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Does information about others' behavior undermine cooperation in social dilemmas?

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Abstract

This project addresses how and why behavior in a resource dilemma differs when one only knows the choices of others versus only knows the state of the resource. Study 1 suggested that resource information is more valuable than social information, in that if the resource can be monitored, whether or not others' choices can also be monitored has no impact on behavior. However, if the state of the resource is not known, the ability to know what others are doing is critical for cooperation. This seems to be because resource information encourages planning and long-term thinking, and social information encourages comparative thinking. Study 2 replicated the behavior pattern, revealed—surprisingly—that warnings that a resource is critically low undermine (rather than promote) cooperation, and that such responses depend on the availability of social and environmental information. Discussion focuses on how incomplete information about a resource might be addressed.

Keywords

cooperation, social dilemmas, uncertainty

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A social dilemma is a situation in which there is a conflict between selfish and collective interests: The behavior that can produce the best personal outcome is not the behavior that can lead to the best collective outcome and vice versa. Twin hallmarks of social dilemmas are that, while the selfish outcome is tempting, in the long run everyone is worse off if there is large-scale pursuit of selfish interests than if there was large-scale pursuit of collective interests (see Van Lange, Joireman, Parks, & van Dijk, 2013). And uniform emphasis on the collective interest is unstable, in that if everyone is doing what is best for the group, it is highly tempting, and easy, for a single person to exploit the collective good for selfish benefit. It is, then, hard to focus people on the collective need instead of selfish outcome, and hard to keep them there.

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A classic example is public broadcasting. It is always personally better to keep one's money than give it away, so when given a choice between giving money to a radio station and listening to their broadcasts, and not giving money to the station while listening to their broadcasts, many people will opt for the latter. However, if everyone does this, the station will not get enough money to continue operating, will go off the air, and the entire audience is worse off as a result. However, if all listeners donate, it will be tempting for any listener to conclude that s/he no longer needs to give—everyone else will keep giving, and the station will never miss one small contribution. As others independently reach the same conclusion, donations crumble, and the station's programming is curtailed.

A feature that is common to most real-world social dilemmas is incompleteness of information. Nobody, including station management, knows for sure how many people listen to the radio programs, and for any particular listener, knowing how much each fellow listener donated is impossible to achieve. Thus, each listener has to decide whether to donate to the station without really knowing who else is giving, how much they are giving, or how many potential donors there are, and this is typically referred to as *social uncertainty*. As well, unless station management is forthcoming with accounting information, the listener will not know how much the station needs to operate, or how much particular programs cost. Lack of information about the dynamics of the entity is referred to as *environmental uncertainty*. Thus, the listener has to decide whether to give without knowing how much needs to be given, whether others are also giving, and whether giving others are sufficiently generous. Since it is unlikely that the donation will be returned if the station ceases to operate, the decision-maker faces some very real consequences from a poor decision. It is thus not surprising that uncertainty has been and remains a popular topic of study among social dilemma researchers (e.g., Messick, Allison, & Samuelson, 1988; Suleiman & Rapoport, 1988; see van Dijk, Wit, Wilke, & Budescu, 2004, for a summary of this research) and is a key element (as a proximal cause) of the model of cooperative decision-making put forth by Parks, Joireman, and Van Lange (2013).

Theory on the role of uncertainty in social dilemma choice has concentrated on how the lack of information impacts individual decision-making, with much emphasis on the assumptions people make about the missing information (e.g., Gustafsson, Biel, & Gärling, 1999a, 1999b, 2000), how uncertainty affects tacit coordination (e.g., de Kwaadsteniet, van Dijk, De Cremer, & de Rooij, 2007; de Kwaadsteniet, van Dijk, Wit, & De Cremer, 2006; Wit, van Dijk, Wilke, & Groenenboom, 2004), how uncertainty interacts with the mechanics of rendering a choice (e.g., Au & Ngai, 2003; Rapoport & Au, 2001), and whether or not uncertainty or lack of information might call for generosity (e.g., Van Lange, Ouwerkerk, & Tazelaar, 2002; Vuolevi & Van Lange, 2010). More recently, researchers have begun to study the social-cognitive effects of uncertainty. For example, McCarter, Rockmann, and Northcraft (2010) showed that environmental uncertainty makes people both increasingly fearful of experiencing a loss, and likely to infer that others share this fear and hence will not cooperate. Next, De Kwaadsteniet, van Dijk, Wit, and De Cremer (2010) found that, compared to conditions of certainty, environmental uncertainty led people to be less angry about suboptimal outcomes, less likely to blame others for their poor outcomes, and less likely to want to punish abusers, seemingly because they attributed others' choices to lack of clarity on what the proper choice behavior was. Our project also takes a social-cognitive approach to the influence of uncertainty. Specifically, we are interested in how uncertainty affects the person's ability to simulate outcome scenarios, and how these simulations in turn affect choice.

