenberg, & Rijnsman, 2011), anger and disappointment (e.g., Wubben, De Cremer, & Van Dijk, 2009), with most acting as stimulators of cooperation.

On a related note, a more recent line of research has focused on how cooperation is impacted when one's partner communicates certain emotions. For example, research shows that when one's partner is not really in a position to retaliate, people are more cooperative when their partner appears happy, but if one's partner can retaliate, people are more cooperative when their partner expresses anger (Van Dijk, Van Kleef, Steinel, & Van Beest, 2008). Such research shows that communicated emotions are often interpreted as a signal that informs us how another person might respond to our non-cooperative and cooperative behavior (e.g., Van Kleef, De Dreu, & Manstead, 2006). Indeed, research also shows that cooperators are more likely than individualists and competitors to smile when discussing even mundane aspects of their day, and that cooperators, individualists, and competitors can be identified simply on the basis of their non-verbal behavior (Shelley et al., 2010).

In summary, personality differences in social values, trust, consideration of future consequences, framing, priming, heuristics, and affect represent a long list of variables that are important to

understanding the psychological processes that are activated in social dilemmas. Presumably, personality influences might be more stable over time and generalizable across situations than some other, more subtle influences, such as framing, priming, and affect. The “stable” and “subtle” influences are both important, as they provide the bigger picture of what the social dilemmas might challenge in people, in different people, and how some of these challenges might be influenced in implicit ways. The effect sizes of framing and especially priming may sometimes be somewhat modest, yet the effects tend to be fairly robust, and therefore they help us understand how cooperation could perhaps be promoted in cost-effective ways, such as by just activating a particular psychological state or mindset in the ways social dilemmas are communicated and presented.

Dynamic interaction processes

In the preceding sections, we focused mainly on how features of the decision, situation, and person influence the decision to cooperate at a given point in time. While some of these variables could be viewed as having a “dynamic” component (e.g., the impact of rewards and punishments on cooperation), most of the variables were “static” in the sense that they did not typically concern how a decision maker faced with a social dilemma *actively responds* to changes in his or her environment *over time*. Sometimes this means that personality differences are expressed in how people respond to others over time (e.g., how an individualist might respond to a tit-for-tat strategy; Kuhlman & Marshello, 1975), or that personality differences become weaker and that most people respond strongly to information about others' behavior in a group as it unfolds over time (e.g., the number of noncooperators in a group, Chen & Bachrach, 2003). In the present section, we consider several promising lines of research addressing on-going interaction processes within the context of social dilemmas by examining what happens *after* group members have made their choices, learned of others choices, and must make a subsequent choice. Specifically, we consider recent work on reciprocal strategies, generosity in the context of misunderstandings (or noise), locomotion, and support for structural solutions to social dilemmas.

Direct reciprocity

There is a long tradition of research on how different reciprocal strategies (e.g., unconditionally cooperative, unconditionally non-cooperative, or conditionally cooperative) impact cooperation in social dilemmas (e.g., Komorita, Parks, & Hulbert, 1992). The well-established finding is that the Tit-For-Tat (TFT) strategy (start cooperative, and then respond in kind to the partner's actions) is the most effective strategy if one is motivated pursue joint welfare as well as own welfare (Axelrod, 1984). The effectiveness of the other's strategy, however, has been shown to depend on an individual's social value orientation. For example, in their classic work, Kuhlman and Marshello (1975) had cooperators, individualists and competitors play 30 trials of a 2-person prisoner's dilemma game against one of three pre-programmed strategies (100% cooperative, TFT, 100% non-cooperative). Kuhlman and Marshello found that cooperators showed high levels of cooperation, unless their partner always chose to behave non-cooperatively; competitors showed low levels of cooperation, regardless of their partner's strategy; and individualists showed high levels of cooperation only when paired with a partner pursuing a TFT strategy. For many years, these findings led to the conclusion that (a) TFT was always the best strategy for eliciting cooperation, (b) that an unconditionally cooperative strategy was sure to be exploited, and (c) that individ-

ualists (but not competitors) could be “taught” to cooperate, when they came to understand it was in their own best interest.

