

# Is it even worth it? The effect of loss prospects in the outcome distribution of a public goods dilemma

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## ABSTRACT

Contributions to public goods are premised on the expectation that the collective will realize benefit in excess of the value of required contributions. However, past research has focused on public goods of fixed and known value, for which the added value of the produced public good is obvious. Research has largely ignored public goods whose eventual value is uncertain at the time contribution decisions are made. Two studies explored the effects of outcome variance on individuals' contributions to a public good and their reasons for contributing. Contributions were negatively affected by loss prospects in the distribution of possible outcomes. Further, loss prospects directly discouraged contributions because of loss aversion, and indirectly discouraged contributions by fueling fears that others would not contribute. The negative effects of loss prospects were stronger when social uncertainty was low. Implications for social dilemma research and the effective management of collective action are discussed.

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## Introduction

Many acts of collective action involve the production of public goods – resources that, once produced, can be enjoyed by any member of the collective both without restraint and without diminishing another member's enjoyment of the benefits. Examples of public goods include community- and nation-wide vaccination initiatives to alleviate communicable diseases (Smith, Woodward, Acharya, Beaglehole, & Drager, 2004), public sporting events such as the Olympics (Hoffmann, Ging, & Ramasamy, 2002), and (in the private sector) generic advertising such as the “Beef – It's what's for dinner!” and “Got Milk?” campaigns (Krishnamurthy, Bottom, & Rao, 2003). The success of these collective actions is based in part on member contributions. If enough members contribute, the campaign, initiative, or event is launched; if members do not sufficiently contribute, the campaign, initiative, or event is underfunded and fails (Messick & Brewer, 1983).

Kollock (1998) notes that a primary characteristic of public goods dilemmas is the amount of benefit provided in relation to the amount of contributions required for its production; contributions to produce public goods are premised on the expectation that the

collective will realize benefit in excess of the value of the required contributions. Past experimental research has focused on public goods of fixed and known value, for which the benefit in excess of the required contributions is obvious. However, many real-world public goods do not resemble the public goods traditionally studied in experimental settings, in which the value of the public good is fixed and known with certainty at the time contribution decisions must be made. For example, no one can know with certainty the amount of revenue a generic advertising campaign will generate for an industry prior to collective investment (Miller, 1982); the benefits of vaccine initiatives often are not known with certainty until after community- or nation-wide inoculation (Picard, 2005); and no one can know how successful public sporting events will be for a nation's or city's commerce until after the event is under way or even complete (Horner, 1997). These examples suggest that there are two different aspects of success in producing a public good: success of the collective in cooperating to produce the public good and success of the public good in living up to its anticipated benefit. Research has largely ignored public goods whose eventual benefit is uncertain at the time contribution decisions must be made.

Uncertainty about the realized value of the public good (henceforth termed *outcome variance*) could lead members of the collective to fear the possibility of a loss even if the public good is produced. This fear might lead individuals to not contribute to the public good, even if the expected value of contributions is positive. Further, individuals may expect other members of the collective to not contribute for fear of realizing a loss, thus further discouraging an individual's own willingness to contribute.

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The current paper details two studies – each using a different public goods dilemma – that explore the effects of outcome variance on both individuals' contributions to a public good and their reasons for contributing. Prior to these two studies, we review research pertinent to our primary hypothesis about when outcome variance will (and will not) influence contribution behavior. We conclude by discussing these two studies' implications for research in the social dilemma paradigm and managing collective action.

### Step-level public goods dilemmas and the role of outcome variance

Since the influential work of Samuelson (1954) and Olson (1965), many researchers have studied contribution behavior in public goods dilemmas (see Ledyard, 1995, for a review). In this paper we focus on public goods dilemmas where the provision of the public good is a step-level function of the amount of resources individuals contribute (Rapoport & Eshed-Levy, 1989; Suleiman & Rapoport, 1992). In such “lumpy” public goods dilemmas, the public good is produced only after a predetermined critical mass (*provision threshold*) of aggregate contributions is reached by the collective (Taylor & Ward, 1982). An example of a step-level public good is the generic advertising campaign launched by the American steel industry, in which participation from 75% of industry members was required before the campaign could be launched (Krishnamurthy, 2001). In this example, if the 75% participation threshold is not reached, the public good – the generic advertising campaign – is not produced.

### Uncertainty and public goods dilemmas

Traditionally, public goods dilemma research has examined how contribution behavior is influenced by uncertainty surrounding the collective's ability to produce the public good (see Ledyard, 1995; van Dijk, Wit, Wilke, & Budescu, 2004; Wit, van Dijk, Wilke, & Groenenboom, 2004, for reviews). Uncertainty about whether other individuals will contribute toward the public good is termed *social uncertainty* (e.g., Messick, Allison, & Samuelson, 1988) – also known as strategic risk (e.g., Bottom, 1998; Ledyard, 1995) or relational risk (e.g., Das & Teng, 1996). Experimental research has shown that as social uncertainty increases, so does the temptation to not contribute toward producing the public good (Sabater-Grande & Georgantzis, 2002). Not knowing what others in the collective will do makes contribution to the public good risky since contributors could waste their contributions or could be taken advantage of by non-contributors (Yamagishi & Sato, 1986).

While social uncertainty is critical to understanding contribution behavior in public goods dilemmas, here we seek to extend the public goods dilemma paradigm by considering outcome variance as an additional source of uncertainty for contributors to a public good. Variance in the outcome of the public good, which is outside the collective's control, is a form of environmental uncertainty (van Dijk, Wilke, Wilke, & Metman, 1999) – also known as performance risk (Das & Teng, 1996). Outcome variance in public goods dilemmas raises a new question for individuals in public goods dilemmas: Is the benefit of the public good likely to be worth the cost of producing it?

Ostrom (1990) was one of the first to suggest that outcome variance is an important element influencing contribution behavior. In her work on managing shared resources (e.g., forests, grasslands, fisheries), she noted that, “Uncertainty has many external sources” that can influence “...the market prices of various inputs or final products” (p. 33). Ostrom provides an example in which the shared benefits of additional water resources (e.g., enhanced crop yields and sanitation) cannot be known with certainty until after farmers

have contributed their private resources to the construction of dams. Gulati, Khanna, and Nohria (1994) further suggest that even when social dilemmas can be structured so that mutual cooperation always pays more on average than unilateral or joint defection, outcome variance from unanticipated changes in the external environment may affect these payoffs and – as a result – influence the tendency to contribute toward collective action.

