THE JOURNAL OF SOCIAL PSYCHOLOGY
2021, VOL. 161, NO. 2, 197–215
https://doi.org/10.1080/00224545.2020.1784826

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# Viewing nature scenes reduces the pain of social ostracism

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**ABSTRACT**

In a series of four studies (*Ns* = 245, 135, 155, 222), we explored the effects of viewing nature scenes on promoting recovery from ostracism. We first manipulated experiences of ostracism, then randomly assigned participants to view photos of either nature, urban scenes, or neutral objects. Across all four studies, participants who viewed nature photos reported significantly lower levels of state social pain, along with significantly higher levels of affect balance and self-esteem. Moreover, when asked to look back and recall how they felt at the time of being ostracized, participants who viewed nature photos reported significantly higher levels of retrospective satisfaction of basic emotional needs than did participants in control conditions. An internal meta-analysis revealed an effect size of $d = 0.58$. These studies are the first, to our knowledge, to provide experimental evidence of how exposure to nature can alleviate the pain of social ostracism.

**ARTICLE HISTORY**
Received 1 September 2018
Accepted 28 May 2020

**KEYWORDS**
Ostracism; nature exposure; social pain; positive emotions; needs satisfaction

"*Nature absorbed some of my pain.*" (Powers, 2010, p. 119)

Ostracism – being excluded and ignored – is stressful and painful. Being ostracized impairs self-regulation (e.g., Baumeister et al., 2005), reduces life satisfaction and overall positive mood (e.g., Ruggieri et al., 2013; Zhang & Shi, 2017), and thwarts the basic emotional needs of belonging, control, self-esteem, and feeling that one has a meaningful existence (e.g., Nezlek, 2012; Williams, 2009; Zadro et al., 2004). Unfortunately, ostracism is a common daily occurrence (Nezlek et al., 2012; Williams, 2009). Identifying strategies to relieve the painful effects of being ostracized is, therefore, important. We propose that engagement with nature can be one strategy to alleviate the pain of ostracism.

## *Responses to ostracism*

As humans, we evolved as interdependent social creatures; we are hardwired to reach out and interact with others (Lieberman, 2013). Maintaining social connections – belonging – constitutes one of our basic needs, without which people experience a diverse array of physical, psychological, and emotional problems (Baumeister & Leary, 1995). William James (1890/1950) wrote of how being socially ignored elicits such deep rage and despair that physical torture would seem less painful. Indeed, the negative effects of being excluded are so adverse that ostracism has been called a social death penalty (Williams, 2007). At its extreme, ostracism can result in physical death, whether by limited access to resources and protection, or by suicide caused by despair and loneliness (Gruter & Masters, 1986; Williams, 2007).

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A burgeoning literature on the outcomes of ostracism has consistently demonstrated that ostracism threatens not only our need for belonging, but our three other basic needs as well: for control, self-esteem, and feeling that we have a meaningful existence (e.g., Garris et al., 2011; Zadro et al., 2004; see also review by Williams & Nida, 2011). Thwarting of these needs by social exclusion is, quite literally, painful. Neuroimaging studies evidence that brain regions related to the processing of physical pain are activated when people experience social ostracism (MacDonald & Leary, 2005).

In general, people respond to ostracism in three ways: (1) moving toward, (2) moving against, or (3) moving away from (Ren et al., 2016; Wesselmann et al., 2015). A moving-toward response to being ostracized involves engaging in prosocial behaviors in order to regain inclusion (Williams, 2009). When re-inclusion appears unlikely, however, people may utilize a moving-against response following social ostracism. Antisocial, aggressive behavior may help the individual to at least gain some sense of control over the situation. By forcing others to pay attention to them, such behavior also helps assuage one's self-esteem in knowing that we are still worthy of attention (James, 1890/1950; Williams, 2009).

The moving-away-from response to ostracism involves seeking solitude and avoiding interactions with others (Ren et al., 2016; Wesselmann et al., 2015). This behavioral strategy of self-ostracizing primarily serves to relieve the pain of social ostracism and to protect oneself from being hurt again (Richman & Leary, 2009; Wesselmann et al., 2014). Ostracized people (in particular introverts) have a greater desire to take part in activities alone (Ren et al., 2016) and prefer sociofugal spaces to ensure both greater privacy and safety when in social situations (Meagher & Marsh, 2016). Of the three behavioral responses to ostracism, the moving-away-from strategy is the least researched (Wesselmann et al., 2015).

## *Nature's potential to relieve the pain of ostracism*

Spending time in nature (or expressing a desire to) is one such moving-away-from strategy that may be employed by ostracized individuals. For example, Poon et al. (2015) evidenced that participants in ostracism (versus control) conditions reported a greater desire to engage in nature-related activities. Recent research also indicates that exposure to nature weakens aggressive responses following an experience of ostracism (Poon et al., 2016). Yet, reducing aggression is only one aspect of recovery, and does not directly speak to the recovery and enhancement of individuals' emotional needs and well-being. From a positive psychology view, full well-being requires not only a reduction in ill-being and negative tendencies, but also requires enhancing well-being and the fulfillment of basic psychological and emotional needs (e.g., Pawelski, 2016). No research has yet directly explored whether exposure to nature can promote these aspects of recovery from ostracism. We propose that exposure to nature may, via various mechanisms, help to not only alleviate the pain of being ostracized, but also aid in persons' more complete recovery.

### *Reduction of felt social pain*

The landmark work of Ulrich (1984) demonstrated that patients in hospital rooms with a window view of nature recover from painful surgeries more quickly, require less pain medication, and report less physical pain than do patients in rooms which do not afford a view of nature. Given the common neurological underpinnings of physical pain and the social pain evoked by experiencing ostracism, it follows that exposure to nature may also help to alleviate social pain.

### *Enhancement of positive emotions*

Attention Restoration Theory (Kaplan & Kaplan, 1989) positions nature as an important resource for restoring cognitive and emotional resources after depleting, stressful experiences. Evidence of the restorative properties of nature (both in vivo nature and nature via photos or videos) has been demonstrated in numerous studies (see reviews by Capaldi et al., 2015; Howell & Passmore, 2013; McMahan & Estes, 2015; Ohly et al., 2016; Russell et al., 2013). This includes aspects of well-being such as positive affect.

### Enhancement of self-esteem and control

Natural environments offer a place to escape from social demands, and can provide feelings of security, privacy, and control (Cooper-Marcus, 1978; Davidson & Smith, 2009; Sobel, 1990). As Passmore and Howell (2014a) noted, we are free to simply *be* in nature, as nature does not impose arbitrary expectations of social propriety. Poon et al. (2015) also noted how nature provides a place free from judgment and rejection. Additionally, people with health complaints or negative moods are more likely to visit natural (as opposed to urban) places to regulate their emotions and self-experience (Korpela, 2003; Korpela & Ylén, 2007). Such self-regulation could aid in enhancing people's sense of control over their lives. We propose that exposure to nature – even via viewing photos – could help to repair damage to one's self-esteem and sense of control caused by the rejection inherent in ostracism, particularly given evidence (Ryan et al., 2010) of increased vitality experienced by people who merely imagined themselves in a natural setting.

### Enhanced sense of belonging

Exposure to nature is simultaneously a moving-away-from and a moving-toward response. Nature represents an important source of bonding (Kellert & Wilson, 1993). Ostracized people have been shown to have an increased desire to feel connected to nature (Poon et al., 2015) in order to restore their threatened feelings of belonging. Joye and Bolderdijk (2015) demonstrated that even briefly viewing photographs of nature can make people feel more connected to others.

