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Cooperation is in our nature: Nature exposure may promote cooperative and environmentally sustainable behavior

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ABSTRACT

Theory and correlational research suggest that connecting with nature may facilitate prosocial and environmentally sustainable behaviors. In three studies we test causal direction with experimental manipulations of nature exposure and laboratory analogs of cooperative and sustainable behavior. Participants who watched a nature video harvested more cooperatively and sustainably in a fishing-themed commons dilemma, compared to participants who watched an architectural video (Study 1 and 2) or geometric shapes with an audio podcast about writing (Study 2). The effects were not due to mood, and this was corroborated in Study 3 where pleasantness and nature content were manipulated independently in a 2 × 2 design. Participants exposed to nature videos responded more cooperatively on a measure of social value orientation and indicated greater willingness to engage in environmentally sustainable behaviors. Collectively, results suggest that exposure to nature may increase cooperation, and, when considering environmental problems as social dilemmas, sustainable intentions and behavior.

1. Introduction

We clearly face significant environmental challenges (e.g., climate change, pollution, accelerating extinctions). Although the causes and solutions are obviously multifaceted and complex, many have suggested that modern lifestyles contribute to environmental destruction—not only via excessive consumption, but also by disconnecting people from nature. This scholarship often draws on Wilson's (1984) biophilia hypothesis, which posits that humans have an innate need to associate with other living things due to our evolutionary history. We evolved in natural environments and, thus, they still support optimal human functioning (Kellert, 1997). We do not need to accept the specific innate need posited by biophilia to see a gap between humans' evolutionary environments and the current living conditions of people in modern societies. This gap may be a source of suboptimal well-being. Consistent with this idea, living near greenspace predicts higher happiness (White, Alcock, Wheeler, & Depledge, 2013) and longevity (Mitchell & Popham, 2008), and spending time in nature seems to provide a variety of cognitive, mood, and physiological benefits (reviewed by Hartig, Mitchell, de Vries, & Frumkin, 2014 and Selhub & Logan, 2012).

Despite nature's apparent benefits, most people spend the majority of their time indoors away from nature (MacKerron & Mourato, 2013). This physical disconnection may also foster a problematic psychological disconnection. That is, when humans do not feel like they are part of larger ecosystems, they may be less inclined to protect the natural environment (Schultz, 2000). Supporting this idea, individual differences in subjective connectedness with nature consistently predict pro-environmental attitudes and behaviors, as well as happiness (Capaldi, Dopko, & Zelenski, 2014; Mayer & Frantz, 2004; Nisbet, Zelenski, & Murphy, 2009; Tam, 2013). Ironically, our threatened natural environments may be critical to fostering the deep concern that would protect them.

Although suggestive, past research linking nature with sustainable behavior is mostly correlational, qualitative, or relies on subjective self-reports. In this research we take an experimental approach by manipulating exposure to nature and observing effects on a laboratory analog of sustainable behavior: a fishing-themed commons dilemma (Gifford & Gifford, 2000). Dawes (1980) described environmental problems as social dilemmas with two key features: individuals benefit by behaving selfishly (e.g., overharvesting resources, polluting) regardless of others' choices, and where all would benefit if everyone cooperated instead of pursuing immediate or narrow self interest (see also Parks, Joireman, & Van

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Lange, 2013). Said another way, broad participation and cooperation are essential to resolving many environmental problems. We hypothesize that participants exposed to nature will make more cooperative, and thus sustainable, choices. We view cooperative behavior as that which contributes to collective benefits (not necessarily without simultaneous personal benefit), and, in this context, sustaining resources.

This prediction is similar to ideas prevalent in environmental psychology—that time in nature and strong subjective connections with nature promote sustainable attitudes (Gifford, 2014). Nonetheless, it departs from most research in the area by suggesting that these effects can be observed over the course of a few minutes in the laboratory. The processes involved in a lifetime of accumulated nature experience may well differ, but we nonetheless draw on the personality-level correlations as part of the rationale for our prediction. Fleeson (2001) has suggested that associations at the trait level often apply at the state level too (e.g., trait extraversion predicts high positive affect and most people experience positive emotions when they behave in extraverted ways). Regarding nature and sustainability, part of the link has been established. Brief exposures to natural settings increase momentary feelings of nature relatedness (Mayer, Frantz, Bruehlman-Senecal, & Dolliver, 2008; Nisbet & Zelenski, 2011; Schultz & Tabanico, 2007). Because trait nature relatedness is strongly associated with sustainable attitudes (Tam, 2013), state nature relatedness, caused by nature exposure, may be too.

