The Impact of Economic Uncertainty and Trust on Cooperation in Environmental Dilemmas Across Cultures

Poonam Arora[1,2], M. Stefan Hoeller[1], Eric Scalone[1], Tetsushi Okumura[3], Nicole Peterson[4]

1   Department of Management, O'Malley School of Business, Manhattan College, Bronx, New York, USA
2   Advanced Consortium on Cooperation, Conflict, and Complexity (AC4), Earth Institute, Columbia University, New York, New York, USA
3   Faculty of Business Administration, Toyo University, Tokyo, Japan
4   Department of Anthropology, University of North Carolina at Charlotte, Charlotte, North Carolina, USA

Abstract

Climate change has resulted in frequent and intense droughts and floods–experienced respectively as contexts of certain loss and uncertainty–by farmers and agribusinesses. Such extreme water events, along with normal rainfall–experienced as certain gain-pose environmental dilemmas. In three studies across five countries, we examined the impact of outcome uncertainty on choices in environmental dilemmas. Cooperation was lowest in certain loss (droughts) and higher in certain gain (normal rainfall) in Study 1, a qualitative field study in Argentina. These results were experimentally replicated in the U.S. in Study 2. Study 3 empirically examined cooperative choice in India, Japan, Spain, and the U.S., replicating patterns for drought and normal rainfall. When the outcome was uncertain (floods), however, culture appeared to moderate cooperation. Two levels of trust (global and local) were also considered. Local trust was a significant predictor of cooperation. Potential mechanisms, and implications are discussed.

Extreme weather events like large scale floods and severe droughts are frequently regional or even global in scope, but their management and impact is typically local, based on choices made by individuals grounded in their local context. These events, which can also be thought of as extreme water events, where there is too much (floods) or too little (droughts) rainfall, can have dire consequences (Damerau et al., 2016; de Fraiture & Wichelns, 2010; Zhang & Vesselinov, 2017) for agriculture and groundwater (García et al., 2018). Although choices to mitigate and modulate the impact of floods and droughts are made independently, whether by an individual farmer or an agribusiness, the consequences are interdependent. Furthermore, local contexts strongly constrain individual choices and ultimately determine the potential impact of water extremes on food production and food security (Golub et al., 2013).

Groundwater, defined here as water in the soil and underground that is collectively available to spatially connected farms, is one such example of a local environmental resource whose use essentially poses two separate *social dilemmas*, or situations where maximizing individual gain in the short-term reduces collective benefit in the long run (Dawes, 1980). Our dilemmas are locally *contextualized social dilemmas*, where perceptions of situational parameters directly influence outcomes beyond the structure of the dilemma itself. The first dilemma stems from the overuse of shared groundwater by one of many spatially connected farms to maximize individual crop yield, particularly during times of water scarcity or droughts, which reduces collective yields by reducing total water availability. Comparatively, the second dilemma emerges during times of excess water or floods, when individual choices to remove standing water from parts of one's land that is best for farming results in excess water on spatially connected land that may be entirely or partially farmed by another.

Profit is a function of crop yield, so maximizing yield is an important economic goal. These groundwater dilemmas under conditions of drought and floods present water-management choices that provide either greater short-term individual or long-term collective benefit, a central characteristic of social and environmental dilemmas. Ostrom et al., (1994) suggest groundwater dilemmas are essentially resource or commons (not contribution or public goods) dilemmas, and in this research, we treat them as such.

In this paper we explore cooperation in real-world environmental dilemmas characterized by outcome uncertainty derived from their broader socio-economic context. We begin with an exploratory qualitative field study in the Argentine Pampas with agribusinesses that actually face groundwater related environmental dilemmas (Study 1), empirically replicate findings from Study 1 with non-agribusiness participants in a controlled setting (Study 2), and finally extend our findings across cultures by collecting data in four countries (Study 3).

While prior research has indicated the relevance of gains and losses for understanding cooperation, these phenomena have not been investigated in real-world environmental dilemmas where outcomes have varying certainty, often derived from the context. In this research, we capture the previously understudied uncertainty that arises in real-world dilemmas when the amounts and directionality of economic outcomes are undefined. Second, bridging the gap between scientific literature and real-world dilemmas, our research supports the creation of more meaningful policies and nudges capable of achieving targeted responses in the field. Third, we offer a potential path to examining real-world dilemmas: By starting with real-world settings and practitioner expertise in the field and then successfully testing the same dilemmas in controlled settings across four cultures, our methodology suggests that we can gain a deeper understanding of potential underlying mechanisms even for complex real-world dilemmas. In the literature review below, we discuss previously identified psychological factors that impact cooperative choice and also provide background on our contextualized dilemmas.

Role of Contextualized Choice in Social Dilemmas

Collective gains in an interdependent situation are best realized via cooperation (Arora et al., 2012; Brewer & Kramer, 1986; Kiyonari & Yamagishi, 2004; Yamagishi & Kiyonari, 2000); and context can greatly influence the choice to cooperate (see Dawes & Messick, 2000 and Weber et al., 2004 for complete reviews). For example, social factors, including social norms (Akerlof, 1980; Chen et al., 2009) and uncertainty regarding others in the dilemma (Messick et al., 1988; Suleiman & Rapoport, 1988) have been shown to influence cooperative choice. Similarly, environmental uncertainty, whether regarding the size (Budescu et al., 1997; Rapoport et al., 1993) or replenishment rate of the resource (Budescu & Au, 2002; Budescu et al., 1990), also influences cooperation in environmental dilemmas. In all cases, reduction of the underlying uncertainty increases cooperation.

Choices with Outcome Certainty and Uncertainty

There has been little work directly exploring the impact of outcome uncertainty on cooperative choice. Köke, Lange, and Nicklisch (2014) found that cooperation rates are higher when cooperative action can ensure certainty of a positive outcome. Similarly, cooperative action increases when structural mechanisms, such as punishment (Xiao & Kunreuther, 2016), reduce the uncertainty of a negative outcome. However, uncertainty in amount and directionality of outcome (positive or negative) have not been studied in social dilemmas, even as such uncertainty characterizes and contextualizes real-world dilemmas.

Droughts and floods, our contextualized dilemmas, can signify two disparate economic outcomes (Arora et al., 2016). Farmers often view droughts as land ceasing to be productive, leaving no feasible path to breakeven or achieve profitability, effectively resulting in a certain loss. Contrarily, although floods restrict movement of the farmers more than droughts, they offer the potential to break even or attain an economic gain as the higher elevated areas of a farm might not get flooded and may even benefit from the higher groundwater level, making otherwise dry land more productive. Thus, while a drought means a certain loss of some uncertain amount, a flood is characterized as an unknown amount of either loss or gain.

As droughts and floods have increased in frequency and intensity due to climate change (Peterson et al., 2013; Wuebbles et al., 2017), the certainty (droughts) or uncertainty (floods) of loss associated with these events has also become more salient. Arkes (1991) finds certainty can act as a salient reference point, and then influence subsequent actions (Dickhaut et al., 2003). Moreover, decision makers overweigh outcomes that are certain compared with outcomes that are only probable (Li & Chapman, 2009). Although well understood as a decision-making bias (Kahneman & Tversky, 1979), the certainty effect has not been studied in social dilemmas.

Independently, since losses loom larger (Kahneman & Tversky, 1979), as the possibility of a drought (certain loss) or flood (uncertainty) increases, so should their salience in the decision process. There is some evidence suggesting that when decision makers face a loss, they may prefer to minimize it through defection (Katz & Halevy, 2015). In contrast, when there is certain gain, ensuring those gains are fully realized becomes a priority (Suleiman et al., 2015), suggesting cooperative action.

Real-World Dilemmas in Argentine Agriculture: Contextualizing the Current Research

Argentina is a major contributor to global food security and has some of the most fertile land in the world, which produces amounts of grain sufficient to feed over five times its current population and has potential to increase production even more (Merlos et al., 2015). It is the leading world

exporter of soybean oil and meal, and the third largest exporter of soybeans as beans. Nevertheless, climate variability as well as global and local economic and social contexts have significantly influenced agriculture in the Argentine Pampas over the last few decades (Bert et al., 2011). Argentine agriculture is not a subsidized sector: Farmers take on the risks inherent in global commodity markets such that their economic incentive is the potential profit based on the actual crop price (Senesi et al., 2013). Additionally, recent structural changes have increased unpredictability due to environmental and social consequences for export crops in the region.

One such change that has been documented is an increase in the probability of floods over the last twenty years (Aragón et al., 2011). Both floods and droughts cause environmental as well as social and economic hardship. Farmers are typically loss averse (Bocquého et al., 2014; Tanaka et al., 2010), and that is particularly true of farmers in the Argentine Pampas where they assign two and a half times more weight to losses than gains (Gonzalez et al., 2018) in their decision processes. Taken together with the overweighting of the certainty of loss, a focus on loss prevention in the short-term can be expected.

Overview of Dilemmas in This Research

Drawing on environmental dilemmas encountered in the Argentine Pampas, we examined the impact of outcome certainty and uncertainty contextualized as droughts and floods on cooperative choices. Based on the advice from four agricultural experts who advise and/or manage a substantial portion of the cropped land in the Pampas (Arora et al., 2015), we added a third dilemma as a control for normal years where a certain gain is typically recorded. All four experts strongly agreed on the real-world accuracy and contextual validity of the three resulting dilemmas in our questionnaire. These are described below.