### Enhanced sense of meaning

Engagement with nature is an important source of meaning for many adults (O'Connor & Chamberlain, 1996; Reker & Woo, 2011; Schnell, 2009; Steger et al., 2013). Experimental research has evidenced that meaning in life is bolstered after spending increased time in nature (Hamann & Ivtzan, 2016; Passmore & Howell, 2014b). Thus, we suggest that exposure to nature is also likely to help ostracized people regain their threatened sense of a meaningful existence.

## The present research

While research has indicated that contact with live nature results in greater well-being boosts than exposure to virtual nature, merely viewing nature photos has proven efficacious in enhancing happiness, prosocial tendencies, and feelings of connectedness and autonomy (see Capaldi et al., 2015). In the current four studies, we tested the hypotheses that viewing nature photos would promote recovery from ostracism via alleviating individual's current level of social pain, enhancing current levels of affect balance and self-esteem, and boosting retrospective assessment of satisfaction of basic emotional needs (i.e., self-esteem, control, belonging, meaning) in direct relation to the ostracizing event. Feelings of social exclusion or inclusion were induced in participants through a recall task (Study 1, 3, 4) or group arrangement (Study 2). Next, participants were invited to view 14 photos (nature or urban) and to immerse themselves in the scenes. All photos used in the studies were copyright-free pictures downloaded from the internet that did not contain images of humans or animals. We based selection of the images on images used in similar previous research exposing participants to photos of nature or urban scenes. Photos were displayed in the same order for all participants within each condition.[1]

Finally, participants completed state measures of affect, self-esteem, and social pain (i.e., how they felt now), as well as a measure assessing retrospective satisfaction of basic emotional needs (that is, looking back on the event now, assessing how they felt at the time).[2] It is possible that viewing nature photos may assist in people's well-being now, but they may still experience significant ill-being when recalling how they felt at the time of being ostracized. It is also possible that nature's effects could spill backwards to influence people's recall of their past emotions as being less detrimental. Thus, we assessed both these temporal perspectives to more fully assess recovery from ostracism.

Manipulation checks for the ostracism recall manipulation (Study 1 and 4) and for awe evoked by mountain photos (Study 3) were conducted which yielded the expected results. For brevity herein, we refer the reader to the Supplementary Materials for complete description, analyses, results, and statistics for the manipulation checks. In all four studies, all participants provided informed consent, no participants guessed the true aim of the study, and all participants' data were analyzed.

## Study 1

The primary aim of Study 1 was to directly examine if exposure to nature, via viewing photos, would ameliorate the pain of being ostracized. Specifically, we hypothesized that participants in the social exclusion condition who viewed photos of nature would report greater overall mood, satisfaction of basic emotional needs, and self-esteem, and lower levels of social pain, than their counterparts who viewed urban photos.

### Method

#### Participants and design

Undergraduate participants ($N = 135$, $M_{age} = 19.96$, $SD_{age} = 1.34$; 48 males, 87 females) from Shaoguan University in China completed the study in exchange for a gift worth approximately 10 Chinese dollars. Participants were randomly assigned to one condition in a 2 (social experience: exclusion vs. inclusion) x 2 (photo type: nature vs. urban) between-subjects design.

#### Procedure and measures

Participants were invited to participate in "two unrelated" studies (in reality, Study 1). Participants were first randomly assigned to recall, and thus reexperience, either an experience of social exclusion and rejection or an experience of social inclusion and acceptance (see Supplemental Material for exact recall instructions). Autobiographical recall is commonly used in ostracism research (e.g., Pickett et al., 2004). After the recall task, participants completed the manipulation check items (see Supplemental Material), following which they were invited to take part in the "second" study on "perception of pictures and well-being inventory". Participants were randomly assigned to view either 14 nature (trees and oceans) or 14 urban photos at their own pace, but they were asked to watch each photo for no less than 5 seconds and to immerse themselves into the scenes. Lastly, after viewing the photos, participants completed one measure each of affect, satisfaction of basic emotional needs, self-esteem, and social pain. Participants were then debriefed, thanked for their participation, and given their compensation gift.

*Affect.* The Chinese version (Qiu et al., 2008) of Watson et al.'s (1988) Positive and Negative Affect Scale (PANAS) was used. Respondents use a 5-point scale ranging from 1 (*very slightly or not at all*) to 5 (*extremely*) to indicate the degree to which they currently feel each of 9 positive and 9 negative emotions. We calculated an affect balance score by subtracting the average of the positive items from the average of the negative items.

***Basic emotional needs satisfaction.*** Eight items assessing retrospective perceived fulfillment of the four basic emotional needs, in relation to the event participants recalled, were adapted from Uskul and Over (2014). Sample items are as follows: belonging – "I felt like an outsider", self-esteem – "I felt good about myself", control – "I had control over the course of the event", meaningful existence – "I felt meaningless". Items were rated on a 5-point scale from 1 (*not at all*) to 5 (*completely*). Items were reverse scored as appropriate, summed, and averaged to create a composite measure of needs satisfaction.

***Self-esteem.*** The state version of Rosenberg's (1965) Self-Esteem Scale was used. The 10 items of this scale (e.g., "I feel that I am a person of worth, at least on an equal plane with others") are rated on a 4-point scale with endpoints of 1 = *disagree strongly* and 4 = *agree strongly*. Participants' ratings were summed and averaged.

***Social pain.*** The affective subscale of the revised Short-form McGill Pain Questionnaire (Dworkin et al., 2009) was used to assess social pain. Participants rated the four items ("tiring-exhausting", "sickening", "fearful", "punishing-cruel") with regard to the intensity of their current painful feelings using a 10-point scale ranging from 1 = *none* to 10 = *worst possible*. Scores were summed and averaged.

### Results[3]

To determine the effect of photo type (nature vs. urban) and social experience (exclusion vs. inclusion) on our dependent variables, we conducted a series of 2 × 2 ANOVAs. (See Table 1 for detailed statistics.) A significant (or marginally significant) interaction between photo type and social experience emerged for each of our dependent variables: affect balance ($\eta^2$ =.10, 90%CI [.00, .07]); satisfaction of basic emotional needs ($\eta^2$ = .05 [.01, .13]), self-esteem ($\eta^2$ = .07 [.01, .15]), and social pain ($\eta^2$ = .03 [.00, .09]). We explored each interaction with an analysis of simple main effects of photo type. (See Figures 1-4.) Participants who recalled social exclusion and who viewed nature (vs. urban) photos, reported significantly higher levels of affect balance ($\eta^2$ = .15 [.07, .24]), satisfaction of basic emotional needs ($\eta^2$ = .05 [.01, .12]), and self-esteem ($\eta^2$ = .06 [.01, .13]), and significantly lower levels of social pain ($\eta^2$ = .07 [.02, .15]). For participants who recalled experiences of social inclusion, no significant differences were evident between those who viewed nature vs. urban photos on any of our dependent variables ($\eta^2$ s = .00, .01, .02, .00).

### Discussion

Our predictions were supported: exposure to nature alleviated the painful feelings that resulted from being socially ostracized and promoted recovery. Participants who recalled experiences of social exclusion and who then viewed nature photos reported less social pain, and greater affect balance and self-esteem than did their counterparts who viewed urban photos. Moreover, in relation to the ostracizing events they recalled, participants who viewed nature photos reported greater overall satisfaction of their basic emotional needs than did those who viewed urban photos. These findings, thus, provide initial evidence that exposure to nature has the potential to mitigate the painful and negative effects of being socially excluded.