Simulated Outcomes in Social Dilemmas

How those engaged in a social dilemma imagine alternate courses of action, and infer the corresponding outcomes, is poorly understood, but the evidence that does exist suggests that such cognition does influence the likelihood of cooperation. For example, Parks, Sanna, and Posey (2003) showed that, in thinking about their current success in managing the dilemma, people who focused on how things could have been worse became less cooperative in the future, while people who emphasized how things could have been better became more cooperative. As well, research on abstract ("overuse of water has global implications") versus concrete ("I need to reduce my water bill") construal of the dilemma has shown that construal interacts with the framing of the dilemma, in that how the dilemma is framed is influential only when the frame matches the person's construal mindset—a person who tends to think abstractly needs to see the dilemma framed abstractly and vice versa (Giacomantonio, De Dreu, Shalvi, Sligte, & Leder, 2010). It is also the case that future outcomes can be made to seem more attractive (Kim, Schnall, & White, 2013) and more urgent (Marx et al., 2007) if they are concretely construed.

Our interest is in how uncertainty influences thinking about the dilemma. We think that whether the person approaches the dilemma abstractly or concretely will influence whether s/he emphasizes long-term or immediate outcomes, and hence the extent to which the person will choose cooperatively. Fujita, Trope, Liberman, and Levin-Sagi (2006) showed that abstract construal of a situation induces decision-makers to take a long-term focus, and to be negative about choosing in response to temptation, whereas concrete construal leads to an emphasis on immediate reward and avoidance of short-term costs. Further, concrete construal seems to be the default for most people. Fujita et al. (2006) noted that construal level is especially likely to be influential in situations in which the concrete and abstract aspects of the task seem to be in conflict. This is a hallmark of a social dilemma—I can turn a faucet on, activate my sprinkler, and have a pretty yard (a concrete outcome), or I can leave the faucet off, and try to prolong the life of a water table that I cannot see, cannot monitor, and is replenished through a complex ecosystem (an abstract outcome). This suggests that, when a person confronts a dilemma that provides full information about both others and the state of the entity, which information is more influential on choice will be affected by the construal level the person employs. If the default is concrete construal, it follows that people will typically act to realize immediate outcomes, behavior which is well-documented in the social dilemma literature. Also consistent with Fujita et al. (2006), research shows that people who tend to take a long-term view on social problems generally cooperate at a relatively more frequent rate (e.g., Joireman, Van Lange, & Van Vugt, 2004).

But what about situations in which a particular type of information is absent (i.e., there is complete uncertainty about an aspect of the dilemma)? Could provision of just a single type of information impact the way in which the person construes the dilemma? There is reason to believe that it can. Specifically, environmental information alone (i.e., "social uncertainty" about how others are behaving) should induce abstract thinking about the dilemma, and social information alone (i.e., "environmental uncertainty" about the state of the resource) should induce concrete thinking. The logic underlying each prediction is straightforward. Social information in a social dilemma tends to induce a focus on relative performance, in that people examine how well they seem to be doing, in terms of outcomes accumulated, relative to others (Parks, Sanna, & Posey, 2003). Thinking in terms of outcomes and self-interest is a form of concrete thought (Fujita, 2008; Hunt, Kim, Borgida, & Chaiken, 2010), which, we argue, should make people focus on immediate payoffs. Consistent with this, Parks, Rumble, and Posey (2002) found that people who felt they were relatively disadvantaged became less cooperative after this insight, in order to try to outgain others. We thus expect that *providing only social information will inhibit cooperation*.

As social information should lead to a focus on own outcomes, environmental information alone should distract people away from thinking about own outcomes. Not knowing what others are doing provides no method by which one can determine whether one's outcomes are above or below average. As well, information that describes the state of the dilemma is largely disconnected from the self—the fact that a water table is 60% full has no direct bearing on self-evaluation—and information of this type tends to instigate abstract thinking (Watkins & Moulds, 2005; cf. Trope & Liberman, 2003). Lack of comparison information should inhibit the impulse to think concretely, and information that does not directly reflect on oneself should enhance the tendency to think abstractly. From this, it follows that *providing only environmental information should facilitate cooperation*.

Study 1

Study 1 was designed to test the propositions that social uncertainty leads to abstract thinking and environmental uncertainty leads to concrete thinking. These ideas should manifest themselves both behaviorally and cognitively, in that environmental information alone should produce descriptions of the dilemma that are abstract, and social information alone should produce descriptions that are concrete (Hypothesis 1); and environmental information alone should produce more frequent cooperation than social information alone (Hypothesis 2).

