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No control, no drive: How noise may undermine conservation behavior in a commons dilemma

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Abstract

Sometimes people may no longer engage in conservational behavior (e.g., to reduce emissions) because their attempts to do so have been thwarted by “negative noise”, or external forces that may cause otherwise cooperative intentions to translate into non-cooperative action (e.g., strikes prevented to commute by public transport rather than by car). The purpose of the present research is to examine whether experiences with negative noise in a commons dilemma may undermine conservational motivation and behavior, even in a subsequent commons dilemma that is free of noise. Participants first interacted in a commons dilemma task—with noise versus without noise—in which the common pool was sustained versus deteriorating. Afterwards, participants were involved in an identical second task in the same pool size condition but noise-free for everybody. Consistent with hypotheses, participants who faced noise and a deteriorating resource in the first task exhibited lower levels of conservation in the second task than did participants who were always acting free of noise. This pattern was mediated by a reduced motivation to preserve the common pool, suggesting that the experience of noise in combination with a decline in collective resources may especially undermine cooperative motivation and behavior. Copyright © 2007 John Wiley & Sons, Ltd.

One of the major environmental challenges that societies face are resource management problems or commons dilemmas. These are situations in which a group shares a common resource (e.g., fish, water, forest or clean air) the individual member can harvest from. It is a dilemma between self-interest and collective interest in that the group interest requires moderate harvests to avoid depletion, but personal interests may induce the individual members to harvest excessively (e.g., Gifford & Hine, 1997; Hardin, 1968; Kopelman, Weber, & Messick, 2002; Ostrom, 1990).

Past research on the commons dilemma has revealed that many people tend to reduce their consumption when resources are in decline in order to preserve them from being depleted (e.g., Kramer, McClintock, & Messick, 1986; Messick, Wilke, Brewer, Kramer, Zemke, & Lui, 1983; Samuelson, Messick, Rutte, & Wilke, 1984; Wilke, 1991). In a parallel manner, scholars of conservational psychology often observe a general pro-environmental attitude in society (e.g., Dunlap, Van Liere, Mertig, & Jones, 2000; Stern, 2000a). Why then, one may ask, does environmental concern in some cases fail to correspond to actual behavior? In the present study, we take a closer look at a novel and important answer to this basic—and socially urgent—question (e.g., Gardner & Stern, 1996; Scott & Willits, 1994): The ubiquitous presence of *noise* in situations of social-ecological interdependence.

By using the broad concept of noise (see Van Lange, Ouwkerk, & Tazelaar, 2002) in the present research, we advance the idea that external forces beyond people's intention and control (i.e., noise) may sometimes unfavorably affect our environmental behavior and lead to outcomes that are less good than intended.¹ For example, a family may be overusing

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¹For this particular application of the concept of noise within social-ecological interaction, we focus on negative noise only. The definition of positive noise would be that the actual outcome of behavior is better than intended. However, we suggest that it is more often the case that peoples' consumption decisions have worse outcomes than intended and that, even more important, worse actual outcomes are of higher relevance, motivationally as well as socially and ecologically. Furthermore, as argued elsewhere (Van Lange et al., 2002), we suggest that an intended outcome, in contrast to an actual outcome, is not necessarily a product of conscious or systematic thought at all (e.g., Rusbult & Van Lange, 1996). On the contrary, we strongly believe that many everyday interactions with eco-systems do not involve a conscious intention to consume a specific amount of resources.

energy, not because it is intending to do so, but they failed to realize that all electrical equipment that is plugged in is constantly consuming electricity; or an employee may unintentionally use the car for commuting to work because public transport is unexpectedly on strike. More specifically, we hypothesize that repeated experiences of noise and deteriorating resources may lead to a reduced conservational motivation due to an experienced loss of behavioral control. Whatever an actor is intending to do in a noisy environment, the common pool may be deteriorating anyway. As a consequence of a reduced motivation to preserve resources, people may consume excessively from a deteriorating resource in noisy situations but maybe also in subsequent situations that are free of noise.

To date, the notion of noisy situations has received little attention in the extant literature of commons dilemmas. Granted, there is a fair amount of research on the notion of reduced behavioral control as an impediment of various behaviors (e.g., Ajzen & Madden, 1986; Bandura, 1986; Maier & Seliman, 1976), including pro-environmental behavior (e.g., Axelrod & Lehman, 1993; Grob, 1995; Stern & Oskamp, 1987; Tanner, 1999). However, there is a very little research which directly assesses noise in social dilemmas beyond the dyad, and—as far as we know—there is no research on the effects of the *experience* of noise. Experiences of noise, especially when shared resources are in decline, may undermine conservational motivation and behavior. This is the key purpose of the present research.

To examine the effects of the experience of noise, we manipulated people's consumption decisions to have a worse effect on a virtual common pool than they actually intended (i.e., a noisy situation) and compared the resulting reactions with the ones of control group acting under conditions free of noise. As outlined below, after briefly reviewing the literature on noise in social dilemmas, the basic hypothesis is that the experience of noise, under conditions in which resources are rapidly depleting, undermines conservational motivation and behavior, in particular in a subsequent commons dilemma that is actually free of noise.