## Study 2

In Study 2, we aimed to replicate and extend the findings of Study 1. Using a different manipulation method to induce ostracism (i.e., group assignment rather than recall), we again tested the hypotheses that socially ostracized participants who viewed nature (vs. urban) photos would report greater overall mood, satisfaction of basic emotional needs, and self-esteem, along with lower levels of social pain. Previous research examining exposure to green nature (trees, plants) compared to blue nature (water) has yielded inconsistent results with regard to the relative health and well-being benefits associated with these different aspects of nature (e.g., Barton & Pretty, 2010; Nordh et al., 2011; Nutsford et al., 2016; Völker & Kistemann, 2015; White et al., 2010). Nonetheless, it is clear that exposure to green and to blue nature has beneficial restorative effects. In Study 2, we also sought to examine the relative efficacy of exposure to green (trees) vs. blue (oceans) nature for aiding in the recovery from the negative effects of ostracism.

**Table 1.** Study 1– 2 (social experience) x 2 (photo type: nature, urban) ANOVAs.

| *Affect Balance* | ANOVA | | | | | Simple Main Effects: Photo Type | | | | Exclusion | | Inclusion | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $\alpha = 0.88$ | $F$ (1, 131) | $p$ | $\eta^2$ | 90% CI | | $F$ (1, 131) | $p$ | $\eta^2$ | 90% CI | Nature | Urban | Nature | Urban |
| Social Experience | 2.25 | .136 | .02 | [.00,.07] | Exclusion | 22.99 | <.001 | .15 | [.07,.24] | $M = 1.54$ | $M = 0.25$ | $M = 1.09$ | $M = 1.26$ |
| Photo Type | 8.89 | .003 | .06 | [.01,.14] | Inclusion | 0.41 | .523 | .00 | [.03,.19] | $SD = 1.18$ | $SD = 1.32$ | $SD = 0.89$ | $SD = 0.95$ |
| Social * Photo Type | 15.02 | <.001 | .10 | [.03,.19] | | | | | | $n = 34$ | $n = 32$ | $n = 34$ | $n = 35$ |
| *Basic Emotional Needs Satisfaction* | | | | | | | | | | | | | |
| | ANOVA | | | | | Simple Main Effects: Photo Type | | | | Exclusion | | Inclusion | |
| $\alpha = 0.81$ | $F$ (1, 131) | $p$ | $\eta^2$ | 90% CI | | $F$ (1, 131) | $p$ | $\eta^2$ | 90% CI | Nature | Urban | Nature | Urban |
| Social Experience | 5.68 | .019 | .04 | [.00,.11] | Exclusion | 7.06 | .009 | .05 | [.01,.12] | $M = 3.51$ | $M = 3.09$ | $M = 3.47$ | $M = 3.67$ |
| Photo Type | 0.99 | .322 | .01 | [.00,.05] | Inclusion | 1.68 | .197 | .01 | [.00,.06] | $SD = 0.67$ | $SD = 0.72$ | $SD = 0.66$ | $SD = 0.56$ |
| Social * Photo Type | 7.87 | .006 | .05 | [.01,.13] | | | | | | $n = 34$ | $n = 35$ | $n = 34$ | $n = 35$ |
| *Self -Esteem* | | | | | | | | | | | | | |
| | ANOVA | | | | | Simple Main Effects: Photo Type | | | | Exclusion | | Inclusion | |
| $\alpha = 0.84$ | $F$ (1, 131) | $p$ | $\eta^2$ | 90% CI | | $F$ (1, 131) | $p$ | $\eta^2$ | 90% CI | Nature | Urban | Nature | Urban |
| Social Experience | 3.97 | .048 | .03 | [.00,.09] | Exclusion | 8.33 | .005 | .06 | [.01,.13] | $M = 2.93$ | $M = 2.58$ | $M = 2.84$ | $M = 3.01$ |
| Photo Type | 1.07 | .302 | .01 | [.00,.05] | Inclusion | 2.16 | .144 | .02 | [.00,.07] | $SD = 0.55$ | $SD = 0.43$ | $SD = 0.53$ | $SD = 0.41$ |
| Social * Photo Type | 9.56 | .002 | .07 | [.01,.15] | | | | | | $n = 34$ | $n = 32$ | $n = 34$ | $n = 35$ |
| *Social Pain* | | | | | | | | | | | | | |
| | ANOVA | | | | | Simple Main Effects: Photo Type | | | | Exclusion | | Inclusion | |
| $\alpha = 0.73$ | $F$ (1, 131) | $p$ | $\eta^2$ | 90% CI | | $F$ (1, 131) | $p$ | $\eta^2$ | 90% CI | Nature | Urban | Nature | Urban |
| Social Experience | 2.63 | .107 | .02 | [.00,.07] | Exclusion | 9.82 | .002 | .07 | [.02,.15] | $M = 3.11$ | $M = 4.30$ | $M = 3.21$ | $M = 3.34$ |
| Photo Type | 6.24 | .014 | .05 | [.01,.12] | Inclusion | .014 | .712 | .00 | [.00,.03] | $SD = 1.42$ | $SD = 1.47$ | $SD = 1.40$ | $SD = 1.81$ |
| Social * Photo Type | 3.93 | .050 | .03 | [.00,.09] | | | | | | $n = 34$ | $n = 32$ | $n = 34$ | $n = 35$ |

Note: As per Steiger (2004), 90% CI were calculated.

