Enhancement of Convergent Creativity Following a Multiday Wilderness Experience

Frank M. Ferraro III

Department of Psychology, Nebraska Wesleyan University, Lincoln, Nebraska.

Abstract

Contact with nature has been shown to improve a variety of psychological indices. The current study tested convergent creativity in undergraduate students following a 6-day wilderness trip to the Boundary Waters Canoe Area Wilderness (BWCAW). An indoor control group was also tested. The students taking the BWCAW trip had significantly more correct solutions on the Remote Associates Test (RAT) compared to the indoor condition. The results contribute to a growing interest in the cognitive benefits of the outdoors by demonstrating that nature immersion can improve correct solutions on a convergent creativity test. Limitations include self-selection issues and lack of rigorous control over extraneous variables while in the wilderness environment. Nonetheless, applications of this data may be important for providing natural experiences for students as a strategy for ensuring healthy cognition in ever-increasing urban environments. Key Words: Convergent creativity—Nature immersion—Remote Associates Test—Wilderness.

Exposure to nature has been shown to improve a variety of psychological constructs. Studies have shown the restorative aspects of nature exposure on multiple measures of cognition, including enhanced directed attention (Berman et al., 2008; Cimprich, 1993; Tennessen & Cimprich, 1995), greater attentional capacity (Berto, 2005; Staats et al., 2003), decreased impulsivity (Berry et al., 2014), and stronger long-term memory function (Pilotti et al., 2014). These findings support the Attention Restoration Theory proposed by Kaplan (1995). Attention Restoration Theory posits that natural environments elicit soft fascination (less directed attention), which yields recovery of cognitive processes that have become fatigued due to constant vigilance and attention. It is important to note that nature exposure has been broadly defined in the literature, ranging from viewing images of nature on computer screens to briefly visiting a variety of outdoor locations.

While nature exposure can produce cognitive enhancements, it is important to know whether the psychological benefits extend to spending significant time (usually more than a day) directly immersed in nature. Fredrickson and Anderson (1999) reported that spiritual inspiration was enhanced in women that completed outdoor backpacking trips to Minnesota or Arizona (trips ranged from 6 to 7 days). Wilderness backpacking trips in California were shown to improve proofreading performance after a 4–7 day experience (Hartig et al., 1991). In addition, some interesting findings have emerged from Japan showing that spending multiple days in forest regions reduces blood pressure, pulse rate, and hormonal markers of stress (Park et al., 2007; Tsunetsugu et al., 2010). Recently, a field study indicated that sixth graders who spent 5 days at an overnight camp showed improved recognition of nonverbal emotional cues compared to a control group that stayed at school (Uhls et al., 2014).

Nature immersion also appears to have a positive benefit on human creativity. Atchley, Strayer, and Atchley (2012) documented that a wilderness setting enhanced creativity responses by using an objective test of creativity. Different groups of participants completed a variation of the Remote Associates Test (RAT; Mednick 1962; Mednick & Mednick, 1967, with additional items from Bowers et al., 1990) while on hiking trips in Alaska, Colorado, Maine, or Washington. Atchley et al. (2012) showed that the number of correct responses on the RAT increased after 4 days of immersion in wilderness environments. The current study aimed to replicate the direct

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effects of spending time in nature on convergent creativity (measured by the RAT, see Method for explanation) by using a multiday canoe trip to northeastern Minnesota. We also decided to incorporate an indoor control group as a between-subject comparison, which was not used in Atchley et al. (2012). Based on Atchley et al. (2012), it was hypothesized that convergent creativity responses would be significantly higher for undergraduate students after a 6-day wilderness trip (outdoor group) compared to students that were tested exclusively in a classroom setting (indoor group).

Method

Participants

Twenty-five undergraduate students from a small, private, liberal arts university served as participants for the study. The majority of students were White/Caucasian ($n = 22$), with other ethnicities including Black/African American ($n = 1$), Asian/Pacific Islander ($n = 1$), and Hispanic/Latino ($n = 1$). All procedures were approved by the Psychology Department Research Review Board prior to the start of the study. Participants completed an informed consent sheet if over 19 years of age. If under 19, a parent or legal guardian completed the form and sent it to the researcher. Students in the outdoor group were individuals that signed up for a first-year seminar course on wilderness. An additional university travel/safety waiver was required and completed by each student taking the trip. The indoor/control group were first-year students enrolled in a seminar course on abnormal psychology.