Research on the short-term consequences of nature exposure also suggests some reasons that nature could promote sustainability, particularly when we think of sustainable behaviors that are also cooperative behaviors. For example, nature exposure is often associated with good moods (Mayer et al., 2008; Nisbet & Zelenski, 2011). Intuitively, and generally consistent with the 'broaden and build' view of positive emotions (Fredrickson, 2001), good moods may facilitate cooperative or prosocial behavior, actions that would also be sustainable in resource dilemmas. Research on mood and cooperation, however, suggests that the link may be complex and depend on context (Hertel, Neuhof, Theuer, & Kerr, 2000). Considering another route, Kaplan and Berman (2010) reviewed nature's effects on attention restoration, crime reduction, subjective energy, frustration tolerance, etc., and suggested that they share the common core of improved self-control. Nature may facilitate cooperation in commons dilemmas by improving self-control, thus curtailing temptations to cheat or overharvest. Perhaps even more relevant, Weinstein, Przybylski, and Ryan (2009) manipulated nature exposure with photographs (nature vs. built environments) or plants (present or absent) and found that nature increased participants' intrinsic aspirations and generosity, and decreased extrinsic, materialistic aspirations. That is, nature caused people to report valuing others and prosocial behavior more, and wealth and fame less. This extended to actual behavior in the 'trust game'; participants exposed to nature gave more actual money to another person that they could have kept for themselves without negative consequence. These effects were mediated by feelings of (state) nature relatedness and autonomy, and were strongest among participants who felt most immersed in the nature. Similar effects may not require deep immersion, however. Mazar and Zhong (2011) found that participants merely exposed to green products in a consumer study gave away more money than participants who viewed more conventional products. Such effects contrast with findings that money primes make people more self-sufficient and less prosocial (Vohs, Mead, & Goode, 2006); nature may function oppositely (Nisbet & Zelenski, 2009). Although suggestive, none of this research has examined sustainability attitudes or behaviors. Commons dilemmas provide a link between nature effects and sustainability because they channel cooperation, trust, and prosocial motivations into sustainable behaviors.

To be clear, cooperative behavior is not always sustainable. Humans often cooperate in ways that ultimately threaten natural environments; most current environmental crises result from economic activity that requires some cooperation among individuals and groups. Moreover, not every sustainable behavior requires cooperative intentions. The environmental benefits may be diffuse (e.g., a reduction in greenhouse gasses benefits all), but the intentions may be completely local and selfish (e.g., thinking, 'a tree would look nice in my backyard'). Said another way, altruism is not required for cooperation or sustainable behaviors. Our primary focus is the confluence of cooperation and sustainability. Environmental problems are classic examples of commons dilemmas, and, thus, research on commons dilemmas has much potential to inform environmentally sustainable behavior and decision making. We have focused on an environmentally themed commons dilemma because it allows us to bridge different literatures in suggesting nature exposure as a potential aid to cooperative or sustainable behavior. We extend the theory and mostly correlational research that suggests a strong link between connecting with nature and sustainability by adding experimental manipulations that speak to causal direction more directly. We extend experimental studies' suggestive hints about nature's effects on mood, self-control, prosocial motivation, and trust by testing them in contexts more relevant to sustainability.

In sum, there are theoretical and empirical reasons to suspect that exposure to natural (vs. built) environments may promote cooperative, sustainable behavior. To test these ideas, we conducted three studies. In the first, we randomly assigned participants to view videos of almost exclusively natural or built environments. Participants were later asked to 'play a fishing game', an iterative, fishing-themed commons dilemma where they were paid for each fish harvested. We also included measures of mood, state nature relatedness, and state trust (as possible mediators), and trait measures of nature relatedness and trust as exploratory predictors or moderators. Study 2 reports a close replication. Study 3 provides a conceptual replication and extension; it begins to disentangle cooperation from sustainability by measuring these outcomes independently. We report how we determined our sample size, all data exclusions, all manipulations, and all measures in all studies (Simmons, Nelson, & Simonsohn, 2012).

2. Study 1

2.1. Method

2.1.1. Participants

Undergraduate students ($n = 111$) were recruited for a study titled 'Personality and Media' via our department online subject pool system. Our goal was $n = 120$ for an exploratory study, and we collected data to the end of a semester. The sample was 70.3% female with a mean age of 20.81 ($SD = 3.10$). Participants received course credit as compensation. They were also paid based on fishing performance, but learned this only after arriving for the study.

2.1.2. Materials

Videos. To manipulate exposure to natural vs. built environments, participants viewed one of two 12-min videos that included educational narration and background music. The nature video excerpted BBC's *Planet Earth* series, beginning in tundra forest with images of trees and animals. It then proceeded to areas around the world and showcased the plants and animals native to those areas, ending in a jungle. We chose this particular excerpt because there are no mentions of marine life or fish, as well as to avoid explicit

appeals for conservation. *Planet Earth* is easily described as a 'nature documentary.' It represents nature as environments relatively untouched by humans (lack of buildings), with abundant and beautiful fauna and flora (see Vining, Merrick, & Price, 2008). The built video excerpted Landmark Media's *Walks with an Architect* series, and featured in-depth looks at buildings, their history, and locations in New York City. The buildings in New York City arguably include some of the world's finest architecture, and we chose this video to contrast with the nature in *Planet Earth* while still conveying impressive content. The fact that nearly every part of the video contains human-built spaces makes it antithetical to common conceptions of nature (Vining et al., 2008). Thus, these excerpts were relatively 'pure' representations of nature and nonnature (cf., a cultivated garden). No pilot data were collected on the effects of these videos, yet some of their impacts (e.g., on mood and subjective connection with nature) are described by this study. Participants viewed videos on desktop computers with 17-inch screens and received sound via headphones.