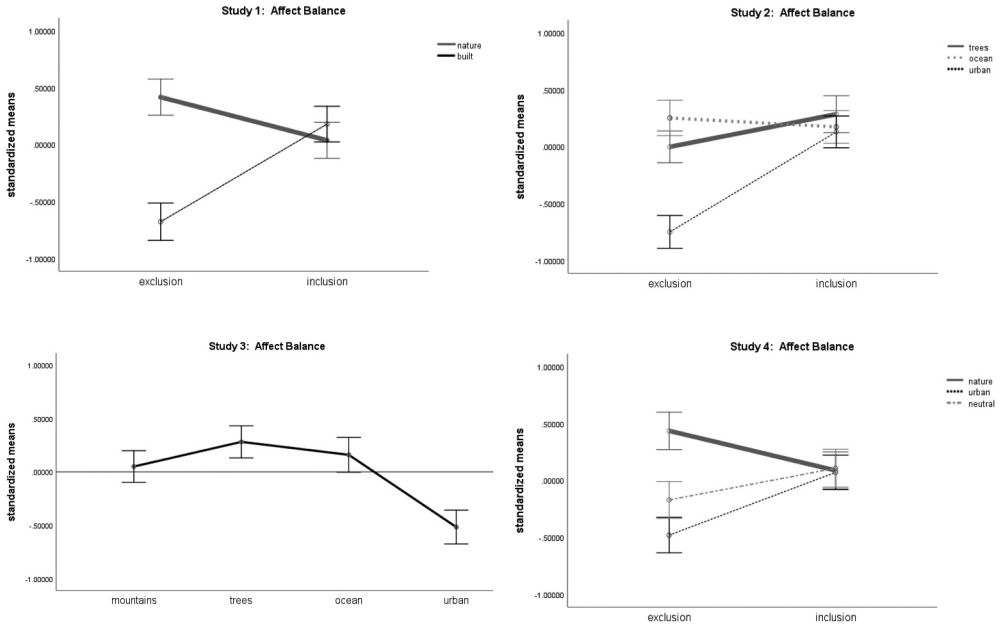


**Figure 1.** Results for affect balance – Study 1, 2, 3, 4.

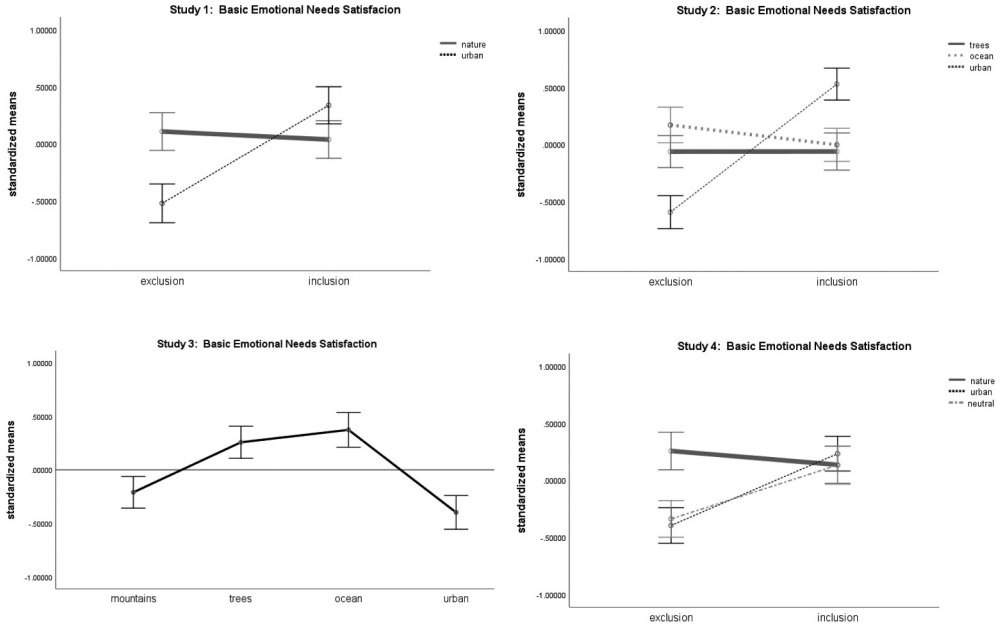


**Figure 2.** Results for basic emotional needs satisfaction – Study 1, 2, 3, 4.

## *Method*

### *Participants and design*

Undergraduate participants ($N$ = 245, $M_{age}$ = 20.28, $SD_{age}$ = 2.48; 60 males, 185 females) from a psychology class at Shaoguan University in China completed the study in exchange for a gift worth approximately 10 Chinese dollars. Participants were randomly assigned to one condition in

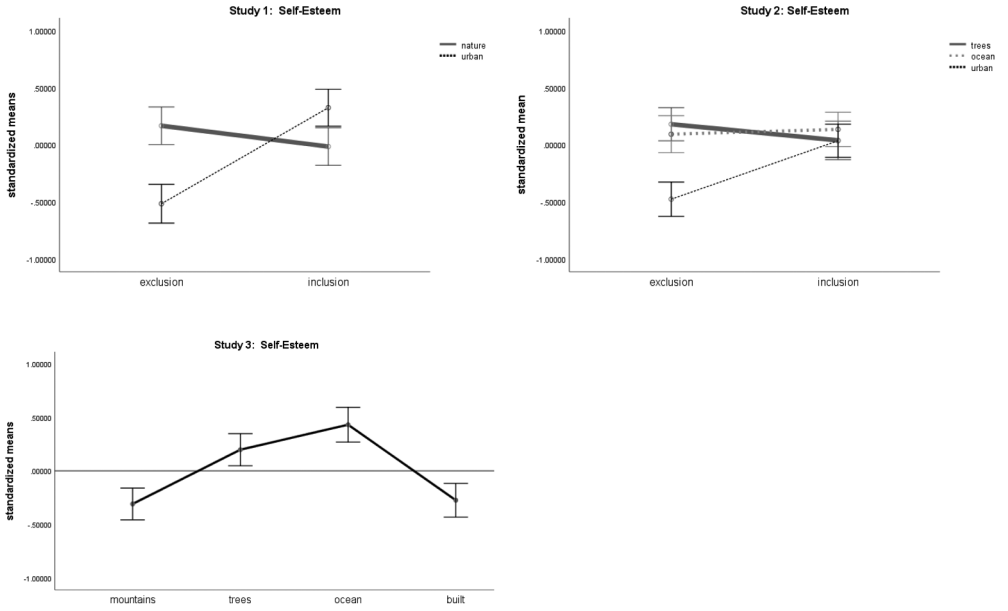


**Figure 3.** Results for self-esteem – Study 1, 2, 3.

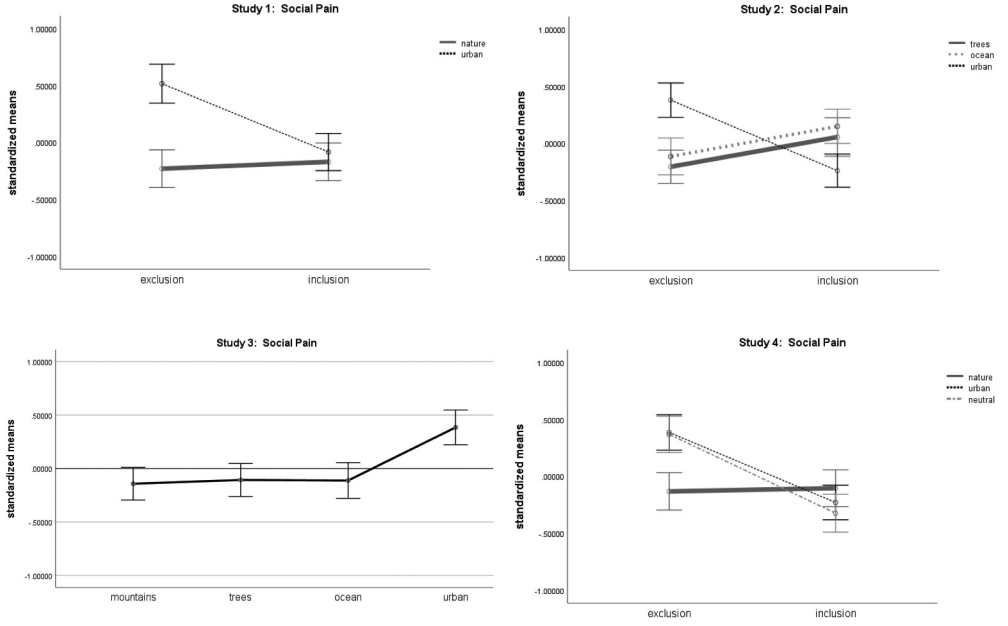


**Figure 4.** Results for social pain – Study 1, 2, 3, 4.

a 2 (social experience: exclusion vs. inclusion) x 3 (photo type: trees, oceans, urban) between-subjects design.

### *Procedure and measures*

Participants visited the lab in groups of 10–12 and were, as in Study 1, invited to participate in "two unrelated" studies (in reality, Study 2). Participants were first asked to sit separately and to write down the

names of 5 classmates currently in the lab with whom they would most like to be in a group with. These names were handed to the experimenter in confidence; the experimenter then left the room telling participants that he would return with the "results" based on the sheets. While participants waited for the group assignments, they completed filler questions from the Big Five Inventory. When the experimenter returned, each participant was given a sheet indicating either that "no one chose you to form a group with" or "everyone chose you to be an in-group member". In reality, participants were randomly assigned to either the exclusion or inclusion conditions. This group assignment approach to manipulate the experience of ostracism was adapted from previous research (Nezlek et al., 1997). This concluded the "first" study.