Method

Participants. The participants were 100 students enrolled in introductory psychology classes at an American university. Participation was in partial fulfillment of a course requirement.

Design. Social and environmental uncertainty were orthogonally manipulated to produce a 2 x 2 between-participants design. For labeling purposes, we will refer to the conditions in terms of which information is provided: no information, social, environmental, and full information.

Procedure. Upon entering the lab, each person was seated in a satellite room that contained a computer terminal. They were told that they would be engaging in many trials (20, though the exact number was not specified) of a collaborative task with five other people, located at various sites around campus, through the computer. (In reality, they would be interacting with a set of programmed choices.) On each trial, each person would have access to a common pool of points from which each person could sample up to 10 units, with samples accumulating across trials. Points left in the pool would be partially replenished by taking a percentage of the remaining points and adding that value into the pool for the next round. On each trial, the specific percentage value would be selected at random from the range 10–40%. If, at the end of the trials, the number of points left in the pool met a criterion value, the pool would be doubled, and this doubled amount would be added to each person's final holdings as a bonus. On the other hand, if the pool became so depleted that it was impossible to fill each person's harvest request, the task would immediately stop, and each person would lose half of his/her holdings as a penalty. They were told that, at the end of the semester, three names would be drawn at random, and each would receive the amount of money equal to 10% of his/her total holding. We used this method of rewarding because it encourages people to accumulate, but does not automatically suggest that one is in competition with others, and provides an incentive to maintain the pool.

Each person was then given a sheet that demonstrated some sample trials, and how the pool bonus worked. The examples were shown for a four-person group with a 5-point per person harvest maximum, so that people would not interpret the examples as hints as to how to behave. They were allowed to keep this sheet handy throughout the session in case they felt confused about aspects of the task.

The manipulations were then introduced. People in the social information condition were told that, on each trial, the computer would show the amount taken from the pool by each person. People in the environmental information condition were told that, on each trial, they would see the amount available for harvesting, and after all harvests had been made, would be told descriptively how close the pool was to the bonus criterion.[1] People in the full information condition received both of these messages, and people in the no information condition were told nothing.

People then activated the computer program. The screen always first said, "You are the third person to log in. Please wait for the remaining group members." Within the next 30 seconds, and at random intervals, messages appeared indicating that the fourth, fifth, and sixth "others" had logged in. At this point, the task began. A message was presented that said, "How many points would you like to take on this trial? You may take from 0 to 10 points." If the person was to receive environmental information (i.e., was in the environmental or full information condition), s/he also saw the message "There are ___ total points available for the group." The person typed his/her choice into a box and clicked a submit button, at which point the message "Please wait for the others" appeared. This message lasted for between 10 and 20 seconds. At that point, if the person was to receive social information (i.e., was in the social or full information condition), the statement "Here is how much every other group member took on the last trial" appeared and member-by-member choices were shown. If the person was to receive environmental information, s/he saw one of five messages: "The pool is currently [*quite a bit larger than/a little larger than/about at/a little less than/quite a bit less than*] the size required for the bonus." All people then saw the message "It's time for the next trial," and the process repeated. Figure 1 presents examples of the prechoice and postchoice interfaces.

To create the social information, in the design phase of the research we used a random number generator to produce a set of 100 nonnegative numbers that had a mean of 6 (established through pilot testing as the most common choice on this task), maximum of 10 and standard deviation of 1. The first five numbers in the set were shown as the choices of the "others" on Trial 1, the second five numbers as "others'" choices on Trial 2, and so on. These same 20 sets of "choices" were shown to every person who received social information. For the environmental information, on each trial we subtracted the set of numbers associated with that trial from the total remaining pool size, and applied an algorithm to the remainder to generate the "size" message (e.g., the pool was described as "quite a bit larger" than the required size if the remainder for that trial was 40–50% larger than the bonus criterion). Importantly, the person's own choice did *not* figure into the environmental message calculations; this meant that every person received the same environmental message on every trial.

After the 20th trial, a message indicated that the task was complete. A text box appeared, along with the instructions "Now please describe the task. If you had to explain to someone what the purpose of the task is, what would you say?" After finishing this, the person clicked a submit button, and the message "Thank you for taking part in this study. Please let the experimenter know you are done" appeared. The experimenter retrieved the person, moved him/her into the main room, provided a written debriefing (including a complete explanation of the deception, why it was used, and reassurance that deception is not normally part of research studies), and dismissed. At the end of the semester, three names were selected at random from the signup master list, and those people were paid according to the reward scheme.