Unfortunately, few empirical studies have explicitly addressed the effects of outcome variance in public goods dilemmas. In one of the only studies examining outcome variance effects (van Dijk et al., 1999), participants (in groups of four) were each endowed with 75 points and were told that the provision threshold to produce the public good was 120 points (e.g., 30 points per participant). Participants were then given a choice of keeping their endowment or contributing some of their endowment towards the public good. The two conditions for public good outcome variance were no outcome variance (the value of the public good was fixed and known to be 300 points) and outcome variance (the public good could be any value – all values equally likely – between 190 and 410 points). Outcome variance had little if any effect on contribution behavior. This finding has led some to conclude that uncertainty about the value of the public good has no influence on contribution behavior in public goods dilemmas (Wit et al., 2004).

However, in the outcome variance condition in the van Dijk et al. (1999) study, if the threshold was reached the lowest possible value of the public good (190 points) exceeded the provision threshold (120 points). This meant that a participant's lowest possible portion of the public good (190 points/4 participants = 47.5 points) exceeded the average required individual contribution (120 points/4 participants = 30 points). Thus, if the public good was produced, participants in this study faced only the possibility of a gain and never faced the possibility of a real loss. A psychological approach to decision making under uncertainty (e.g., Kahneman, Slovic, & Tversky, 1982) provides some understanding of how the possibility of a real loss would influence contribution behavior.

### Risk aversion and prospect theory

Research on risk preference maintains that an individual's evaluation of an investment changes as a function of the amount of variance in its return (Bell, 1995; Sebora & Cornwall, 1995). All other things equal, individuals are risk averse (Levy, 1992): they prefer certain investments over uncertain investments (Green, 1971). As a consequence of risk aversion, individuals should “prefer lower to higher (outcome) variance” in investments – assuming the expected value remains unchanged (Cheung, 1969, p. 26). With regards to public goods production, this would predict that individuals will contribute less toward producing a public good with outcome variance compared to a public good with a certain, fixed return – assuming the expected return for both was the same. As noted earlier, although outcome variance in the van Dijk et al. (1999) study did not influence contributions to the public good, outcome variance in that study also did not create the prospect of losses if the public good was produced. The difference between outcome distributions that entail only possible gains versus outcome distributions that entail both possible gains and possible losses is significant, as psychological research reminds us that individuals tend to think about gains and losses differently (see Taylor, 1991, for a review).

Prospect theory suggests that gain and loss prospects are created by the comparison of possible benefits realized relative to a reference point (Kahneman & Tversky, 1979), but van Dijk and Wilke (1995, p. 3) have suggested that, “...it is difficult to meaningfully apply prospect theory to social dilemmas...” because it is

difficult to know how contributions and benefits figure into the perception of losses-and-gains. This problem likely has been exacerbated in past research because the possibility that the value of a realized public good could be less than the provision threshold has not been considered. *de Cremer (2007)* has suggested that in a step-level public goods dilemma, a likely reference point for assessing gains and losses is the provision threshold (at the collective level) or average required contribution (at the individual level), since individuals typically follow a proportionality rule when deciding how much to contribute toward the public good (*van Dijk & Wilke, 1995*). That is, when decision makers are faced with the decision of whether to contribute, they judge any possible benefits realized by themselves or the collective against what they and others would have to contribute for the public good to be produced.

For example, imagine the average individual contribution required to produce a public good is \$100 per individual and that the individual-level benefit of the public good could be anywhere between \$50 and \$250. In this particular public goods dilemma, the outcome variance in the value of the public good contains both gain (as high as +\$150) and loss (as low as −\$50) prospects. Any amount of value received from the public good that is *greater* than the individual's contribution of \$100 would be a gain (e.g., the individual contributes \$100 and receives \$250 from the public good for a gain of \$150) and any amount of value received from the public good that is *less* than the individual's contribution of \$100 would be a real loss (e.g., the individual contributes \$100 but receives \$50 from the public good for a loss of \$50).

Prospect theory maintains that decision makers tend to subjectively place greater weight on the prospect of losses than on the prospect of equivalent-sized gains (*Tversky & Kahneman, 1992*), a process referred to as *loss aversion* (*Rabin & Thaler, 2001*). Because prospective losses count more (subjectively) than equivalent prospective gains, outcome distributions that entail possible gains and possible losses should be disproportionately less attractive compared to outcome distributions that entail only possible gains – even if the mean expected (objective) outcome for both outcome distributions is the same (*Sebor & Cornwall, 1995*). The impact of loss prospects in public goods dilemmas is likely to be two-fold. First, because losses “loom larger” (are given more weight) than comparable gains (*Tversky & Kahneman, 1992*), the presence of loss prospects (albeit even unlikely ones) will lower the subjective expected net benefit of a public good, thus discouraging contributions. Second, research on the “false consensus effect” (e.g., *Ross, Green, & House, 1977*) suggests that individuals typically believe that others will assess situations and behave similarly. For example, *Offerman, Sonnemans, and Schram (1996)* found that an individual's expectations about other collective members' contributions to the public good influenced their own contribution decisions. Therefore, individuals may also project their loss aversion fears onto the other members of the collective, fueling expectations that others will not contribute, and thus also discouraging an individual's own contributions via increased social uncertainty.

## Study 1

To summarize, outcome variance in the value of a public good creates loss prospects when the lowest possible value of the public good, if produced, is less than the provision threshold, meaning that the average share of the produced public good could be less than the average required level of individual contribution. In such cases, loss prospects decrease the subjective attractiveness of contributing to a public good (relative to its mean expected outcome), decreasing an individual's willingness to contribute. Further, when production of the public good can possibly yield a loss, an individ-

ual is also less likely to contribute out of fear that others will not contribute and the public good will not be produced. This leads to the following hypotheses:

**Hypothesis 1** (*Replication of van Dijk et al., 1999*). Keeping the expected return constant, outcome variance will not influence an individual's contribution toward a public good as long as the distribution of possible outcomes includes gains-only prospects.

**Hypothesis 2.** Keeping the expected return constant, outcome variance will decrease an individual's contributions toward a public good only when the distribution of possible outcomes includes the prospect of losses.

**Hypothesis 3a.** Outcome distributions including the prospect of losses-and-gains (compared to outcome distributions including only the prospect of gains) will increase the likelihood of loss aversion as a determinant of contribution behavior.

**Hypothesis 3b.** Outcome distributions including the prospect of losses-and-gains (compared to outcome distributions including only the prospect of gains) will increase the likelihood of fear of others' non-contribution as a determinant of contribution behavior.

These hypotheses were tested in the context of a laboratory study utilizing a step-level public goods dilemma.

## Methods – Study 1

### Participants and design

Participants were 72 undergraduates (58% female) in two upper-level business courses at a large Midwestern university, who participated in exchange for extra credit with an opportunity to receive money based on individual and group decisions in the study. Because past research has found that the threshold level influences contribution toward public goods (e.g., *Cadsby & Maynes, 1999; Poppe & Zwikker, 1996*), three levels of provision threshold were included to assure that this study's findings were not threshold-dependent. The study therefore used a 4 (outcome variance: no variance, low variance, medium variance, high variance)  $\times$  3 (threshold: low threshold, medium threshold, high threshold) within-subjects design. This design thus involved 12 independent contribution decisions for each participant.