Table 1
Agricultural Dilemmas Presented to Participants, Including Action Choices

For lower levels of rainfall (droughts) participants had the option to:	Cooperate:	Plant regular seeds and make groundwater evenly available to neighbors, which increases collective yields.
	Defect:	Plant drought-resistant seeds with roots that reach twice the depth and reduce groundwater available to neighbors, which increases individual yield and reduces collective yields.
For higher levels of rainfall (floods) participants had the option to:	Cooperate:	Let the water accumulate on the land and allow flood water to be distributed evenly to neighbors, which increases collective yields.
	Defect:	Dig a channel to neighbor farm to reduce water accumulation on the land and increase flood water for others, which increases individual yield and reduces collective yields.
In regular levels of rainfall (normal) participants had the option to:	Cooperate:	Plant regular seeds and enable a uniform distribution of insects, which increases collective yields.
	Defect:	Plant insect resistant seeds and make it more likely that insects would go to neighboring farms, which increases individual yield and reduces collective yields.

Our contexts, reflecting the reality of farmers and agribusiness owners, began with assumptions for forecasted rainfall levels for the coming year [lower; higher; normal], the state of the soil [quite dry; quite wet; neither too wet nor too dry], and groundwater levels [low; high; normal] due to [little; excess; normal] rainfall in the past. The resulting three dilemmas offered choices between cooperation and defection as presented in Table 1, allowing for a systematic examination of the impact of certain loss, uncertainty, and certain gain across all three studies and corresponding with our research question. This paper asks: How is cooperative choice in environmental dilemmas influenced by uncertainty in amount and directionality of outcome across cultures?

Study 1

A major goal for this field study was to gain insight into the local decision processes for coping with the environmental dilemmas presented by floods, droughts, and normal years of rainfall. Specifically, we sought to examine the perception of outcome uncertainty associated with varying levels of rainfall, the resulting influence on cooperation in groundwater dilemmas, and possible motivators of the decision to cooperate.

Participants

Fifteen male CEOs (over 99% of agribusiness CEOs in Argentina are male) between the ages of 32 and 60 who employ between 2 and 20 people in family agribusinesses in the Argentine Pampas participated in this study. The participants were either owners or owner-managers of their agribusiness, making them either the only or the primary decision maker. All agribusinesses have been in the family for multiple generations. The CEOs were contacted as part of a random sample of approximately 100 members by AACREA (www.aacrea.org.ar), Asociación Argentina de Consorcios Regionales de Experimentación Agrícola, a non-profit farmers association that supports farm efforts through dissemination of information and technology. All but two CEOs were current members of AACREA. Typically, AACREA farmers own medium to large farms and agribusinesses as smaller farms tend not to be sustainable in the Argentine Pampas (Bert et al., 2011) and are involved in agricultural activities ranging from growing and processing cash crops to ranching and dairy enterprises. The average land farmed by participants in our study was 1,000 hectares and the agribusiness values were estimated to be between US$20-200 million. AACREA staff was the point of contact for potential participants. Our interviewees had no prior knowledge of, or information about, the interview questions, project research goals, or authors on this paper.

Design

All interviews were conducted in-person with each CEO in Spanish or English at their choice, typically at their place of work or on their farm. All interviews were recorded and transcribed. The interviews began by asking the CEOs to share their decision processes for land-use allocation and water management made in years when a drought is likely (local scarcity of water), when a flood is likely (local excess of water), and when normal rainfall is expected. All participants responded to all dilemmas (a within-subjects study design) described above in random order. They were asked three follow-up questions: (i) What would you do in a situation like this? This was followed by: Why would you do what you decided to do? (ii) Do you think your choice is selfish? (iii) What would you think if your neighbor were to defect? All participants responded to all questions. Since the CEOs were the

primary (if not only) decision maker for their agribusiness, their responses represented their individual and organizational choice.

Results

Participants experienced droughts as contexts of certain loss where the best action was the one most likely to maximize immediate economic outcomes and minimize the loss, or defection. In fact, 87% (13 out of 15) of the CEOs chose to defect or plant drought resistant seeds in the dilemma, and many made comments similar to: "I fear droughts because the loss is total. You feel you have some control over the floods, but none over the droughts." Additionally, they did not think of that action as selfish. Another concern mentioned was that globally determined commodity prices would not be sufficiently impacted by a local Argentine drought. Any defection by the neighbor was seen as "allowing him to earn a good living" rather than as a selfish action. Nearly half of the CEOs also pointed out that if they had a relationship with (trusted) the neighbor, they would discuss the drought and the new seed variety with him.

Normal rainfall levels were experienced as years of certain gain, where the farm would make some profit. All participants (100%) chose to cooperate by planting regular seeds. They mentioned the need for relationships with neighbors to ensure everyone cooperated ("I would coordinate with the neighbor to buy regular seeds together. That is better for everyone."), suggesting a focus on the collective good. Additionally, participants mentioned the importance of ensuring savings for years when there might be a loss. When asked about their response to a defecting neighbor, a common response was: "If I know (like, trust, have a relationship with) my neighbor, I would talk to him."

Floods were thought of as uncertain situations–they could result in a small loss, allow for breakeven, or even result in a small gain depending upon the topography of the land on the farm. Here 87% (13 out of 15) of the CEOs cooperated, choosing not to construct a channel to move the excess water. Perhaps interdependence is obvious as spatial farm boundaries are not a deterrent to flowing water. Nearly all (14 out of 15) participants mentioned the importance of cooperation (adopting a cooperative attitude, considering the relationship with neighbors, openly communicating with neighbors to find optimal solutions) when faced with uncertainty. There was also less expressed concern with the possibility of a loss as uncertainty meant there was some chance of breaking even or even generating a small gain (as illustrated by: "Flooding produces loss of some productive land, but also leaves yield.").

In Study 1, the contextualized dilemmas indeed translated into experiences of certainty and uncertainty: Droughts were experienced as certain loss, floods were experienced as uncertainty (where the economic outcome was an unknown, ranging from a small loss to breakeven to a small gain), and normal rainfall levels were experienced as certain gain. The majority of interviewees defected when faced with certain loss, cooperated in certain gain, and also under uncertainty. Collectively, and as a preliminary response to the research question, these three contexts translated into different experiences resulting in varying levels of cooperation. They provide some initial support for the influence of outcome certainty and uncertainty on choices in real-world environmental dilemmas. As predicted, cooperation is higher when experiencing certain gain compared with certain loss, while decision makers experiencing the uncertainty of floods tend to cooperate and behave similarly to when experiencing certain gain.

This study was performed without anonymity and with a small sample, however the findings of this qualitative study were informative and provided real-world validity. The next study places these contextualized environmental dilemmas in an experimental research design to explore generalizability and test for causality.

Study 2

Rationale and Hypotheses

Study 1, a field study grounded in real-world dilemmas, provided some preliminary evidence for a main effect of outcome uncertainty on likelihood of cooperation in environmental dilemmas. To ensure that this main effect was not just due to a small sample size in a qualitative (interview) study, and to control for any agricultural domain-specific effects, data were collected with a larger non-agricultural sample. Thus, Study 2 tested the replicability and generalizability of these findings with a bigger U.S. sample in a controlled setting. Participants were provided with the same real-world environmental dilemmas from Study 1 and were paid for their participation. Additionally, while Study 1 participants stated that they saw floods as offering the opportunity for a gain and thus cooperated, previously-discussed literature suggests the opposite where increased environmental uncertainty leads to a greater concern for individual outcomes and increased defection. Possibly, this contradiction existed as the uncertainty also encompassed the potential for gain during floods, unlike in previous studies where uncertainty was linked only to losses. Specifically, for Study 2, we predicted the following:

H1A. *The percentage of cooperators will be higher in the normal rainfall condition, which is experienced as a certain gain, than in the drought condition, which is experienced as a certain loss.*

H1B. *The percentage of cooperators will be higher in the flood condition, which is experienced as uncertainty, than in the drought condition, which is experienced as a certain loss.*

Participants

Three hundred participants (aged 18 to 69) from the United States were recruited through Amazon MTurk to participate. No other demographic data was collected. Restrictions were placed to only allow master workers to ensure higher quality responses. As a quality measure, time taken to complete the questionnaire was scrutinized to identify any unreasonable outliers (less than 10 minutes to complete the experiment), and none were identified.

Design

The same three dilemmas were used as in Study 1 but with a between-subjects design: Participants were randomly assigned to one of the three conditions (drought, normal rainfall, and flood), which, as shown in Study 1, are experienced as certain loss, certain gain, and uncertainty. The actions for defection and cooperation were, as shown in Table 1, identical to Study 1. Reflecting the nature of groundwater dilemmas, these choices follow patterns observed in other social and environmental dilemmas that are commons dilemmas. A complete text of the dilemmas used in Study 2 can be found in the Appendix.

Participants read the dilemmas and responded to two comprehension questions. Comprehension questions could be attempted three times before participants were terminated for any incorrect responses. Upon first attempt, 287 participants correctly answered the comprehension questions. The 13 participants who did not were asked to re-read the scenario and reattempt the comprehension questions. All comprehension questions were answered correctly in the second

attempt; thus, we were able to use data from all 300 participants. Individual participants in Study 2 were told they were the CEOs and primary decision makers for their farms.