As in Study 1, participants were then invited to take part in the "second study" on "perception of pictures and well-being inventory". Participants were randomly assigned to view photos of either trees, oceans, or urban scenes. Consistent with Study 1, each photo type condition consisted of 14 photos; viewing instructions were consistent with those described for Study 1. After viewing the photos, participants completed the measures of affect, satisfaction of basic emotional needs, self-esteem, and social pain used in Study 1. Participants were then debriefed, thanked for their participation, and given their compensation gift.

## Results[4]

In order to determine the effect of photo type (trees vs. oceans vs. urban) and social experience (exclusion vs. inclusion) on our dependent variables, we first conducted a series of 3 × 2 ANOVAs. (See Table 2 for detailed statistics.) A significant (or marginally significant) interaction between photo type and social experience emerged for: affect balance ($\eta^2$ = .04 [.01, .09]), satisfaction of basic emotional needs ($\eta^2$ = .09 [.04, .14]), self-esteem ($\eta^2$ = .02 [.00, .05]), and social pain ($\eta^2$ = .04 [.01, .09]). We explored each interaction with an analysis of simple main effects of photo type (trees, ocean, urban). (See Figures 1-4.) Consistent with results from Study 1, participants who experienced social exclusion and then viewed nature photos of trees or oceans (vs. urban photos) reported significantly higher levels of affect balance ($\eta^2$ = .07 [.02, .13]; $\eta^2$ = .12 [.05, .20]), satisfaction of basic emotional needs ($\eta^2$ = .04 [.01, .10]; $\eta^2$ = .07 [.02, .14]), and self-esteem ($\eta^2$ = .05 [.01, .12]; $\eta^2$ = .04 [.01, .10]), and significantly lower levels of social pain ($\eta^2$ = .05 [.01, .11]; $\eta^2$ = .03 [.00, .08]). For participants who experienced social inclusion, no significant differences emerged for those who viewed nature (trees or oceans) vs. urban photos in affect balance and self-esteem ($\eta^2$ s = .00, .00, .00, .00). A marginally significant difference emerged in social pain for those who experienced social inclusion and who viewed oceans vs. urban photos ($\eta^2$ = .02 [.00, .06]), but a non-significant difference in social pain emerged for those who viewed trees vs. urban photos ($\eta^2$ = .01). However, participants who experienced social inclusion reported significantly higher levels of satisfaction of basic emotional needs if they viewed photos of urban scenes rather than photos of trees or oceans ($\eta^2$ = .06 [.01, .13]); ($\eta^2$ = .04 [.00, .09]). Viewing photos of trees vs. oceans did not result in any significant differences, in either the exclusion or inclusion condition, for any of our main dependent variables (exclusion: $\eta^2$ s = .01, .01, .00, .00; inclusion: $\eta^2$ s = .00, .00, .00, .00).

## Discussion

Findings supported our hypotheses regarding the beneficial effect that exposure to nature can have for people who have been socially excluded. Replicating results from Study 1, participants in Study 2 who viewed nature photos after experiencing social ostracism reported less social pain, in addition to greater affect balance and self-esteem than did those socially excluded participants who viewed urban photos. Also replicating results from Study 1, in relation to their experience of ostracism via the group "assignment", participants who viewed nature photos reported greater satisfaction of their basic emotional needs than did ostracized participants who viewed urban photos. These results provide additional evidence that exposure to nature can reduce the pain that socially ostracized people feel.

**Table 2.** Study 2– 2 (social experience) x 3 (photo type: trees, ocean, urban) ANOVAs.

| *Affect Balance* | ANOVA | | | | | | Simple Main Effects: Photo Type | | | | Exclusion | | | Inclusion | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $\alpha = 0.88$ | *F* (df) | *p* | $\eta^2$ | 90% CI | | | *F* (df) | *p* | $\eta^2$ | 90% CI | T | O | U | T | O | U |
| Social Experience | 9.03 (1, 243) | .003 | .04 | [.01,.08] | T.-O. | Excl. | 1.75 (1, 157) | .188 | .01 | [.00,.05] | *M* = | *M* = | *M* = | *M* = | *M* = | *M* = |
| Photo Type | 7.67 (2, 243) | .001 | .06 | [.02,.11] | | Incl. | 0.22 (1, 157) | .636 | .00 | [.00,.03] | 1.26 | 1.51 | 0.53 | 1.54 | 1.43 | 1.39 |
| Social * Photo | 5.53 (2, 243) | .004 | .04 | [.01,.09] | T.-U. | Excl. | 11.74 (1, 166) | .001 | .07 | [.02,.13] | *SD* = | *SD* = | *SD* = | *SD* = | *SD* = | *SD* = |
| | | | | | | Incl. | 0.08 (1, 166) | .783 | .00 | [.00,.02] | 0.93 | 0.87 | 0.93 | 0.84 | 1.89 | 1.02 |
| | | | | | O.-U. | Excl. | 22.26 (1, 166) | <.001 | .12 | [.05,.20] | *n* = | *n* = | *n* = | *n* = | *n* = | *n* = |
| | | | | | | Incl. | 0.02 (1, 166) | .881 | .00 | [.00,.01] | 46 | 37 | 43 | 34 | 43 | 46 |
| *Basic Emotional Needs Satisfaction* | ANOVA | | | | | | Simple Main Effects: Photo Type | | | | Exclusion | | | Inclusion | | |
| $\alpha = 0.71$ | *F* (df) | *p* | $\eta^2$ | 90% CI | | | *F* (df) | *p* | $\eta^2$ | 90% CI | T | O | U | T | O | U |
| Social Experience | 6.83 (1, 243) | .010 | .03 | [.00,.07] | T.-O. | Excl. | 1.15 (1, 157) | .285 | .01 | [.00,.04] | *M* = | *M* = | *M* = | *M* = | *M* = | *M* = |
| Photo Type | 0.53 (2, 243) | .591 | .00 | [.00,.02] | | Incl. | 0.05 (1, 157) | .825 | .00 | [.00,.01] | 3.42 | 3.54 | 3.13 | 3.42 | 3.45 | 3.74 |
| Social * Photo | 11.70 (2, 243) | <.001 | .09 | [.04,.14] | T.-U. | Excl. | 6.73 (1, 166) | .010 | .04 | [.01,.10] | *SD* = | *SD* = | *SD* = | *SD* = | *SD* = | *SD* = |
| | | | | | | Incl. | 10.56 (1, 166) | .001 | .00 | [.01,.13] | 0.50 | 0.53 | 0.73 | 0.35 | 0.61 | 0.57 |
| | | | | | O.-U. | Excl. | 12.17 (1, 166) | .001 | .07 | [.02,.14] | *n* = | *n* = | *n* = | *n* = | *n* = | *n* = |
| | | | | | | Incl. | 6.33 (1, 166) | .013 | .04 | [.00,.09] | 46 | 37 | 43 | 34 | 43 | 46 |
| *Self-Esteem* | ANOVA | | | | | | Simple Main Effects: Photo Type | | | | Exclusion | | | Inclusion | | |
| $\alpha = 0.74$ | *F* (df) | *p* | $\eta^2$ | 90% CI | | | *F* (df) | *p* | $\eta^2$ | 90% CI | T | O | U | T | O | U |
| Social Experience | 1.20 (1, 243) | .274 | .00 | [.00,.03] | T.-O. | Excl. | 0.19 (1, 157) | .663 | .00 | [.00,.02] | *M* = | *M* = | *M* = | *M* = | *M* = | *M* = |
| Photo Type | 3.24 (2, 243) | .041 | .03 | [.00,.06] | | Incl. | 0.17 (1, 157) | .682 | .00 | [.00,.02] | 2.56 | 2.54 | 2.38 | 2.52 | 2.54 | 2.52 |
| Social * Photo | 2.47 (2, 243) | .086 | .02 | [.00,.05] | T.-U. | Excl. | 9.48 (1, 166) | .002 | .05 | [.01,.12] | *SD* = | *SD* = | *SD* = | *SD* = | *SD* = | *SD* = |
| | | | | | | Incl. | 0.01 (1, 166) | .909 | .00 | [.00,.00] | 0.24 | 0.28 | 0.29 | 0.28 | 0.24 | 0.26 |
| | | | | | O.-U. | Excl. | 6.96 (1, 166) | .009 | .04 | [.01,.10] | *n* = | *n* = | *n* = | *n* = | *n* = | *n* = |
| | | | | | | Incl. | 0.18 (1, 166) | .669 | .00 | [.00,.02] | 46 | 37 | 43 | 34 | 43 | 46 |
| *Social Pain* | ANOVA | | | | | | Simple Main Effects: Photo Type | | | | Exclusion | | | Inclusion | | |
| $\alpha = 0.70$ | *F* (df) | *p* | $\eta^2$ | 90% CI | | | *F* (df) | *p* | $\eta^2$ | 90% CI | T | O | U | T | O | U |
| Social Experience | 0.06 (1, 243) | .804 | .00 | [.00,.01] | T.-O. | Excl. | 0.33 (1, 157) | .569 | .00 | [.00,.03] | *M* = | *M* = | *M* = | *M* = | *M* = | *M* = |
| Photo Type | 0.45 (2, 243) | .636 | .00 | [.00,.02] | | Incl. | 0.34 (1, 157) | .559 | .00 | [.00,.03] | 2.61 | 2.74 | 3.44 | 2.98 | 3.11 | 2.56 |
| Social * Photo | 5.68 (2, 243) | .004 | .04 | [.01,.09] | T.-U. | Excl. | 7.94 (1, 166) | .005 | .05 | [.01,.11] | *SD* = | *SD* = | *SD* = | *SD* = | *SD* = | *SD* = |
| | | | | | | Incl. | 2.21 (1, 166) | .139 | .01 | [.00,.06] | 1.02 | 1.05 | 1.66 | 1.33 | 1.72 | 1.39 |
| | | | | | O.-U. | Excl. | 4.36 (1, 166) | .033 | .03 | [.00,.08] | *n* = | *n* = | *n* = | *n* = | *n* = | *n* = |
| | | | | | | Incl. | 3.11 (1, 166) | .079 | .02 | [.00,.06] | 46 | 37 | 43 | 34 | 43 | 46 |