NOISE IN DYADIC SITUATIONS

In dyadic situations, noise is defined as “discrepancies between intended and actual outcomes for an interaction partner due to unintended errors” (Van Lange et al., 2002; see also Axelrod & Dion, 1988; Bendor, Kramer, & Stout, 1991; Bendor, Kramer, & Swistak, 1996; Kollock, 1993). Indeed, our everyday one-to-one interactions with others are typically prone to be affected by unintended errors. For example, one may come late for an appointment because a train was delayed, or one may not pay a bill because the mail containing it got lost. In the same vein, we argue that noise is also omnipresent in everyday interactions with others *and* the natural environment in social-ecological interaction.

By applying the concept of noise to the level of a commons dilemma, an important difference to previous research using dyads has to be stressed. In the latter kind of studies, the notion of *reciprocity* has received wide attention (see Axelrod, 1984; Komorita & Parks, 1999; Van Lange, 1999). In this context, reciprocity is defined by responding cooperatively to a partner's cooperative choice and responding non-cooperatively to a partner's non-cooperative choice in the previous interaction. Of particular interest, Van Lange et al. (2002) have recently shown that the adherence to strict reciprocity may lead to suboptimal outcomes for both interaction partners when the social environment is noisy.

If reciprocal strategies are interacting in a noisy environment, an unintended non-cooperative act can lead to an intended non-cooperative answer, the so-called “echo effect” (Axelrod, 1984). At first, one party may misinterpret the unwanted non-cooperation of the other party as an intentional act and retaliates. Then, the other party may reciprocate again with non-cooperation, leading to endless cycles of defection and suboptimal collective outcomes. Such an unwanted development can be prevented with means that may facilitate cooperation in the presence of noise, for example generosity (Van Lange et al., 2002; Wu & Axelrod, 1995), communication (Tazelaar, Van Lange, & Ouwerkerk, 2004) or empathy (Rumble, Van Lange, & Parks, 2005). In a commons dilemma, however, direct reciprocity is often less relevant than in a dyadic situation because people do not directly interact, but we expect noise to have a different mode of operation than the one described above.

NOISE IN A COMMONS DILEMMA

Motivational approaches to behavior in commons dilemmas have received quite some attention in the past. A case in point is that several social dilemma theorists have suggested that people have the goal—besides individualistic and altruistic goals—to preserve the pool from being depleted. An evident indicator for this notion is the repeated observation that many

people adapt to a deteriorating pool by substantially cutting down their consumption (e.g., Messick et al., 1983; Samuelson et al., 1984). However, this conservational motivation may be undermined by the presence of noise or repeated experiences thereof. While cooperative motivation is clearly undermined by noise in dyadic interaction, there is almost no research that speaks to the experience of noise at the level of small groups and beyond.

In a broad sense, we suggest that past research on perceptions of behavioral control may be relevant to our understanding of noise, in that a perceived lack of behavioral control, like noise, points at discrepancies between intention (and effort) and realization of goals. Indeed, past research on perceived behavioral control, defined as the confidence in the ability to engage in a behavior, has revealed that perceived behavioral control is a crucial determinant of the intention to conduct goal-directed behavior (e.g., Ajzen, 1991; Ajzen & Madden, 1986; Bandura, 1997). Obviously, people's confidence in their ability to engage in a certain behavior is reduced when they face noisy situations that they can neither predict nor influence (e.g., the availability of an unreliable public transport system). Therefore, the repeated experience of noise in a commons dilemma likely leads to a reduced perception of behavioral control, which may result in a reduced motivation to conserve and less adapted consumption behavior in times of resource scarcity.

Making it even worse in the case of a commons dilemma, while the conservational motive may be undermined by noise, the individual motive to maximize personal outcomes is not affected and may remain stable. In other words, in the presence of noise a person is still able to follow individualistic goals (e.g., to get from A to B) but the compliance with conservational goals may be undermined (e.g., the transportation mode to get from A to B cannot be freely chosen because of strikes). Going a step further along this line of reasoning, one could even argue that individualistic goals may get boosted by the presence of noise because they can provide an excuse for non-conservational behavior. For example, a person may use the car for walking distances with the excuse that public transport is probably not available.

Because the concepts of noise and perceived behavioral control are closely related, it is important to discuss the similarities and differences between the two concepts, and in doing so, outlining the unique contribution that the concept of noise can make to the literature on cooperation in commons dilemmas. To begin with, the roots of perceived behavioral (lack of) control are often located within the person (rather than the situation), in that the concept refers to the (in)capacity of an individual to reach a desired goal due to external constraints as they are *perceived* by the person. For example, an individual may not use public transport anymore because it was perceived to be very unreliable in the past. In contrast, noise is defined as a feature of the situation (rather than as a feature of the person), in that the concept typically refers to externally caused constraints to an individual's intended actions. For example, a person may unintentionally pollute the environment by getting stuck in a traffic jam that could not be foreseen. Thus, perceived behavioral control is more strongly linked to an individual's perceptions, while noise is defined as a feature of the situation.

Second, it is also important to discuss the causal relationship between the two concepts. We suggest that the occurrence of noise can lead to perceived lack of control, whereas a perceived lack of control is unlikely to actually influence noise in the situation. As such, the increasing frequency (and intensity) of noise often means that there are more situational constraints, which may reduce perceived behavioral control. Therefore, the presence of noise may cause an individual to be less motivated which finally leads to a lower chance that the desired actions will be taken.

