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The Influence of Natural Sounds on Attention Restoration

Lauren C. Abbott
Derrick Taff
Peter Newman
Jacob A. Benfield
Andrew J. Mowen

EXECUTIVE SUMMARY: Parks and protected areas offer refuge from the fatigue of daily life. An existing body of literature provides evidence that experiences in nature can promote restoration and improve overall health and well-being. Previous research on sounds in national parks has determined that manmade sounds negatively impact visitors' enjoyment, as well as, their assessment of the landscape. Additionally, previous studies have indicated that experiencing the restorative sounds of nature is important to visitors in national parks, and despite the growing body of protected area soundscape-focused research, very little attention has been placed on the relationship between natural sounds and cognitive health. As anthropogenic sounds and human-caused noise continues to increase in national parks, it is imperative to understand how these sounds influence visitor experience. This laboratory simulation aimed to increase understanding regarding the positive effects of natural sound on attention restoration. Using an experimental design, the researchers tested the effects of natural and anthropogenic sound, on attention restoration by having participants complete cognitive tasks after exposure to various sound clips or with no sound present. Based on previous studies, the researchers hypothesized that participants exposed to a natural sound condition would score higher on a cognitive task than those exposed to anthropogenic sound conditions. The relationship in mean cognitive performance scores between participants in the natural, anthropogenic, and control sound conditions were found to be approaching statistical significance. Findings suggested that participants who received the natural sound condition outperformed those in the no sound or control condition. Results from the study indicate that natural sounds can potentially facilitate attention restoration. Outcomes of this study provide a better understanding of how parks can serve holistically as places for human, environmental, and ecological health, as specifically measured through the role of natural sounds on recovery from mental fatigue. In addition, gaining a better understanding of the benefits natural sounds can have on restoration from mental fatigue will further validate the protection of park soundscapes. Finally, this research will help park and protected area managers, specific programs and initiatives, such as the Healthy Parks Healthy People and the Natural Sounds and Night Skies Division, develop plans and policies that aim to provide visitors with a beneficial, cognitively restorative soundscape experience.

KEYWORDS: *Natural sounds, national parks, well-being, management, noise, recovery*

AUTHORS: Lauren C. Abbott is with the Recreation, Park and Tourism Management and Human Dimensions of Natural Resources and the Environment Departments at Pennsylvania State University, lca132@psu.edu. Derrick Taff is with the Recreation, Park and Tourism Department at Pennsylvania State University. Peter Newman is with the Recreation, Park, and Tourism Management Department at Pennsylvania State University. Jacob A. Benfield is with the Department of Psychological and Social Sciences at Pennsylvania State University. Andrew J. Mowen is with the Recreation, Park, and Tourism Management Department at Pennsylvania State University.

Introduction

The U.S. National Park Service (NPS) manages the world's largest and most complex group of protected areas, offering parks, monuments, preserves, reserves, seashores, lakeshores, historic parks, battlefields, parkways, scenic and historic trails, memorials, recreation areas, scientific reserves, and other protected areas. Beyond traditional values such as recreation and scenic beauty, parks are increasingly being assessed for the ecosystem services they provide, and measured through the lens of coupled, environmental and social health. The idea that parks can influence human health and well-being is not new. Historically, NPS units were promoted as destinations where individuals could recover physically and mentally. For example, during World War II, the Ahwahnee Hotel in Yosemite served as a Navy hospital intended for neuro-psychiatric rehabilitation because of the peaceful setting within the park (McDonnell, 2007; NPS, n.d.). More recently, researchers are quantifying the benefits of parks to human health and well-being. A limited yet growing body of research suggests that the unique and unparalleled ecological features that can be experienced in national parks, such as natural sounds, can foster well-being, leading to initiatives such as the Healthy Parks Healthy People (HPHP) program in 2011. Subsequently, the HPHP Science Plan was developed to identify research gaps including determining and evaluating health resources, documenting and understanding the link between the environment and physical and mental health and well-being, evaluating nutrition, improving socioecological health and communication strategies, and establishing metrics for long-term evaluation (NPS HPHP Science Plan, 2013).