The participants were not provided with an actual amount of the payoff in order to maintain real-world conditions. This was also done to replicate the difference between the certainty of loss, gain, and uncertainty of knowing whether a loss or gain was likely rather than make this a numerical calculation about the actual payoff itself. Thus, we chose to systematically vary what is uncertain by having an unknown amount of a certain negative payoff (drought condition), unknown amount of a certain positive payoff (normal rainfall condition), and a third condition where the amount and direction of outcome – whether a possible loss or gain – were both uncertain (flood condition). The amounts are unknown across all conditions allowing for direct comparison. The unknown amounts are also more accurate representations of the actual impact of extreme weather/water events, where the final outcomes are not predictable in advance, though their directionality may be known in advance (Mearns, 2010).
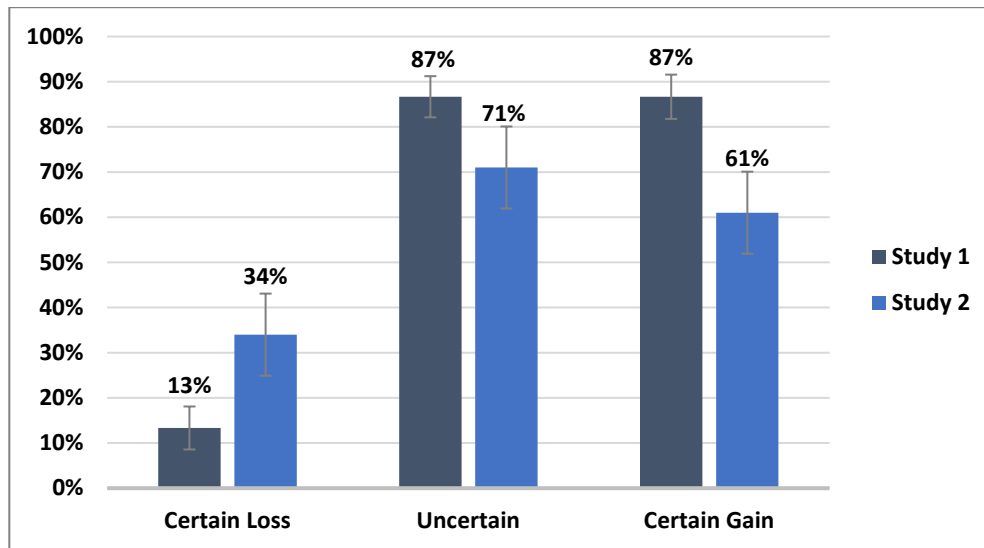
Results

As shown in Figure 1, the percent of participants who cooperated by condition was comparable to those observed in Study 1, and in both cases, the percent of participants who cooperated was the lowest in the drought condition (experience of certain loss) and substantially higher in the normal rainfall condition (experience of certain gain). Since cooperation is a dichotomous dependent variable, chi-square tests and binary logistic regressions were used to test for H1A and H1B. We began by considering the percent of people who cooperated by condition. Specifically, 34% of the people in the drought condition cooperated compared with 61% in the normal rainfall condition (χ^2(1, N=200) = 14.62; p < .001), providing initial support for H1A. In contrast, 71% of the participants cooperated in the flood condition, which was comparable to the normal rainfall condition (χ^2(1, N=200) = 2.23; p = .136), but significantly higher than in the drought condition (χ^2(1, N=200) = 27.45; p < .001), providing initial support for H1B.

In a binary logistic regression, condition was entered as our categorical independent variable with normal rainfall as the base case (-*2 Log Likelihood* = 382.39, *Nagelkerke R^2* = .13). Cooperation in drought condition was predicted by a significant negative deviation (β = -1.11, p < .001), further supporting H1A. There was, however, no difference in the likelihood of cooperation predicted in the flood (β = 0.45, p = .137) and the normal rainfall conditions.

The overall pattern of cooperation was similar between Studies 1 and 2: Percent of participants who cooperated was higher in the normal rainfall and in the flood conditions compared to the drought condition. Additionally, as in Study 1, these results also reflected the spectrum of outcome uncertainty, from certain gain (normal rainfall) to uncertainty (floods) to certain loss (droughts) experienced across the contexts by participants. Expanding on Study 1, Study 2 replicated the findings in a controlled setting where participants were not expected to have any agricultural knowledge, providing further support for H1A, H1B, and some basis for the generalizability of these results as the answer to our research question.

Figure 1

Percentage of Cooperation by Economic Condition in Study 1 and Study 2. Error Bars are 95% CI.

Study 3

Hypothesis and Rationale

Study 2 replicated the findings from a real-world groundwater dilemma in a lab setting with a large number of participants, but there remain questions about generalizability, underlying motivations, and mechanisms. As noted in the result in Study 1, participants frequently mentioned the importance of a relationship and communication with their neighbor in their decision process. Strong relationships that result in mutual cooperation are often based upon trust (Buchan, 1998). Furthermore, a distinct characteristic of AACREA, the association from which all but two CEOs in Study 1 were current members, is the strong bond of trust among members in general, and particularly with those in the same geographic area (see Orlove et al., 2011 for a detailed review of member characteristics). This is relevant as trust has been shown to significantly influence cooperation in social dilemmas (De Cremer et al., 2001; Ostrom & Walker, 2003; Parks et al., 1996).

Trust has been defined as an expectation and willingness of mutual vulnerability between parties (Brett, 2007; Mayer et al., 1995). In social dilemma research, it is defined as a behavior between trustor and trustee (Fehr, 2009) where the trustee is willing to be vulnerable based on positive expectations or beliefs regarding the trustee (van Lange, 2015). Trust is built on the assumption that others in an interdependent decision will behave honestly with the intent to cooperate (Parks et al., 2013). Thus, high trust results in a greater willingness to cooperate (Parks, 1994; Yamagishi, 1986), while low trust leads to greater support of punishing noncooperators (Yamagishi, 1986). Trust is typically operationalized as the belief in others involved in the interdependent decision who may be known, such as members of an in-group. In addition to manifesting within a local context for specific others (Fukuyama, 1995; Uslaner, 2010), trust can also be a global variable as seen in high (low) trust cultures that are characterized by a general overall willingness to believe in and cooperate (or not cooperate) with another (Balliet & Van Lange, 2013). These cultural attributes, if internalized by the decision maker (Olivola, et al., 2018), are likely to profoundly influence trust between individuals

(Dinesen, 2012). Currently, it is unknown whether farmer decision making is influenced by the global trust observed at the level of a culture, or the more local contextualization of the concept seen as greater trust in others involved in the decision. In our dilemmas, local trust is trust in the neighbor.

Both the AACREA CEOs and U.S. participants in Study 2 responded to the environmental dilemmas in a high-trust context–AACREA has very high levels of trust among its members while the U.S. is a high-trust culture (Brett, 2007)–and higher levels of trust have been associated with higher levels of cooperation as previously noted. Environmental dilemmas, however, are local in nature and may not be entirely influenced by a general level of trust. The specific trust in the neighbor could also be the relevant factor in such choices. Thus, there remains the question of whether it is the overall level of trust of others in a culture (global trust) or the trust of the other in a local context (local trust) that influences cooperation in environmental dilemmas. We investigate the potential effect of both local and global trust variables on cooperative choice. Building on extant research (Balliet & Van Lange, 2013; Gunia et al., 2011; Kong et al., 2014; Rothstein, 2000; Van Lange et al., 1998), we posit that beyond condition, trust should predict cooperation. Furthermore, since interdependence in contextualized dilemmas is fundamentally local, arguably it is local trust that should matter.

In Study 3, we replicated and extended the findings from Study 2 across cultures with varied levels of global trust. To extend the findings from Study 2 to contexts that were not necessarily high trust like AACREA or the U.S., we considered natural cultural variations in global trust. The World Values Survey (Wave 6: 2010-2014) suggests cultures vary in their overall levels of global trust and can be thought of as generally high-trust or low-trust. These descriptions further impact choices made in mixed motive situations (Gunia et al., 2011). The World Values Survey results show Japan and the U.S. as having a much higher level of global trust compared with India and Spain. Nearly 36% and 35% of people in Japan and the U.S. respectively agreed with the statement, "generally speaking most people can be trusted," while only 19% and 17% agreed with the same statement in Spain and India respectively (India 2012, Japan 2010, Spain 2011, United States 2011). Johnson and Mislin (2012) empirically show that trust as measured by the World Values Survey is positively correlated with experimentally measured global trust.

Conducting Study 3 in four cultures with natural variations in trust we propose Hypothesis 2 regarding local trust. Additionally, we explore differences in cooperation based on global trust levels, acknowledging that global trust may provide additional insights into cooperative choice.

H2. *Context-specific local trust, which is operationalized as trust in a neighbor, will predict cooperation in environmental dilemmas.*

Participants

For Study 3, 362 participants from the United States, 369 participants from India were recruited via MTurk and 397 participants from Spain were recruited via Prolific. Since online recruitment was not available to us for Japan, 142 individuals, who were mostly students in the executive MBA program at Tokyo University, were recruited. Data were collected in India and the U.S. prior to their collection in Spain and Japan. This time lag was mainly due to an initial lack of funding.

Design

Study 3 was identical to Study 2 in all respects except, prior to making their choice in the dilemma but after reading the scenario to which they were randomly assigned, participants agreed or disagreed with a statement about whether or not they could trust their neighbor (local trust) on a

scale of 1 to 5 where 1 = Strongly Disagree and 5 = Strongly Agree. Also, participants from the U.S. and India responded to a questionnaire in English[1], those from Japan responded to a questionnaire in Japanese, and those from Spain received a Spanish version. The questionnaires were translated by native speakers and tested for conceptual accuracy.