Finally, it is noteworthy that the concept of noise has evolved in neighboring disciplines (e.g., theoretical biology, mathematics, political science, economics) where computer simulation models were run to show that noise in social dilemmas can dramatically reduce collective outcomes and may represent a serious threat to cooperation (e.g., Bendor et al., 1991; Kollock, 1993; Wu & Axelrod, 1995). However, the psychological underpinnings of these effects in real groups of bigger size have not been studied intensively so far. With the present research, we aimed to bridge that gap between disciplines by translating the original concept of noise into an experimental manipulation within a typical laboratory experiment using a commons dilemma paradigm. In doing so, we hope to provide convincing evidence for the causal relationship between the presence of negative noise and its undermining effect on subsequent motivation and effort to preserve the common pool.

THE PRESENT RESEARCH

In the present study, we assumed that a noisy commons dilemma situation may unfavorably affect conservation behavior in times of scarcity by undermining the conservational motivation to preserve the pool from being depleted. We further

expected that the “motivational damage” due to the experience of a noisy situation may persist somewhat longer than the actual physical presence of noise is lasting. If our reasoning is correct, and conservational motives are generally affected by the presence of noise, then the negative effects on consumption behavior should “throw a shadow into the future”. Even if a follow-up situation is noise-free, behavior would still partly be guided by a conservational motivation that has suffered losses from the previous presence of noise.

To examine this line of reasoning, our experimental paradigm consisted of two consecutive commons dilemma tasks, separated by a brief questionnaire. Both tasks featured pool size (abundant vs. deteriorating) as a between-participants variable. The first task additionally included a noise manipulation. After having experienced a noisy situation versus a noise-free situation with an abundant versus a deteriorating pool, participants filled out self-reports about their experienced motivations during the first task. Subsequently, they engaged in a second commons dilemma in the same pool size condition as before, but noise-free for everybody.

We expected that participants in a noise-free situation are showing the same pattern of conservational behavior that is known from classic commons dilemma studies (e.g., Kramer et al., 1986). The group facing a decreasing pool will use less resources than the group facing an abundant pool. In contrast, participants facing a noisy situation may no longer show this well-known pattern. While noise may not affect participants managing a pool in abundant supply, it may affect participants managing a decreasing pool because their attempts to preserve the pool seem to be fruitless. This way, noise may undermine their conservational motivation and they may no longer engage in conservational behavior but use more than in a noise-free situation.

The pattern described above will result in a two-way interaction between pool size and noise. We expected to find this two-way interaction in the first task where one half of the participants are beginning to experience a noisy situation. More important, this pattern may even be stronger in the second noise-free task, when one half of the participants have made enduring experiences with noise while the other half has not. To test the hypotheses that noise really undermined conservational motivation, we additionally conducted a mediation analysis. The effects of previous noise when the pool was decreasing in the second task may be mediated by participants reported motivation during the first task when noise was present.

METHOD

Participants and Experimental Design

One hundred fifty-six undergraduate students (63 men and 93 women) of different subjects from a major university in the Netherlands with an average age of 21.6 years took part in the present study in exchange for a five Euro payment each (this equaled US\$ 6.50 at the end of March 2005). The completion of the study took 34 minutes on average.

The experimental design was a 2 (noise: noise vs. no noise) \times 2 (pool size: abundant vs. deteriorating) factorial, which was tested on the level of consumption from a common pool in two independent commons dilemma tasks. The first task consisted of 12 trials and included the noise manipulation, the second task consisted of four completely noise-free trials. As explanatory variable, we collected participants' reports on their motivation to preserve the common pool in the first task—and additional reports on other relevant goals in the first task.

Procedure

Upon arrival in the laboratory, each participant was greeted and escorted to 1 of 10 cubicles, which prevented any kind of contact between participants during the entire session. The stimulus material of the experiment and the questionnaire were presented on a computer screen using a program written in Macromedia's Authorware (Version 7). Participants responded by using the keyboard of the computer. After being welcomed, participants were informed that the study would last about 30–40 minutes. Then, participants were told that the study consisted of a group task and a subsequent questionnaire related to their experiences in the group task. After the completion of the group task and the questionnaire, participants were

unexpectedly asked to join another unrelated group task with different partners. After the second group task, participants were paid and debriefed.

First Commons Dilemma Task

After agreeing to participate, participants received instructions that they are connected with four others in the laboratory via a computer network. In these groups of five they were supposed to share a common pool of points. They learned that each of them can take out between 0 and 10 points out of the pool, all at the same time. After each and everyone had made a decision, the computer would then subtract the summed-up group usage from the pool and multiply the remaining amount of points in the pool with a constant factor of 1.5. A constant regeneration factor prevented people from attributing the pool size development to the pool regeneration dynamics. Then, a new round would begin where again points could be taken out of the pool. The task would be going on like this until the pool was empty. To make it more clear, a numerical example was presented to the participants: If the pool had 50 points and the participant decided to take out 5 points, whereas the other group members took 0, 3, 4, and 8 points, respectively, then the collective usage in that particular round would be 20 points to be subtracted from the actual pool size. The remaining 30 points then were multiplied by 1.5, leaving 45 points in the pool, which was five less than in the trial before.

Participants were instructed that each point they take out of the pool would be equal to a raffle in a lottery being held after the completion of the study. The more points they make the higher their chances would be to win one of the additional cash prizes of ten Euro (= US\$ 13.00). This was meant as an incentive to take as many points as possible. At the same time, they were introduced to the dilemma structure of the task with an example. If the pool had 75 points in the first round and the average take-out of the group members was 7 points per round, then the pool would last for three rounds and each person's outcome would be 21 points on average. However, if the average take-out was only 6 points per round, the pool would last for four rounds and each person's outcome would be 24 points on average. It was stated again that the task would be over as soon as the pool was empty, but as long as the pool was maintained the group could maximize collective payoffs. After completion of the study, five participants were randomly drawn—independently of their outcomes in the commons dilemma task—and received a cash prize of ten Euro each.