Results

One person in the environmental condition asked to leave before data collection was complete. As such, analysis is on 99 cases.

We first analyzed harvest sizes by calculating each person's mean harvest across the 20 trials and executing a 2 x 2 ANOVA (environmental information by social information) on these means. The Levene test indicated no variance issues ($F <$ 1.00). For this dependent variable, cooperation is associated with small values—one who does not take very much out of the pool is leaving more for others and is helping preserve the pool in order to earn the bonus. Thus, a small mean harvest indicates cooperative tendency, and a large mean

Prechoice screen

How many points would you like to take on this trial? You may take from 0 to 10 points.

There are **250** total points available for the group. [**shown in environmental and full conditions only**]

Type your choice in the box below, then click the "Submit" button.

I would like [ ] points.

Submit

Postchoice screen

Here is how much every other group member took on the last trial: [**shown in social and full conditions only**]

Person 1 **4**
Person 2 **6**
Person 3 **You**
Person 4 **4**
Person 5 **3**
Person 6 **7**

The pool is currently **a little larger** than the size required for the bonus. [**Shown in environmental and full conditions only**]

It's time for the next trial. Click the "Continue" button to go to the next trial.

Continue

Figure 1. Sample computer interfaces for prechoice and postchoice.

harvest selfish tendency. In this analysis, there was a main effect for environmental information, $F(1, 95) = 27.33$, $p < .01$, with those who possessed environmental information harvesting less ($M = 5.32$) than those who could not monitor the resource ($M = 6.82$). The interaction was also significant, $F(1, 95) = 6.07$, $p < .05$. The cell means are shown in Figure 2, along with the Tukey HSD value. Hypothesis 2 speaks to the interaction, in that having environmental but not social information should lead to smaller harvests than having social but not environmental information, and the HSD value shows that this is in fact the case: Having only environmental information led to significantly smaller harvests ($M = 4.79$) than having just social information ($M = 6.64$). The HSD analysis also indicates that, if social information is not provided, whether or not environmental information is provided is crucial, but if social information is provided, it does not matter whether one also provides environmental information or not. Perhaps most interestingly, the comparisons also show that, if environmental information is provided, withholding social information helps reduce (over)harvesting, but providing social information does not. Thus, in the presence of environmental information, social information can undermine cooperation. Finally, the results indicate that it is better to provide full information than no information at all.

Thus, we have evidence that focusing on environmental information is more effective at

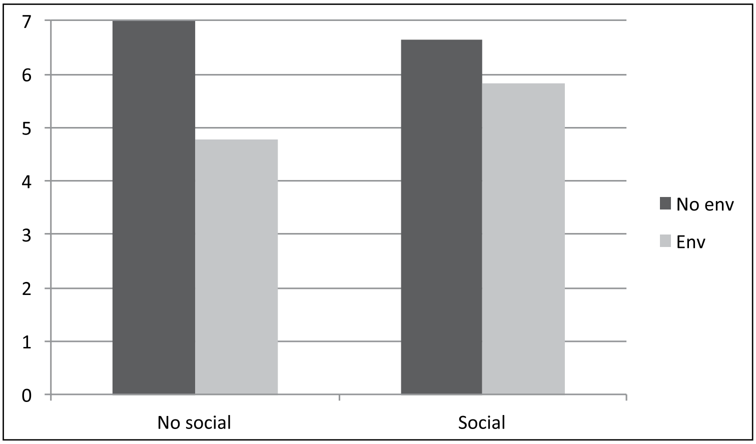

Figure 2. Mean harvest sizes—Environmental Information x Social Information—Study 1.
Note. For comparison of cell means, MSE = 2.03, HSD = 1.05.

Table 1. Sample abstract and concrete explanations of the purpose of the task: Study 1.

Abstract	You're trying to keep the pool large so you can get a big bonus at the end. Take a lot now = bad bonus, or maybe no bonus at all.
	The experimenters are trying to make something like water conservation, to see if people can plan out how much they will use and not take as much as they want to.
	The purpose is to see if people will take only half of what they can take. The only way to get the bonus is if everyone just takes half. So they're trying to see if people can figure this out.
Concrete	It's to see how many points a person can get.
	I would tell them that you can take a lot of points every time, but you probably shouldn't always take 10, because you could look greedy.
	It's simple, you just take stuff out of a pool. But you need to watch the bonus, and if it's getting low, you should not take as much, if you want the bonus (which I did).

inducing cooperation than is focusing on social information. Hypothesis 1 predicts that this is because the two types of information induce different mindsets. To test this, we had two independent, blind coders evaluate each person's explanation of the task. We instructed the coders to label a description "A" if it referenced general notions of cooperation, competition, preservation, and depletion, and "C" if it referenced specific behaviors like taking and leaving. We created and worked through several examples of the coding scheme and gave the coders the opportunity to practice and receive feedback. The interrater reliability (Cronbach's α) was .84. We analyzed only those statements for which the coders agreed on the classification; this led to 13 people being left out of this analysis. Sample statements of each type are shown in Table 1.