Materials and procedure

All participants were given a 10-item RAT and were allowed 10 min to complete the test. The RAT consists of three words (triads), and the task is to write a fourth solution word that is related to the triad (e.g., Falling, Actor, Dust. Solution = Star). The RAT was developed by Mednick (1962) to test associative aspects of creativity in a domain-general manner. The RAT was first used to evaluate creative abilities of psychology graduate students at the University of Michigan (Mednick, 1962). While the RAT has been used primarily to test creativity and insight (Ansburg, 2000; Storm et al., 2011), it has also been used to assess psychopathologies (Fodor, 1999), test reactions to positive affect (Mikulincer & Sheffi, 2000), and evaluate perceptions of success and failure (Vohs & Heatherton, 2001). The RAT has a single, correct solution, unlike divergent creativity tests (e.g., Guilford's Alternative Uses Test, Guilford, 1967). There are also artistic and self-assessment tests used in the field, but they tend to have subjective scoring qualities. The purpose of the current study was to investigate whether nature immersion can improve an objective and convergent measure of creativity, as opposed to divergent, artistic, or self-assessed creative processes.

The researcher obtained one set of RAT items that were used by Atchley et al. (2012) to measure creativity (see Table 1). The 10 RAT questions were randomized for all students to control for order effects. A brief RAT pretest (3 random items not used in the actual study) was given to both the indoor and outdoor groups to familiarize students with the test conditions. The pretests occurred in a standard college classroom (movable single desks with a podium and video screen at front) for both the indoor and outdoor groups. An initial t test confirmed that pretest scores were not significantly different between the groups: $M_{\text{outdoor}} = 1.68$, $SD = .25$, $M_{\text{indoor}} = 1.75$, $SD = .29$, $p > .05$.

Undergraduate students enrolled in a first-year seminar course ($n = 11$, $M_{\text{age}} = 18.27$, $SD = 1.05$) were administered the RAT at the end of the 6-day Boundary Waters Canoe Area Wilderness (BWCAW) trip (note: testing occurred outside, near a take-out point along a lake). An indoor control group ($n = 14$, $M_{\text{age}} = 18.36$, $SD = .97$) of first-year students were also given the RAT 6 days after the pretest, to match the temporal sequence of the outdoor condition.

Students on the BWCAW trip did not have access to cell phones or other multimedia technology for 6 days. These students were instructed to leave all technological devices in the travel van. This procedure was done for two reasons: First, cell phone coverage does not exist in many areas of the BWCAW, and electronic devices can

Table 1. Remote Associates Test with Solution Probabilities

TRIAD	SOLUTION	*p*(UNSOLVED)
Widow Bite Monkey	Spider	.25
Coin Quick Spoon	Silver	.30
Playing Credit Report	Card	.40
Room Blood Salts	Bath	.40
Water Tobacco Stove	Pipe	.40
Barrel Root Belly	Beer	.50
Hall Car Swimming	Pool	.60
Board Magic Death	Black	.65
Magic Plush Floor	Carpet	.70
Shopping Washer Picture	Window	.75

Note. Solution probabilities from Mednick (1962); Mednick and Mednick (1967); and Bowers, Regehr, Balthazard, and Parker (1990).

easily be damaged by water while on the trip. Second, previous data (Atchley et al., 2012) suggest that creativity may increase while outdoors due to the participants' lack of technology use. Participants were given a verbal and written debriefing at the conclusion of the study. Creativity data were analyzed using an independent samples *t* test. The level of statistical significance was set at $p < .05$.