Commons dilemma. To assess cooperation, participants engaged in a fishing-themed commons dilemma, specifically FISH 3.1 (Gifford & Gifford, 2000; see http://web.uvic.ca/~rgifford/fish/). In this microworld simulation, participants make choices about how many fish to harvest across multiple 'seasons'. In our application, participants harvested from an ocean shared by three other fishers who were, unbeknownst to participants, actually simulated. Between each season, fish regenerated at a rate of 1.5, and fishing continued until fish were gone or 15 rounds had passed, but participants were not informed of this limit. The ocean began with 50 fish, and participants were paid $.10 per fish harvested. A fee of $.05 was charged to go to, and return from, sea, thus making it necessary to catch at least two fish to profit in any one season (though participants could stay 'on shore' for free). Information about the number of fish harvested, fish remaining in the ocean, profits, and other fishers' catches were all displayed continuously on the screen. Simulated fishers were programmed to behave relatively cooperatively (an average of .5 on the 0 to 1 'greed' setting). FISH yields measures of fish harvested, total seasons, profits, as well as calculated indexes of efficiency and restraint (see Gifford & Gifford, 2000). The indexes were calculated in each season, and then averaged across seasons so each participant received a single score. Restraint tracks the raw number of fish harvested while accounting for group size (but not regeneration rate); higher numbers (between 0 and 1) are necessary for a sustainable resource. Efficiency tracks the number of fish taken *relative* to the current size of the fish population and the regeneration rate. Scores above 1 indicate 'unnecessary' efficiency, i.e., taking less than would regenerate, whereas scores below 1 indicate that more fish were taken than could be regenerated in the next season, thus shrinking the population.

State Scales. To assess state nature relatedness, participants completed the single-item Inclusion of Nature in Self measure (INS; Schultz, 2002). Participants were presented with seven pairs of circles labeled *self* and *nature* that differ in the degree of physical overlap. Participants choose the pair that represented, "… your relationship with the natural environment at this point in time. How interconnected are you with nature right now?" As distractors, participants also rated pairs of circles labeled "self" and "people, family, friends, community, an urban center, and to all humanity."

A mood questionnaire included the Positive and Negative Affect Scales (PANAS; Watson, Clark, & Tellegen, 1988). Participants rated adjectives on a Likert scale of 1 (*very slightly or not at all*) to 5 (*extremely*) to describe their feelings "in the moment". Because the 10-item positive affect ($\alpha = .85$) and negative affect ($\alpha = .81$) scales assess only high arousal affects (e.g., *enthusiastic*, *proud*, *interested*, and *afraid*, *nervous*, *distressed*, respectively), we added adjectives that were lower in arousal, yet still pleasant, and intuitively associated with nature experiences: *fascination*, *peaceful*, *content*, *in awe*, *curious*, and *relaxed*. Although this scale is admittedly ad hoc, it may capture aspects of the 'soft fascination' described by Kaplan (1995). Nature is also a prototypical trigger of awe (Keltner & Haidt, 2003). This pleasant affect scale had good internal consistency ($\alpha = .79$).

Following a practice round of the FISH simulation, participants also completed a 3-item ad hoc measure of trust in other fishers ($\alpha = .79$). They rated items like, "I expect that my group members will be trustworthy" on a 5-point scale of agreement.

Trait Scales. Participants completed the 5-item Faith in People Scale (trust; Rosenberg, 1957), and the 6-item Short Nature Relatedness Scale (Nisbet & Zelenski, 2013). These were embedded in the 44-item Big Five Inventory (John & Srivastava, 1999), a broad measure of personality traits, to avoid suggesting our interest in specific individual differences.

2.1.3. Procedure

Participants arrived at the lab and were ushered to a small testing room. One or two participants were tested simultaneously, but the lab layout suggested the possibility of more. After informed consent and a brief description of the study (framed as being about personality and perceptions of media), participants completed the trait measures. They were then randomly assigned to watch the *Planet Earth* or *Walks with an Architect* video. Following the video, they completed a brief questionnaire about their liking of the video (cover story), the INS, and mood questionnaire. Next, participants received detailed written and verbal instructions about FISH, including a three-season practice session. They then completed the state trust measure and began the actual FISH simulation of up to 15 seasons. Following FISH, participants completed a brief questionnaire about their impressions of the 'fishing game' (cover story), a demographics questionnaire, and a questionnaire that probed for suspicion.[1] Finally, participants were debriefed and paid according to their FISH performance.

2.2. Results

Our primary hypothesis was that exposure to natural (vs. built) environments, operationalized as Planet Earth (vs. architecture) videos, would produce higher rates of cooperative and sustainable behavior. We tested this hypothesis across various FISH indicators. Many had substantial skew, kurtosis, and outliers, so we present comparisons in two ways: as *t*-tests with 15 outliers[2] excluded from all tests, and nonparametric Mann–Whitney's *U* with all participants (see Table 1). Results generally supported hypotheses. Participants who watched the Planet Earth video harvested significantly fewer fish per season and had commons pools that lasted more seasons than those who watched the architecture video. These differences are mirrored in the indices of restraint and efficiency with the Planet Earth condition showing more of both. Participants who viewed the architecture video made significantly more money, suggesting that this scenario favored a short-term, unsustainable strategy (i.e., large harvests across a few rounds). By season 15, 49.09% of the architecture condition's oceans went

[1] Depending on the criteria, between 4 and 11 participants (<10%) reported somewhat accurate guesses about hypotheses. They were disproportionately (but not exclusively) in the nature condition, yet omitting them from analyses did not change results substantially (see Supplement).