If Hypothesis 1 is correct, then a disproportionate number of statements in the environmental condition should be abstract, and there should be similar imbalance toward concrete statements in the social condition. We thus conducted a 4 (condition) x 2 (statement type) chi-square analysis. Statement frequency by condition is shown in Table 2. The pattern is quite straightforward. There are more abstract than concrete statements (16 vs. five) in the environmental condition, and conversely, fewer abstract than concrete statements (six vs. 15) in the social condition. The number of abstract versus concrete statements was quite equal in the no-information (11 vs. 12)

Table 2. Frequency of abstract and concrete descriptions of the task by condition: Study 1.

	Abstract	Concrete	Row total
No Information	11	12	23
Environmental only	16	5	21
Social only	6	15	21
Full information	8	12	20
Column total	41	44	85

and full information (eight vs. 12) conditions. Statistical tests indeed reveal that the cell counts differ from equality, $\chi^2(3) = 10.37, p < .01$. Single-degree-of-freedom tests indicate that both the environmental and social conditions deviate in the predicted directions ($\chi^2 = 5.76$ for environmental and 3.86 for social), but the counts in the full information condition are functionally equal ($\chi^2 = 0.80$).

These data, then, suggest that it is best for the induction of cooperation if there is some incomplete information about the situation. Specifically, being able to monitor the state of the dilemma but not what others are doing is associated with more abstract processing and stronger levels of cooperation. Further, if it is possible to monitor others' actions, it does not seem to matter whether there is environmental uncertainty or not.

Study 2

Study 1 examined the relative impact on cooperation of knowing, or not knowing, what others are doing and/or what the state of the resource looks like. Study 2 extended the research question to an extreme situation, namely, that in which the resource is in peril of drying up. While research on cooperative choice in the face of a resource crisis is scant, it is known that people faced with such a crisis generally do a poor job of responding to the crisis and end up exhausting the resource, sometimes because they assume others are hoarding and they do likewise (Kramer, McClintock, & Messick, 1986), including those with cooperative intentions (i.e., prosocials; Brucks & Van Lange, 2007), and sometimes because they underestimate the magnitude of behavior change needed to resolve the crisis (Joireman, Posey, Truelove, & Parks, 2009). Joireman et al.'s findings were established under complete environmental uncertainty and varying social uncertainty. In a similar vein, Loomis and colleagues (Loomis, Samuelson, & Sell, 1995) found response to a resource crisis to be best when environmental information was moderately specific, but their tests were done under complete social uncertainty. As we have shown, being able to monitor the resource is important for cooperation, but whether or not social information is provided is important as well. Thus, the overall purpose of Study 2 was to examine the interplay between the availability of social and environmental information when a social dilemma is in danger of failing.

The results from Study 1 indicate some specific and differential predictions regarding reaction to a warning. As environmental information induces long-term thought, it follows that a warning should serve to indicate that reality is at odds with what should be happening, and people should behave to correct this. By contrast, as social information induces short-term thought, the warning should highlight that the person will not be able to acquire much longer, and this should motivate them to get as much as they can now. We thus predict that cooperation after a warning should be stronger when there is environmental certainty than when there is social certainty.

Method

Participants. The participants were 120 American students enrolled in introductory psychology courses. Participation was in partial fulfillment of a course requirement.

Design. The design was a 2 (environmental information: yes/no) x 2 (social information: yes/no) x 2 (crisis: yes/no) between-participants design.

Procedure. The procedure was of the same basic structure as that used in Study 1, though because of equipment issues, the task was done manually

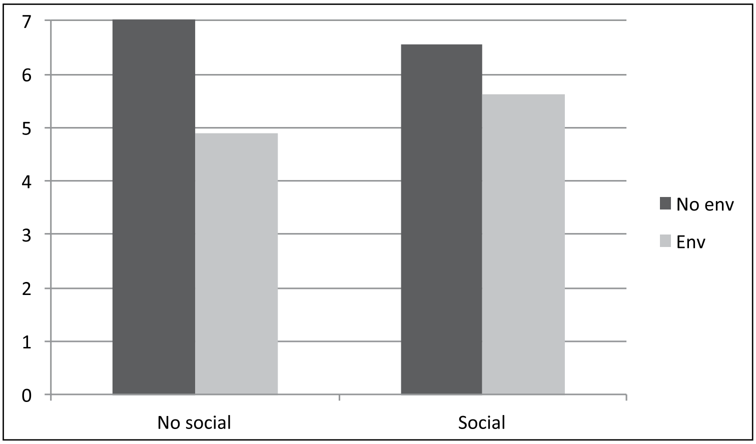

Figure 3. Mean harvest sizes—Environmental Information x Social Information—Study 2.
Note. For comparison of cell means, *MSE* = 1.28, HSD = 1.09.