Several theories have been developed to explain the positive interaction between nature and humans. This paper focuses on Attention Restoration Theory (ART; Kaplan, 1995; Kaplan & Kaplan, 1989). Within this theory, restoration refers to recovery from directed attentional fatigue. According to Stephen Kaplan (1987), the mental fatigue that occurs from our busy lives can cause us to lose the ability to focus, control our emotions, and make clear decisions. Restoration from this type of mental fatigue can transpire from spending time in a natural setting or even sitting near a window with a natural view (Berman, Jonides, & Kaplan, 2008; Hartig, Mang, & Evans, 1991; Kaplan, 1995; Kaplan & Kaplan, 1989). National parks and protected areas also serve as places where one can escape the fatigue caused by daily life and restore the mind and body (NPS HPHP Science Plan, 2013).

An important aspect of a park experience is the auditory experience. A primary motivation for visitors to national parks is the enjoyment of natural quiet and the sounds of nature (McDonald, Baumgartner, & Iachan, 1995). However, as park visitation increases, so do anthropogenic sounds. Earlier studies on sounds in national parks have indicated the negative impact of noise on visitors' enjoyment (Pilcher, Newman, & Manning, 2009) and landscape assessment (Weinzimmer et al., 2014). However, the field of park soundscapes research lacks information regarding how anthropogenic and natural sounds

impact restoration. Sounds such as birdsong, water, and wind can provide more than a pleasant listening experience; they may improve cognitive performance and replenish the mind. Information that links natural sounds to attention restoration, measured by recovery from mental fatigue, will add a missing link to the existing body of literature and could potentially aid natural resource managers in further justifying the protection of natural sounds. Suggesting that natural sounds are not only important to visitors' experience, but are also important for their cognitive health can help managers promote the protection of natural sounds by developing plans and policies that aim to provide visitors with a beneficial, restorative soundscape experience. Therefore, the purpose of this study is to understand the influence of national park-based natural and anthropogenic sounds on attention restoration and cognitive health.

Attention Restoration Theory

Researchers have most commonly used ART to understand one restorative benefit of natural environments: recovery from directed attentional fatigue (Kaplan & Kaplan, 1989). This theory asserts that functioning in our daily lives requires directed attention, meaning that substantial effort is required to ignore distractions and focus on the task at hand which can gradually lead to trouble focusing, controlling emotions and making clear decisions. Sustained directed attention leads to cognitive depletion and mental fatigue (Kaplan & Kaplan, 1989). The early stages of ART theory development were based on past research providing evidence for splitting attention into two mechanisms: voluntary and involuntary attention. Voluntary attention or directed attention is described as requiring effort to eliminate outside stimuli, enhance focus, and leads to mental fatigue (Kaplan, 1995). Conversely, involuntary attention is triggered by fundamentally captivating stimuli that draw attention without necessitating active or directed focus. ART proposes that in order for an environment to facilitate recovery from mental fatigue, it needs to elicit fascination and involuntary attention. When this occurs, the mind can replenish and recover from mental fatigue.

According to ART, an environment can aid recovery from mental fatigue if it is composed of the following components: (1) it should elicit soft fascination or captivating stimuli that does not require directed attention, (2) it should elicit the feeling of being away or escaping from one's day-to-day life, (3) it should elicit extent or be engaging and enriching enough to capture one's complete attention, and (4) it should have compatibility which refers to how one should be able to accomplish their purpose in the given setting. Natural environments such as those found in National Parks are often capable of containing these four components and providing visitors with potential for restoration from mental fatigue.

While not soundscape focused, Berman, Jonides, and Kaplan (2008) assessed how different environments influenced ART as measured by recovery from directed attentional fatigue. Following a mentally fatiguing task, participants walked for 50-55 minutes in either a natural or urban environment. This research found that participants who walked in a natural environment had significantly higher cognitive test scores following the walk, than those who walked in an urban environment; suggesting the natural environments ability to improve directed attention. Because this study used actual environments to test subjects, the entire environment, both auditory and visual, was being experienced and subsequently impacting results.