Results

Comparing Cooperation in the U.S. Across Studies 2 and 3

To ensure replicability of results, the percent of participants who cooperated by condition for the U.S. only were compared across Studies 2 and 3. Specifically, the percent of people who cooperated in the normal rainfall (χ^2(1, 219) = 0.03; p = .86), flood (χ^2[1, 216] = 0.11; p = .75), and drought (χ^2[1, 225] = 0.004; p = .95) conditions showed no statistical difference across the two studies. Furthermore, these results suggest that independent of country and as in previous studies, participants in Study 3 may also have experienced the drought condition as one of certain loss, the normal rainfall condition as one of certain gain, and the flood condition as one of uncertainty.

Testing for H1A and H1B

We began by testing whether H1A and H1B were true independent of country. On average, 39% of the participants in the drought (certain loss) condition and 65% in the normal rainfall (certain gain) condition cooperated, which was a significant difference (χ^2(1, 853) = 54.65; p < .001) that supports H1A. Subsequently, whether or not a participant cooperated was regressed on condition (as a categorical variable with base = normal rainfall) using a binary logistic regression (*-2 Log Likelihood* = 1699.40, *Nagelkerke R²* = .06), and the flood (β = -0.52, p < .001) as well as drought (β = -1.04, p < .001) conditions were both significant negative predictors of cooperation, further supporting H1A.
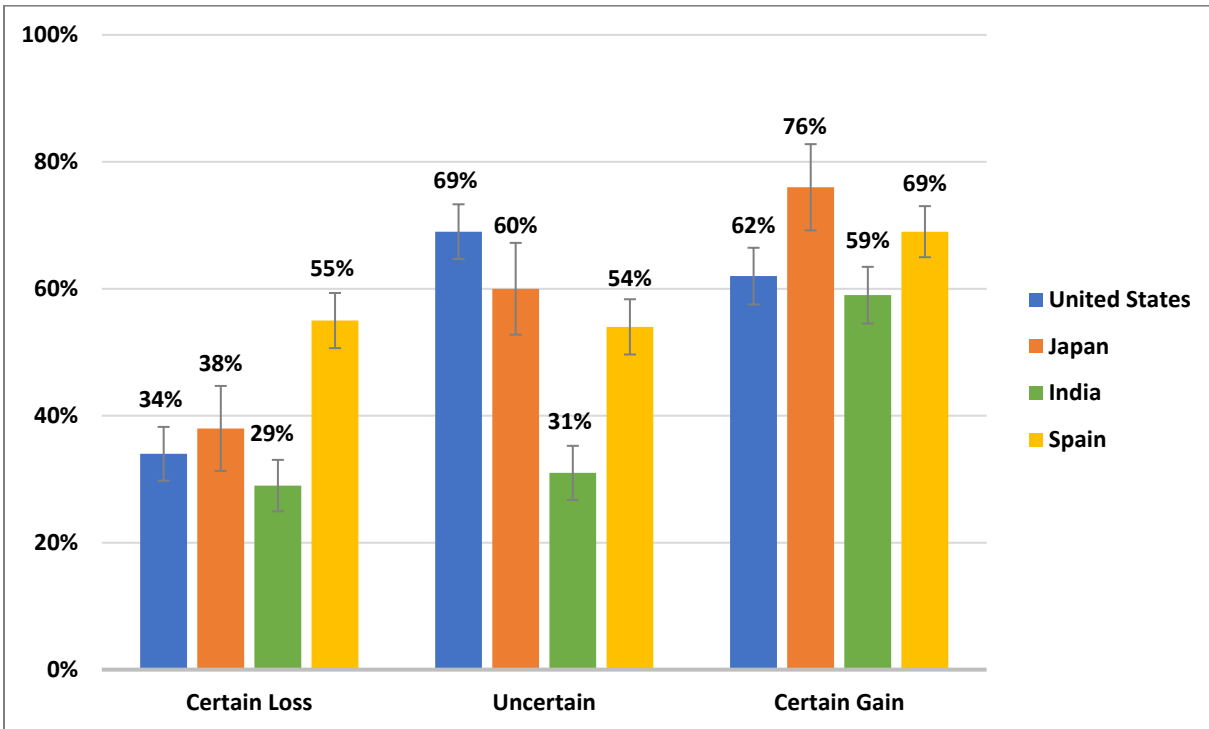
Additionally, and as shown in Figure 2, the percent of participants who cooperated were not significantly different by country (χ^2[3, 416] = 5.67; p = .129) in the normal rainfall condition, but they were different by country in the drought condition (χ^2[3, 437] = 21.42; p < .001), with Spain driving that difference, which we return to later. There were also significant differences in the percent of participants who cooperated by country in the flood condition (χ^2[3, 414] = 35.47; p < .001). Further exploration of the flood condition revealed that the percent of participants who cooperated were similar in the U.S. and Japan, but different in India and Spain. Specifically, cooperation in the flood condition were similar to that in the normal rainfall condition in Japan (χ^2[1, 88] = 2.55; p = .110) and the U.S. (χ^2[1, 235] = 1.20; p = .27). However, percent of people who cooperated were similar in the flood and drought conditions in India (χ^2[1, 242] = 18.40; p < .001) and Spain (χ^2[1, 265] = 6.62; p = .010). Thus, the experience of uncertainty (flood) appears to result in similar choices as the experience of a certain gain (normal rainfall) in the U.S. and Japan, while in India and Spain it results in choices similar to those made when a certain loss (droughts) is experienced.

Collectively, cooperation patterns support H1A independent of country such that cooperation levels are always higher in the normal rainfall condition compared to the drought condition. H1B, however, is only partially supported by these results (for the U.S. and Japan), which further suggests that H1B may have a culture-specific component. We return to the implications of this pattern of results in the general discussion.

---

[1] Participants from India answered the questionnaire after completing English fluency questions as has been previously used with considerable success (Boyles & Arora, 2015).

Figure 2

Percentage of Cooperation by Economic Condition in Study 3. Error Bars are 95% CI.

The Influence of Local vs. Global Trust

Data were also collected on local trust. An ANOVA with local trust as the dependent variable (DV) and country as the independent variable (IV) revealed a significant difference [F[3, 1266] = 27.60, $p < .001$] in the average level of local trust by country: U.S. ($M = 3.68$, $SD = 0.87$); Spain ($M = 3.41$, $SD = 0.83$); Japan ($M = 3.33$, $SD = 0.77$); and India ($M = 3.11$, $SD = 0.87$). These self-reported results follow the general pattern of global trust in the World Values Survey for the U.S., Japan, and India, but not for Spain. We discuss this difference later.

Since differences in trust are being considered post-hoc, we test for these accordingly. As a first step we conducted a Levene's test of variance, which revealed unequal variances of local trust (F[3,1266] = 1.26, $p = .288$) (Shingala & Rajyaguru, 2015). The suggested post hoc analysis to assess differences amongst countries for unequal differences in variance is the Games-Howell test (Field, 2013). Pairwise comparisons among the four countries (see Table 2), showed significantly higher levels of local trust in the U.S. compared with Spain ($p < .001$), India ($p < .001$), and Japan ($p < .001$). Both Spain and Japan reported significantly higher levels of local trust than India ($p < .001$) but there was no significant difference between Spain and Japan ($p = .682$).

Interestingly, self-reports of local trust levels in Spain among our participants were consistently higher than those reported by the World Values Survey. This may have been due to the nature of the question–participants were asked about trust in a neighbor. World Values Survey data regarding trust in neighbors in Spain is much higher than overall global trust and similar to levels observed in this study (79% of participants responded they completely or somewhat trust people in their neighborhood in Spain, compared with 72% in the U.S. and 56% in Japan). Thus, this self-reported trust measure appeared to replicate the trend for neighbors in Spain, which may also explain the

higher percentage of cooperation in the certain loss condition. Similarly, trust levels in Japan were lower than global trust but consistent with reported values for trust in neighbor based on the World Values Survey. This might also be due in part to the comparatively smaller sample size for Japan (N = 142).

Table 2
ANOVA Comparisons of Local Trust Across Four Countries

Country	N	M	SD	Games-Howell Comparison		
				Spain	India	Japan
Spain	397	3.413	0.832			
India	369	3.112	0.872	.000		
Japan	142	3.327	0.770	.682	.034	
United States	362	3.680	0.874	.000	.000	.000

The role of local trust as a possible influence and mechanism for cooperation was tested using a binary logistic regression (*-2 Log Likelihood* = 493.22, *Nagelkerke R^2* = .23) where global trust (coded as a dichotomous variable – high- or low-trust) and trust in the neighbor (local or specific trust) were used to predict cooperation. Global trust was not a significant predictor (β = -0.07, p = .59) while local trust was a significant predictor (β = 0.98, p < .001). Replacing the dichotomous variable for global trust with the exact data from the World Values Survey yielded the same results. Interestingly, although trust influences cooperation independent of the condition (drought, flood, normal rainfall) or country, local trust directly predicts cooperation in our Study.