Before the actual commons dilemma task began, we checked participants' understanding of the task's instructions with four questions. The first two questions checked whether participants had understood the dilemma structure of the task, the third question made sure that participants were aware of the size of their group, and the fourth question checked participants understanding of the pool dynamics. Only if participants answered all four questions correctly, they could proceed to the commons dilemma task itself, otherwise the test had to be repeated. As soon as someone had successfully passed the comprehension test, a so-called waiting screen was presented. Here, participants were told that they had to wait for the other members of the group who had not yet finished reading the instructions, in order to begin with the group task simultaneously.

Manipulation of Noise

Participants in the noise condition were told that actions in everyday life may sometimes have different consequences than intended, and that such uncertain outcomes would be part of the group task as well. They learned that, from time to time, the computer would modify their decisions by adding either one, two, or three points to their intended consumption. As a consequence, they would always get as many points as they wanted but the number of points subtracted from the pool could be larger than the number of points they had received. In other words, noise had potentially negative effects on the pool size but no effects on the immediate outcome for the participant. The instructions also stated that the computer could perform such a modification in any trial without telling in advance. Only after participants had already made a decision they received feedback that the computer had modified it. However, a warning message before every trial announced the potential presence of noise. This way, participants were always reminded of the presence of noise during the complete course of the task. In fact, only 7 out of the 12 trials included the feedback that noise was present which equals a noise frequency of close to 60 per cent. Finally, participants learned that all members of the group were affected by the modifications of the computer, but not necessarily at the same time and with the same magnitude.

Manipulation of Pool Size

Participants in the abundant pool size condition received preprogrammed feedback about an abundant and stable pool (i.e., 75, 69, 65, 71, 80, 81, 76, 73, 70, 74, 78, and 75 points). After 12 trials, they read that the group had successfully managed the pool but the task would be over now. Participants in the deteriorating pool size condition, on the other hand, received feedback that the pool was steadily decreasing (i.e., 75, 69, 60, 57, 49, 45, 39, 35, 27, 24, 15, and 8 points). After 12 trials, they read that the group had emptied the pool and the task was over (for similar designs of pool size development, see Brucks, 2004; Brucks, Reips, & Ryf, 2007; Kramer et al., 1986; Roch & Samuelson, 1997). In each trial, the participants were informed about the absolute pool size and about its relative development compared with the previous trial (e.g., the pool contains 57 points in the present trial, which is a decrease of 8 points since the last trial). At the end of the task, they were free to provide their e-mail addresses for participation in the lottery.

Conservational Motive and Other Motives

After the first group task, participants completed a questionnaire assessing their goals in the first group task. We asked for six goals that participants may have had in the first task and used the respective answers as indicators for their motivations in the first task: a conservational motive, an equality motive, a cooperative motive, an individualistic motive, a competitive motive, and an altruistic motive (see Van Lange et al., 2002, for a detailed description of this measurement). For the present purpose, the two items measuring the conservational motive are of particular interest: “*I tried to preserve the pool as long as possible*” and “*I tried to keep the pool on a high level*” (1 = disagree; 7 = agree).

Second Commons Dilemma Task Without Noise

After completing the questionnaire a message appeared on the screen asking participants to join another group because the first group task had been done faster than expected by the experimenter, and the initial payment of five Euro for the whole session of about 30 minutes would allow to do another group task according to the official regulations of the department. No extra payment or any other reward was given for the second group task. When a participant agreed to join—which all participants did—the second group task started the same way as the first one by showing a waiting screen to simulate the presence of four other group members. When the task started after 30 seconds, the development of the pool was identical to the first task for each participant but people who experienced noise in the first task were told that this would not be the case in the new group. In other words, the second task included the pool size manipulation as well but it was completely free of noise. After four trials, a message was shown that the study was over because the laboratory’s computer network had crashed and the participant was allowed to leave the cubicle. All participants were then paid, thanked, and debriefed.

RESULTS

Manipulation Checks

To check the manipulation of noise (noise vs. no noise) we asked participants after the first task to rate two statements “*The computer often changed my decisions in the group task*” and “*The computer did not modify my decisions in the group task (reversed)*” (1 = disagree; 7 = agree) and constructed a noise manipulation check scale ($r = .45, p < .01$). A 2 (noise: noise vs. no noise) \times 2 (pool size: abundant vs. deteriorating) ANOVA on that scale discovered the expected main effect of noise, $F(1, 152) = 64.95, p < .001, \eta^2 = .30$, and no other effects. Participants in the noise condition ($M = 5.36; SD = 1.13$) reported to have experienced more modifications by the computer than participants in the no-noise condition ($M = 3.66; SD = 1.46$), indicating that the manipulation of noise caused the intended perceptions.

To check the manipulation of pool size (abundant vs. deteriorating) we confronted participants after the task with the two items “*During the group task the pool remained stable on a high level (reversed)*” and “*During the group task the pool*

deteriorated to a very low level" (1 = disagree; 7 = agree) and constructed a pool size manipulation check scale ($r = .78$, $p < .01$). A 2 (noise: noise vs. no noise) \times 2 (pool size: abundant vs. deteriorating) ANOVA on that scale discovered the expected main effect of pool size, $F(1, 152) = 569.2$, $p < .001$, $\eta^2 = .79$, and no other effects. Participants in the deteriorating pool size condition ($M = 5.70$; $SD = 1.11$) reported to having experienced a non-stable and decreasing pool in contrast to participants in the abundant pool size condition ($M = 1.93$; $SD = 0.87$), indicating that the manipulation caused the intended perceptions.