Recent research, however, has called into question each of these conclusions. For example, Van Lange et al. (2002) have shown that in situations involving negative noise (i.e., when one’s cooperation level is not as high as it was intended), TFT is actually less effective at eliciting cooperation than a more generous strategy in which one responds in a slightly more cooperative manner than one’s partner did on the previous trial (e.g., TFT + 1). One explanation for this finding is that when one’s partner adopts a generous reciprocal strategy, it encourages one to maintain the impression that one’s partner has benign intentions and can be trusted (see also Klapwijk & Van Lange, 2009). Second, arguing against the inevitable exploitation of unconditional cooperators, Weber and Murnighan (2008) showed that consistent cooperators can effectively encourage cooperation in social dilemmas, often ultimately promoting their own long-term best interests. Third, whereas it was long assumed that competitors could not learn to cooperate, Sheldon (1999) showed that, when given enough time, competitors increase their level of cooperation in response to a tit-for-tat strategy. Finally, Parks and Rumble (2001) showed that the *timing* of rewards and punishments matters: whereas prosocials are most likely to cooperate when their cooperation is immediately reciprocated, competitors are most likely to cooperate when punishment for non-cooperation is delayed. In sum, recent research has shed new light on how reciprocal strategies can promote cooperation.

Indirect reciprocity

Recent research has also explored how indirect reciprocity can encourage cooperation. Whereas the effects of direct reciprocity are observed in repeated encounters between two individuals, cooperation in larger settings may be promoted by indirect reciprocity. According to this view, cooperation may be advantageous because we tend to help people who have helped others in the past. As noted earlier, and briefly illustrated by the experiment of Wedekind and Milinski (2000), indirect reciprocity models build on reputation effects by assuming that people may gain a positive reputation if they cooperate and a negative reputation if they do not. Indeed, people are more likely to cooperate with others who donated to a charity fund like UNICEF (Milinski, Semmann, & Krambeck, 2002). Notably, people also seem to be well aware of these positive effects, as they are more willing to donate and cooperate if they feel their reputation will be known by others than if they feel others are not aware of their contributions (e.g., Griskevicius et al., 2010). There is even evidence indicating that subtle cues of being watched – by means of an image of pair of eyes – can enhance donations (Bateson, Nettle, & Roberts, 2006), which suggest the subtle power of reputational mechanisms.

Locomotion

Typically, experimental research on multi-trial social dilemmas has explored how people respond to a given partner or group. However, in the real world, one is not inevitably “stuck” with certain partners. One can exit relationships and groups, and enter others. Recognizing exit and selection (and exclusion) of new partners as viable options in social dilemmas, a number of recent studies have begun to study locomotion and changes in group composition in social dilemmas. For example, Van Lange and Visser (1999) showed that people minimize interdependence with others who have exploited them, and that competitors minimize interdependence with others who pursue TFT, which is understandable, as competitors cannot effectively achieve greater (relative) outcomes with a partner pursuing TFT. Similarly, it is clear that conflict within a group may induce people to leave their group, eventually lead-

ing to group fissions (Hart & Van Vugt, 2006). The conflict may come from failure to establish cooperation in the group or a decline in cooperation as cooperative members exit (Yamagishi, 1988a; Van Lange & Visser, 1999; see also De Cremer & Van Dijk, 2011), or from dissatisfaction with autocratic leadership (Van Vugt, Jepson, Hart, & De Cremer, 2004). Conversely, prospects of cooperation may encourage individuals to enter groups, for example, when sanctions of non-cooperation promote the expectation of cooperation (see Güreker et al., 2006).

Communication

Frequently, communication is conceptualized as a psychological variable. After all, communication is often conceptualized in terms of verbal or non-verbal messages that are characterized by a fair amount of interpretation and subjectivity. In the social dilemma literature, various forms of communication have been compared. Classic research on social dilemma has shown that communication can effectively promote cooperation (see Komorita & Parks, 1994). But it is not just “cheap talk” that explains why communication might promote cooperation, even though face-to-face interaction by itself may be helpful. To simply to talk about issues that are not in any way relevant to the social dilemma does not seem to promote cooperation (Dawes, McTavish, & Shaklee, 1977). Some researchers have suggested and found that, at least in single-trial social dilemmas, promising (to make a cooperative choice) may be quite effective, but only if all group members make such a promise (Orbell et al., 1988). Subsequent research supported this line of reasoning, in that “communication-with-pledge” promotes cooperation, because it promotes a sense of group identity and a belief that one’s choice matters (i.e., that one’s choice is believed to be critical; Chen, 1996). These findings are important not only because they inform us about the psychology of decision-making in social dilemmas, but also how they might help us explain the dynamics of cooperation. Moreover, in real life social dilemmas, group members may actually decide whether they favor a structure in which they openly communicate their intended choices. For example, as noted by Chen (1996), in work groups, managers could ask to make a pledge of time and effort, and then propose several binding pledge systems, especially those that are “group-based” such that they create a common fate whereby they serve as normative standards for everybody involved. Communication may strengthen a sense of identity, but it also promotes a norm of (generalized) reciprocity, which is why it might speak to similar mechanisms as those that dynamically underlie the effects of direct and indirect reciprocity.