To better examine the collective model, we ran a binary logistic regression with local trust, condition, and country as our predictors of cooperation. Both condition (base = normal rainfall) and country (base = U.S.) were included as categorical variables. As shown in Table 3, the resulting model was highly significant (*-2 Log Likelihood* = 1489.03, *Nagelkerke R^2* = .25). Notably and in support of H2, there is a strong main effect for local trust. Furthermore, also as expected, there is a main effect of condition (supporting H1) where cooperation is always lower in the drought condition than in the normal rainfall condition independent of country or local trust (supporting H1A).
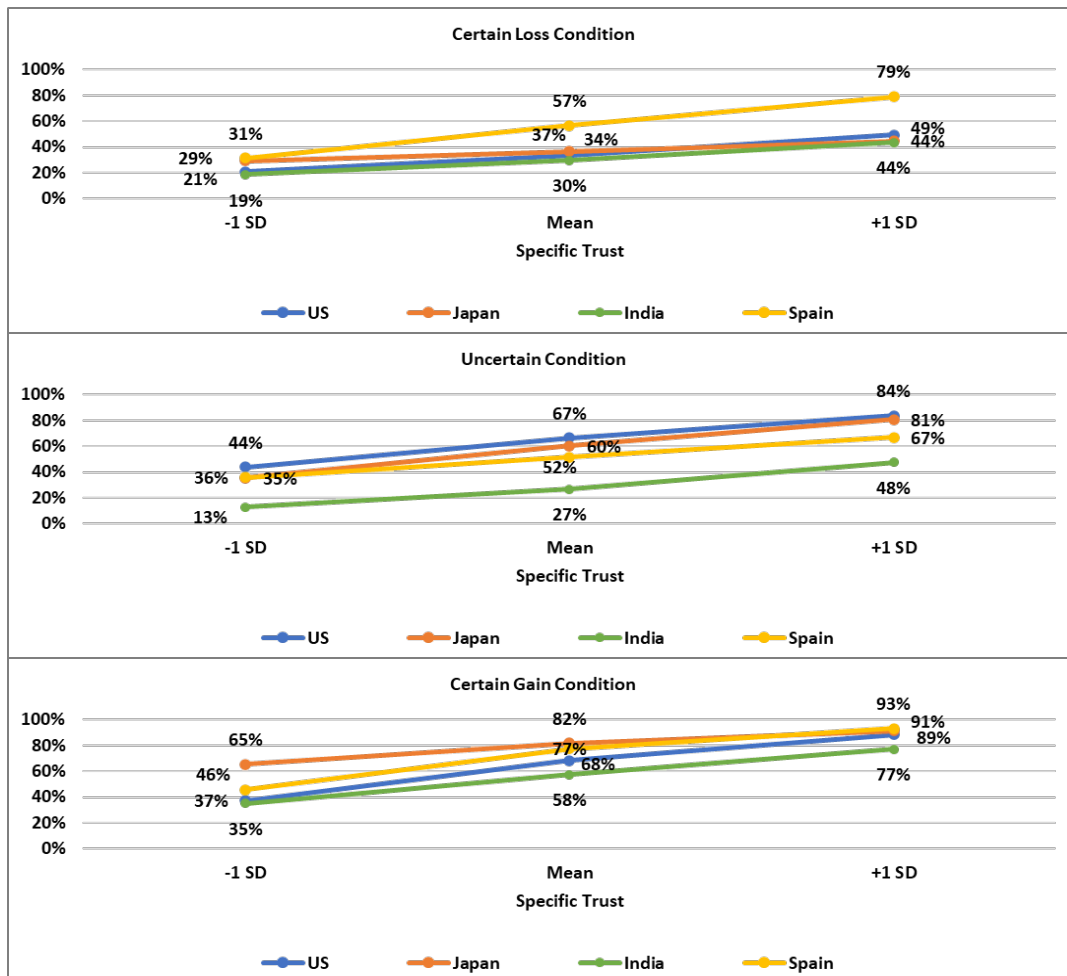
Table 3
Logistic Regression with Specific Trust, Country Code, and Economic Condition

Variable	β	SE β	p
Constant	-2.870	0.330	.000
Specific Trust	1.025	0.086	.000
Country Code {United States}	NA	NA	.000
Country Code (1) {Japan vs. United States}	0.454	0.219	.038
Country Code (2) {India vs. United States}	-0.179	0.169	.290
Country Code (3) {Spain vs. United States}	0.486	0.163	.003
Condition {Certain Gain}	NA	NA	.000
Condition (1) {Uncertain vs. Certain Gain}	-0.791	0.157	.000
Condition (2) {Certain Loss vs. Certain Gain}	-1.219	0.156	.000

Exploratory Analysis

Cross-cultural differences in cooperation were explored while controlling for individual differences in trust. To allow for direct comparisons, we considered cooperation at three standardized levels of local trust (mean and ± 1 SD). Figure 3 shows the percent of participants who cooperated as a function of country and level of local trust. Although the percent of people who cooperated varied by level of local trust, they appeared to follow similar patterns for droughts and normal years independent of country. Cooperation in the flood condition, however, appeared to vary by country. Specifically, H1B, or cooperation should be higher during floods than during droughts, is supported for the U.S. and Japan, but not for India and Spain. Perhaps cooperation under uncertainty is influenced by country/culture. To further explore this possible interaction, we used Model 1 (a standard moderation model) in PROCESS macro version 3.4 in SPSS 26 (Hayes, 2013), with condition as the predictor, country as the moderator, cooperation as the DV, and local trust as a covariate variable (*-2 Log Likelihood* = 1461.96, *Nagelkerke R^2* = .28, *p* < .001). This allowed an examination of the impact of culture on condition while controlling for the main effect of local trust. Both country and condition were entered as categorial variables with the U.S. and certain gain as the base case.

Figure 3
Predicted Percentage of Cooperation by Country and Level of Specific Trust in Study 3.

General Discussion and Limitations

The structure of social dilemmas incentivizes individuals to act non-cooperatively, valuing short-term self-interest over long-term collective benefit. The context of a dilemma in the real-world, however, can exert considerable influence on an individual's cooperative choice, especially when the outcome itself is uncertain. While there is some research on environmental dilemmas showing uncertainty of resource reduces cooperation rates (Anderson, 1981; Budescu et al., 1990; Messick et al., 1988), there is little to no prior work that directly addresses choices given the certainty effect or when the outcome itself is uncertain. We investigated this in the context of real-world dilemmas where droughts, floods, and normal rainfall levels effectively result in the experience of certain loss, uncertain outcome, and certain gain.

Our findings show, independent of country, the percent of participants who cooperate are always higher in the normal rainfall condition compared to the drought condition. Thus, the experience of a certain gain results in more cooperation than the experience of a certain loss. Cooperation in the flood condition, however, is similar to the normal rainfall condition for the U.S. and Japan, and to the drought condition for India and Spain. Thus, there is a cultural element to the cooperative choice when it is made under the experience of uncertainty. This is further supported by the observed moderation of cooperation by culture in the flood condition only. Finally, we find local trust predicts cooperation, independent of culture.

Results in the normal rainfall and drought conditions (certain gain and loss) may be explained through the theoretical lens of the logic of appropriateness, wherein choices are derived from the answer to the question "what does a person like me (identity) do (rules) in a situation like this (recognition) given culture (group)?" (Kopelman, 2009; Kopelman et al., 2016). In the certain loss condition for example, the participants are highly concerned with reducing the certainty of a loss and ensuring survival, thereby showing increased self-interested focus. Conversely, in the certain gain condition there is limited environmental or economic uncertainty where the participants are willing to consider maximizing collective gain, suggesting perhaps it is the nature of the outcome that influences the framing and therefore what is seen as "appropriate" (Aaldering & Bohm, 2020).

The flood or uncertain condition, however, presents an interesting dynamic where culture moderates choice. When faced with uncertainty, participants appear to look beyond the frame of the situation for additional information to help them make a choice. Specifically, we find a moderation of cooperation by culture in this condition, controlling for local trust. Perhaps participants are seeking information beyond trust in interdependent others to inform their choice to cooperate under conditions of uncertainty.

The Globe Project (2004) suggests nine cultural dimensions of which we believe three may be relevant and should be further explored – collectivism, uncertainty avoidance, and future orientation. Past research has shown that there is a main effect of collectivism on cooperation (Parks & Vu, 1994). Furthermore, cultural differences in group identity, accountability, and communication can also be moderators of the effect of collectivism on cooperation (Chen et al., 1998). Irwin and Berigan (2013) have made the case that the influence of trust on cooperation also varies between individualist and collectivist societies.

There is also strong cultural variation in dealing with uncertainty. Ladbury and Hinsz (2009) find that uncertainty avoidance influences choices in potential gains but not losses. Uncertainty avoidance has been studied in negotiations, where uncertainty avoidant negotiators look to rules and seek out structure to help guide them. Future orientation may be even more relevant than the individual social value orientation in predicting cooperative behavior in social dilemmas (Hernandez

et al., 2006; Joireman et al., 2004), and is another factor whose influence under uncertainty is not well understood. India and Spain have a lower future orientation (as per the Globe Project). Therefore, they are more likely to defect and maximize gain in the short-term, suggesting this may be one of the variables influencing the lower rate of cooperation in the uncertain condition. Future studies need to unpack the true influence of these cultural variables on cooperation in social dilemmas and its interaction with local trust.