T: Trees; O: Ocean: U: Urban; T.-O.: Trees-Ocean; T.-U.: Trees-Urban; O.-U.: Ocean-Urban; Excl: Exclusion; Incl: Inclusion
As per Steiger (2004), 90% CI were calculated

Further, images of green trees and images of blue oceans were equally effective at mitigating the overall negative emotional impact of social exclusion.

## Study 3

In Study 3, we aimed to replicate and extend our findings from Study 1 and 2. We again hypothesized that socially ostracized participants who viewed nature (vs. urban) photos would report greater overall mood, satisfaction of basic emotional needs, and self-esteem, along with lower levels of social pain. We further predicted that, consistent with Study 2, no significant differences between the trees and oceans conditions would emerge for socially excluded participants on any of our dependent variables. In both Study 1 and 2, exposure to images of natural scenes helped to mitigate ostracism's aversive effects. However, the photos of trees and oceans used in Study 1 and 2 were somewhat mundane. Although a recent meta-analysis showed that exposure to tamed vs. untamed nature effected similar boosts to positive emotions (McMahan & Estes, 2015), research also suggests that viewing awe-evoking nature (prototypically high mountain peaks) triggers greater improvement in mood than does viewing more mundane (or less "awesome") images of nature (Joye & Bolderdijk, 2015). In light of these previous findings, in Study 3 we sought to compare the effects of viewing awesome nature (via images of mountains) to the effects of viewing trees and oceans with regard to mitigating the social pain and enhancing recovery from ostracism.

### Method

#### Participants and design

Undergraduate participants ($N = 155$, $M_{age} = 19.28$, $SD_{age} = 1.67$; 105 males, 50 females) from Zhejiang Ocean University in China completed Study 3 in exchange for partial course credit. Participants were randomly assigned to one of four conditions (trees, oceans, mountains, urban) in a 4-level between-subjects design.

#### Procedure and measures

Participants were asked to recall an experience of social exclusion and rejection (as per the ostracism manipulation in Study 1). Following recall, participants were randomly assigned to view photos of either trees, oceans, mountains, or urban scenes. Each photo-type condition again consisted of 14 photos and viewing instructions were consistent with those described for Study 1. After viewing the photos, participants completed the awe manipulation check item (see Supplemental Materials), and the measures of affect, satisfaction of basic emotional needs, self-esteem, and social pain noted previously. Participants were then debriefed, thanked for their participation, and given their compensation gift.

### Results[5]

In order to examine if levels of affect balance, satisfaction of basic emotional needs, self-esteem, and social pain differed among photo-type conditions, we conducted a series of ANOVAs with post-hoc analyses. (See Table 3 for detailed statistics). Consistent with results from Study 1 and 2, socially ostracized participants who viewed photos of trees or oceans (mundane nature) vs. viewing urban photos, reported significantly higher levels of affect balance ($d = 0.88$ [0.40, 1.33]; $d = 0.76$ [0.28, 1.23), satisfaction of basic emotional needs ($d = 0.67$ [0.21, 1.12]; $d = 0.76$ [0.28, 1.23]), and self-esteem ($d = 0.50$ [0.04, 0.95]; $d = 0.79$ [0.30, 1.26]), in addition to reporting significantly lower levels of social pain ($d = 0.46$ [0.01, 0.91]; $d = 0.48$ [0.01, 0.95]). Ostracized participants who viewed photos of mountains (awesome nature) vs. urban photos also reported significantly higher levels of affect balance ($d = 0.57$ [0.12, 1.02]) and significantly lower levels of social pain ($d = 0.49$ [0.04, 0.09]). However,