Support for structural solutions

One final issue being addressed concerns structural solutions to social dilemmas which involve changing the decision-making authority (e.g., by electing a leader), rules for accessing the common resource, or the incentive structure facing decision makers (e.g., by making the cooperative response more attractive). In the lab, the most heavily studied structural solution has been the election of a leader. Many early studies showed that people were more likely to elect a leader when the group had failed to achieve optimal outcomes in a social dilemma (e.g., underprovided a public good, or overused a common resource; Messick et al., 1983; Van Vugt & De Cremer, 1999). Additional research shows that, after a group has failed, willingness to elect a leader tends to be lower in commons dilemmas (as opposed to public goods dilemmas) (e.g., Van Dijk, Wilke, & Wit, 2003), when collective failure is believed to be the result of task difficulty (as opposed to greed) (Samuelson, 1991), and among those with a prosocial (vs. a proself) orientation (De Cremer, 2000; Samuelson, 1993). Research com-

paring different leadership alternatives shows that group members are more likely to support democratic (vs. autocratic) leaders, and to stay in groups led by democratic (vs. autocratic) leaders (Van Vugt et al., 2004). Finally, a new and promising line of research on leadership and cooperation introduces evolutionary concepts. This research, for example, has revealed that competition within groups may increase the preference for female leadership, whereas intergroup competition may increase preferences for male leadership (Van Vugt & Spisak, 2008).

Beyond the lab, a number of field studies have also explored support for structural solutions, many building off of Samuelson's (1993) *multiattribute evaluation model*. Samuelson proposed that decision makers evaluate structural solutions in terms of efficiency, self-interest, fairness, and freedom, and that the importance of the four dimensions varying as a function of individual differences (e.g., in social value orientation or consideration of future consequences). Samuelson's model has received support in several field studies exploring support for improvements in public transportation (e.g., Joireman, Van Lange et al., 2001). Field research on structural solutions has also explored the impact of private metering during a water shortage (Van Vugt & Samuelson, 1999), and reaction against the first carpool lane in Europe (Van Vugt et al., 1996). Finally, as noted earlier, research on structural solutions to social dilemmas has been greatly advanced by Ostrom and her colleagues who have studied the development of institutions designed to manage common pool resources (e.g., Ostrom, 1990; Ostrom, Gardner, & Walker, 2003). The broad conclusion reached by Ostrom and colleagues is that local management of small communities, and the enhancement and maintenance of trust in these communities, is essential for both the communities and the broader collective. Or as Ostrom and Ahn (2008) stated: "the very condition for a successful market economy and democracy is that a vast number of people relate in a trustworthy manner when dealing with others to achieve collective actions of various scales." (p. 24).

In summary, it is one thing to predict and explain how people might behave in relatively static situations, such as social dilemmas without repeated interaction. It is quite another thing to predict and explain dynamic interaction patterns. While classic research has emphasized reciprocity, such as Tit-For-Tat, as a functional strategy promoting cooperative interaction, more recent research suggests that it is functional to add a bit of generosity. One reason is that generosity helps to maintain or promote trust, which in turn is a key ingredient to cooperation. Further, when social dilemmas do not elicit sufficient cooperation, we see that people exhibit a greater willingness to support several solutions, including the option of communication with binding elements (such as pledges), and the structural solution of electing a leader. In doing so, they tend to support democratic leadership over autocratic leadership. Together, feelings of trust, criticality, and "we-ness" (such as the feeling "we are in this together") seem essential for small communities to productively approach and resolve social dilemmas. They may not only underlie cooperation, but also why participants contribute to dynamic interaction patterns and structural changes in social dilemmas, and why such instrumental contributions are effective in promoting cooperation.