In our studies we distinguish between local trust in the neighbor, which is relevant to our dilemmas and is a strong predictor of cooperation, and general trust measured as a global cultural construct. Trust, however, manifests at multiple levels (Delhey et al., 2011; Fukuyama, 1999; Goertz, 2006) that have not been studied in an interdependent context. The level of trust measured in our study in Spain is higher than what would be expected when the global or cultural level is considered but is consistent with what is expected at the neighborhood or communal level. These differences are meaningful when local actions need to be nested within a global context: Farmers are more likely to follow water management strategies or plant specific seed varieties that may be globally prescribed by scientists and agricultural experts if those strategies account for short-term local constraints (Gonzalez et al., 2018) and their day-to-day survival, further necessitating that choices are understood in context (Arora et al., 2016).

Future research might especially focus on extended group sizes and repetition of the dilemma. Extending the group of decision makers to more than two might have an effect on the local trust between decision makers and therefore on the decision to cooperate. Additionally, repeated games would allow us to better understand decision makers' timeframes and potential discounting of future payoffs under conditions of uncertainty. With increasing frequency and intensity of extreme weather events, this becomes especially relevant. Our findings have policy implications for issues involving environmental dilemmas and negotiation ramifications for global environmental treaties whose implementation is steeped in cultural nuances. As uncertainty and economic risk increases with climate change, our findings ask for a stronger local and contextualized focus when studying decision making in environmental dilemmas.

Conclusion and Future Directions

Though the impacts of climate change and resulting weather patterns are global, their manifestation as extreme droughts and floods is local. It is these local responses to the resulting environmental dilemmas at the farm level that influence global issues of food and agricultural sustainability and conflict. For there to be good policies and responses to environmental dilemmas, such issues need to be better understood at the level at which they occur so that interventions and nudges are developed within a local context.

In this research, we began with real-world dilemmas posed by droughts, floods, and normal rainfall levels, which were then brought into a controlled environment to gain insight into underlying motivational mechanisms across four cultures. Our unusual methodological approach provided a realistic account of why people cooperate in varying contexts. Furthermore, it gave some insight into how contextualized dilemmas can be approached to develop the necessary knowledge for more effective designs of policies that promote cooperation. We show that across cultures, policymakers can increase cooperation by guaranteeing a certain minimum gain, e.g., through climate insurances, pooling of resources, or guaranteed subventions in years with climate extremes. Through this, long-term sustainability of groundwater resources can be ensured supporting a stable food supply. However, while these groundwater dilemmas are global in scope, choices are made locally and a grasp

of the cultural variables that matter in the local context becomes essential, particularly when uncertainty is central to the dilemma, as is the case with most wicked problems humanity faces today.

References

Aaldering, H., & Böhm, R. (2020). Parochial vs. universal cooperation: Introducing a novel economic game of within- and between-group interaction. *Social psychology and personality sciences, 11*(1), 36-45.

Akerlof, G. A. (1980). A theory of social custom, of which unemployment may be one consequence. *The Quarterly Journal of Economics*, *94*(4), 749-775.

Anderson, B. F. (1981). *Concepts in judgement and decision research: Definitions, sources, interrelations, comments*. Praeger Publishing.

Aragón, R., Jobbágy, E. G., & Viglizzo, E. F. (2011). Surface and groundwater dynamics in the sedimentary plains of the Western Pampas (Argentina). *Ecohydrology*, *4*(3), 433–447. https://doi.org/10.1002/eco.149

Arkes, H. R. (1991). Costs and benefits of judgment errors: Implications for debiasing. *Psychological Bulletin, 110*(3), 486-498. https://doi.org/10.1037/0033-2909.110.3.486

Arora, P., Bert, F., Podesta, G., & Krantz, D. H. (2015). Ownership effect in the wild: Influence of land ownership on agribusiness goals and decisions in the Argentine Pampas. *Journal of Behavioral and Experimental Economics*, *58*, 162-170. https://doi.org/10.1016/j.socec.2015.02.007

Arora, P., Peterson, N. D., Krantz, D. H., Hardisty, D. J., & Reddy, K. S. (2012). To cooperate or not to cooperate: Using new methodologies and frameworks to understand how affiliation influences cooperation in the present and future. *Journal of Economic Psychology*, *33*(4), 842-853. https://doi.org/10.1016/j.joep.2012.02.006

Arora, P., Peterson, N. D., Bert, F., & Podestá, G. (2016). Managing the triple bottom line for sustainability: A case study of Argentine agribusinesses. *Sustainability: Science, Practice and Policy*, *12*(1), 60-75. https://doi.org/10.1080/15487733.2016.11908154

Balliet, D., & Van Lange, P. A. (2013). Trust, conflict, and cooperation: A meta-analysis. *Psychological Bulletin*, *139*(5), 1090-1112. https://doi.org/10.1037/a0030939

Bert, F. E., Podestá, G. P., Rovere, S. L., Menéndez, Á N., North, M., Tatara, E., . . . & Toranzo, F. R. (2011). An agent-based model to simulate structural and land use changes in agricultural systems of the argentine pampas. *Ecological Modelling, 222*(19), 3486-3499. https://doi.org./10.1016/j.ecolmodel.2011.08.007

Bocquého, G., Jacquet, F., & Reynaud, A. (2014). Expected utility or prospect theory maximisers? Assessing farmers' risk behaviour from field-experiment data. *European Review of Agricultural Economics, 41*(1), 135-172.

Boyles, J., & Arora, P. (2015, July). Role congruence in advisor choices in social dilemmas. Paper presented at the International Association for Conflict Association Conference, Clearwater, FL.

Brett, J. M. (2007). *Negotiating globally: How to negotiate deals, resolve disputes, and make decisions across cultural boundaries*. John Wiley & Sons.

Brewer, M. B. & Kramer, R. M. (1986). Choice behavior in social dilemmas: Effects of social identity, group size, and decision framing. *Journal of Personality and Social Psychology*, *50*(3), 543-549.

Buchan, N. R. (1998). Culture, fairness, and trust: Contrasting influences on negotiation behavior and outcomes in China, Korea, Japan, and the United States.

Budescu, D. V., & Au, W. T. (2002). A model of sequential effects in common pool resource dilemmas. *Journal of Behavioral Decision Making*, *15*(1), 37-63. https://doi.org/10.1002/bdm.402

Budescu, D. V., Au, W. T., & Chen, X. P. (1997). Effects of protocol of play and social orientation on behavior in sequential resource dilemmas. *Organizational Behavior and Human Decision Processes*, *69*(3), 179-193. https://doi.org/10.1006/obhd.1997.2684

Budescu, D. V., Rapoport, A., & Suleiman, R. (1990). Resource dilemmas with environmental uncertainty and asymmetric players. *European Journal of Social Psychology*, *20*(6), 475-487. https://doi.org/10.1002/ejsp.2420200603

Chen, C. C., Chen, X. P., & Meindl, J. R. (1998). How can cooperation be fostered? The cultural effects of individualism-collectivism. *Academy of Management Review*, *23*(2), 285-304.

Chen, X. P., Pillutla, M. M., & Yao, X. (2009). Unintended consequences of cooperation inducing and maintaining mechanisms in public goods dilemmas: Sanctions and moral appeals. *Group Processes & Intergroup Relations*, *12*(2), 241-255. https://doi.org/10.1177/1368430208098783

Damerau, K., Patt, A. G., & Van Vliet, O. P. (2016). Water saving potentials and possible trade-offs for future food and energy supply. *Global Environmental Change*, *39*, 15-25. https://doi.org/10.1016/j.gloenvcha.2016.03.014

Dawes, R. M. (1980). Social dilemmas. *Annual Review of Psychology*, *31*(1), 169-193. https://doi.org/10.1146/annurev.ps.31.020180.001125

Dawes, R. M., & Messick, D. M. (2000). Social dilemmas. *International Journal of Psychology, 35*(2), 111–116. https://doi.org/10.1080/002075900399402

De Cremer, D., Snyder, M., & Dewitte, S. (2001). 'The less I trust, the less I contribute (or not)?'The effects of trust, accountability and self-monitoring in social dilemmas. *European Journal of Social Psychology*, *31*(1), 93-107. https://doi.org/10.1002/ejsp.34

De Fraiture, C., & Wichelns, D. (2010). Satisfying future water demands for agriculture. *Agricultural Water Management*, *97*(4), 502-511. https://doi.org/10.1016/j.agwat.2009.08.008

Delhey, J., Newton, K., & Welzel, C. (2011). How general is trust in "most people"? Solving the radius of trust problem. *American Sociological Review*, *76*(5), 786-807.

Dickhaut, J., McCabe, K., Nagode, J. C., Rustichini, A., Smith, K., & Pardo, J. V. (2003). The impact of the certainty context on the process of choice. *Proceedings of the National Academy of Sciences, 100*(6), 3536-3541.

Dinesen, P. T. (2012). Does generalized (dis)trust travel? Examining the impact of cultural heritage and destination-country environment on trust of immigrants. *Political Psychology*, *33*(4), 495-511.

Fehr, E. (2009). On the economics and biology of trust. *Journal of the European Economic Association*, *7*(2-3), 235-266.

Field, A. (2013). *Discovering statistics using IBM SPSS statistics*. SAGE.

Fukuyama, F. (1995). *Trust: The social virtues and the creation of prosperity* (Vol. 99). New York: Free press.

Fukuyama, F. (1999). Social Capital and Civil Society. Paper presented at the IMF Conference on Second Generation Reforms, *November, 8*(9), 1999.

García, P. E., Menénendez, A. N., Podestá, G., Bert, F., Arora, P., & Jobbágy, E. (2018). Land use as a possible strategy for managing water table depth in flat basins with shallow groundwater. *International Journal of River Basin Management*. *16*(1), 79-92.