rather than through computer: People were still seated in cubicles, but wrote their harvest choices on slips of paper that were collected by the experimenter. Because of the change to manual procedures, and the corresponding need for more time to execute one trial, we had to reduce the number of trials from 20 down to six. To further the impression that the remaining pool size had to be calculated, the experimenter took the slips to another cubicle and used a calculator. The experimenter then gave each person a slip of paper with either the social or environmental information on it. Different from Study 1 is that after the third trial, half of the people received a warning message, patterned after Loomis et al. (1995), that the remaining pool was critically low and in danger of being exhausted. Consistent with the first study, however, people did not know for how many trials the game would last. As in Study 1, the prize money was awarded after completion of data collection.

Results

One person in the no environmental certainty-social certainty-warning condition indicated on a postsession questionnaire that s/he had not understood how to perform the task. This person was removed from the data set. For each analysis, the homogeneity of variance assumption was first checked, and the F-value for the Levene test was always acceptably small.

Replication of Study 1. We first analyzed just the data from the no warning conditions. These four cells represent a conceptual replication of Study 1. A 2 x 2 ANOVA of the mean harvest across the six trials revealed a main effect for environmental information, $F(1, 56) = 27.94$, $p < .01$, and the interaction was also significant $F(1, 56) = 4.06$, $p < .05$. For the main effect, as in Study 1, those who had environmental information were more cooperative ($M = 5.25$) than those who lacked the information ($M = 6.79$). The cell means are shown in Figure 3, along with the Tukey HSD information for comparing the means. Comparing these means, we see that, while the numbers are in the same arrangement as was found in Study 1, statistically the only difference is between the extreme values, with people being more cooperative when given just environmental information than when given no information at all. We believe this is likely to be a power issue, as there were fewer per-cell cases in this study (15) than in Study 1 (24/25), and we feel confident that these data support the original conclusions from Study 1: It is better to have information than no information at all; and if environmental information is provided, it is better to withhold social information than to provide it.

Postwarning behavior. Our hypotheses speak specifically to behavior after receiving a warning. We expected that those who had received environmental information would be more cooperative than those who had received social information. To test this, we first conducted a 2 x 2 ANOVA on the mean of the three postwarning trials for those in the warning condition. Both main effects were significant: environmental information, $F(1, 55) = 67.38, p < .01$, and social information, $F(1, 55) = 12.97, p < .01$. As expected, people were more cooperative when they received environmental information ($M = 3.89$) than not ($M = 6.90$), and when they lacked social information ($M = 4.73$), compared to when social information given ($M = 6.05$). The interaction was not significant; however, our specific interest was in understanding how each type of information alone affected reaction to the warning. As such, we conducted a focused comparison of those who received just environmental information ($M = 3.27$) against those who received just social information ($M = 7.60$). The difference between means is significant, $t(27) = 10.92, p < .01$. This is direct evidence of our argument that the efficacy of a warning will be affected by what the person knows about the situation, whereby the provision of environmental information is essential to promote cooperation (while the provision of social information undermines cooperation).

General effects of warning. To test the overall impact of warning, we analyzed mean harvest size across the latter three trials (i.e., after participants received the warning message) for all people. For this analysis, main effects associated with environmental information and social information have no theoretical meaning, as there is no reason to expect that different levels of either would be associated with differential performance across the second half of the task: The splitting of the data into halves is relevant only to the warning variable. As such, we executed a modified, Type III ANOVA in which only effects associated with warning (its main effect, the interactions with the other two variables, the three-way interaction) were tested, with mean harvest across the first three trials included as a covariate. The covariate was significant, $F(1, 110) = 64.02, p < .01$, so the resulting analyses are on the adjusted means. The main effect of warning was significant, $F(1, 110) = 5.05, p < .05$, as were each of the two-way interactions: $F(2, 110) = 4.28$ for Social Information x Warning, and $F(2, 110) = 60.76$ for Environmental Information x Warning. The three-way interaction was not significant. The main effect of warning shows that harvests were larger when a warning was provided ($M_{adj} = 5.99$) than when it was not ($M_{adj} = 5.44$). This is consistent with some prior studies suggesting that warnings can do more harm than good (e.g., Joireman et al., 2009; Kramer et al., 1986).