In the following sections, we first report the results of a mixed-model ANOVA on the 12 repeated consumption decisions of the first task, analyzed by three blocks of four decisions each. In a next step, we report a two-way ANOVA with the four pooled consumption decisions of the second task. Finally, we present a mediation analysis to explain the effects of noise when the pool is deteriorating.

Consumption Behavior in Task 1

We submitted the consumption data of the first task to a 2 (noise: noise vs. no-noise) \times 2 (pool size: abundant vs. deteriorating) \times 3 (blocks of trials) mixed model ANOVA with three repeated measures on the latter variable (for means, see Figure 1). The analysis revealed a main effect of pool size, $F(1, 152) = 5.21$, $p < .05$, $\eta^2 = .03$. However, given our theoretical interest in the noise versus no-noise contrast, it is important to consider this main effect in light of the marginal interaction effect of pool size and noise, $F(1, 152) = 2.98$, $p = .08$, $\eta^2 = .02$. Indeed, closer inspection revealed that this main effect of pool size is primarily due to a simple main effect in the no-noise condition, where participants consumed significantly less when the pool deteriorated, $F(1, 152) = 8.03$, $p < .01$, $\eta^2 = .05$. In contrast, within the noise condition, the simple main effect of pool size was not significant, $F(1, 152) = 0.15$, $p = .70$, because participants in the noise condition, when experiencing a deteriorating pool, consumed somewhat more than participants without noise, but when experiencing an abundant pool, they consumed somewhat less than participants without noise.

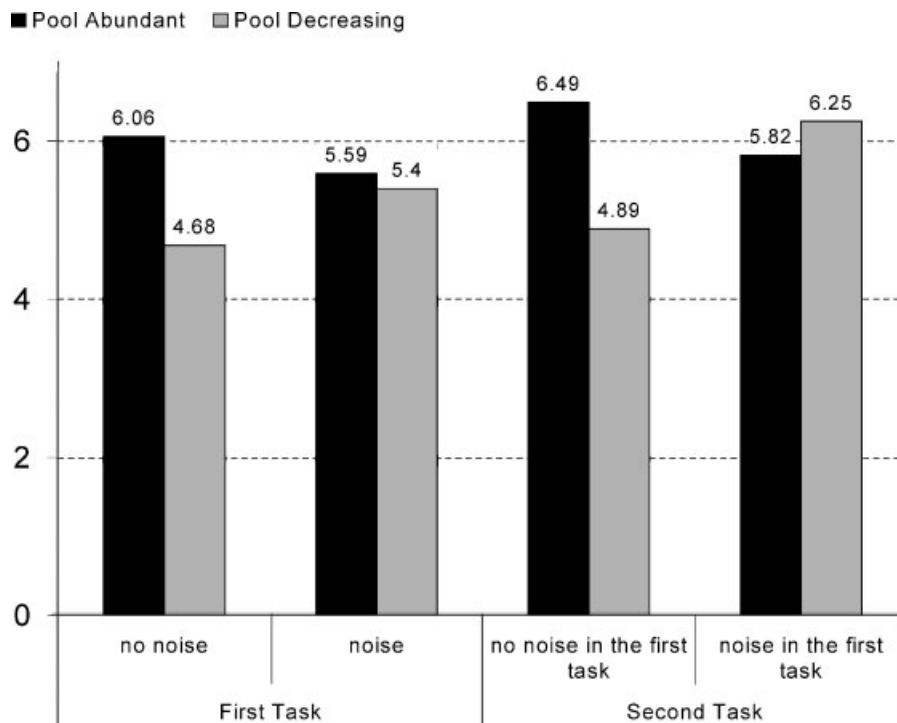


Figure 1. Mean consumption on a scale from 0 to 10 in the first task (left side) with full control or with noise when the common pool was either abundant or when it deteriorated, and mean consumption in the second task (right side) with full control for all participants when the common pool was either abundant or when it deteriorated. Note: $N = 156$

Of lesser relevance, the analysis also revealed a within-subjects effect of blocks, $F(2, 304) = 9.54, p < .001, \eta^2 = .06$, indicating that participants changed their consumption behavior during the course of the task. The interaction of blocks with pool size, $F(2, 304) = 6.82, p < .05, \eta^2 = .02$, decomposed this main effect further. Participants experiencing an abundant pool steadily increased their consumption over all three blocks, $M_s(SD_s) = 5.55(2.29), 6.17(2.30), 6.45(2.13)$, without noise; $M_s(SD_s) = 5.12(2.45), 5.64(2.54), 6.01(2.53)$, with noise. Participants experiencing a deteriorating pool, in contrast, showed a decrease of consumption in the third block to adapt to the worsening state of the pool, $M_s(SD_s) = 4.43(2.25), 5.04(2.58), 4.57(2.64)$, without noise; $M_s(SD_s) = 5.01(2.14), 5.82(2.74), 5.37(2.59)$, with noise.