### Task and procedure

Participants were escorted into the laboratory individually and were provided written instructions to a series of 12 independent “games.” Each game was a four-person step-level public goods dilemma, adapted from *van Dijk et al. (1999)*. The participants were told that for each dilemma (the term “game” was used for the participant), they would have 125 points to contribute – in any amount – to either a shared or personal account. Any points allocated to the personal account were theirs to keep and not share with anyone else, while any points contributed to the shared account would not be returned. They were also told that the shared account in each dilemma offered the possibility of a “bonus” (the public good). If the total amount of points contributed to the shared account by all four participants in any dilemma met or exceeded a particular threshold, the public good would be provided and divided equally among the four participants. If the total amount of points in the shared account did not meet the given threshold, there would be no public good produced. All choices were made privately and anonymously.

Participants were informed that at the end of the experimental session each of his or her choices would be combined at random with the choices of three other participants for each of the 12 dilemmas; no participant's choices would be assigned to those of the same group of participants more than once. Participants were also informed that it was possible for their choices to be combined with those of participants from previous sessions. Participants were told that one of the choices they made would be chosen at random and that they would earn real money at the rate of 1 point = \$0.01 for that choice only. No additional information about performance in any of the dilemmas or about group members was provided and there was no communication or contact among participants.

Twelve different orderings of the dilemmas were used, so that each of the choices participants faced appeared for some participants in each position in the order. Orders were blocked by threshold – participants made all choices for each threshold sequentially, but within threshold they used one of four different sequences of the outcome variance conditions. This was done as the focal comparison was prospects within threshold level and to ease the cognitive strain on the participants that would have likely resulted from switching both threshold level and outcome variance every game. Three different orders of the threshold blocks were used across participants.

After participants read the instructions, they completed a quiz testing their understanding of those instructions. If a participant provided incorrect answers to the quiz, the experimenter coached that participant until they arrived at the correct answer. Upon completing the quiz, each participant at their own pace read the scenario for each game, made their contribution decision for that game, and answered some questions about that game (see Measures). Upon completing all 12 games, each participant was debriefed, paid, and dismissed.

#### Operationalization of key variables

##### Contribution

Contribution was the number of a participant's 125 points allocated to the shared account in each game.

##### Outcome variance

Following van Dijk et al. (1999), outcome variance was manipulated by increasing the bounds of a uniform outcome distribution (all values equally likely) while keeping the *mean expected value of the public good constant at 600 points*:

- No variance: bonus = 600 points (150 points per participant).
- low variance: bonus = 400–800 points (between 100 and 200 points per participant).
- Medium variance: bonus = 200–1000 points (between 50 and 250 points per participant).
- High variance: bonus = 0–1200 points (between 0 and 300 points per participant).

Outcome variance was presented in the instructions to the participant as follows: “The bonus for this game is an amount randomly chosen between 400 and 800 points (all values equally likely to be chosen).”

##### Threshold

There were three provision threshold conditions:

- High threshold: 440 points (on average 110 points/participant).
- Medium threshold: 300 points (on average 75 points/participant).
- Low threshold: 160 points (on average 40 points/participant).

#### Outcome prospects

As noted, there were 12 dilemmas completed by each subject (3 threshold conditions  $\times$  4 outcome variance conditions). Included were six dilemmas that featured gains-only outcome distributions (three of which featured no outcome variance), and six dilemmas that featured losses-and-gains outcome distributions. Whether a dilemma had gains-only prospects or losses-and-gains prospects was a function of both the threshold level and the outcome variance. If the required contribution for a particular threshold level (e.g., 75 points per participant) was *less than* the lowest possible return from the public good if produced (e.g., 100 points per participant), then that dilemma contained gains-only prospects. If the required contribution for a particular threshold level (e.g., 75 points) was *greater than* the lowest possible return from the public good if produced (e.g., 0 points), then that dilemma contained losses-and-gains prospects. To avoid any negative effects of uncertainty about complex computations (Messick & Rutte, 1992), in all 12 games the threshold and bonus levels were both easily divided by four into whole numbers.

#### Measures

##### Strategy choice

Participants selected one of six strategies indicating the reason behind their contribution decision in each game. Three strategy options explained contributions below the average required contribution: “I chose to allocate the number of points I did because:” (1) fear of others' non-contribution – “I think the other participants will not allocate points to the shared account and we will not get the bonus;” (2) greed/opportunism – “I think other participants will allocate points to the shared account and I can benefit from the bonus without having to contribute;” (3) loss aversion – “I don't know what others are going to do and it's not worth the risk of contributing to the shared account.” Three parallel strategy options explained contributions at or above the average required contribution: (4) no fear of others' non-contribution – “I think the other participants will contribute to the shared account, so I want to contribute as well;” (5) moral obligation – “I think contributing to the shared account is the right thing to do, regardless of what the other participants decide;” and (6) risk seeking – “I don't know what others are going to do and it's worth the risk of contributing to the shared account.” In this study, we were primarily interested in the first three strategies as these represented reasons for not contributing.

##### Fear of incurring a loss

As a supplemental test for loss aversion, a one-item measure assessed participants' fear of incurring a loss: “If the bonus is provided, how concerned are you about incurring a loss?” (1 = not at all concerned, 7 = very concerned).

##### Manipulation check measures

##### Outcome variance

To serve as a manipulation check for outcome variance, participants answered a survey item indicating how certain they were of the value of their portion of the public good if provided: “If the bonus is provided, how certain are you about the number of points you would earn?” (1 = not at all certain, 7 = very certain).

##### Provision threshold

To serve as a manipulation check for the threshold required to achieve the bonus, participants selected from a list of choices what portion of their endowment each of the four players would have to contribute to achieve the threshold level: 40, 75, 110, or 150 points.



## Results and discussion – Study 1

Ten participants were removed from the dataset because of either incomplete data or indication that they did not understand the game played (e.g., several participants indicated to the experimenter that they were saving points across games thinking they would be able to exchange all of them combined for money). The removal of these participants resulted in no significant differences for any of the hypothesis tests. The final sample size for Study 1 was 62 (55% female). The average number of participants per session was 12.

### Manipulation checks

Analyses for Study 1 primarily utilized repeated-measures ANOVA. The manipulation of outcome variance was successful, as participants' certainty about the value of their portion of the public good decreased as outcome variance increased;  $F_{1,61} = 117.63$ ,  $p < .001$ . Post hoc contrasts comparing a participant's certainty about the value of their portion of the public good across each level of outcome variance showed a significant decrease in certainty for each increasing level of outcome variance; all  $p$ -values  $< .001$ .<sup>3</sup> In addition, all participants answered the threshold manipulation checks correctly.