[2] We used ± 3 SD as a loose criterion for outliers while also considering visual inspection of frequency distributions (across studies).

Table 1
Study 1 FISH outcomes by condition.

Variable	Planet earth (nature) $n = 46$	Architecture (built) ($n = 50$)	t	U	d
	M (SD)	M (SD)			
Seasons	13.61 (3.35)	10.90 (5.01)	3.13**	1291.5†	.63
Total fish	36.52 (3.30)	37.44 (2.43)	−1.56	1232.0†	.32
Fish/season	3.16 (2.06)	4.97 (3.66)	−3.01**	1133.5**	.60
Profits	2.50 (.46)	2.73 (.45)	−2.58*	1261.0†	.51
Restraint	.39 (.38)	-.02 (.66)	3.74**	1146.0**	.75
Efficiency	.42 (.39)	-.002 (.70)	3.73**	1149.0**	.74

Note. For U, nature $n = 56$, built $n = 55$ (all participants).
†$p < .10$, *$p < .05$, **$p < .01$.

extinct, compared to 28.57% in the Planet Earth condition, χ^2 (1, $N = 111$) = 4.92, $p = .03$.

We anticipated that the Planet Earth video might produce better moods and more feelings of nature relatedness and trust compared to the architecture video. These suspicions were only partially confirmed (see Table 2). Participants who saw the Planet Earth video reported significantly more pleasant affects and less negative affect, but groups did not differ significantly on (high arousal) positive affect, state nature relatedness, or trust. Given that the Planet Earth video produced somewhat more pleasant states, we conducted exploratory bootstrapping mediation analyses (Preacher & Hayes, 2008) with all FISH indicators as dependent variables. In no case was negative affect or pleasant affect a significant mediator. (Said another way, controlling for mood made no difference.) In other exploratory analyses, we tested whether relevant personality variables (nature relatedness and trust) predicted FISH behavior or moderated the effect of our experimental manipulation, but results were almost uniformly not statistically significant.

2.3. Discussion

The results of Study 1 provide preliminary evidence that exposure to nature can promote cooperative or sustainable decisions. Participants who viewed the Earth video harvested more sustainably (i.e., fewer fish per season and extinctions) than participants who watched the architecture video. Although the mechanisms of this effect are not clear, data suggest that mood, trust, and subjective feelings of nature relatedness do not account for differences.

3. Study 2

In Study 2 we attempted a close replication with minor alterations. First, we adjusted the FISH parameters slightly to see whether results would extend to a context that did not favor a short-term strategy (in terms of profits). That is, we reduced the cost of going out to sea so each fish was more profitable, especially in small catches. We also increased the maximum number of seasons, giving fishers more time to benefit from a sustainable, long-term strategy—small profits in each season add up when there are more seasons. In addition, we added another more neutral control condition to confirm that the action of the effect was not entirely due to the architecture video. Finally, we omitted some of the exploratory measures from Study 1.

Table 2
Study 1 state measures by condition.

Variable	Planet earth (nature) ($n = 46$)	Architecture (built) ($n = 50$)	t	d
	M (SD)	M (SD)		
Positive affect	2.90 (.67)	2.79 (.82)	.74	.15
Negative affect	1.28 (.34)	1.47 (.54)	−2.16*	.42
Pleasant affect	3.54 (.78)	3.11 (.72)	2.80**	.57
Inclusion of nature	3.46 (1.41)	3.22 (1.28)	.86	.18
State trust	3.37 (.73)	3.59 (.63)	−1.60	.32

*$p < .05$, **$p < .01$.

3.1. Method

3.1.1. Participants

With procedures identical to Study 1, 121 students (71% female) were recruited and randomly assigned to either the nature, built, or neutral conditions. Our goal was 40 subjects per condition, allowing good power to detect the effect sizes observed in Study 1. All received course credit (and money) as compensation.

3.1.2. Materials and procedure

The study was identical to Study 1 with the following exceptions:

A new control condition consisted of watching the iTunes visualizer (full screen) while listening to the Grammar Girl podcast, *The Rules of Story*.

In FISH, the cost of going out to, and returning from, sea was reduced to $.02, and the maximum number of seasons was increased to 25.

Trait nature relatedness and both trust measures were omitted. A Big Five personality measure remained (recall the cover story about personality and media), but was changed to the 40-item 'mini markers' (Saucier, 1994) as this was helpful to an unrelated project.

3.2. Results

As in Study 1, our primary hypothesis was that the Planet Earth video would produce more cooperative and sustainable FISH decisions compared to the architecture video and grammar podcast. Skew, kurtosis, and outliers were again concerns with FISH variables, so we conducted parametric analyses with three outliers excluded and nonparametric analyses with no exclusions. (See Supplementary Materials for more Study 2 analysis details.) When comparing omnibus tests across the three conditions, we found differences that were often marginally significant (e.g., ANOVA ps from .06 to .14 and Kruskal-Wallace ps from .03 to .08), with the exception of profits where there were somewhat smaller differences (ps = .27 and .15). Across indicators, the architecture and grammar conditions were most similar (comparisons produced ps all > .26), and both tended to differ from the Earth condition. Table 3 provides means, SD, and an indication of where differences between two conditions are statistically significant. Unless one is

Table 3
Study 2 FISH outcomes by condition.