Prospects for the future of social dilemmas

Looking back, researchers have made significant progress in theory development, applied and interdisciplinary research, and in understanding the impact of structural, psychological and dynamic factors on cooperation. Moreover, on the whole, we see increased attention to paradigms and issues more closely approximating real-world dilemmas (e.g., paradigms that recognize asymmetries, noise, structural solutions). In sum, the field has

made significant and exciting advances over the past 15–20 years, yielding valuable insights into the dynamics of cooperation in a variety of social dilemmas. We should admit that our review has not been comprehensive, in that important literatures on social dilemmas and human cooperation have not been addressed – we are thinking of seminal papers by, anthropologists, evolutionary scientists, experimental economists, mathematicians, political scientists, and theoretical biologists. The most important reason for this is limitations in terms of space and, admittedly, time. But the important point to be made is that by focusing on the psychology of social dilemmas we are underestimating the diversity in conceptual approach, interdisciplinary research, and methodological paradigms. And all signs suggest that this diversity will continue and expand in the next decades.

Looking ahead, we see several promising directions for future research. At the broadest level, we believe the field would benefit from continued attention to developing an overarching theoretical framework. Earlier we reviewed interdependence theory and evolutionary theory as relatively broad theoretical frameworks. These frameworks share a number of meaningful connections. Broadly conceived, by its focus on the analysis of situational structure, interdependence theory is an ideal position to start our conceptual analysis. The same could be argued for game theory, but interdependence theory has the advantage of providing a relatively coherent framework in which the conceptual links among situations are delineated by providing a taxonomy of dimensions, including situational "dimensions" such as degree of dependence, degree of conflicting interest, information availability, and time (horizon) as key dimensions (e.g., Kelley et al., 2003; Van Lange & Rusbult, 2012). This taxonomy helps us understand the game (read: situation) people are facing, and the problems or opportunities that the game (again read: situation) affords. This interdependence-based analysis not only provides key insights into the structure of situation (what is the situation about?), it also suggests the broad relevance of our own interaction goals (are we cooperative or not?) and those we attribute to others in a global or concrete manner (are other people cooperative or not?). The latter attributions or beliefs are, of course, closely linked to trust.

Evolutionary theory provides a broad framework for understanding the (ultimate) mechanisms relevant to trust and cooperation. And psychological theory, including the appropriateness framework, should help us understand the (proximal) mechanisms relevant to trust and cooperation. To illustrate, interdependence theory (and game theory) suggests the importance of incomplete information. In social dilemmas defined by a conflict of self-interest and collective interest, incomplete information begs trust: did the other intentionally help (or harm) the collective interest? Evolutionary, this is important because it challenges the ways in which cooperation may be evolved: for example, it may help us understand why giving strangers the benefit of doubt has functional (and survival) value. Even more, it may help us understand the roots of generosity (Nowak & Sigmund, 1992). Proximally, giving others the benefit of doubt, especially when accompanied by the communication of generosity, will enhance trust the other has in your intentions – which in turn is crucial for coping with uncertainty and incomplete information (Van Lange et al., 2002). We are truly looking forward to a fruitful and comprehensive integration of adaptation to structure (the game we play), the psychological and interpersonal processes involved (what we make of the game), and the ultimate functions it serves in terms of psychological, economic, and evolutionary outcomes.

Such integrative theorizing has clear potential in understanding empirical (and interdisciplinary) research on uncertainty, noise, social exclusion, and sanctions. We also believe the field would benefit by devoting increased attention to structural solutions to social dilemmas, as these solutions seem to hold the greatest po-

tential for encouraging cooperation in the many, wide-scale dilemmas we face. Arguably, one of the most important dilemmas we face is the problem of global warming. Unfortunately, international attempts to raise support for a structural solution to this dilemma have encountered challenges. Given its complexity, solving the dilemma of global warming will inevitably require teams of scientists who bring strong theory, valid methods, and a willingness to approach the problem from an interdisciplinary perspective. From our perspective, social dilemma researchers are clearly poised to contribute to that effort.

Science is about finding the truth, general knowledge, progress and innovation, and applicable knowledge (Van Lange, 2013). This is what makes science so exciting. The science of social dilemmas makes it even more exciting because it addresses the basic question of human nature – the selfish and prosocial aspects of human-kind – and because we often face a reality in which we experience social dilemmas on a weekly or even daily basis. Imaginary or real, people often find themselves in situations that have much in common with social dilemmas – with strangers, with colleagues, with friends, with close partners. These social interactions can be quite challenging – and sometimes even puzzling (“why did she do that to me?”). How do we deal with strangers? Do we trust them? Does our image or reputation matter? And on a larger scale, newspapers are often addressing issues of scarcity (e.g., the risk of depleting specific fish species), greed, the excessive pursuit of self-interest (e.g., incentives for the executive officers in the financial sector), or difficulties in establishing contractual agreements among countries for maintaining a healthy levels of environmental quality.