### Hypothesis testing

#### Outcome prospects

**Hypothesis 1** predicted that a participant's contribution to the public good would not change as a function of the presence of outcome variance as long as the distribution of outcomes offered only the prospect of gains. The mean number of points participants contributed to the shared account, controlled for threshold level, are displayed in Table 1. There was no difference in the mean contribution for the no variance condition ( $M = 66.52$ ) as compared to the outcome variance with gains-only condition ( $M = 66.54$ );  $F_{1,61} < 1.00$ ,  $p > .95$ . This result replicates van Dijk et al. (1999), and provides support for Hypothesis 1.

**Hypothesis 2** predicted that participants would contribute significantly less when the public good offered the prospect of either gains or losses than when the public good included only the prospect of gains. To test this second hypothesis, we compared the contributions of participants to the shared account in the losses-and-gains conditions ( $M = 58.98$ ) with the contributions of participants in both the no variance and gains-only conditions ( $M = 66.53$ ). In support of Hypothesis 2, participants contributed significantly less toward the shared account in losses-and-gains prospect conditions than in the no variance and gains-only prospect conditions;  $F_{1,61} = 4.73$ ,  $p < .05$ . Further analysis showed that the difference in contribution behavior between gains-only and losses-and-gains prospects did not change as function of threshold level;  $F_{1,61} = .05$ ,  $p > .80$ . Therefore, the effects of outcome prospects on contribution behavior were robust across threshold levels.

#### Strategy choice

Adjusted for threshold effects, strategy choices closely mirror the findings for contributions. Specifically, the proportion of participants selecting non-contribution strategies was significantly greater in the losses-and-gains prospect condition (32.8%) than in the other two conditions combined (21.6%);  $\chi^2_1 = 69.08$ ,  $p < .001$ . This provides further support for Hypothesis 2.

To test Hypotheses 3a and 3b, which state that both loss aversion and fear of others' non-contribution will be determinants of

decreased contributions, participants selected from a list of strategies the one that best characterized the motivation behind each decision. Fig. 1 displays by condition the proportions of participants who chose greed/opportunism versus fear of others' non-contribution versus loss aversion in the three outcome variance conditions. In support of Hypothesis 3a, the proportion of participants allocating less to the shared account than the required average individual contribution for reasons of loss aversion was significantly greater in the losses-and-gains conditions (14%) than in the gains-only and no variance (4%) conditions;  $\chi^2_1 = 21.55$ ,  $p < .001$ . In support of Hypothesis 3b, the proportion of participants allocating less to the shared account than the required average individual contribution out of fear of others' non-contribution was significantly greater in the losses-and-gains conditions (17%) than in the gains-only and no variance (6%) conditions;  $\chi^2_1 = 13.70$ ,  $p < .001$ .<sup>4</sup> These findings support the idea that concerns about loss prospects can also be projected onto others, further decreasing contribution via increased social uncertainty.

### Supplemental analysis and findings

In support of de Cremer (2007) suggestion that in a step-level public goods dilemma provision threshold or average required individual contribution provides an important reference point for assessing gains and losses, participants reported being significantly more fearful of incurring a loss in losses-and-gains conditions ( $M = 3.60$ ) than in the no variance and gains-only conditions ( $M = 3.00$ );  $F_{1,61} = 14.93$ ,  $p < .001$ . Additional post hoc analysis showed that fear of incurring a loss did not significantly differ between the no variance and gains-only conditions;  $F_{1,61} < 1.00$ ,  $p > .69$ . These findings support the conclusion that fear of incurring a loss was not solely a function of increasing outcome variance; instead, fear of incurring a loss was a function of the presence of loss prospects in the distribution of possible outcomes, as would be predicted by prospect theory.

Although provision threshold had no significant effect on fear of incurring a loss ( $F_{1,61} < 2.50$ ,  $p > .12$ ), we explored the possibility that provision threshold might influence strategy choice or why participants facing loss prospects chose not to contribute. As shown in Table 2a, at higher threshold levels, the dominant strategy choice was fear of others' non-contribution; at lower threshold levels, the dominant strategy choice was loss aversion, or fear that the public good would not produce benefit in excess of required contributions. Additional post hoc analysis (using a Fisher's exact test) confirmed that the proportion of participants selecting fear of others' non-contribution as their strategy choice to participants selecting loss aversion as their strategy choice differed significantly across threshold conditions;  $p < .05$ .

### Discussion

Outcome variance significantly and negatively affected contributions in a step-level public goods dilemma only when participants were faced with the prospect of a loss. The strategy choice findings suggest that participants contributed significantly less in the face of loss prospects out of fear of a loss even if the public good was produced. The strategy choice findings also suggested that participants contributed significantly less in the face of loss prospects out of fear that others were not going to contribute and that therefore the public good was not going to be produced. These results support the idea that the prospect of a loss not only directly

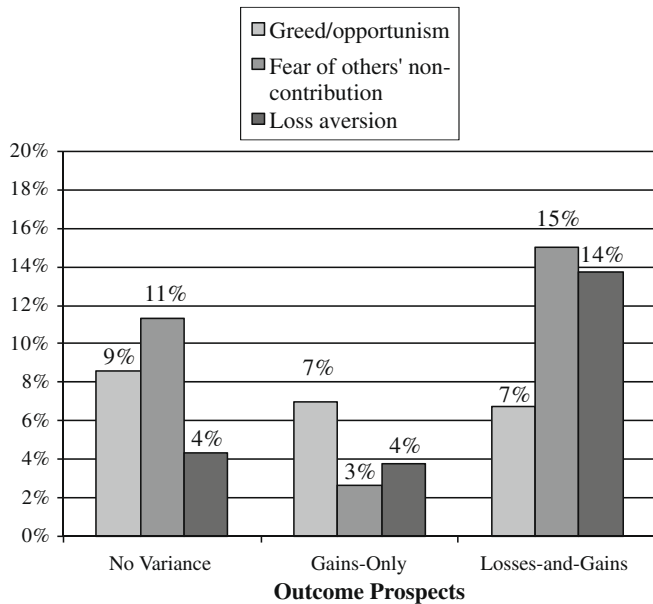
<sup>3</sup> All post hoc, pair-wise contrasts in Study 1 used a Bonferroni-adjusted  $\alpha = 0.004$  (Kutner, Neter, Nachtsheim, & Li, 2004).

<sup>4</sup> Except where noted, standard  $\chi^2$  tests were used for analyzing the proportions of motivation strategies selected by participants in both studies. Because these studies utilized within-subjects designs, strategy selections across games are not independent.