Variable	Planet earth (nature) ($n = 39$)	Architecture (built) ($n = 39$)	Grammar (Control) ($n = 40$)	d N-B	d N-C	d B-C
	M (SD)	M (SD)	M (SD)			
Seasons	21.97 (6.06)^a	19.00 (8.58)^{ab}	18.43 (8.78)^b	.40	.47	.07
Total fish	59.54 (9.51)^a	56.38 (11.53)^{ab}	54.83 (11.02)^b	.30	.46	.14
Fish/season	3.02 (1.22)^a	4.04 (2.70)^b	4.20 (2.91)^b	.49	.53	.06
Profits	5.14 (.82)^a	4.95 (.86)^a	4.84 (.78)^a	.23	.38	.13
Restraint	.35 (.41)^a	.12 (.61)^{ab}	.10 (.63)^b	.44	.47	.03
Efficiency	.38 (.42)^a	.13 (.66)^b	.12 (.67)^b	.45	.46	.02

Note: d N-B = Cohen's d for nature vs. built, d N-C for nature vs. control, and d B-C for built vs. control. Within a row, means not sharing a superscript differ at $p < .05$; nonparametric comparisons are in Supplementary Materials.

rigid about the $p < .05$ criterion, results replicate Study 1's finding that Planet Earth produces more sustainable fishing behavior, though effect sizes are somewhat smaller. Also, as anticipated, adjustments to FISH parameters resulted in better outcomes for a sustainable strategy; the Planet Earth condition now harvested more fish than architecture or grammar conditions.

Mood differences were also similar to Study 1 with nature somewhat more pleasant; the new grammar control produced moods similar to the architecture condition. Exploratory mediation analyses again failed to provide any evidence that mood was responsible for the effects of videos on FISH outcomes.

4. Study 3

To build on two studies with very similar methods and findings, Study 3 addressed some issues of generalizability (e.g., going beyond the particular Planet Earth clip) and took a stronger approach to ruling out mood as a possible (yet increasingly unlikely) explanation for nature's effect on cooperation. To accomplish this, we created a new video manipulation that independently varied pleasantness and nature content with a 2 × 2 design. In addition, we replaced FISH, as a measure of cooperation, with social value orientation, a conceptually similar and empirically related measure (Balliet, Parks, & Joireman, 2009) that includes no environmental connotations, followed by some more explicit questions about sustainable behaviors.

4.1. Method

4.1.1. Participants

Undergraduate students were recruited via our department online portal until 250 had completed the study. To ensure valid responses, analyses excluded participants who finished in less than 10 min (median time was 21 min) and who did not comply with two requests to leave items blank; thus, $n = 228$.

4.1.2. Materials

Videos. Drawing on videos from YouTube, we created 2 min clips designed to independently manipulate pleasantness and natural (vs. built) context. We used criteria similar to Study 1 to determine nature and built contexts. To enhance the valence manipulation, we replaced original sound with upbeat, pleasant music or minimalist, foreboding music. Visual content included: Las Vegas strip (pleasant, built) which included images and video from this street at night with neon signs and edited in a fast, 'upbeat' way; old-growth forest (pleasant, nature) which showed a time lapse clip of undergrowth sprouting and aerial shots of large, mature trees; abandoned, decrepit house (unpleasant built) which slowly toured a clearly abandoned and distressed building with minimal furnishings; a flood (unpleasant nature 1) which showed expansive and fast moving water in a clearly flooded landscape that included some occasional damaged houses; a wolf pack (unpleasant nature 2) which showed wolves antagonizing a bison and bear, and hunting and killing an elk. The 'extra' unpleasant nature video was included as a comparison because the flood video included brief built elements, i.e., houses being washed away. They are sometimes combined in results for efficiency, but yield similar results individually.

Questionnaires. Cooperation was assessed with the social value orientation slider measure (SVO; Murphy, Ackermann, & Handgraaf, 2011). Across six items, participants allocated points (imagined as money) to themselves and a hypothetical other via a forced choice of nine alternatives that vary benefits to self vs. other. Although typically conceptualized as an individual difference measure, instructions do not imply anything trait-like, and similar measures are sensitive to context (Bekkers, 2004). High scores indicate more pro-social choices. SVO scores were missing for two otherwise complete cases.

Table 4
Means (standard deviations) by video for study 3 outcomes.

	Built		Nature		
	Negative (old house) ($n = 48$)	Positive (Las Vegas) ($n = 46$)	Negative (flood) ($n = 45$)	Negative (wolves) ($n = 44$)	Positive (forest) ($n = 45$)
PANAS					
PA	2.34 (.82)	2.69 (0.93)	2.36 (0.91)	2.16 (0.80)	2.79 (1.02)
NA	2.19 (0.96)	1.55 (0.61)	1.98 (0.85)	1.94 (0.76)	1.39 (0.50)
INS	3.06 (1.39)	2.78 (1.32)	3.29 (1.56)	3.48 (1.53)	3.22 (1.61)
SVO	28.70 (15.02)	28.41 (14.54)	30.58 (11.50)	32.45 (11.83)	33.06 (10.21)
WPSB	4.81 (0.85)	4.42 (1.07)	4.90 (1.08)	4.74 (0.99)	4.98 (0.85)

Note. PANAS = Positive and Negative Affect Schedule; PA = Positive Affect; NA = Negative Affect; INS = Inclusion of Nature in Self; SVO = Social Value Orientation; WPSB = Willingness to Perform Sustainable Behaviors.