We acknowledged already the relevance of applicable knowledge. One broad lesson that one might infer from the social dilemma literature is that, often, it is the combination of measures, rather than their isolated effects, that effectively promote cooperation. For example, authorities are often associated with structural solutions such as sanctioning free-riding and rewarding cooperative action, and trust is often associated with interpersonal relations (at least in psychology). But like (horizontal) trust among people, vertical trust between people and institutes (institutional trust) is crucial for the acceptance of rewards and punishment. Above and beyond outcomes in a narrow sense, people want to be treated fairly and respectfully. For example, a (local) government who listens to the concerns that people may have, and provides accurate information in a transparent manner, might often not only enhance vertical trust, but also a stronger commitment and willingness among people to make a positive contribution to urgent social dilemmas. A case in point is Tyler and Degoey's (1995) research on the 1991 water shortage in California, which demonstrated that people exercised more constraint on their water consumption if they felt treated more fairly by the authorities.

Likewise, it is often true that relatively small groups in large societies, such as local communities, have enormous potential to organize and manage themselves in ways that promote cooperation and prevent them from depleting natural resources. In small groups people are able to develop rules that match the local circumstances, they are able to monitor one another's behavior, and punish free-riding and reward generosity quite effectively. People care very strongly about their image or reputation in their local community, and so if the norms favouring cooperation are well-specified, then often the mere presence of others makes a big difference. These are important virtues of a local organization, formal or informal, relative to a more global authority.

It is crucial that members of small communities trust each other so that monitoring and norm-enforcement can take place in a cost-effective, informal manner. There is a recent meta-analytic study involving 18 societies that provides evidence that trust and social norm enforcement may reinforce each other in securing and promoting cooperation in large-scale societies. In societies where trust

is low (such as Greece or South Africa), punishment was hardly effective in promoting cooperation, but in high-trust societies (such as Denmark or China) possibilities for punishment in public goods dilemmas promoted cooperation very effectively. The broad conclusion is that the effectiveness of punishment in promoting cooperation in a public goods experiment is greater in societies with high trust, rather than low trust (Balliet & Van Lange, *in press-a*). Another important result of this meta-analysis is that societies with stronger democracies demonstrate a greater ability to secure and promote contributions towards public goods by the use of peer punishment. These findings paint a picture in which the ways in which individuals relate to each other in small groups and local communities is important to the overall functioning of society – and this suggests the strong positive reinforcement among structural solutions, third-party intervention, and psychological solutions.

As noted earlier, many of the insights described above were already recognized by the late Elinor Ostrom, who passed away in 2012 at the age of 78. More than 20 years ago, she suggested that institutes could play a very important role in regulating the local management to preserve natural resources and avoid ecosystem collapses (Ostrom, 1990). In retrospect, her insights in many ways reinforce conclusions that are now supported by a meta-analytic study. In particular, among smaller units, such as dyads and small groups, it is trust and reciprocity that matters (and we would add, generosity and forgiveness), along with effective communication. Within a frame of sufficient vertical trust, people will adopt an accepting attitude to governmental interventions, such as the provision of rewards and punishment, and some constraint on their autonomy. These are also analyses of social dilemmas where the various scientific fields and disciplines should inform one another to effectively understand how small groups might help effectively manage and resolve ongoing social dilemmas.

Looking back and ahead, we cannot help but conclude that the study of social dilemmas is “alive and kicking.” Over the years, the field has produced numerous replicable findings, advanced our theoretical understanding of human cooperation, fostered communication among scientific disciplines, and has at least made a beginning of applying such knowledge to social dilemmas as we face them in everyday life. Being dedicated social dilemmas researchers ourselves, our observations may be a bit colored. But we think that the research that has accumulated has resulted in a “sea of knowledge” that should be exceptional useful in facing the numerous challenges – theoretical, empirical, methodological, and societal – that the field will encounter in the future. Examples of some key challenges are understanding the how and why of rewards and punishment, the strength of fairness (and perhaps altruism) as social preferences, and the power of beliefs about humankind (as individuals and groups) and how these might impact our behavior. Also, the field has just started to explore the role of emotions, construal processes, facial information, intergroup issues, reputation, gossip and many more issues that are relevant to how people approach others in social dilemmas. We could go on, but simply thinking about these intriguing issues makes us look forward to the next several decades of research on social dilemmas.

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