Attention Restoration and Natural Sounds

There is substantial evidence that viewing natural environments provide humans with holistic benefits (Berto, 2005; Felsten, 2009; Hartig et al., 1991; Hartig et al., 2003; Kaplan & Kaplan, 1989; Kaplan & Talbot, 1983; Tennessen & Cimprich, 1995), with the primary outcomes either being related to stress and emotional recovery or to the restoration of directed attention following fatigue. Specific to auditory stimulus rather than purely visual access to nature, much of the research to date has focused on emotional or stress recovery following unpleasant or stressful events. For example, Benfield, Taff, Newman,

and Smyth (2014) determined that natural sounds, independent of viewing natural scenery, can improve participant's mood after viewing a disgusting video. It was also shown that the addition of human sounds to the natural soundscape nullified the mood recovery observed in the natural condition. Similarly, Alvarsson, Wiens, and Nilsson (2010) tested the influence of sounds on the rate of recovery from a stressful work situation as measured through skin conductance levels. Those study participants exposed to natural sound tended to recover faster than those exposed to traffic or ambient noise. More generally, researchers have shown that natural sounds can elicit positive emotions more than sounds containing human elements (Benfield, Bell, Troup, & Soderstrom, 2010).

However, within the domain of ART and cognitive restoration, the research on natural soundscape is scarcer and less conclusive. Payne (2013) measured participants' self-report of sounds based on the Perceived Restorative Soundscape Scale (PRSS) which tests the potential restorative qualities of sound based on the four components of ART. This study found rural park sounds to be rated higher in potentially restorative ART qualities than urban park sounds. Similarly, Ratcliffe, Gatersleben, and Sowden (2013) used a qualitative methodology to explore the impacts of bird sounds on potential attention restoration and concluded that bird sounds may be related to the four components of ART. More experimental and direct tests of restorative soundscapes and cognitive ability are limited to possibly a single study.

Emfield and Neider (2014) tested the influence of both visual and auditory environments on ART. Laboratory participants were asked to complete a series of cognitive tasks to emulate mental fatigue. Participants were then randomly assigned to a restoration period where they were exposed to one of six conditions: urban scenery, natural scenery, urban sounds, natural sounds and a combination of both sights and sounds. To measure restoration, participants were then given the same series of cognitive tasks. Participants were also asked to rate their mood before and after the restoration exercise. Consistent with prior work on mood restoration, this study found that the natural sights and sounds improved participant mood. However, the cognitive restoration component of the study was not supportive of ART research on visual or auditory natural environments and did not result in a significant improvement or restoration on the cognitive measures for any of the conditions. Thus it appears that while researchers have been able to connect natural soundscapes with emotional and stress recovery, the connection between soundscapes, ART, and cognition generally has been less often studied and has been difficult to experimentally demonstrate.

Study Purpose and Hypotheses

While there is a substantial body of evidence demonstrating the restorative impact of the visual natural environment upon attention restoration, less is known about the benefits of natural sounds, particularly with regard to attention restoration and cognitive recovery. Benfield et al. (2010) measured the influence of sounds on memory, a function of cognition, but did not examine attention restoration specifically. In line with other studies on ART, this paper aims to examine the influence of natural and anthropogenic sounds on attention restoration as measured by cognitive performance. Further measurement of the effects natural sound has on attention, measured by cognitive performance, will help demonstrate the positive relationship between the natural environment and cognitive health.