Willingness to behave sustainably was assessed with a 30-item questionnaire developed by Ferguson, Branscombe, and Reynolds (2011). Participants indicated their willingness to engage in a variety of sustainable behaviors, such as, "Reduce the amount of warm and hot water used" on a 7-point Likert scale ranging from 1 (*extremely unwilling*) to 7 (*extremely willing*). Items cover transportation, energy and water use, social advocacy, tax support, and regulation support. Scores reflect mean ratings, $\alpha = .94$.

Similar to Study 1, mood was assessed with the 20-item PANAS (PA and NA αs = .91) interspersed with 6 vitality items; state nature relatedness was assessed with the INS (plus *family* and *society* as foils). The full 21-item trait nature relatedness scale ($\alpha = .90$) was embedded in a 100-item IPIP (ipip.ori.org) Big Five personality questionnaire, and, as a validity check, "Please leave this item blank" was inserted twice.

4.1.3. Procedure

Participants were directed to a Qualtrics webpage that administered the study. Following consent, they completed the personality measures and were then randomly assigned to view one of five videos. Following the video, they completed measures of mood, INS, cooperation, and willingness.

4.2. Results

Manipulation checks suggested that videos altered pleasantness and nature exposure relatively independently. In 2 × 2 (valence by environment) ANOVAs, we found significant effects of valence on positive affect, $F(1, 224) = 12.61$, $p < .001$, $\eta_p^2 = .053$, and negative affect, $F(1, 224) = 33.70$, $p < .001$, $\eta_p^2 = .13$ (see Table 4 for means). Corresponding effects of environment were null for positive affect, $F(1, 224) = .01$, $p = .92$, $\eta_p^2 < .01$, and marginally significant for negative affect, with built videos producing slightly higher ratings, $F(1, 224) = 3.49$, $p = .06$, $\eta_p^2 = .015$. We also observed a marginally significant effect of environment on INS, $F(1, 224) = 3.46$, $p = .06$, $\eta_p^2 = .015$, with nature videos producing higher levels of subjective nature relatedness. Thus, manipulations functioned largely as expected.

Our primary hypothesis was that nature videos (forest, wolves, and flood) would produce more cooperative choices than built videos (Las Vegas and old house). A 2 × 2 ANOVA with SVO as the dependent variable revealed that environment had a significant effect, $F(1, 222) = 4.43$, $p = .04$, $\eta_p^2 = .020$, with nature videos

producing more pro-social responses (and no effect of valence or interaction).[3] We also tested whether this extended to willingness to engage in environmentally sustainable behaviors, and found a similar effect of environment, $F(1, 224) = 4.51$, $p = .04$, $\eta_p^2 = .020$. However this was qualified by an interaction with valence, $F(1, 224) = 3.96$, $p = .05$, $\eta_p^2 = .017$.[4] Essentially, the built, pleasant, Las Vegas video produced particularly low levels of willingness compared to the other groups, which were similar (see Table 4).

Exploratory bootstrapping analyses suggested that state nature relatedness (INS) mediated the effect of videos (nature vs. built) on SVO (95% CI: .002, 1.45) and willingness (.01, .25; see Fig. 1), though 'significance' depended somewhat on using this approach (cf. Baron & Kenny) and combining the negative nature videos (see Supplement). Thus, state nature relatedness may account for nature's effects on cooperation and sustainability, but the evidence is somewhat inconsistent. There was also a significant correlation between SVO and willingness in this study ($r = .28$). Thus, we tested the possibility that SVO mediated the effect of videos on willingness. Bootstrapping indicated a possible mediation path when negative nature conditions were combined (95% CI: .002, .16; see Fig. 1), though 'significance' again depended somewhat on this particular approach (see Supplement). The films' effect on sustainability may be due to shifts in cooperation, but evidence is again somewhat inconsistent. Finally, we also explored the role of trait nature relatedness and found that it correlated significantly with SVO ($r = .28$), INS ($r = .61$), willingness ($r = .64$), and positive affect ($r = .23$), but typically did not interact with manipulations in predicting these things.

In sum, this study provides a conceptual replication supporting the idea that exposure to nature (in this case forest, flood, and wolf videos) promotes cooperative decisions, even absent an environmental context. These effects did not depend on nature's pleasantness, and also extended to explicit statements about environmental behavior under some circumstances.