**Table 3.** Study 3 – One-way ANOVA with post-hoc analyses -between group differences.

| | | Post-hoc Statistics [95%CI] | | | | | | Exclusion | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ANOVA | Mountains to Urban | Trees to Urban | Oceans to Urban | Mountains to Trees | Mountains to Oceans | Trees to Oceans | M | T | O | U |
| AB | $F(3, 151) = 5.07$ | $p = .010$ | $p < .001$ | $p = .003$ | $p = .277$ | $p = .620$ | $p = .585$ | $M = 1.59$ | $M = 1.85$ | $M = 1.71$ | $M = 0.95$ |
| $\alpha = 0.90$ | $p = .002$ | $d = 0.57$ | $d = 0.88$ | $d = 0.76$ | $d = -0.22$ | $d = -0.10$ | $d = 0.13$ | $SD = 1.24$ | $SD = 1.08$ | $SD = 1.03$ | $SD = 0.96$ |
| | | [0.12, 1.02] | [0.40, 1.33] | [0.28, 1.23] | [−0.65, 0.21] | [−0.55, 0.35] | [−0.58, 0.32] | $n = 42$ | $n = 41$ | $n = 35$ | $n = 37$ |
| BNS | $F(3, 151) = 5.54$ | $p = .387$ | $p = .003$ | $p = .001$ | $p = .028$ | $p = .009$ | $p = .601$ | $M = 3.59$ | $M = 3.85$ | $M = 3.91$ | $M = 3.49$ |
| $\alpha = 0.74$ | $p = .001$ | $d = 0.17$ | $d = 0.67$ | $d = 0.76$ | $d = -0.52$ | $d = -0.62$ | $d = -0.13$ | $SD = 0.54$ | $SD = 0.46$ | $SD = 0.48$ | $SD = 0.61$ |
| | | [−0.27, 0.62] | [0.21, 1.12] | [0.28, 1.23] | [0.08, 0.95] | [0.16, 1.08] | [−0.58, 0.32] | $n = 42$ | $n = 41$ | $n = 35$ | $n = 37$ |
| SE | $F(3, 151) = 5.39$ | $p = .873$ | $p = .032$ | $p = .002$ | $p = .017$ | $p = .001$ | $p = .292$ | $M = 2.90$ | $M = 3.10$ | $M = 3.19$ | $M = 2.91$ |
| $\alpha = 0.76$ | $p = .001$ | $d = -0.03$ | $d = 0.50$ | $d = 0.79$ | $d = -0.52$ | $d = -0.80$ | $d = -0.22$ | $SD = 0.35$ | $SD = 0.42$ | $SD = 0.38$ | $SD = 0.33$ |
| | | [−0.47, 0.41] | [0.04, 0.95] | [0.30, 1.26] | [0.08, 0.95] | [0.32, 1.25] | [−0.67, 0.23] | $n = 42$ | $n = 41$ | $n = 35$ | $n = 37$ |
| SPain | $F(3, 151) = 2.48$ | $p = .019$ | $p = .029$ | $p = .034$ | $p = .872$ | $p = .894$ | $p = .983$ | $M = 2.54$ | $M = 2.59$ | $M = 2.58$ | $M = 3.28$ |
| $\alpha = 0.77$ | $p = .064$ | $d = -0.49$ | $d = -0.46$ | $d = -0.48$ | $d = -0.04$ | $d = -0.03$ | $d = 0.01$ | $SD = 1.39$ | $SD = 1.35$ | $SD = 1.23$ | $SD = 1.62$ |
| | | [0.04, 0.94] | [0.01, 0.91] | [0.01, 0.95] | [−0.47, 0.39] | [−0.48, 0.42] | [−0.46, 0.44] | $n = 42$ | $n = 41$ | $n = 35$ | $n = 37$ |

AB = Affect Balance; BNS = Basic Needs Satisfaction; SE – Self-Esteem; SPain = Social Pain; M = Mountains; T = Trees; O = Ocean; U = Urban

levels of satisfaction of basic emotional needs and self-esteem did not differ significantly between those who viewed awe-evoking-mountain vs. urban photos ($d$ = 0.17 [−0.27, 0.62]; $d$ = 0.03 [−0.47, 0.41]).

Comparisons were also made within nature photo types. Levels of affect balance and social pain were not significantly different across the mountains, trees, and oceans photo conditions ($d$s = 0.22, 0.10, 0.13, 0.04, 0.03, 0.01)). Levels of basic emotional needs satisfaction and self-esteem were not significantly different after viewing trees vs. oceans ($d$s = 0.13, 0.22); however, significant differences did emerge in the awe-evoking-mountains vs. ocean and in the awe-evoking-mountains vs. trees comparisons. Compared to viewing awesome mountain photos, basic emotional needs satisfaction and self-esteem were significantly higher after viewing tree ($d$ = 0.52 [0.08, 0.95]; $d$ = 0.52 [0.08, 0.95]) and ocean ($d$ = 0.62 [0.16, 1.08; $d$ = 0.80 [0.32, 1.25]) photos. (See Figures 1-4.)

Study 3 provided further support for our prediction that exposure to nature helps to ease the pain of social exclusion. Replicating findings from Study 1 and 2, socially ostracized participants who viewed photos of trees or oceans reported less social pain, in addition to greater affect balance and self-esteem compared to socially ostracized participants who viewed urban photos. Also replicating results from Study 1 and 2, in relation to their recalled experience of ostracism, participants who viewed photos of trees or oceans reported greater satisfaction of their basic emotional needs than did participants who viewed urban photos. Consistent with Study 2, photos of green trees and photos of blue oceans were equally effective at alleviating the negative emotional repercussions that stem from being socially excluded. Images of awe-evoking mountains were equally effective at reducing social pain and boosting affect balance of socially ostracized participants as were images of trees and oceans; however, viewing images of awesome mountains appeared to have little effect on self-esteem or on satisfaction of basic emotional needs in relation to the ostracizing event. These results provide additional evidence that exposure to nature (perhaps particularly mundane or less awe-evoking nature) can reduce the pain that socially ostracized people feel.

## Study 4

It is possible that the relative reductions in social pain, and boosts to positive affect, basic emotional needs satisfaction, and self-esteem evidenced in our first three studies were a reflection of urban scenes hindering recovery rather than nature scenes aiding recovery from social ostracism. In Study 4 ($N$ = 222), we followed the same procedure as in Study 1, but we added a control condition wherein participants viewed neutral images (as per Joye & Bolderdijk, 2015). The same measures of affect balance, satisfaction of basic emotional needs, and social pain were administered.[6] Results from Study 4 (see Figures 1-4) replicated results from Study 1, 2, and 3: participants who viewed photos of nature after recalling experiences of social ostracism reported less social pain and greater affect balance than did their counterparts who viewed urban or neutral photos. Further, in relation to the ostracizing events they recalled and reexperienced, participants who viewed nature photos reported greater satisfaction of their basic emotional needs than did those who viewed urban or neutral photos. No differences emerged between the urban and neutral conditions. These findings help substantiate our claim that exposure to nature can mitigate the painful and negative effects of being socially excluded.

## Internal meta-analysis for effect of viewing nature on reducing social pain

We conducted an internal random-effects meta-analysis across our four studies (as recommended by Goh et al., 2016) on the effect of viewing nature photos on reducing the social pain individuals felt from ostracism. Social pain scores of participants in the ostracism conditions who had viewed urban photos were compared to ostracized participants who had viewed nature photos. Trees and ocean conditions in Study 2 and 3 were collapsed to yield a single nature score. JAMOVI version 0.9.0.5 was used to conduct the analysis. Results of a Hedges random-effects meta-analysis revealed an overall effect size estimate of $d$ = 0.58 [0.37, 0.79], $Z$ = 5.31, $p$ < .001, $SE$ = 0.11. This effect is large in magnitude (Lipsey, 1990). A test for heterogeneity was not significant, $Q(3)$ = 1.25, $p$ = .740; $I^2$ = 0% (Higgins

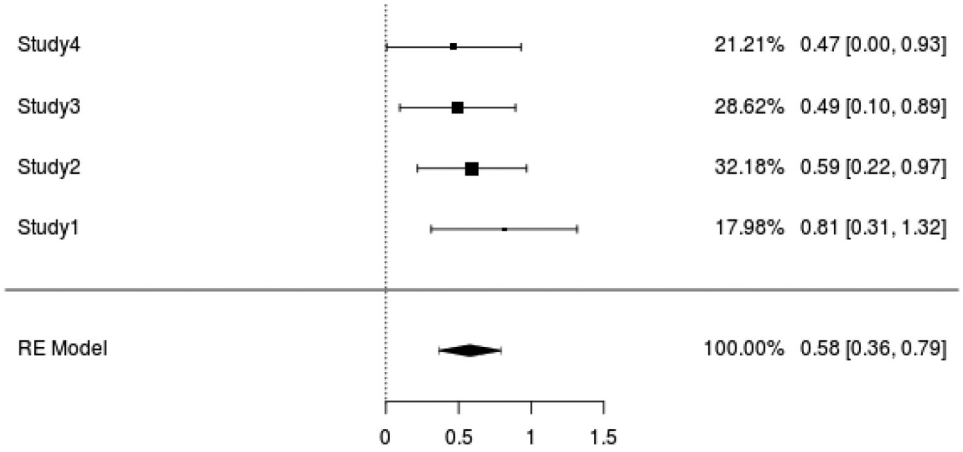


**Figure 5.** Forest plot of meta-analysis on effect of viewing nature (vs. urban) photos on reducing social pain in participants in ostracism conditions.

et al., 2003); effect sizes for social pain scores across the four studies ranged from $d = 0.47$ to 0.81. (See Figure 5.)