Consumption Behavior in the Noise-free Task 2

We pooled the four consumption decisions of the second task and submitted the average score to a 2 (noise [in task 1]: noise vs. no noise) \times 2 (pool size: abundant vs. deteriorating) ANOVA. This analysis revealed the predicted interaction between noise and pool size, $F(1, 152) = 4.92, p < .05, \eta^2 = .03$ (see Figure 1, right side), that was already foreshadowed in the first task. The simple main effect of pool size within the no-noise condition, $F(1, 152) = 6.10, p < .05, \eta^2 = .04$, reveals that participants facing no noise in the first task but experiencing a deteriorating pool again in the second task ($M = 4.89$; $SD = 3.10$) exhibited significantly lower levels of consumption than did participants facing no noise in the first task and experiencing an abundant pool again ($M = 6.49$; $SD = 2.66$). Moreover, a within-subjects analysis showed that they took about the same amount of points than they did in the identical block 1 of the first task when the pool began to deteriorate—the difference was 0.46 points (*n.s.*). This pattern—visible in the first and the second task—is well known from classic commons dilemma studies (e.g., Kramer et al., 1986), and accords with the assumption of a strong motive to preserve a deteriorating common pool when the situation is not challenged by noise.

In contrast to the pattern for noise-free situations, participants acting in the presence of noise in the first task and experiencing a deteriorating pool again in the second task ($M = 6.25$; $SD = 2.97$) consumed even somewhat more than participants acting in noisy circumstances in the first task and experiencing an abundant pool again ($M = 5.82$; $SD = 2.67$), see Figure 1, bars on the very right. Moreover, a within-subjects analysis showed that they took 1.24 points more than they did in the identical first block of the first task when the pool began to deteriorate, $p < .05$. This demonstrates that people acting in a noisy environment in task 1 increased their consumption in task 2 instead of trying to preserve the deteriorating pool. The simple main effect of noise within the deteriorating pool condition, $F(1, 152) = 4.31, p < .05, \eta^2 = .03$, further supports our assumptions (see Figure 1, gray bars on the right side). People having experienced noise ($M = 6.25$; $SD = 2.97$) consumed significantly more in a subsequent situation of resource degradation than people who acted in a noise-free situation ($M = 4.89$; $SD = 3.10$).

The behavioral reaction to resource degradation presented above is contrary to all previous commons dilemma research and challenges our notion of a strong motivation to preserve a deteriorating common pool. To further investigate how conservation behavior in a noise-free situation is affected by the previous presence of noise, a mediation analysis was conducted within the condition of a deteriorating pool ($n = 76$) in the second task, where the simple effect of noise was found.

Noise and the Motivation to Preserve the Pool

To test the hypothesis that noise may lead to more consumption when a resource is deteriorating by undermining conservational motivation, we measured participants' motivation to preserve the declining pool with the two items presented earlier, which constituted a conservational motivation scale ($r = .77, p < .01$). Then, we adopted the approach of Baron and Kenny (1986) to examine whether people's motivation to conserve the pool mediates the effects of previously experienced noise on consumption behavior in the second task and conducted three regression analyses (see Baron & Kenny, 1986, for a detailed description of this procedure).

A first regression analysis revealed a relationship between previously experienced noise and consumption behavior in a noise-free situation, $\beta = .22, t(75) = 1.95, p = .055$ that was already found as a simple effect of noise in the ANOVA described above. Participants experiencing noise and a deteriorating pool in the first task took more points in the noise-free second task ($M = 6.25$; $SD = 2.97$) than participants who had no noise in the first task ($M = 4.89$; $SD = 3.10$). A second

regression analysis revealed a negative relationship between experienced noise and the conservational goal reported afterwards, $\beta = -.25$, $t(75) = -2.23$, $p < .05$. Participants acting in the noisy environment reported a lower motivation to preserve the pool during the first task ($M = 4.18$; $SD = 1.65$) than participants in the noise-free condition ($M = 4.97$; $SD = 1.44$). Finally, in a third regression analysis with both noise and the conservational motive as predictors of consumption behavior the unique effect of noise on consumption behavior weakened and became unreliable, $\beta = .12$, $t(75) = 1.11$, while the conservational motive had a strong and significant effect on consumption behavior, $\beta = -.40$, $t(75) = -3.72$, $p < .01$.

Furthermore, the Sobel Test (see Kenny, Kashy, & Bolger, 1998) revealed that the reduction of effect size attributable to participants' motivation to preserve the pool was significant, $Z = 1.97$, $p = .05$. Thus, we obtained evidence that people experiencing noise in the first task were less motivated to conserve over the course of the task, leading them in the second task to consume more than people who acted in a noise-free situation.

Similar analyses showed that the presence of noise changed people's whole motivational structure and made them less cooperative but more individualistic and competitive. For example, the presence of noise enhanced the individualistic motive to get as many points as possible out of the common pool, measured with the two items "*I wanted to get as many points as possible for myself*" and "*I wanted to get as many points as possible no matter what others get*" (1 = disagree; 7 = agree). An ANOVA on the individualistic motive scale ($r = .79$, $p < .01$) revealed a main effect of noise, $F(1, 74) = 5.90$, $p < .05$, $\eta^2 = .07$. Participants experiencing a noisy environment ($M = 4.31$; $SD = 1.84$) reported to have higher individualistic goals than participants acting noise-free ($M = 3.34$; $SD = 1.63$). Further analyses also showed that individualistic, competitive, and cooperative motives at least partially mediated the effect of noise on consumption behavior in a theoretically reasonable manner.