Regarding the interactions, the environmental information–warning adjusted cell means are plotted in Figure 4. Application of the Tukey post hoc value of 1.02 reveals that the differential effect of warning versus not warning occurs only when there is no environmental information; when environmental information is present, it does not matter whether a warning is given or not. This suggests that the ability to monitor the resource reduces the temptation to just use it up when one is told it is close to depletion. The social information–warning adjusted cell means appear in Figure 5. Analysis of these means indicates that provision of full information (warning, knowledge of others' actions) produces less cooperation than provision of no information.

Taken together, these results suggest that to promote cooperation, it is best to keep people apprised of the state of a resource, and in the dark as to how others are using it. Alerting people that the resource is in a perilous state has little value, and in fact is likely to produce the opposite of what is desired. If a warning is deemed necessary, one would want to first make sure that users had been earlier provided some information about the state of the resource.

General Discussion

We have reported two experimental studies demonstrating that it is beneficial for preservation of a resource if users are given at least some information about the state of the resource. By contrast, it

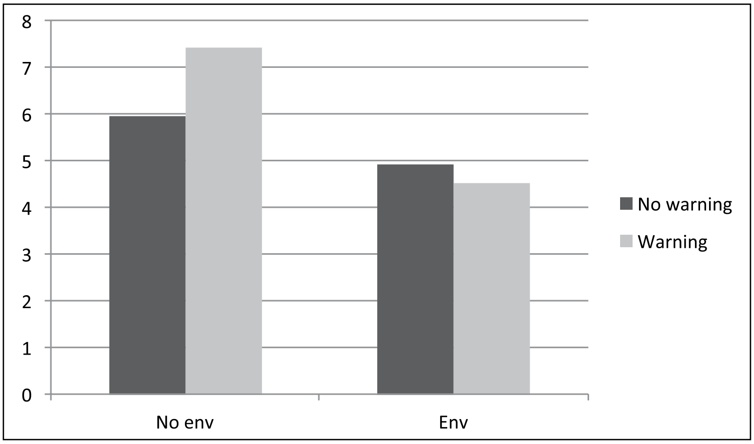

Figure 4. Adjusted-mean harvest across last three trials—Environmental Information x Warning—Study 2.
Note. For comparison of cell means, *MSE* = 1.11, HSD = 1.02.

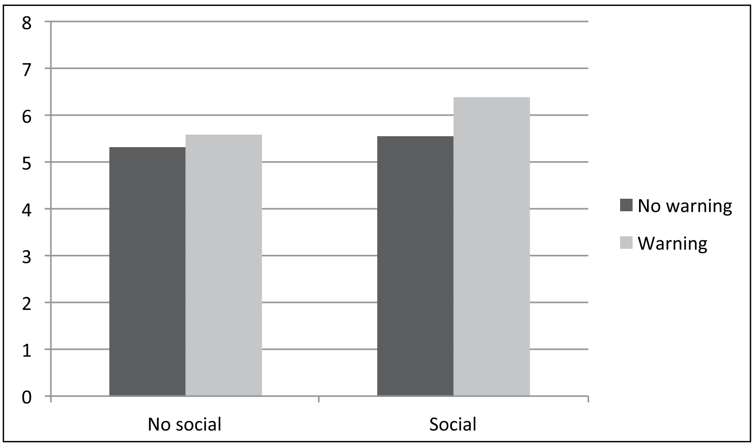

Figure 5. Adjusted-mean harvest across last three trials—Social Information x Warning—Study 2.
Note. For comparison of cell means, *MSE* = 1.11, HSD = 1.02.

is generally harmful to preservation if users are aware of what others are doing, especially if this is the only information the user is provided. The environmental information becomes especially important if users are to be warned when the resource is dangerously low, as the information is likely to offset the impulse to assume that recovery of the resource is hopeless, and so one should scavenge the little bit that is left. The dynamic that might help us understand such responses is the type of thinking that the information stimulates: Environmental information induces more abstract thought, and social information more concrete thought. We found that people were more likely to make reference to the long-term aspects of the dilemma if they had received environmental information, and more likely to refer to immediate outcomes if they received social information.