The purpose of this study was to examine the influence of natural and anthropogenic sounds on restoration in a simulated park setting. Past studies in a similar context have been successful in describing the negative effects of noise on perceptions of park scenery and enjoyment (Benfield et al., 2010; Weinzimmer et al., 2014) and different types of parks (Rainbolt, Benfield, & Bell, 2012). Based on previous research that suggests visual access to natural settings can provide relief from mental fatigue and promote cognitive performance (Berman et al., 2008; Berto, 2005; Emfield & Neider, 2014; Holden & Mercer, 2014; Tennessen & Cimprich, 1995) the researchers hypothesized:

H_1 Natural sound will promote restoration in cognitive performance following a fatiguing task while anthropogenic noise will fail to show similar cognitive recovery on a cognitive task.

H_2 Participants who listen to natural sound will perform better on a cognitive performance task than the control group as measured by a cognitive task.

Methods

Study Location and Participants

This project was conducted in a research laboratory on the Pennsylvania State University's University Park campus, a large university in the northeast United States. One hundred and sixteen graduate and undergraduate students over the age of 18 were recruited on campus. Only participants who self-identified as having normal or corrected vision and hearing were accepted for participation.

Experimental Design

The experimental design was comprised of three separate steps. First, participants completed a mentally fatiguing depletion task. Second, participants were given time to recover while listening to one of three different sound conditions (natural, anthropogenic, or no sound) during a recovery period (See Table 1). Finally, participants completed a cognitive task to measure how well they recovered from the depletion task.

Depletion task. Similar to the methods used by Berman et al. (2008) and Emfield and Neider (2014), study participants were first asked to complete a cognitively-demanding task with the intention to induce mental fatigue so that recovery can be measured. Using a delayed free recall task, participants were verbally given a nine-digit number to be recalled and then asked to complete a questionnaire that required writing different numbers. Upon completion of the questionnaire (about 10-15 minutes), the participant was asked to recite, out loud, the nine-digit number, which the researcher recorded and later coded for accuracy. The procedure was then repeated with a different nine-digit number and a shorter questionnaire, only lasting about five to seven minutes. This task mentally fatigued participants by placing dual demands upon their attention (i.e., the demand to maintain one set of numbers while reporting and writing a competing set of numbers), in order to later measure attention with an alternative cognitive task (Emfield & Neider, 2014). The researchers pilot tested the depletion task to ensure its effectiveness in depleting participants.

Table 1

Sound Conditions and Sound Levels

Sound Condition	Sound Level dB(A)
Control	No sound (noise canceling headphones)
Natural	
Bird song and wind	60
Anthropogenic	
Bird song and wind	52.8
Propeller plane	66.6
Motorcycle	61.4

Recovery period. Participants were given a recovery period lasting seven minutes. The time for recovery was determined by the researchers' pilot data and other research using similar methods (Benfield et al., 2014; Emfield & Neider, 2014). During this time, participants were prompted to imagine that they were relaxing in a national park. A video taken from a meadow in Yosemite National Park was viewed on a large projection screen.

Utilizing a randomized sampling schedule (Vaske, 2008), participants listened to one of three soundscape conditions through noise-cancelling headphones (Bose Quiet Comfort 15 brand noise-canceling headphones). The three sound clips included (1) a control condition of no sound, (2) a natural clip, and (3) an anthropogenic clip (see Table 1).

The sound clips were prepared with assistance from the NPS's Natural Sounds and Night Skies Division and The Pennsylvania State University Acoustical Engineering Department. All clips were extracted from acoustic recordings in national parks. The natural sounds chosen for this experiment were wind and birdsong, which have been rated as highly pleasing in past studies (Pilcher et al., 2009). Editing and mixing were performed using Audacity®. The sounds levels for all three sound conditions were measured with a binaural head and torso simulator (Brüel & Kjær type 4100). Table 1 describes the sounds used and the sound level for each individual sound.

Subjects were randomly exposed to one of the three sound conditions (Table 1). Motorcycle and propeller plane sounds were chosen as a source of anthropogenic noise because these sounds have been rated as more annoying than other sounds in a natural setting (Kariel, 1990; Weinzimmer et al., 2014). Factors such as loudness and frequency of anthropogenic noise events were determined based on previous research (Benfield et al., 2010; Benfield et al., 2014). Moreover, anthropogenic sounds faded in and out of the sound clip to better imitate how these sounds are heard in a park setting. Both the natural and anthropogenic sound clips were played at a similar dB(A) so that loudness was not a conflicting stimuli.