Results

Statistical analyses revealed that the outdoor group ($M = 7.45$, $SEM = .45$) solved significantly more RAT items than the indoor condition ($M = 5.00$, $SEM = .46$), $t(23) = 3.68$, $p < .001$, $d = 1.47$ (see Fig. 1). The calculated effect size is considered large (Cohen, 1988) and indicates that the outdoor condition had creativity scores 1.47 standard deviations above the indoor group. Examination of the data set revealed that the outdoor condition had a range of scores from 5 to 10 items correct with a mode of 7. RAT scores from the indoor group ranged from 1 to 7 with a mode of 6. A Levene's test for equality of variances was conducted on the data, and equal variances was assumed ($F = .34$, $p > .05$). This is important, as conducting a *t* test on a small sample could produce a Type I error if the data is not normally distributed. However, because the Levene's test was not statistically significant, equal variances were assumed, indicating that our small data set did not violate this assumption of the independent *t* test.

Discussion

As humans shift to living predominately in urban settings, it is important that we maintain a connection to undisturbed natural environments to promote psychological health (Galea et al., 2005). The results of the current study indicate multiday wilderness experiences may aid convergent creativity ability. A significant increase in creativity (measured by selected items from the RAT) was found in first-year students completing a BWCAW trip compared to an indoor control group. Interestingly, the percentage increase (the calculated percentage difference between outdoor and indoor RAT scores) seen in the current study (49%) is similar to the cognitive improvements published by Atchley et al. (2012), showing nearly a 47% increase in RAT scores in an outdoor hiking condition. It seems that multiday nature immersion yields similar benefits to solving the RAT despite testing in different outdoor conditions such as mountainous hiking (Atchley et al., 2012) or the portaging and canoeing features of the BWCA trip. A strength of the current study is that pretest creativity scores for both the indoor and outdoor groups were not significantly different. Only after a multiday wilderness experience did the outdoor group show a significant increase in correct RAT items, establishing temporal precedence of the nature effect.

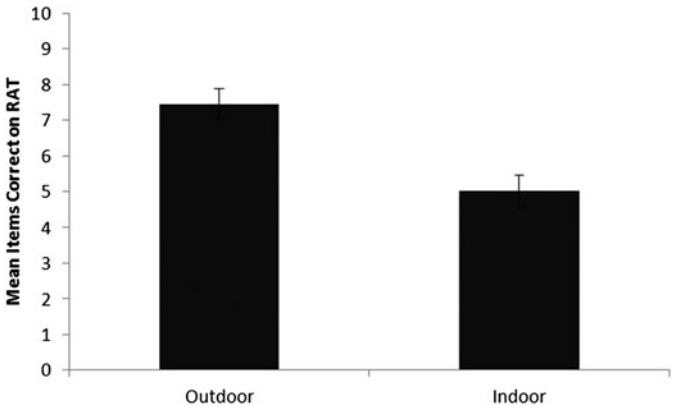

Fig. 1. Mean (±*SEM*) correct responses on the RAT in outdoor and indoor groups.

Another explanation for increased creative solutions in the outdoor condition may be the lack of technology use for several days. Preliminary research indicates that higher levels of texting are associated with shallower cognitive and moral reasoning (Trapnell & Sinclair, 2012). It is intriguing that some aspects of human creativity may be improved simply by abstaining from technology use for multiple days. More data is needed to support whether the causal factor is technology removal, nature immersion, or some combination of both factors.

Nature may allow for restoration of prefrontal cortex functionality. The prefrontal region is implicated in executive cognitive tasks such as planning, decision making, impulse control, and sustained attention (Alvarez & Emory, 2006). Nature may be rejuvenating to the prefrontal cortex based on recent theorizing that outdoor scenes provide "soft" fascination/attention as opposed to the direct and alerting attentional stimuli often encountered in urban environments (Kaplan, 1995). Further, advancements in neuroscience research indicate that the human brain has a "default mode" when people experience wakeful rest (Immordino-Yang et al., 2012; Raichle et al., 2001). The default mode is a network of brain regions (subdivisions of the prefrontal cortex, cingulate cortex, inferior parietal cortex, and hippocampus) that are active during internally focused mental processing. It is possible that restful experiences in nature promote neural activation of this default network, which may contribute to attentional restoration. While no direct physiological measurements of the brain were collected in the current study, the results obtained here and in Atchley et al. (2012) provide a foundation to explore the neural underpinnings of the restorative benefits of nature on human cognition.