5. General discussion

After finding that short walks in nature produced both pleasant moods and feelings of nature relatedness, Nisbet and Zelenski (2011) suggested nature as a 'happy path to sustainability'. This research takes the critical next step by explicitly testing the link between nature exposure and sustainable behaviors, rather than inferring this from the trait–level association between nature relatedness and sustainable behavior. Across three studies, we found consistent evidence for the idea that exposure to nature (videos) can produce cooperative behavior, which was also sustainable behavior in the context of commons dilemmas. Viewing environmental problems as social dilemmas underscores the link between cooperation and sustainability. Environmental issues are classic examples of social dilemmas, and cooperation is essential in solving them. In our lab analog, exposure to nature increased sustainable fishing and helped determine whether or not fish stocks collapsed. These effects appear to be due to nature *per se* as both built and neutral control comparisons produced similar results. Moreover, although pleasant moods are typically associated with nature, they did not explain its effect on cooperation. Results held using statistical mood controls, and when we directly manipulated pleasant and unpleasant representations of nature.

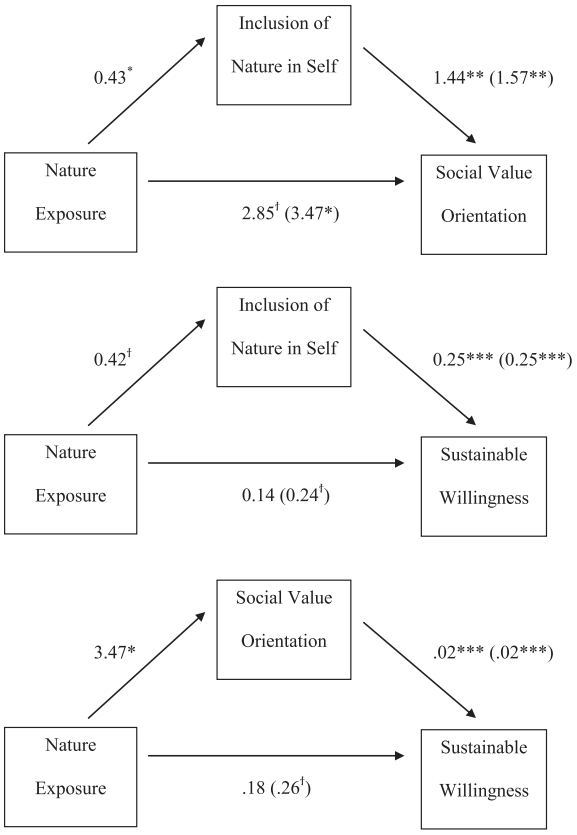

Fig. 1. Path values for exploratory mediation models in Study 3. The effect of nature (vs. built) videos on social value orientation and sustainability willingness may be mediated by state ratings of inclusion of nature in self. The effect of nature videos on sustainable willingness may be mediated by social value orientation. The coefficients associated with nature exposure predicting inclusion of nature in self slightly change between analyses due to exclusion of two participants with no score on social value orientation in analyses involving social value orientation. Note: $^{\dagger}p < .10$, $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$.

The mediation results for state nature relatedness were inconsistent across studies (significant only in Study 3), and not robust enough to provide strong evidence for this as the only path. Although it remains plausible that time in nature fosters connectedness and sustainable attitudes over the long term (Schultz, 2000), different processes may explain nature's effect on cooperative or sustainable behavior in the moment. That is, repeated experiences in nature, especially pleasant ones, may foster a more stable sense of nature relatedness, and then a desire to protect nature, habits of spending more time in nature, associating with individuals and groups that value nature and sustainable practices, etc. (e.g., Bragg, 1996; Kals, Schumacher, & Montada, 1999; Mayer & Frantz, 2004; Nisbet et al., 2009; Orr, 1993). Such connections likely develop over time. A single exposure to nature will probably not permanently change a person's attitudes or behavior, and it is entirely possible that momentary feelings of connectedness with nature do not cause sustainable choices in the same way that a more stable sense of a nature related self does. Previous correlational research on these topics likely speaks more to the stable *contents* of personality, whereas the studies we report here deal more with shifts in *processing*.

Momentary nature exposure may produce a set of changes in emotion and cognition that are temporary and relatively distinct from personality-level processes. Our studies found little support for improved mood or trust as reasons that nature influences momentary cooperation or sustainability. Other research has

[3] Considering the wolves and flood videos separately yields a similar pattern with environment effects of $F(1, 177) = 4.65$, $p = .03$, and $F(1, 179) = 2.88$, $p = .09$, respectively.

[4] The pattern was similar between wolves and flood videos, for environment effects, $F(1, 179) = 3.06$, $p = .08$ and $F(1, 180) = 5.14$, $p = .03$, respectively, and for interactions, $F(1, 179) = 4.92$, $p = .03$ and $F(1, 179) = 2.38$, $p = .11$, respectively.