**Table 1**  
Contributions to the step-level public good.

Variable	Means		
	Outcome prospects		
	No variance	Gains-only	Losses-and-gains
Study 1 – contributions (amount of endowment contributed)	66.52 <sup>a</sup> (26.06)	66.54 <sup>b</sup> (19.98)	58.98 <sup>a,b</sup> (29.33)
Study 2 – contributions (% of games with contributions)	0.72 <sup>a</sup> (0.45)	0.76 <sup>b</sup> (0.42)	0.49 <sup>a,b</sup> (0.52)

Standard deviations are given in parentheses. Across a row, means and proportions that share a superscript are significantly different at  $p < .05$ , two-tailed test.



**Fig. 1.** Study 1 – strategy choice rates for those contributing below the average required contribution.

**Table 2**  
Strategy choices in losses-and-gains games by study<sup>a</sup>.

Strategy choice	Proportion Choosing by Threshold		
	Low	Medium	High
<i>(a) Study 1</i>			
Fear of others' non-contribution	7.7	40.4	51.4
Loss aversion	61.5	34.0	36.5
Greed/opportunism	30.8	25.5	12.2
	Proportion Choosing by Group Size		
	2	8	
<i>(b) Study 2</i>			
Fear of others' non-contribution	43.7	70.6	
Loss aversion	56.3	29.4	

<sup>a</sup> These strategy choices represent reasons why individuals contribute below the average required contribution (Study 1) or who do not contribute at all (Study 2).

discourages contribution behavior, but also may indirectly discourage contributions by increasing social uncertainty (fear that others will not contribute). Further, the results indicate that when the provision threshold was high participants were more likely to not contribute out of fear that others would not contribute than out of loss aversion, which was the dominant strategy at low threshold levels.

The findings from Study 1 also highlight concerns about what it means to cooperate in the context of a step-level public good di-

lemma. The term “cooperation” is used in traditional social dilemma research to reflect choices favoring collective over individual interests (Dawes, 1980; Zeng & Chen, 2003). In step-level public goods dilemmas, a minimum aggregate level of contributions is required for the public good to be realized (Taylor & Ward, 1982), so cooperation can be thought of as occurring to the extent that an individual contributes at or above the average amount required by all members of the collective to reach the provision threshold. Defection, then, occurs to the extent that an individual contributes less than the average amount required by all members of the collective. However, whether individuals “intended” to cooperate can be ambiguous in a step-level public goods dilemma, as perhaps they thought they were being “cooperative” just by contributing any amount. Study 2 utilized an assurance game, in which all contribution choices are dichotomous, so that cooperative intent is more easily known.

## Study 2

One purpose of Study 2 was to replicate the findings of Study 1 using an assurance public goods dilemma. In an assurance public goods dilemmas all members of the collective must contribute or the public good is not produced, so free-riding is not possible (Cortazar, 1997). Unlike step-level public goods dilemma in which cooperation can only be inferred when individuals contribute at or above the average individual contribution required to reach the provision threshold, in assurance public goods dilemmas the cooperation/defection choice is dichotomous. This dichotomy also means members of the collective cannot contribute more than the required individual contribution to insure against non-contributors (Kollock, 1998). The dilemma in assurance public good production is that for contribution to make sense, everyone must believe that everyone else will cooperate (Liebrand, 1983) – even more so than in step-level public goods dilemmas where over-contribution is possible. What differentiates assurance dilemmas from other step-level public goods dilemmas (such as the one featured in Study 1) is that members of the collective will receive a full portion of the public good only if everyone fully contributes. If all individuals do not contribute, any individual who does not contribute (defects) keeps their complete initial endowment while those who contribute toward the public good lose their endowment.

An example of an assurance public goods dilemma is the development of a wind-powered energy grid covering a territory of private property. The energy grid is intended to provide a public good (e.g., energy cost savings) to residents across all the areas of a territory. For the energy grid to be built (and the public good enjoyed), each and every property owner must cooperate and give permission to allow power lines to be laid across their property. Significantly in this example, even if all property owners cooperate and the energy grid is built, there will still be uncertainty about the energy cost savings to be realized – if any at all (see Joyce, 2009; Nussbaum, 2004).

In addition to replicating Study 1's findings in the context of a different public goods dilemma, Study 2 also provided an opportu-

nity to connect the findings of Study 1 with past public goods dilemma research by testing for a possible interaction between loss prospect effects and a well-established determinant of social uncertainty and contribution behavior in public goods dilemmas: group size (Wit et al., 2004).

#### *Outcome variance in assurance dilemmas*

As with step-level public goods dilemmas, the probability of contribution in an assurance dilemma should not be affected by outcome variance that entails gains-only prospects (*Hypothesis 1*), and should be negatively affected by outcome variance that entails both losses-and-gains prospects in the outcome distribution (*Hypothesis 2*). As noted above, this is because loss prospects are subjectively weighted more heavily than gain prospects (Kahneman & Tversky, 1979), thus decreasing the relative attractiveness of opportunities that entail losses-and-gains prospects over those that contain gains-only (Kahneman & Tversky, 1979). This should lead individuals to not contribute out of fear of incurring a loss (*Hypotheses 3a*). Further, when outcomes contain losses-and-gains prospects individuals may also fear others will defect, further increasing defection (*Hypothesis 3b*).

#### *Social uncertainty in assurance public good dilemmas*

A common feature of many collective efforts is that the number of individuals involved exceeds two parties (Franzen, 1995; McCarter & Northcraft, 2007). Increasing group size in assurance dilemmas should negatively influence cooperation rates, as increasing group size is one way to increase uncertainty about what others will do, or social uncertainty (Messick & Rutte, 1992). Franzen (1995), for example, found that cooperation rates significantly dropped as the size of the group increased from two to seven in one-shot assurance games. As social uncertainty increases, individuals become less likely to contribute toward public good provision so as to avoid being played the sucker (Chen, Au, & Komorita, 1996; Sniezek, May, & Sawyer, 1990). This leads to the following hypothesis.

**Hypothesis 4** (*Replication of Franzen, 1995*). An individual's likelihood of contributing toward the public good will be less when group size is large than when group size is small.

#### *Interaction of social uncertainty and outcome prospects*

Increasing social uncertainty should minimize the effects of loss prospects on the likelihood of contribution. This hypothesis is based on the observation that individuals in social dilemmas follow basic decision rules or “choice heuristics”: they first ask themselves whether the group is capable of achieving the public good; e.g., will we attain the provision threshold (Messick & Rutte, 1992, p. 106). If the answer to this question is “no,” the individual defects and contributes nothing toward the public good's production; but if the individual believes the group is capable of achieving the threshold, the individual goes on to consider other elements of the dilemma scenario (Messick & Rutte, 1992). Other elements of the scenario could include evaluations of the payoffs (Schroeder, Sibicky, & Irwin, 1995), such as outcome variance.