Performance measure/cognitive task. The backwards digit-span task was used to measure recovery from mental fatigue. The purpose of this task was to measure directed attention performance, however, the task has been used to measure other cognitive functions such as memory (Conklin, Curtis, Katsanis, & Iacono, 2000). Ultimately, the backward digit-span task has been successful in measuring attention restoration and has been used in similar studies (Berman et al., 2008; Emfield & Neider, 2014), which is why it was deemed appropriate for this study. Participants were asked to listen to a digit sequence and were then asked to replicate the same sequence in backwards order. Digit sequences began with two digits and ascended up to eight digits. For example, the research assistant would read out loud to the participant a series of numbers such as, "1, 3, 5". The participant would then recite the same series back to the researcher, but in backwards order (e.g., "5, 3, 1"). The backwards digit-span score was based on the maximum number of digits the participant could recite backwards to the researcher, eliciting a score between two and eight.

Data Analysis

A between subjects design was used to test the potentially restorative effect of different sound conditions on attention restoration. To test H_1 a one-way analysis of variance (ANOVA) test was used to investigate significant differences between all three sound conditions based on the mean score for the backwards digit-span task (score between 2 and 8). H_2 was tested using two separate independent sample *t*-tests to identify differences in mean scores between both the natural and anthropogenic sound conditions and the control group. Means and *t*-values were reported. These data were analyzed using Statistical Packages for the Social Science (SPSS) version 20. For both hypotheses significance was tested at the .05 level. An adjustment for multiple comparisons was not used in the analysis of H_2. Hypotheses were developed based on similar studies and ART. Had the study been more exploratory, a correction would have been used to account for significance resulting in a Type I error[1].

Effect size was calculated to further describe the significance of the relationship between the control group and other sound conditions. According to Vaske (2008), the use of effect size can emphasize the strength of a relationship. The value of Cohen's *d* for the

[1]Other researchers have noted that adjusting significance levels increases the possibility of Type II error and reduces statistical power that could uncover real effects (Mayo & Cox, 2006; O'Keefe, 2003).

independent samples *t*-test comparing performance in the control condition to the natural sound condition was .60, which is classified as a medium to large correlation (Cohen, 1988). According to Cohen (1988), a ".5 correlation is about as high as they come in predictive effectiveness in applied psychology" (as cited in Vaske, 2008, p. 108). Therefore, the value of Cohen's *d* found here represents a strong relationship.

Results

The goal of this study was to measure attention restoration; therefore, participants who were not depleted and requiring recovery were excluded from the study. The researchers determined depletion based on the maximum number of digits the participant could recite following the questionnaire (the first task in the lab procedure). If the participant could memorize five or more digits on either test or recite four or more digits on both tests, they were coded as "depleted." Those who could not meet this requirement were coded "not depleted" and were not used in the analysis of these data. It was assumed that if participants failed to score moderately on the depletion task, then they did not retain the numbers and therefore did not experience mental depletion. A total of 93 participants were coded as "depleted". Twenty-three participants were not included in the data analysis (20%). The sample included more male participants than female (59% male and 41% female). The majority of participants were between the ages of 21 and 25 (61%), 31% were between the ages of 18 and 20, and 8% were 26 years of age and older.