DISCUSSION

When common pool resources are in decline, a noisy environment may have unfavorable effects on an individual's conservation behavior. Indeed, the present study revealed that the repeated experience of noise led to increased consumption from a deteriorating pool, even in a subsequent situation free of noise. A mediation analysis suggested that the behavioral effects in a noise-free situation may have occurred because the previously experienced noise had largely modified the individuals' motivational structure. Most important, the mediation analysis revealed that the experience of noise undermined the motivation to conserve. In the following, we discuss the contribution of this research, its strengths and limitations, and conclude by pointing out the theoretical and societal relevance of the present findings.

In the literature on social dilemmas, the presence of external factors beyond an actor's control has been coined as noise in social interaction (e.g., Axelrod & Dion, 1988). So far, noise research has focused on computer simulations (e.g., Kollock, 1993) or dyadic situations in the laboratory (e.g., Van Lange et al., 2002). With the present commons dilemma study, similar detrimental effects of noise on conservation behavior could be shown for an n-person situation. However, the psychological underpinnings of noise in an n-person situation may be quite different from those in dyadic situations. For example, norms of direct reciprocity definitely play an important role in one-to-one interactions, and in combination with noise they can lead to an unwanted escalation of conflict. However, beyond dyads, even in small groups, noise does not directly affect the outcomes of interaction, but its perceived presence seems to affect the actors' motives. The present results offer an explanation how the motivational effect takes place. In contrast to the mostly anonymous individual choices, the collective outcome (i.e., the pool size) is often publicly known in a larger collective. The combination of noise with a suboptimal collective outcome (i.e., a deteriorating pool) led to changes in the actors' motivational structure in the present study. It undermined conservational motivation and behavior.

Of fundamental significance is the finding that the effects of noise threw "a shadow on future behavior" and made it less conservational, even in the absence of noise. These assumed long-term effects may have consequences for attempts of behavioral change. While certain remedies for the detrimental effects of noise in a dyad are immediately effective (e.g., generosity, communication, empathy), the restoration of the originally beneficial motivation to conserve after the repeated exposure to noise may be more costly in a commons dilemma. We do not claim, however, that the detrimental behavioral effects of noise are extremely persistent over time or even irrevocable. After repeated experiences in a noise-free environment, conservational motivation may recover completely.

From a theoretical and societal perspective, it is interesting to link the present findings to the Theory of Planned Behavior (Ajzen, 1991) and its applications to conservational behavior (e.g., Grob, 1995). As alluded to earlier, the theory states that people's perceptions of behavioral control have effects on their intention to engage in goal-directed behavior. The more difficult the enactment of a behavior seems to be, the lower a person's intention will be to perform it. Consequentially, the performance of conservation behavior, as an instance of goal-directed behavior (see Kaiser, 2004), also depends on the perception of behavioral control. The present results clearly support this notion by showing that people's repeated experience of noise led to a loss of conservational motivation.

Moreover, the present findings also speak to Stern's (2000b) Value Belief Norm (VBN) theory, a model of environmental concern and conservation behavior. This model represents a loose scheme of causalities leading to pro-environmental behavior. As most basic cause for behavior, the authors identify social structure that provides opportunities and constraints and therefore shapes behavior. Noise as defined in the present study may be the part of such a social structure. Below social structure, the authors view "values and worldview as causally antecedent to more specific beliefs, which in turn are antecedents to personally held norms, intentions, and other proximate causes of particular actions." In the present study, values, worldview and more specific beliefs were not assessed, but our manipulation of social structure (noise vs. no noise) exerted influence upon the motivation to conserve, finally leading to conservation behavior. Such, the present findings corroborate the causal chain of variables proposed by the VBN model.

The VBN model points at two possible extensions of the present research that would be worth examining by including them in a forthcoming study of similar design: the values of a decision-maker (e.g., social value orientations, see Van Lange, 2000) and his or her relevant worldviews (e.g., measured with the New Environmental Paradigm, see Dunlap et al., 2000) that should be influenced by attributes of the social structure such as noise, and exert influence on specific beliefs. For example, it seems possible that noise would moderate the relationship between values and behavior. In general, prosocial values would predict less consumption, but perhaps less so in the presence of noise. Recently, Brucks and Van Lange (2007) have shown that prosocially motivated people are changing in the presence of noise and begin acting like proselves by overusing a deteriorating resource.

Strengths, Limitations, and Future Directions

The present study is among the first ones in the laboratory to illuminate the causal relationship between noise and conservation behavior in a commons dilemma. Most earlier research on losses of behavioral control and the subjective perception associated with them was conducted using correlational methods. If we agree that the effects of our everyday behavior on the environment are often seriously modified by factors beyond our intention and control (e.g., third agencies, technical means), our study adds external validity to previous research conducted in the field and in the laboratory. Furthermore, our design allowed to some degree for the analysis of effects that extended over time. As such, it provides some initial evidence that experiences of noise can exert effects in a subsequent task administered later.

At the same time, we should acknowledge some limitations of the present research, and outline interesting avenues for future research. To begin with, one important limitation of the present research is that it did not include a measure of perceived lack of behavioral control that was assumed to be relevant in explaining the undermining effects of negative noise. However, by including such a measure in this study, a potential drawback would be that in doing so we might heighten the salience of perceived behavioral control, which in turn may affect our findings on motivation and cooperation in unforeseen ways. Hence, the present results confirm that negative noise undermines conservational behavior due to a loss of conservational motivation but they do not directly speak to the role of perceived lack of behavioral control. Therefore, in future studies with similar design, it may be useful to complement the present research by including a measure of perceived behavioral control to illuminate its mediating status.