This suggests that an individual in an assurance game will first assess whether it is likely that the threshold will even be reached and the public good produced. When group size is small, social uncertainty and fear of other participants defecting is low, resulting in the individual believing the public good is more likely to be produced. In that case, subjective evaluation of the expected benefit of the public good – specifically, whether the public good

if produced will be worth the cost of producing it – should influence contribution behavior as shown in Study 1.

When group size is large, however, uncertainty about others' cooperation and the probability that at least one person will defect increases, making an individual more reluctant to cooperate (Franzen, 1995). This would result in the individual deciding to defect (not contribute) before even considering the subjective value of the public good. Thus, outcome variance – whether the outcome distribution contains only gains versus losses-and-gains – should have less of an effect on contribution behavior when group size is large than when group size is small. This is because increasing group size creates social uncertainty that leads to defection before subjective outcome prospects of the dilemma are even considered.

**Hypothesis 5.** Group size will moderate the relationship between outcome variance and the likelihood of cooperation such that outcome distributions that contain both losses-and-gains (compared to outcome distributions that contain gains-only) will more negatively influence the rate of cooperation when group size is small than when group size is large.

## **Methods – Study 2**

### *Participants and design*

Participants were 84 (49% female) undergraduates. This study used a 3 (outcome variance: certain gain prospect, uncertain gains-only prospect, uncertain losses-and-gains prospect)  $\times$  2 (group size: two players, eight players) within-subjects design.

### *Task and procedure*

The design followed a procedure similar to that used in Study 1. Participants were escorted into the laboratory individually and were provided written instructions for a series of assurance public good dilemmas. Appearance of the six dilemmas was ordered using a Latin square design. Instructions and payment to participants were identical to Study 1 with the following exceptions: contributions were all-or-nothing (125 points or no points) for each choice; if all participants in a particular dilemma contributed their points to the shared account, a bonus (the public good) would be provided and divided equally among all participants, while if not all participants contributed their points to the shared account, there would be no bonus. Participants' choices were randomly combined (at the conclusion of the experimental session) with one or seven other participants to create each two-person or eight-person dilemma.

After completing the pre-experiment quiz, each participant read the scenario for each choice, made their contribution decision, and answered some questions about that choice (see Measures). After all choices were completed, participants were debriefed, paid, and dismissed.

### *Operationalization of key variables*

#### *Cooperation*

A participant was considered to have cooperated if they contributed their 125 points to the shared account (cooperation = 1, defection = 0).

#### *Group size*

Group size was either two participants or eight participants. Eight participants was chosen for the large group condition since past research on assurance dilemmas found no significant differences in cooperation rates for groups of between seven and nine players (Franzen, 1995).

### Outcome variance and prospects

As in Study 1, outcome variance was manipulated by increasing the bounds of a uniform distribution (all values equally likely) for the bonus. To avoid potential effects on contribution behavior because of changes in bonus size (Van Lange, Liebrand, Messick, & Wilke, 1992), each participant's mean expected individual portion of the public good was 300 points in all games. The contrast of the required 125 point contribution and the three outcome variance conditions provided for the different types of prospects:

- No variance: portion of bonus = 300 points per participant.
- Gains-only prospects: portion of bonus = between 150 and 450 points per participant.
- Losses-and-gains prospects: portion of bonus = between 0 and 600 points per participant.

The overall size of the bonus differed depending on group size so as to keep the expected value at 300 points for all games. For example, in the gains-only prospect condition, for two participants the bonus was 300–900 points (all values equally likely); for eight participants the bonus was 1200–3600 points (all values equally likely). In the losses-and-gains prospect condition, for two participants the bonus was 0–1200 points (all values equally likely); for eight participants the bonus was 0–4800 points (all values equally likely).

### Measures

#### Strategy choice

Because free-riding is impossible in assurance dilemmas, opportunism was not possible (Kollock, 1998) and was therefore dropped from the list of strategy options. Moral obligation was also dropped since the category was minimally selected in Study 1. The loss-aversion strategy statement was rephrased to more clearly differentiate this strategy from fear of others' non-contribution. The strategies explaining non-contribution were thus: (1) fear of others' non-contribution – e.g., “I chose to allocate my 125 points to my personal account because I don't know what the other player is going to do and because of this it's not worth the risk” and (2) loss aversion – e.g., “I chose to allocate my 125 points to my personal account because – even if the other player and I both allocate our 125 points to the shared account – my personal payoff is not worth the risk.”

As in Study 1, there were also corresponding contribution strategies: (3) no fear of others' non-contribution – e.g., “I chose to allocate my 125 points to the shared account because I expected the other player would also allocate their 125 points to the shared account;” and (4) risk seeking – e.g., “I chose to allocate my 125 points to the shared account because – assuming we both allocate our 125 points to the shared account – the payoff is worth the risk.”

#### Fear of incurring a loss

Similar to Study 1, a single-item measure assessed how fearful the participant was of incurring a loss, e.g., “If you and the other player both allocated your 125 points to the shared account, how concerned would you be about incurring a loss?” (1 = not at all concerned, 7 = very concerned).

## Results and discussion – Study 2

Nineteen participants were removed from the sample because of either incomplete data or indication that they did not understand the games played.<sup>5</sup> The removal of these participants resulted in no significant differences in any of the hypothesis tests. The final sample size for Study 2 was 65 (48% female). The average number of participants in a session was 12.

### Hypothesis testing

Because the design is within-subjects and the dependent variable in assurance games is dichotomous, analyses for this study's hypotheses utilized Generalized Estimating Equations (Ballinger, 2004), yielding a coefficient similar to standard logistic regression that is tested with a Wald  $\chi^2$  statistic.

Table 1 displays the contribution data for Study 2. *Hypothesis 1* states that a participant's likelihood of contributing toward the public good should not change as a function of outcome variance as long as the outcome distribution includes only the prospect of gains. Consistent with this prediction, there was no significant difference in the contribution rate between the gains-only conditions (76%) and the no variance conditions (72%); Wald  $\chi^2_1 = 0.10, p > .74$ .

*Hypothesis 2* predicted that a participant's likelihood of contributing toward the public good when the outcome distribution included the possibility of losses-and-gains would be less than when the outcome distribution included only the possibility of gains. In support of *Hypothesis 2*, participants were significantly less likely to contribute to the public good in the losses-and-gains conditions (48%) than in no variance and gains-only conditions (74%); Wald  $\chi^2_1 = 19.74, p < .001$ .

*Hypothesis 4* predicted that a participant's likelihood of contributing toward the public good would be higher when group size is small than when group size is large. Replicating past results, a participant's likelihood of cooperation was higher in a small group than in a large group; Wald  $\chi^2_1 = 52.23, p < .001$ . Finally, *Hypothesis 5* predicted an interaction between outcome variance and group size such that the negative effect of losses-and-gains prospects on a participant's likelihood of contribution would be greater when group size was small than when group size was large. No significant interaction was found; Wald  $\chi^2_1 = 0.20, p > .65$ . Thus, *Hypothesis 5* was not supported.