These data reinforce the point, first made by van Dijk, Wilke, Wilke, and Metman (1999), that environmental uncertainty is problematic for effective coordination of action in social dilemmas, and highlight the importance of keeping people as informed as possible about the state of a resource. And this information does not even need to be terribly specific. Recall that people were merely told the size of the pool, and given a broad indication of its status relative to what was needed to earn the bonus. Some research on environmental uncertainty in social dilemmas has suggested that, absent any hard information about the resource, people tend to assume it is maximally plentiful (e.g., Budescu, Rapoport, & Suleiman, 1990; Gustaffson et al., 1999b). Simple information about the state of the resource likely serves as a corrective to this. Describing the resource as "reasonably larger" than some criterion hardly implies an overflow. By contrast, the sudden, specific piece of information that the resource is critically low seems not to encourage people to cut back, but rather suggests that preservation is hopeless, and one needs to get what one can before it is gone. We regard this as a surprising effect, in that policy makers might often believe that warnings are helpful in discouraging consumption of scarce resources (e.g., water use during droughts). Yet for the people involved it is psychologically understandable that warnings sometimes yield a boomerang effect. People might think that several other members of the group are unlikely to reduce their harvesting (especially those who have overharvested), and so it becomes "understandable" that even those who exercised restraint might think: "Now I want to have my share as well of that what is left." Interestingly, some recent analyses by energy researchers also suggest that the effects of warnings and alarms tend to be overestimated (Rees, 2010; York, 2010). In terms of construal level, it might be that the sudden warning induces concrete thought—a warning identifies a problem that needs immediate attention—and as we have shown, concrete thought induces harvesting. It may also be that the warning triggers reactance, an effect that has been demonstrated with advisories about questionable media content (e.g., Bushman, 2006).

Our data also emphasize why it might not be a good idea to inform the person about what others are doing. People were consistently more consumptive of the resource when they were able to track the behavior of others. It is important to remember that the "others" were making mostly moderate choices in a random fashion—there were no extremists who could serve as models. Given this, plus the research on social comparative processes in social dilemmas (Parks et al., 2002) as well as the strength of descriptive over injunctive norms as an influence on behavior (Cialdini, 2003), it is unclear to us what value there might be in informing about how others are behaving in resource consumption situations. It may be, as Cialdini (2003) argued, that communicators are trying to provoke change by making salient a social norm, but in a mixed-motive situation, as we have shown, social information leads people to think about what should be done right now, and such immediate thinking typically indicates that one should act selfishly rather than cooperatively. An unanswered question is whether social information has value when others are being uniformly cooperative. Cialdini's (2003) work suggests that it does, in that it would communicate a choice norm, though it could also signal that others are ripe for exploitation, further decreasing the likelihood that the person will cooperate (see, e.g., Szolnoki & Perc, 2012; Yamagishi, Kanazawa, Mashima, & Terai, 2005). This is an issue well worth studying.

Another plausible line of reasoning focuses on the specifics of social information, in that people received information about each member of their group, including the cooperative members and the noncooperative members. There is evidence that information about the noncooperative members, at least in the context of small groups, tends to exert detrimental effects on cooperation in that such information typically outweighs the favorable effects of information about cooperative members (i.e., the bad apple effect; Kerr et al., 2009). Thus, in addition to being more concrete, it is possible that people have a perceptual readiness to focus on the least cooperative member—rather than the average or most cooperative member. Following this argument, one might speculate that it is the negative and concrete information that accounts for the somewhat disappointing effects of social information. It is also worth noting that, in the Parks et al. (2013) model of cooperative choice, attributions for others' behavior is one of the last influences before a decision is rendered. Thus, if social information does have a detrimental effect on the decision-maker, there is little opportunity to intervene and counteract its influence. All told, it seems clear that, if one is trying to raise levels of cooperation within a group, there is little value in informing on what other group members are doing.

Concluding Remarks

How much oil do we have left? To what extent are carbon emissions contributing to climate change? How plentiful is drinkable water? Needless to say, these are pressing societal issues. Moreover, these are issues that are inherently social. Although some technical solutions may help, in the final analysis is the human behavior that counts. Getting a grip on how governments can optimally persuade people to do what is best for all of us in the long run is an important scientific puzzle—one that we believe psychology can help address and resolve. We suggest that we have uncovered at least a small piece of that puzzle: People should be kept as informed as possible about the state of these resources. Such information should encourage the greatest amount of long-term thinking about these resources and how best to preserve them. At the same time, one should be careful (and perhaps rethink) about providing social information, or information about what other people do, did, or might do. Information along the lines of "The typical American drives 30 miles per day" or "The average American uses 80 gallons of water per day" should only encourage people to be more, not less, consumptive. Indeed, that people are social animals does not *always* mean that social information brings out the best in the people.

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Note

1. Because people do not know the specific replenishment rate, mere subtraction of consecutive pool sizes tells them nothing about the choices of others. This keeps the social uncertainty manipulation independent of environmental uncertainty.

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