Given that present research is relatively novel, and given that we did not include several measures in between the two tasks to illuminate mediation, it is important to do justice to some prominent alternative interpretations of the present findings. First, a noisy environment, as it is induced in the present experiment, may elicit behavioral reactions that share features with the well-known concept of "learned helplessness" (Abramson, Seligman, & Teasdale, 1978; Seligman, 1975). After the repeated exposure to uncontrollable events such as electrical shocks, for example, an individual may have learned that it is not able to escape these events, that it is helpless. As a result in the future, an individual may stay passive and become depressive in the face of similar unpleasant or damaging situations, even when it does actually have the power

to make a change for the better. In the case of natural resource management, repeated experiences of helplessness in the face of resource degradation may lead an individual to believe that all attempts to save resources are futile, even if the individual would have the power to make small contributions for the better. On a societal level, one could argue, that the degradation of natural resources can also lead to a form of collective depression. For example, not a few people seem to be convinced that human mankind will not be able to stop global environmental degradation, and all actions to prevent that will be useless.

A complementary line of research suggests that not having control when one expects to have it may have different consequences than does not having control when one had no expectations for it (e.g., Baum, Fleming, & Davidson, 1983; Baum & Gatchel, 1981). The latter case—not having control when one had no expectations for it—may lead to feelings of passivity and helplessness as they were described above. The former case, in contrast—not having control when one expects to have it—may also be true in noisy situations as the present one, when external forces suddenly interfere with our intentions to obtain a desired collective goal. The sudden and unexpected loss of control may then lead to reactance and stress-like arousal (see Wortman & Brehm, 1975). In the face of a deteriorating resource, the inability to save resources due to a loss of control may then lead to a form of reactance that manifests itself in a tendency to take more than a sustainable consumption would be. Both, learned helplessness and reactance may be potential explanations for a reduction in conservational motivation and behavior, and should be assessed accordingly in future studies of this kind.

Second, from a learning psychology perspective, one may also argue that behavior in the first part of the study was rewarded and therefore maintained in the second part. Although possible, we do not regard this interpretation very plausible. After all, no explicit or implicit reward was given after the completion of the first group task. Moreover, although the feedback to participants that the first task was done faster than expected may be interpreted as a positive reward in a general sense, it seems unlikely to have served as such in the present context because rapidness was not a goal declared in the instructions. Indeed, it appears very unlikely that the behavior of participants experiencing an empty pool at the end of the first task, representing a collective failure, was positively reinforced. Furthermore, participants received no further payment or any other kind of reward to stay for the second group task. Therefore, although we cannot exclude any interpretation derived from a learning psychology perspective, we do not regard the above line of reasoning very plausible.

Finally, a third broad explanation may be derived from the literature on believe perseverance (Ross, Lepper, & Hubbard, 1975), which states that once we have decided to believe (or justify) something, we will tend to keep on believing (or justifying) it, even in the face of disconfirming evidence because other beliefs (or justifications) do still apply. For example, it is plausible that participants in the noise condition justified their exploitative consumption for a number of reasons—the presence of noise being only one of them—that they inferred from the perceived task requirements given in the instructions. While we have no direct evidence, we may speculate that negative noise may not only undermine perceived behavior control, but also enhance self-serving interpretations, or excusing, of one's non-cooperative behavior. This possibility is interesting in light of previous research showing that people may often justify their non-cooperative actions in quite creative ways (e.g., Kerr & Kaufman-Gilliland, 1997). With the presence of negative noise, one should be able to find justification in a relatively effortless, perhaps even automatic manner (“I could not help it”).

Before closing, we want to briefly discuss the short temporal distance between the occurrence of noise in one situation and its detrimental behavioral effects in another situation. After having experienced a very noisy world in the first task, our participants may not have fully adopted the new information that the following situation would be noise-free (and we did not check it by asking them). If they did, it would still be interesting to see how long it takes until repeated experiences in a noise-free situation would lead to a restoration of their original motives. As the collective outcome obviously plays a role as well in this process, we assume that only experiences of successful pool management without noise would restore people's original motivation. This hypothesis is potentially worrying in real life contexts. In a world full of noise and constantly deteriorating natural resources many people may have suffered from losses in conservational motivation that may take constant positive feedback, trust, and patience to be fully restored.

Practically, on the part of noise, the protection of common pool resources can be warranted by providing more means for engaging in conservational behavior and better feedback about its consequences. On the part of pool size, this feedback should include not only the absolute state of environmental affairs—which may still be suboptimal after the means to conserve have been provided—but also the relative improvement of the situation, to motivate people for resource conservation. For example, for a voluntary change to public transportation people may need both, the means to do it (e.g., reasonable ticket prices) and the feedback about positive societal consequences (e.g., a stable and improving air quality).

Concluding Remarks

The belief that we often have full control over our actions and their intended consequences may be appealing, but it is far from realistic. This holds not only for dyadic interactions, but also for commons dilemma situations that often are challenged by noise rooted in social-ecological mechanisms. The present research provides strong evidence that noisy situations can have far-reaching consequences, in that they may lead to excessive consumption and eventually to exploiting the natural resources that are available to the collective. Moreover, the finding that even a group as small as five people may be incapable of managing resources when challenged by noise does not feed optimism about the ability of people to do so in larger groups. Such findings underscore the relevance of research on the detrimental effects of noise in commons dilemmas, in particular, the ways in which these detrimental effects can be prevented, reduced, or even overcome.

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