### Strategy choice

As in Study 1, participants selected from a list of strategies the one that best characterized the motivation behind their contribution decisions. Fig. 2 reveals that the proportion of participants who did not contribute from fear of other's non-contribution was larger (33%) in the losses-and-gains conditions than in the no variance and the gains-only conditions (26%), but this difference did not reach significance;  $\chi^2_1 < 2.30, p = .12$ . Fig. 2 also reveals that the presence of loss prospects in the outcome distribution discouraged contributions due to loss aversion, as this was the only non-contribution strategy that significantly differentiated the no variance and gains-only conditions (0%) from the losses-and-gains conditions (18%);  $\chi^2_1 = 29.24, p < .001$ .

### Supplemental analysis and findings

Consistent with Study 1 and again in support of de Cremer's (2007) suggestion that in a step-level public goods dilemma provision threshold or average required individual contribution provides an important reference point for assessing gains and losses, participants were more fearful of incurring a loss in the losses-

<sup>5</sup> Of the 19 participants removed from Study 2, four participants had missing data, 12 participants in a gains-only condition indicated they defected because they feared a loss even if the public good was provided (an impossible situation), and four participants indicated to the experimenter that they were not treating the games as independent; e.g., some indicated they were saving points believing that their payoff from the experiment was aggregated across all conditions.



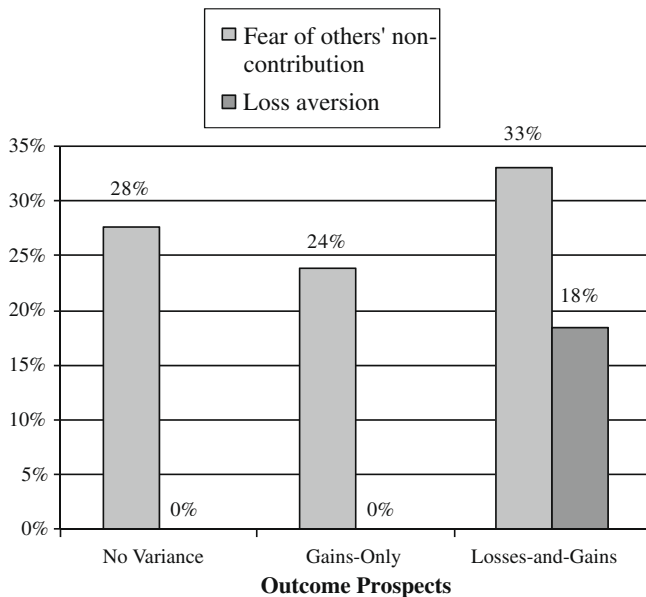


Fig. 2. Study 2 – strategy choice rates for those not contributing.

and-gains conditions than in no variance and gains-only conditions:  $F_{1,64} = 20.38, p < .001$ .

We also investigated whether individuals in different group size conditions chose different defection strategies. As shown in Table 2b, when faced with the prospect of a loss, defectors were more concerned about others defecting (70.6%) than avoiding a loss (29.4%) in large groups, but more concerned about avoiding a loss (56.3%) than others defecting (43.7%) in small groups;  $\chi^2_1 = 3.82, p = .05$ .

### Discussion

Overall, Study 2 confirmed the main findings from Study 1 in a different public goods dilemma. Outcome variance influenced contributions to a public good only when loss prospects were present in the distribution of possible outcomes. The strategy choice data, also consistent with Study 1, showed that participants were particularly likely to not contribute to the public good because of the potential loss involved when loss prospects were present. As in Study 1, it seems that participants faced with the possibility of a loss were more reluctant to contribute, likely because of the perceived increased risk – even though the objective expected value of the public good never changed. Also when social uncertainty was high (group size was eight), non-contribution was influenced by concerns about what others' were going to do; in contrast, when social uncertainty was low, non-contribution was influenced by concerns about real losses occurring even if the public good was produced.

### General discussion

While past research on public goods dilemmas has focused on uncertainty about others' contributions, it is often the case in public goods dilemmas that certainty about the eventual value of mutual cooperation is also lacking. The empirical results reported here extend previous research (van Dijk et al., 1999) by demonstrating when outcome variance influences contribution behavior and when it does not. Outcome variance negatively influences cooperation only when the distribution of possible outcomes includes the possibility – even a slim possibility – of a loss. Prospect theory suggests this is because individuals place greater subjective weight on the prospect of losses than the prospect of gains, and this decreases

the relative attractiveness of opportunities that entail loss prospects (Kahneman & Tversky, 1979).

### Theoretical implications

These findings make several contributions to social dilemma research. First, outcome variance that creates loss prospects highlights a different aspect of environmental uncertainty critical to the study of public goods dilemmas. Past research has primarily focused on uncertainty about whether the threshold is attainable (e.g., Wit & Wilke, 1998); the current paper explores the role of uncertainty about whether contributing to the public good is worth the cost even if the public good is produced. Irrespective of provision threshold and irrespective of group size, the presence of loss prospects in the distribution of possible outcomes negatively influenced contributions to the public good. This suggests that both types of uncertainty – social uncertainty and outcome uncertainty – should be considered as potential barriers to effective collective action.

Second, supplementary data from both studies provide preliminary support for fear of incurring a loss as a motivation for non-contribution in public goods dilemmas. Previously (e.g., Yamagishi & Sato, 1986), non-contribution in public goods dilemmas was categorized as either offensive (greed) or defensive (fear of others' non-contribution). Our findings have identified another type of defensive non-contribution: non-contribution from fear of incurring a loss, even when others can be counted on to contribute. This fear led participants in our studies to not contribute to the public good, a finding consistent with prospect theory. The implication for the social dilemma literature is that individuals are particularly sensitive to risk, not just from others not cooperating, but from any factor that makes attainment of desired benefits of collective action less likely.

Third, the introduction here of outcome variance containing losses-and-gains prospects as a determinant of contribution behavior extends the ecological validity of the social dilemma paradigm. Many real-world collective actions involve creating public goods whose value to the collective cannot be known prior to joint investment. In addition to more traditional public goods such as generic advertising (Miller, 1982), vaccination initiatives (Picard, 2005), and public sporting events (Horner, 1997), strategic alliances can also be viewed as public goods dilemmas that have uncertainty surrounding the value of cooperation (McCarter & Northcraft, 2007; Zeng & Chen, 2003). For example, joint investments for new product development or process innovation cannot guarantee that the products or processes will yield high profits – or any profits at all (Rindova & Petkova, 2007). The presence of loss prospects in the public good may weigh heavily in alliance partners' contribution decisions (Gulati et al., 1994). Outcome variance that creates losses-and-gains prospects thus adds a new dimension to understanding complex collective action dilemmas.