## General discussion

In this series of four studies, we examined if viewing nature photos could lessen the pain of, and promote recovery from, social ostracism. We also compared the relative efficacy of viewing different types of nature (i.e., green trees, blue oceans, awe-evoking mountains) in ameliorating the negative emotional effects of ostracism. Ostracism was manipulated via autobiographical recall (Study 1, 3, 4) and by current group assignment (Study 2). In all four studies, viewing photos of nature after experiencing ostracism assisted participants in recovering from the adverse emotional effects of being socially excluded and ignored. These findings suggest that exposure to nature aids in recovering from ostracism in two ways. Firstly, recovery was promoted via effects on current emotions; when ostracized participants were asked how they felt now, those who had viewed nature photos reported feeling less social pain, and greater overall mood and self-esteem, than did their counterparts who had viewed urban photos. Secondly, recovery was promoted via effects on how emotionally negative an ostracizing experience was remembered as being. When asked to retroactively think about how they felt about the ostracizing experience itself, participants who had viewed nature photos scored higher on satisfaction of basic emotional needs. Effect sizes ($0.34 < ds < 0.87$) in the medium to large range were evidenced (Lipsey, 1990; $\eta^2$ s converted to $d$s as per DeCoster, 2012). These effect sizes evidenced for viewing nature photos did not appear to be a result of urban scenes causing comparative distress, as no differences in affect balance, satisfaction of basic emotional needs, or social pain emerged for participants in Study 4 who had viewed urban vs. neutral photos. An internal meta-analysis across the four studies estimated a large effect size ($d = 0.58$) for nature's attenuating effect on feelings of social pain from being ostracized.

Photos of green nature (trees) and photos of blue nature (oceans) were equally effective, in both Study 2 and 3, at reducing current social pain, at bolstering current overall mood and self-esteem, and at enhancing satisfaction of basic emotional needs in relation to the ostracizing experience itself. Previous research has yielded inconsistent results with regard to the benefits associated with exposure to green and blue nature. A number of factors may have contributed to the inconsistency of these previous findings, such as the mixing of green and blue natural elements in the manipulations, unequal levels of remoteness or proximity of blue compared to green space, dissimilar levels of attractiveness or quality of blue and green space photos, differing opportunities for physical recreation in blue vs. green

space (see White et al., 2010; Wyles et al., 2017). In the current studies, photos of green nature were distinct from photos of blue nature, both sets of photos were of scenes equally attractive and of settings that were equally remote. It is interesting that exposure to photos of trees and oceans were equally effective at reducing the negative effects of ostracism in both Study 2 and 3, despite that participants in Study 3 were from a university situated in a coastal region.

The effects of viewing photos of awe-evoking nature (i.e., mountains) were somewhat inconsistent. Results of Study 3 indicated that while viewing photos of awe-inspiring mountains was equally effective as viewing photos of trees and oceans in reducing current levels of social pain and enhancing current mood, current levels of self-esteem were largely unaffected. Viewing photos of awe-evoking mountains had little effect on how participants viewed satisfaction of their basic emotional needs in relation to a particular instance of ostracism. Awe is an emotion comprising a mix of positive and negative emotions; indeed the Chinese term for awe is a combination of respect and fear (Gordon et al., 2017). Given that participants in Study 3 were from a coastal region of China, we speculate that perhaps they felt more "at home" when viewing trees and oceans, and/or more threatened when viewing awe-evoking mountains. Previous research has suggested that the threatening aspect of awe will be more pronounced in cultures in which mixed emotional states are more common (Bagozzi et al., 1999; Shiota et al., 2011; see also Lomas, 2016). This may have translated to lower feelings of satisfaction of basic emotional needs while also still providing the mood-enhancing and pain-reducing benefits so widely documented in nature literature.

As with all studies, the current studies have limitations. Our samples were undergraduates in China, possibly inhibiting the generalizability of our findings. However, our results replicated across four studies and are consistent with the well-documented salutogenic effects of exposure to nature (see reviews Capaldi et al., 2015; Howell & Passmore, 2013; Ohly et al., 2016; Russell et al., 2013). Although Study 4 included a neutral condition, future research in this area would benefit from including a full complement of pre-intervention assessments, allowing researchers to measure the degree to which viewing nature shifts levels of social pain. Inclusion of additional neutral conditions (i.e., neither inclusion nor exclusion, neither nature nor urban) would further help to illuminate the impact of exposure to nature on mitigating the negative effects of ostracism. We could have asked participants how long ago the event they recalled occurred (Study 1, 3, 4). Doing so in future research would allow for testing of any moderating effects of time on nature's ability to impact the perception of feelings of belonging, sense of self-esteem, and having a meaningful existence that being ostracized impacted.

Limitations notwithstanding, across the four studies, the impact of exposure to nature on aiding in recovery from adverse effects of ostracism was striking. Merely viewing photographs of nature (in particular photos of trees or oceans) lessened the painful sting of being socially excluded and ignored. These results are important; while previous studies have established the impact of exposure to nature on alleviating physical pain (e.g., Ulrich, 1984), to our knowledge the current studies are the first to provide experimental evidence that exposure to nature can also alleviate social pain. Perhaps Derek Jarman (1992) was wrong when he wrote that physical "pain can be alleviated by morphine but the pain of social ostracism cannot be taken away" (p. 113). Results of the current four studies suggest that nature can, if not remove, at least lessen the pain of social ostracism.

## Notes

1. All materials, stimuli, and data related to the studies described in this manuscript are freely available on the OSF page at https://osf.io/6xv3t/?view_only=ad5559d16ce74f62b3206b0cd4148cd2. Please note that, although the studies were conducted in Chinese, we have uploaded English versions of all materials to make them accessible to a wider audience.
2. For simplicity, given that affect, self-esteem, and social pain were each assessed at the current state level, we forgo noting "state" in front of these terms in the manuscript. Similarly, all references to basic emotional needs satisfaction refer to a retrospective assessment of what was felt at the time.
3. As per Steiger (2004), 90% CI were calculated.
4. As per Steiger (2004), 90% CI were calculated.

5. As per convention for *d* effect size, 95%CI were calculated.
6. For brevity, we provide only a summary of results from Study 4. Complete descriptives, analyses, and results are provided in the Supplemental Materials.

## Acknowledgements

We would like to thank the critical, detailed review and recommendations provided by the two anonymous reviewers and the editor of The Journal of Social Psychology on an earlier version of this manuscript.

## Disclosure statement

No potential conflict of interest was reported by the authors.

## Data availability

The data described in this article are openly available in the Open Science Framework at https://osf.io/nbh6u.

## Open scholarship

This article has earned the Center for Open Science badges for Open Data and Open Materials through Open Practices Disclosure. The data and materials are openly accessible at https://osf.io/nbh6u.

## Funding

This work was supported by the Department of Education of Zhejiang Province [2018QN001].

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