Differences Between Sound Conditions (H_1)

The primary purpose of the data analysis was to understand the influence of sounds on attention restoration as measured by cognitive performance. A one-way analysis of variance (ANOVA) test was used to investigate significant differences between sound conditions (natural, anthropogenic, and control) based on the mean score for the backwards digit-span task (score between 2 and 8). With sound condition as the independent variable and mean backward digit span score as the dependent variable, we found the differences between the mean backward digit span score in the three sound conditions to be marginally significant ($p = .062$). This test did not fully support H_1 and participants who listened to the natural sound condition ($M = 6.14$, $SD = 1.14$) did not have significantly higher cognitive scores when compared to those who listened to anthropogenic sounds ($M = 6.03$, $SD = 1.28$) or control group ($M = 5.45$, $SD = 1.23$) when using a .05 criterion. However, the p-value observed was nearly at the assigned cut-off and the descriptive trend of the findings were consistent with predictions and existing theory suggesting that cognitive restoration could be occurring.

Restoration Relative to the Control Condition (H_2)

The results from H_1 were approaching formal significance, which led to further investigation of the effects of sound condition on cognitive performance. In H_2 we predicted that participants who listen to natural sounds will perform better on a cognitive performance task than the control group as measured by the backwards digits span task. In order to test this, we conducted two independent samples *t*-tests to compare attention restoration in participants who received the control condition with those who listened to the natural sounds and those who listened to anthropogenic sounds. First, we compared the natural sound condition to the control. We found that the natural sound group significantly outperformed the control ($t = -2.25$, $p<.027$). We also tested the difference between the anthropogenic sound condition and the control condition. No significant differences were shown in the anthropogenic sound condition ($t = -1.55$, $p > .05$). This pair of tests supports H_2; participants who listened to natural sounds had a more restorative experience than the control group, as measured by performance on the backward digit span task. A similar effect was not shown when comparing anthropogenic sounds to the control group.

Discussion

The aim of this study was to measure how natural and anthropogenic sounds influence attention restoration by measuring cognitive performance. The data was partially supportive of H_1. While traditional levels of statistical significance were not reached, both the descriptive trend of the data and the low *p*-value observed (.062) suggest that cognitive recovery was indeed occurring for some conditions and not others. Follow-up analyses (H_2) show that natural sounds outperformed the control condition on cognition, but anthropogenic sounds did not, which provided further evidence of natural sound-induced attention restoration.

These findings are different from those of Emfield and Neider's (2014) study, which found no significant differences between sound conditions, and are perhaps the first to demonstrate any form of soundscape induced cognitive restoration. Thus, these data partially support the assertion that natural sounds can promote recovery from mental fatigue, while anthropogenic sounds have no restorative effect. Similar to Berman et al. (2008), participants who experienced a natural condition performed better on a cognitive task than those who experienced an anthropogenic condition. While this study did use a visual stimulus (video from Yosemite National Park), all participants viewed the same scene, including the control group. Therefore suggesting, that the influence of sounds was independent of the visual. Data from this study determined that similar to viewing nature scenes or walking through a natural area, the sounds of nature can relieve the directional attentional fatigue caused by daily life. To the researchers' knowledge, findings from this study are the first of their kind.

While H_1 was found to be partially significant, there are potential issues related to the test not reaching statistical significance. The anthropogenic sound condition contained natural sounds overlaid with interruptions of motorcycle and propeller plane noise. The sound clip was developed in a way that imitated a park experience. Had the researchers developed a sound clip of solely anthropogenic noise, they might have found a stronger effect. Additionally, the small and relatively homogenous sample size might have contributed to an outcome that was approaching significance.

These data also supported the notion that natural sounds, specifically bird song and wind, promote restoration over hearing no sound (H_2). Based on a comparison of mean cognitive performance scores from the natural sound condition with the control condition, participants who listened to natural sounds significantly outperformed those who experienced to no sound. With mental recovery being the indicator of restoration, the natural sound group had an acoustic experience more conducive to recovery from mental fatigue than those in the control condition. Furthermore, when the anthropogenic sound condition was compared to the control, there was no effect. This further validates our suggestion that natural sounds encourage recovery from mental fatigue.