Globe Project. (2004). An overview of the 2004 study: Understanding the Relationship Between National Culture, Societal Effectiveness and Desirable Leadership Attributes. *Global*

leadership & Organizational Behavior Effectiveness. Retrieved from https://globeproject.com/study_2004_2007

Goertz, G. (2006). *Social science concepts: A user's guide*. Princeton University Press.

Golub, A. A., Henderson, B. B., Hertel, T. W., Gerber, P. J., Rose, S. K., & Sohngen, B. (2013). Global climate policy impacts on livestock, land use, livelihoods, and food security. *Proceedings of the National Academy of Sciences*, *110*(52), 20894-20899.

Gonzalez-Ramirez, J., Arora, P., & Podesta, G. (2018). Using insights from prospect theory to enhance sustainable decision making by agribusinesses in Argentina. *Sustainability, 10*(8), 2693. https://doi.org/10.3390/su10082693

Gunia, B. C., Brett, J. M., Nandkeolyar, A. K., & Kamdar, D. (2011). Paying a price: culture, trust, and negotiation consequences. *Journal of Applied Psychology*, *96*(4), 774-789. https://doi.org/10.1037/a0021986

Gunia, B., Brett, J., & Nandkeolyar, A. K. (2014). Trust me, I'm a negotiator: Diagnosing trust to negotiate effectively, globally. *Organizational Dynamics*, *43*(1), 27-36. https://doi.org/10.1016/j.orgdyn.2013.10.004

Hayes, A. F. (2013). *Methodology in the social sciences. Introduction to mediation, moderation, and conditional process analysis: A regression-based approach.* Guilford Press.

Hernandez, M., Chen, Y. R., & Wade-Benzoni, K. A. (2006). Toward an understanding of psychological distance reduction between generations: A cross-cultural perspective. In *National culture and groups*. Emerald Group Publishing Limited.

Irwin, K., & Berigan, N. (2013). Trust, culture, and cooperation: A social dilemma analysis of pro-environmental behaviors. *The Sociological Quarterly*, *54*(3), 424-449. https:/doi.org/10.1111/tsq.12029

Johnson, N. D., & Mislin, A. (2012). How much should we trust the World Values Survey trust question? *Economics Letters*, *116*(2), 210-212. https://doi.org/10.1016/j.econlet.2012.02.010

Joireman, J. A., Van Lange, P. A., & Van Vugt, M. (2004). Who cares about the environmental impact of cars? Those with an eye toward the future. *Environment and Behavior*, *36*(2), 187-206. https://doi.org/10.1177/0013916503251476

Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica, 47*(2), 263-291. https://doi.org/10.2307/1914185

Katz, J., Halevy, N. (2015, July). Risk sharing in groups. Presented at the International Conference on Social Dilemmas, Hong Kong.

Kiyonari, T., & Yamagishi, T. (2004). Ingroup cooperation and the social exchange heuristic. *Contemporary psychological research on social dilemmas*, 269-286. https://doi.org/10.1111/j.1467-839X.2008.00258.x

Köke, S., Lange, A., & Nicklisch, A. (2014). Cooperating on Environmental Goods: Infinite Play, Uncertain Damages and Learning.

Kong, D. T., Dirks, K. T., & Ferrin, D. L. (2014). Interpersonal trust within negotiations: Meta-analytic evidence, critical contingencies, and directions for future research. *Academy of Management Journal*, *57*(5), 1235-1255. https://doi.org/10.5465/amj.2012.0461

Kopelman, S. (2009). The effect of culture and power on cooperation in commons dilemmas: Implications for global resource management. *Organizational Behavior and Human Decision Processes*, *108*(1), 153-163. https://doi.org/10.1016/j.obhdp.2008.06.004

Kopelman, S., Hardin, A. E., Myers, C. G., & Tost, L. P. (2016). Cooperation in multicultural negotiations: How the cultures of people with low and high power interact. *Journal of Applied Psychology*, *101*(5), 721-730. https://doi.org/10.1037/apl0000065

Ladbury, J. L., & Hinsz, V. B. (2009). Uncertainty avoidance influences choices for potential gains but not losses. *Current Psychology: A Journal for Diverse Perspectives on Diverse Psychological Issues, 28*(3), 187-193. https://doi.org/10.1007/s12144-009-9056-z

Li, M., & Chapman, G. B. (2009). "100% of anything looks good": The appeal of one hundred percent. *Psychonomic Bulletin & Review, 16*(1), 156-162. https://doi.org/10.3758/pbr.16.1.156

Mayer, R. C., Davis, J. H., & Schoorman, F. D. (1995). An integrative model of organizational trust. *Academy of Management Review*, *20*(3), 709-734. https://doi.org/10.5465/AMR.2007.24348410

Mearns, L. O. (2010). The drama of uncertainty. *Climatic Change*, *100*(1), 77-85. https://doi.org/10.1007/s10584-010-9841-6

Merlos, F. A., Monzon, J. P., Mercau, J. L., Taboada, M., Andrade, F. H., Hall, A. J., ... & Grassini, P. (2015). Potential for crop production increase in Argentina through closure of existing yield gaps. *Field Crops Research*, *184*, 145-154. https://doi.org/10.1016/j.fcr.2015.10.001

Messick, D. M., Allison, S. T., & Samuelson, C. D. (1988). Framing and communication effects on group members' responses to environmental and social uncertainty. *Applied Behavioral Economics*, *2*, 677-700.

Olivola, C. Y., Kim, Y., Merzel, A., Kareev, Y., Avrahami, J., & Ritov, I. (2020). Cooperation and coordination across cultures and contexts: Individual, sociocultural, and contextual factors jointly influence decision making in the volunteer's dilemma game. *Journal of Behavioral Decision Making*, *33*(1), 93-118. https://doi.org/10.1002/bdm.2135

Orlove, B., Taddei, R., Podestá, G., & Broad, K. (2011). Environmental citizenship in Latin America: Climate, intermediate organizations, and political subjects. *Latin American Research Review*, *46*, 115–140. https://doi.org/10.1353/lar.2011.0034

Ostrom, E., & Walker, J. (Eds.). (2003). *Trust and reciprocity: Interdisciplinary lessons for experimental research*. Russell Sage Foundation.

Ostrom, E., Gardner, R., & Walker, J. (1994). *Rules, Games, and Common-Pool Resources.* University of Michigan Press.

Parks, C. D. (1994). The predictive ability of social values in resource dilemmas and public goods games. *Personality and Social Psychology Bulletin*, *20*(4), 431-438. https://doi.org/10.1177/0146167294204010

Parks, C. D., & Vu, A. D. (1994). Social dilemma behavior of individuals from highly individualist and collectivist cultures. *Journal of Conflict Resolution*, *38*(4), 708-718.

Parks, C. D., Henager, R. F., & Scamahorn, S. D. (1996). Trust and reactions to messages of intent in social dilemmas. *Journal of Conflict Resolution*, *40*(1), 134-151.

Parks, C. D., Joireman, J., & Van Lange, P. A. (2013). Cooperation, trust, and antagonism: How public goods are promoted. *Psychological Science in the Public Interest*, *14*(3), 119-165. https://doi.org/10.1177/1529100612474436

Peterson, T. C., Heim, R. R., Hirsch, R., Kaiser, D. P., Brooks, H., Diffenbaugh, N. S., . . . & Wuebbles, D. (2013). Monitoring and understanding changes in heat waves, cold waves, floods, and droughts in the United States: State of knowledge. *Bulletin of the American Meteorological Society, 94*(6), 821-834.

Rapoport, A., Budescu, D. V., & Suleiman, R. (1993). Sequential requests from randomly distributed shared resources. *Journal of Mathematical Psychology*, *37*(2), 241-265. https://doi.org/10.1006/jmps.1993.1015

Rothstein, B. (2000). Trust, social dilemmas and collective memories. *Journal of Theoretical Politics*, *12*(4), 477-501. https://doi.org/10.1177/0951692800012004007

Senesi, S.I., Palau, H., Chaddad, F.R., & Daziano, M. (2013). The evolution of farming networks in a fragile institutional environment: The case of Argentina. *Journal on Chain and Network Science*, *13*(1), 71-82. https://doi.org/10.3920/JCNS2013.x219

Shingala, M. C., & Rajyaguru, A. (2015). Comparison of post hoc tests for unequal variance. *International Journal of New Technologies in Science and Engineering, 2*(5), 22-33.

Suleiman, R., & Rapoport, A. (1988). Environmental and social uncertainty in single-trial resource dilemmas. *Acta Psychologica*, *68*(1-3), 99-112. https://doi.org/10.1016/0001-6918(88)90048-0

Suleiman, R., Aharonov-Majar, E., & Luzon, P. (2015). The sharing dilemma: Joining cooperative groups and sharing resources as a means of coping with environmental risk. *Journal of Behavioral Decision Making*, *28*(2), 130-136. https://doi.org/10.1002/bdm.1831

Tanaka, T., Camerer, C. F., & Nguyen, Q. (2010). Risk and time preferences: Linking experimental and household survey data from Vietnam. *American Economic Review*, *100*(1), 557-571.

Uslaner, E. M. (2010). Trust and the economic crisis of 2008. *Corporate Reputation Review*, *13*(2), 110-123. https://doi.org/10.1057/crr.2010.8

Van Lange, P. A. (2015). Generalized trust: Four lessons from genetics and culture. *Current Directions in Psychological Science*, *24*(1), 71-76.