Limitations

The current study contained a small sample of first-year students; greater participation would increase the ability to generalize the findings to broader populations. However, a statistically significant nature effect was found coupled with a large effect size (Cohen, 1988). Despite the small number of participants, there was no violation of the equality of variances assumption of the *t* test (Levene's test was not significant). Therefore, the current findings are unlikely to be due to a Type I error. It is difficult to travel and supervise large numbers of undergraduate students on wilderness trips. Current university regulations and safety concerns make large travel groups prohibitive. Further, the BWCAW restricts the number of people and watercraft in the area to ensure a pristine environment for all that visit. The U.S. Forest Service (www.fs.usda.gov, 2014) strictly enforces that a total of nine people (and four watercraft) are allowed to gather anywhere in the BWCAW at one time. Therefore, while a larger sample size is desirable in many psychological studies, government regulations limit human access in the BWCAW. For these appropriate reasons, it is argued that a small sample size should be placed in the context that it allows the protection of a unique and ecologically important wilderness area.

It is possible that students' RAT scores increased because of a practice effect. It should be noted that our procedures attempted to control for practice effects by administering different RAT triads during the pre- and posttests. Further, we presented RAT triads that were varied for solution probability (.25% to .75%) based on normative data provided by Bowden and Jung-Beeman (2003) as a way to distribute question difficulty. These testing procedures are designed to minimize practice effects in behavioral testing, but we cannot claim that practice effects were totally eliminated. Lastly, the students that traveled in the outdoor group selected the wilderness course from other course options. It is possible that self-selection issues influenced this study in terms of increased interest for outdoor activity and greater desire to obtain restorative benefits from nature in students that were part of the outdoor condition.

Future directions

The present study has a high degree of ecological validity, but it is difficult to control for a variety of intervening factors that may influence creative thinking. Future studies should aim to control potential confounding variables that occurred in the outdoor condition such as increased physical activity, changes in diet, and alterations in sleeping habits. In addition, it is unclear how long nature restoration effects last. While some findings suggest the onset of restorative effects within an hour or less (Berman et al., 2008), the duration of the cognitive benefits are not typically examined. Whether cognitive benefits extend for periods of time after people leave wilderness areas is unknown, and more data in this area is needed.

Conclusions

Nature immersion may be one strategy to enhance objective creativity responses in young adults. The current findings may be expanded to how nature could help improve student undergraduate experiences. Providing outdoor green spaces and views on a university campus is not just an appealing aesthetic consideration; they are critical features to promote healthy cognitive functioning (Felsten, 2009). Several levels of outdoor experiences (e.g., nature trails, campus arboretums, and wilderness trips) could provide additional benefits such as fewer stress-related visits to university or college health centers (based on benefits reported by Ulrich, 1983; Ulrich et al., 1991; Seitz et al., 2014). Also, buildings with windows displaying outdoor views can be relaxing to humans (Kahn et al., 2008). Growing evidence also points to the importance of nature exposure as a therapeutic strategy to reduce depression and anxiety and improve health and well-being (Frumkin & Jackson, 2014; Walsh, 2011). It should be noted that not all aspects of nature are judged to be safe by people (Gatersleben & Andrews, 2013), so careful consideration should be given to the way nature is offered. Finally, significant challenges exist for researchers in this area, including controlling for confounding variables, obtaining more representative samples, quantifying the level of nature exposure/immersion, expanding outcomes beyond health measures, and applying our findings to the whole planet (Frumkin & Jackson, 2014). Clearly if we are to offer practical strategies for aiding human health and cognition, we will need to conduct sound and innovative research immediately.

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Address correspondence to:
Frank M. Ferraro III
Nebraska Wesleyan University
Department of Psychology
5000 St. Paul Ave.
Lincoln, NE 68504

E-mail: fferraro@nebrwesleyan.edu

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