Management Implications

The main goal of this study was to understand the influence of natural and anthropogenic sounds on attention restoration. The methods used in this study were developed in a way that simulated a national park experience. During the recovery period, participants were shown a video from Yosemite National Park and prompted to imagine that they were actually in that scene. Additionally, the sound conditions were developed in a way that mimicked actual park experiences. The purpose of this methodology was to not only add information to existing academic literature, but to also offer real world application in parks and protected areas. For example, park and protected area managers can suggest places that are rich in natural sound for visitors seeking a cognitively restorative experience. Moreover, parks can designate quiet areas or zones of the park so that natural sounds can be heard by visitors. For example, as a result of soundscapes research in Muir Woods National Monument, the Cathedral Grove area is designated as a "quiet zone" and is a permanent part of the park's management strategy (Manning & Anderson, 2012; Stack, Newman, Manning, Aiken, & Fristrup, 2011).

Findings from this study also justify the importance of natural sounds and their protection in national parks and other protected areas. The Healthy Parks Healthy People initiative aims to understand the link between the natural environment and human health and well-being. The results from this study and others that have evaluated the benefits of natural sounds to well-being suggest that a park experience, rich in natural sounds, can benefit the mind (Benfield et al., 2014 & Weinzimmer et al., 2014).

Limitations and Future Studies

This study was limited by a few different factors. First, the demographic sampled was fairly homogenous. Like most laboratory studies in the social sciences field, we conveniently sampled undergraduate and graduate students. Additionally, the nature of undergraduate life might have resulted in testing participants who were cognitively depleted even before entering the lab. University students are spending their days attending lectures, studying, and balancing a social life, which probably leaves them mentally exhausted. In the future, it would be beneficial to test the same methods on a different demographic (e.g., children or older adults) to understand if natural sounds have the same effect on a wider range of individuals.

Because the purpose of this study was to understand how sounds in national parks could affect visitors, the researcher used a visual stimuli—a video of Yosemite National Park. The study did not determine if the sounds would be as restorative without the visible nature scene. Although all participants (including the control) received the same visual treatment, this study was limited in that sounds were not tested independent of a visual component. In the future, it would be beneficial to test the same methods without a nature scene, instead asking participants to sit in front of a blank wall, similar to the methods used by Benfield et al. (2014).

Future research that aims to understand the influence of natural sounds on human health and well-being can significantly contribute to the goals of the HPHP Science Plan and strengthen the connections between park environments and human health. If researchers can better understand the contribution of parks to well-being, managers will be able to further justify the importance of parks for both ecological and social health. The current study provides some evidence that natural sounds can provide a cognitively restorative experience, but future research expanding on this concept will provide useful information to park managers promoting natural areas as a place to restore the body and mind.

Conclusion

This study was successful in understanding the influence of natural and anthropogenic sounds on attention restoration. Based on previous literature that used natural scenery, both real and simulated, to suggest natural environments can restore participants from mental fatigue by measuring cognitive performance, the researchers hypothesized that natural sounds could have the same effect. Moreover, the study methods were designed so as to simulate a national park experience, to add information to the existing literature on the impacts of anthropogenic and natural sounds to park visitors. These data partially supported H_1 and fully supported H_2. Therefore, we conclude that natural sounds, specifically birdsong and wind, can provide relief from mental fatigue.

Ultimately, parks and protected areas serve as a place to conserve ecosystems for future enjoyment. Based on the findings of this study as well as other research examining the restorative qualities of nature, parks and protected areas can also serve as places to promote cognitive health and restoration. As visitor studies have discovered (Driver, Nash, & Haas, 1987; McDonald, Baumgartner, & Iachan, 1995), the experience of natural sound is an important motivation or experience preference for park visitors. Whether we are conscious of it or not, hearing bird song or wind rustling in an aspen grove are sounds that are not just enjoyable, but perhaps vital to attentional restoration in a fast-paced, multi-tasking society. Spending time in natural settings and listening to natural sounds can recover our mental fatigue, improving our ability to focus on important aspects of daily

living. These relationships are yet another reason that parks and protected areas serve as places to preserve ecosystems, as well as a place for humans to improve cognitive health.

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