Van Lange, P. A., Vugt, M. V., Meertens, R. M., & Ruiter, R. A. (1998). A social dilemma analysis of commuting preferences: The roles of social value orientation and trust. *Journal of Applied Social Psychology*, *28*(9), 796-820. https://doi.org/10.1111/j.1559-1816.1998.tb01732.x

Weber, J. M., Kopelman, S., & Messick, D. M. (2004). A conceptual review of decision making in social dilemmas: applying a logic of appropriateness. *Personality and Social Psychology Review*, *8*(3), 281–307. https://doi.org/10.1207/s15327957pspr0803_4

World Values Survey. (2014). World Values Survey: Wave 6. Retrieved from www.worldvaluessurvey.org/WVSDocumentationWV6.jsp

Wuebbles, D. J., Fahey, D. W., & Hibbard, K. A., Arnold, J. R., DeAngelo, B., Doherty, S., ... & Walsh, J. (2017). Climate science special report: Fourth national climate assessment (NCA4), Volume I. Retrieved from https://science2017.globalchange.gov/downloads/CSSR2017_FullReport.pdf

Xiao, E., & Kunreuther, H. (2016). Punishment and cooperation in stochastic social dilemmas. *Journal of Conflict Resolution, 60*(4), 670-693.

Yamagishi, T. (1986). The provision of a sanctioning system as a public good. *Journal of Personality and Social Psychology*, *51*(1), 110-116.

Yamagishi, T., & Kiyonari, T. (2000). The group as a container of generalized reciprocity. *Social Psychology Quarterly, 63*, 116–132.

Zhang, X., & Vesselinov, V. V. (2017). Integrated modeling approach for optimal management of water, energy and food security nexus. *Advances in Water Resources*, *101*, 1-10. https://doi.org/10.1016/j.advwatres.2016.12.017

Author Note

Author Bios

Dr. Poonam Arora is the Louis F. Capalbo Professor and Chair of the Management Department at Manhattan College, and a Research Scientist at AC4 , Earth Institute, Columbia University. Her research explores sustainability in dynamic socio environmental-economic systems. Specifically, she examines how individuals, organizations, and communities manage conflicting goals to ensure long-term economic, social and environmental sustainability. Her research has been published in management, psychology, economics, and sustainability journals.

Marc Stefan Hoeller is a Manhattan College alumnus currently working as a Strategy Consultant for a global management consulting firm in Germany. His research interests include understanding the role of cognitive biases in choices made by organizations that impact the triple bottom line and multimotive situations like social dilemmas.

Eric Scalone is a Manhattan College alumnus currently working at a private equity firm where he advises and underwrites various types of transactions in the Media and Entertainment industries. His research interests include understanding the role of context on choices in real world dilemmas.

Tetsushi Okumura is a professor of Organizations and Management at Toyo University (Tokyo, Japan), Faculty of Business Administration. His research interests include negotiation and managerial behavior, dispute resolution, and land dispute settlements in social infrastructure developments. His research has appeared in the Academy of Management Journal, Journal of Applied Psychology, Negotiation Journal, Journal of Experimental Psychology, Management and Organization Review, and International Studies of Management & Organization Journal.

Nicole Peterson is an Associate Professor of Anthropology at UNC Charlotte and has examined Charlotte area food systems, how people adapt to changing climates and agricultural systems, and community-oriented sustainability efforts. Dr. Peterson has published in Sustainability, Climate and Development, Conservation and Society, Development and Change, Sustainability: Science, Policy, and Practice, and most recently in Culture, Agriculture, Food and Environment.

Appendix
Prompts for Each Condition

Uncertain Condition (Flood) Scenario

Please read the scenario below and put yourself in the role of the CEO of an agribusiness – a business that owns farms, grows crops like soybeans and corn on that land and then sells the crops on the world commodity markets.

You are the owner of an agribusiness that owns a large amount of farmland in a very fertile area of the country. Your land borders along one edge with a single neighbor who has a similar farm. Your farm has been in your family for three generations and is a very profitable enterprise. Currently, you employ 15 individuals full-time ranging from agricultural experts to farm workers. The farm and agribusiness have managed to support these 15 individuals, as well as your family for many years now. You generally grow some combination of soybean, corn, and wheat and given growing global demand for these grains, have no trouble selling all you grow. In fact, you could probably sell a lot more, if you could grow it.

Every year, before planting season you look at the weather forecasts for the upcoming growing season to get an idea of what crops you should plant as the temperature and rain will determine how well the plants grow, and thus the overall profit made by your farm. The average level of rainfall over the past few years has been higher than normal. In five of the last ten years your farm was flooded due to excessive rain. Floods in your region destroy part of your harvest but rarely all of it. This year it has been raining a lot so far and the ground is already quite wet. Since your farm is not entirely flat, during a flood the lower-lying areas have standing water, while the higher areas are fine. Although you lose the crop from the lower areas due to flooding, you can come close to break-even or even break-even from the crop that survives in the higher-lying areas of the farm. The neighboring farm that borders your land is a lot like yours, and also has lower-lying and higher-lying areas with similar outcomes.

At the start of the planting season, you can choose to dig a channel that will drain excessive water from the lower-lying areas of your farm. Once you plant, you cannot dig a channel. Digging a channel could help any standing water due to flooding in your lower-lying areas to flow out, but it can also result in underground water that is very close to the surface. Thus, a channel could worsen the flood this year, and may increase the chances of flooding in the following years. Participants were asked to choose whether or not they would dig a channel.

Certain Loss Condition (Drought) Scenario

Please read the scenario below and put yourself in the role of the CEO of an agribusiness – a business that owns farms, grows crops like soybeans and corn on that land and then sells the crops on the world commodity markets.

You are the owner of an agribusiness that owns a large amount of farmland in a very fertile area of the country. Your land borders along one edge with a single neighbor who has a similar farm. Your farm has been in your family for three generations and is a very profitable enterprise. Currently, you employ 15 individuals ranging from agricultural experts to farm workers full time. The farm and agribusiness have managed to support these 15 individuals, as well as your family for many years now. You generally grow some combination of soybean, corn, and wheat and given growing global demand for these grains, have no trouble selling all you grow. In fact, you could probably sell a lot more, if you could grow it.

Every year, before planting season you look at the weather forecasts for the upcoming growing season to get an idea of what crops you should plant as the temperature and rain will determine how well the plants grow, and thus the overall profit made by your farm. The average level of rainfall over the past few years has been lower than normal. In five of the last ten years your farm experienced drought due to minimal rain. Drought in your region destroys almost all of your entire harvest. This year it has not rained much so far, and the ground is already quite dry. Since your farm is not entirely flat, during a drought the lower-lying areas have some moisture, while the higher areas are very dry. Therefore, you lose the crop from the higher areas due to the drought but can harvest a little from the lower-lying areas. However, it is never enough to allow you to cover your costs, thus you end up with a substantial loss. The neighboring farm that borders your land is a lot like yours, and also has lower-lying and higher-lying areas with similar outcomes.

At the start of the planting season, you can choose to plant drought resistant seeds. These seeds have deeper roots allowing them to reach lower levels of groundwater. Groundwater is water that is available deep under the soil and if plants are able to reach it, they can use it even in times of drought. Drought resistant seeds will grow and provide a regular harvest despite even extremely dry

conditions, but they will lower the water level available underground. Thus, they will worsen the drought this year and may increase the chances of drought in the following years.

Participants were asked to choose whether or not they would plant drought resistant seeds.

Certain Gain Condition (Normal Rainfall) Scenario

Please read the scenario below and put yourself in the role of the CEO of an agribusiness – a business that owns farms, grows crops like soybeans and corn on that land and then sells the crops on the world commodity markets.

You are the owner of an agribusiness that owns a large amount of farmland in a very fertile area of the country. Your land borders along one edge with a single neighbor who has a similar farm. Your farm has been in your family for three generations and is a very profitable enterprise. Currently, you employ 15 individuals ranging from agricultural experts to farm workers full time. The farm and agribusiness have managed to support these 15 individuals, as well as your family for many years now. You generally grow some combination of soybean, corn, and wheat and given growing global demand for these grains, have no trouble selling all you grow. In fact, you could probably sell a lot more, if you could grow it.

Every year, before planting season you look at the global demand for crops. You use this to decide which crops to plant and in what quantity. What you plant will determine the overall profit made by your farm. This year the U.S. changed its subsidy for corn and as a result there will be less farmers growing corn in the US. Because of this, financial experts are predicting that corn prices will be substantially higher than normal for the next years while the supply and demand readjust to a new equilibrium. You are considering growing corn during the next few cropping cycles to benefit from the forecasted high prices. Given the price forecast you could end up with a substantial profit if you plant corn. However, corn is particularly prone to certain insects local to your area that tend to attack the young plants and reduce yield. This could reduce your total profit, though it is not likely that you won't have some profit.

At the start of planting season, you can choose to plant an insect resistant variety of corn called BT corn, which will increase the yield despite the presence of local insects. In this case the insects will attack other corn plants that are not of the BT resistant variety. The downside is that the more BT corn you grown, the more resistant the insects become. Insect resistance can develop very quickly and may occur within one season. Thus, it will increase your profits this year, but it might lower profits in the future. Participants were asked to choose whether or not they would plant insect resistant seeds.