shown that nature exposure can help restore attention or self-control resources (see Kaplan & Berman, 2010). Perhaps related to this, two recent articles have found that nature reduces temporal discounting (Berry, Sweeney, Morath, Odum, & Jordan, 2014; van der Wal, Schade, Krabbendam, & van Vugt, 2013). That is, nature appeared to shift people's preferences from immediate gratification to larger but more distant payoffs. Nature's ability to improve self-control in this way seems very consistent with the more sustainable strategies we observed in the FISH studies (though our studies did not guarantee a higher payoff with a long-term strategy). Additional research is needed, however, to determine which of these, or other, changes are more fundamental to nature exposure. Said another way, the improvements in sustainable behavior that we observed in these studies may be due to (mediated by) more basic shifts in delay of gratification. On the other hand, the measures in Study 3 suggest that there is more than temporal discounting at stake. The SVO measure is about immediate allocations and seems to measure prosociality more than self-control (see also Guéguen & Stefan, 2014). In addition, Study 3 included self-reported willingness to perform sustainable behaviors. Nature seemed to increase these, but the effect was qualified by an unexpected interaction. In addition, the effect of nature on willingness appeared to be mediated by SVO (prosociality or cooperation). Thus, we suggest a cautious interpretation of possible momentary changes in explicit environmental attitudes. Said another way, it is possible that nature's ability to promote sustainable behavior 'in the moment' applies primarily to cooperative contexts or commons dilemmas (or possibly even an explicit understanding of the choice as a social dilemma). Nature may shift cooperation more than sustainability *per se* when the two are dissociated. As with all meditation claims, determining the exact mechanism(s) of nature's effect on sustainability and cooperation will take considerable (more) research (see Bullock, Green, & Ha, 2010).

This research bridged gaps between experimental studies of nature exposure that have not considered sustainable behavior, and correlational studies that suggest a link between nature relatedness and sustainable attitudes. Like most experimental studies, our methods trade apparent external validity for methodological control. Although we argue that they maintain psychological realism, testing generalizability is clearly an issue for future research. Our participants were all Canadian students exposed to representations of (not actual) nature, 'fishing' in a simulation for relatively low stakes and in relatively cooperative contexts, or completing questionnaires in Study 3. In addition, studying the effects and active ingredients of 'nature' is tricky given its nearly infinite exemplars and the absence of clear or direct controls. We began to deal with this issue of stimulus sampling (Wells & Windschitl, 1999) by comparing four nature videos with four comparison conditions across our studies (i.e., Planet Earth, forest, wolves, and flood vs. architecture, grammar podcast, Las Vegas, and decrepit house). One could develop hypotheses about why, for example, Las Vegas or wolves might have particular effects beyond the natural-built distinction (indeed, we believe they must in some ways), but given a 4 vs. 4 comparison, the more parsimonious explanation seems to be an effect of nature—this is the consistent theme across all stimuli. Still, despite some breadth across these studies, this research begs for future conceptual replications, falsification attempts, and search for boundary conditions. Collectively our results suggest that nature may increase cooperation and sustainable choices, yet additional exemplars should be tested in future work before considering the matter settled.

As one specific and potentially important example, our nature videos may have primed the idea of conservation, thus creating demand. Although possible, some design choices argue against this particular problem: 1) we chose nature videos that excluded marine life and pro-environmental messages that might make the link obvious; 2) we paid our research participants for each fish harvested, giving them an incentive inconsistent with pleasing the experimenter; 3) we used a between-subjects design so that the video content could not be compared across conditions or become an obvious cue; 4) we crafted a plausible cover story about the study's purpose (i.e., about personality and reactions to media) that included distracting measures to support that story. In addition, Study 1 included a funneled debriefing for suspicion, and even with a liberal criterion, less than 10% of participants could identify the study's purpose, and removing these participants' data had little effect on the results. Finally, there is nothing 'environmental' about the SVO measure in Study 3 where nature again produced cooperative responses. Thus, narrow priming or demand (i.e., nature videos to conservation) seems like an incomplete explanation for our results. It seems more plausible that nature could prime cooperation broadly, similar to, but opposite, the self-sufficiency primed by money (Vohs et al., 2006).

With these caveats in mind, we turn to more speculative implications. As a methodological note for researchers, nature images or videos are often used as 'neutral' stimuli in control conditions. Our results suggest that nature can produce psychologically meaningful effects, and, thus, its 'neutrality' may be unwisely assumed in some research contexts. For example, a recent registered trial of 'brain training' failed to find much benefit for the cognitive exercises, but participants in a control condition, which consisted of watching short nature videos, reported significant improvements in psychological well-being and decreased stress over time (Borness, Proudfoot, Crawford, & Valenzuela, 2013). Also, three of nine studies in the money priming article just mentioned included control conditions that seem like nature (e.g., images of fish, a flower poster, and a seascape poster; Vohs et al., 2006). Appropriate comparison conditions depend on context, but nature may be appropriate less often than many assume.

Outside the lab, conservation activists have long used nature imagery in persuasive appeals, but recent messaging around climate change often prefers economic or security arguments. Given the effects of priming money vs. nature, nature imagery may produce more persuasive appeals or better reminders to behave sustainably—environmental problems are social dilemmas, and cooperation is key to sustainable solutions. Future empirical work could compare the relative efficacy of such appeals more directly. Our research also contributes to a growing body of work that suggests nature's benefits extend beyond individual well-being, for example, to prosocial aspirations (Weinstein et al., 2009) and behavior (Guéguen & Stefan, 2014) and reduced aggression and crime (Kuo & Sullivan, 2001). Such findings, combined with nature's salubrious effect on socioeconomic health disparities (Mitchell & Popham, 2008), suggest that societies might consider investing more in nature. Similar to arguments for public education, providing nature access to all citizens could possibly provide a net social or financial benefit.

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Appendix A. Supplementary Materials

Supplementary materials and analyses related to this article can be found at http://dx.doi.org/10.1016/j.jenvp.2015.01.005.

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