Our results also provide some important insights into the cognitive process of those facing loss prospects and trying to decide whether to contribute to producing a public good. It seems that environmental uncertainty may breed social uncertainty. Particularly in Study 1, the presence of loss prospects in the distribution of possible outcomes was associated with decreased contributions out of fear of incurring a loss, but also decreased contributions out of fear that others would not contribute. This suggests that when environmental uncertainty is high, individuals may project their own fears onto others and not contribute because they do not believe others will contribute.

Our results also suggest how concerns about loss prospects are most likely to influence contribution and cooperation decisions. Provision threshold and group size have been extensively studied as causes of social uncertainty (Franzen, 1994; Poppe & Zwikker,

1996), with both high provision thresholds and large groups eliciting concerns that others in the collective will not contribute. As noted in Table 2a, contributions in Study 1 were influenced primarily by concerns that others would not contribute when threshold was high, but primarily by concerns of realizing a loss when threshold was low. As noted in Table 2b, defection in Study 2 was fueled primarily by concerns that others would defect when group size was large, but primarily by concerns of realizing a loss when group size was small. Thus, in line with recent work by de Cremer (2007), it appears that individuals are less concerned about outcome uncertainty (and specifically the prospect of real losses) when social uncertainty is so high that successful production of the public good seems unlikely anyway. One implication of these findings is that individuals may “believe” they are not contributing because of social uncertainty (especially when social uncertainty already exists) when the underlying reason is really outcome uncertainty, a factor whose importance our results highlight.

### Managerial implications

In addition to theoretical contributions, our studies’ findings provide several important implications for the management of collective action. First, the main finding that losses-and-gains prospects negatively influence public good production provides some insight into why some public goods in organizations are either under-produced or not produced at all. For example, workforce diversity is a public goods dilemma since recruiting diverse employees provides long-term benefits to an organization but at the short-term cost of figuring out how to get dissimilar individuals to work together effectively (Schneider & Northcraft, 1999). Managers may not contribute to workforce diversity initiatives not only because they are certain about the short-term costs but also because they are uncertain about the long-term benefits the public good will provide (Australasian Business Intelligence, 2003). This suggests that workforce diversity may be seen as having uncertain value *that includes loss prospects*, in that managers may invest a great deal of time and effort and see little or no benefits in return. This particular example also highlights the dangers of inter-temporal dilemmas (e.g., Wade-Benzoni, 2002), in which current generations may only experience certain losses for their contributions, in the service of creating uncertain gains for future generations.

A second insight for management speaks to the relative benefit of strengthening relationships in multi-partner alliances in the hope of encouraging greater cooperation. Some have suggested that insuring cooperation in multi-partner alliances is all about reducing social uncertainty – making sure no one thinks anyone else is planning to defect and exploit the alliance (e.g., Adabor, 2006). Our findings suggest that while social uncertainty plays an important role in determining alliance cooperation, low social uncertainty is not enough to insure that alliance partners will do their share. In both studies, losses-and-gains prospects created significant amounts of non-contribution *even when social uncertainty was low*. This finding reminds us that the keys to attaining the benefits of collective action lie not only in the question “Can I be assured that others will not exploit me?” but also in the question “Is the likely benefit of this assurance even worth my cooperation?”

### Future research directions

Our findings suggest several avenues for further work. First, some participants cooperated even in loss prospect conditions, possibly because they were optimistic that the value of the public good would be very high. This suggests that some participants may have reacted to the range of potential outcomes rather than the presence of gains versus losses. On the other hand, some partici-

pants were fearful of incurring potential losses in the same conditions. To reconcile these apparent inconsistencies, it may prove fruitful to investigate the moderating effects of individual risk preferences on the effects of outcome variance (and possibly on the individual perception or interpretation of varied outcomes) in public goods production.

Another avenue for future investigation would be to examine the potential interaction effects of exposure with loss prospects. Exposure is the proportion of an individual’s total amount of resources that individual must invest to cooperate – to allocate their required individual contribution to producing the public good (Cho & Lee, 2006; Cunningham, 1967). Research on resource conservation suggests that individuals become more fearful and experience greater stress when their private resources are threatened with a loss (Hobfoll, 1998). This suggests that the larger proportion of an individual’s private resources that individual stands to lose if the public good value is a loss, the more under-contribution may occur in public goods production.

Third, the introduction of outcome variance into the discussion of public goods dilemmas brings to the fore the issue about how collectives may navigate the negative effects of outcome variance that contain loss prospects. Resolving this issue poses a new challenge to social dilemma scholars since – as found in Study 2 – the negative effects of outcome variance with loss prospects significantly decreased cooperation even when social uncertainty was minimized. In other words, whereas previous research has focused on mechanisms that relieve social uncertainty – e.g., communication (Chen & Komorita, 1994), pledges (Chen, 1996), and removing anonymity (Kollock, 1998) – our findings suggest the need for mechanisms that address both social and environmental uncertainty. A potential dual uncertainty-reducing mechanism may be restructuring the public goods dilemma in a way that allows individual to make contributions in stages (Fawcett, Magnan, & McCarter, 2008), thereby allowing the collective to unveil more information both about the value of the public good (thereby reducing environmental uncertainty) and the intentions of individual members (thereby reducing social uncertainty).

Finally, although not a strong finding in either study, a slight increase in cooperation appeared when individuals faced uncertain gains-only prospects versus situations in which there was no variance in the outcome (see Figs. 1 and 2) – a tendency also found by van Dijk et al. (1999). This suggests that individuals may become more risk seeking when faced with only uncertain gains, perhaps suggesting an overweighting of the “best case scenario” when all the prospects are gains. While not explicitly investigated here, this speculation implies that uncertain outcomes could be structured or presented in such a way that enhances contribution behavior in mixed-motive situations, if individuals can be influenced to see even an uncertain outcome as one in which they “can’t lose.” This possibility would appear to warrant further investigation.

### Conclusions

It has been suggested by some that uncertainty about the value of a public good will not influence contribution behavior (Wit et al., 2004). However, previous work on outcome variance in public goods dilemmas has not pushed uncertainty in the value of the public good far enough to create loss prospects (van Dijk et al., 1999). The presence of losses-and-gains prospects places an additional dimension of uncertainty in the mind of contributors – uncertainty not only about whether their contribution will make a difference in creating collective value, but also about whether the collective value created will even be worth their contributions. Our findings show how uncertainty in public goods dilemmas is about more than just whether others intend to cooperate. When

the value of a public good offers the prospect of a loss, even high assurance that others will cooperate may not be enough to make contributing an attractive option, and effective collective action a reality.

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