



# Student performance and high school landscapes: Examining the links

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## ABSTRACT

High school students today are experiencing unprecedented levels of school-related stress. At the same time, a growing body of research has linked views of nature with restoration from mental fatigue and stress reduction. How important are such views for students while they are at school? This study investigated 101 public high schools in southeastern Michigan to examine the role played by the availability of nearby nature in student academic achievement and behavior. The analyses revealed consistent and systematically positive relationships between nature exposure and student performance. Specifically, views with greater quantities of trees and shrubs from cafeteria as well as classroom windows are positively associated with standardized test scores, graduation rates, percentages of students planning to attend a four-year college, and fewer occurrences of criminal behavior. In addition, large expanses of landscape lacking natural features are negatively related to these same test scores and college plans. These featureless landscapes included large areas of campus lawns, athletic fields, and parking lots. All analyses accounted for student socio-economic status and racial/ethnic makeup, building age, and size of school enrollment.

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## 1. Introduction

High school students have a great need for restorative and stress-reducing environments, and this need may be growing. School work loads and the competition that students face in the college application process have increased to unprecedented levels in recent years (Mundy, 2005; Ramírez, 2009; U.S. Department of Education, 2005). Research dealing with life events has cited school-related issues as the leading sources of stress for this age group (Ainslie et al., 1996; Kaiser Family Foundation, 2005; Stuart, 2006). In addition, high school dropout rates in major urban areas throughout the United States are high and student satisfaction with the high school experience has decreased significantly (Dillon, 2009; Freeman, 2004).

At the same time, a growing body of research has linked views of and access to nature with restoration from mental fatigue and stress reduction. With regard to children and teenagers, this nature-based restoration process has been associated with higher test scores (Heschong Mahone Group, 2003a), better attention levels among children suffering from attention-deficit hyperactivity disorder (Faber Taylor and Kuo, 2009; Faber Taylor et al., 2001; Kuo and Faber Taylor, 2004), and greater cognitive functioning (Wells,

2000). Researchers have also hypothesized that such restoration should be positively linked with better behavior. For example, findings have associated greater nature exposure with enhanced levels of self-discipline in children (Faber Taylor et al., 2002). In addition, both recovery from mental fatigue and stress were postulated to explain the positive connections found between the presence of indoor classroom plants and reductions in misbehaviors, feelings of unfriendliness, and hours of sick leave of junior high school students (Han, 2009). These cognitive, social, and behavior benefits found among children and younger teenagers, then, should translate into better overall high school student performance involving academic performance, interest in staying in school, and classroom behaviors.

How important is such contact with outdoor nature for high school students while they are at school? What features of the campus landscape have the most affect on student academic achievement and behavior? Surprisingly, there appears to be little information to answer these questions, particularly with respect to high school aged students.

### 1.1. Nature contact benefits in diverse settings

#### 1.1.1. School setting

As Owens (1997, p. 158) suggested, there has been “limited interest in improvements to the design of exterior spaces at high schools.” In the context of elementary schools, the Heschong Mahone Group (2003a) found that ample classroom window views (i.e., 100 sq. ft. of window area or greater per classroom) that

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included vegetation (i.e., primarily trees or shrubs) or human activity (e.g., playground, lunch area, parking lot), and objects in the far distance were associated with higher scores on standardized tests. Other studies in the grade school context have concentrated on playgrounds in preschool, kindergarten, and elementary school. These studies have found positive connections between natural playscapes and enhanced physical activity (Dyment and Bell, 2007), motor development (Fjørtoft, 2004), creative play behaviors (Dyment and Bell, 2007; Herrington and Studtmann, 1998; Tranter and Malone, 2004), environmental learning (Tranter and Malone, 2004), and preference as compared to traditional playgrounds (Ozdemir and Yilmaz, 2008).

### 1.1.2. Other settings

In the context of the present study, research in workplace settings may be the most pertinent as high school students spend many hours in school buildings. Studies have provided evidence that views of nature out of an office or factory are associated with increased employee productivity, enhanced feelings of job and life satisfaction, greater psychological and physical well-being, and reduced levels of frustration and stress (Heerwagen and Wise, 1998; Heschong Mahone Group, 2003b; Kaplan, 1993a; Leather et al., 1998; Shin, 2007).

In addition, the psychological, social, and physical health benefits of views of and access to nature for individuals have been shown in residential settings (De Vries et al., 2003; Faber Taylor et al., 2002; Gidlöf-Gunnarsson and Öhrström, 2007; Jackson, 2003; Kaplan, 2001; Kearney, 2006; Kuo, 2001; Kuo and Sullivan, 2001a,b; Kuo et al., 1998; Lee et al., 2008; Maas et al., 2009; Sullivan et al., 2004; Tzoulas et al., 2007; Wells, 2000; Wells and Evans, 2003) including college dormitories (Tennesen and Cimprich, 1995), prisons (e.g., Moore, 1981), and homes for elderly people (Ottosson and Grahn, 2005), and also hospital settings (Curtis et al., 2007; Ulrich, 1984).

A growing body of research, therefore, suggests that views of and experiences with nearby nature provide many benefits for individuals while at work, at home, imprisoned, or hospitalized. In spite of these studies, however, we know very little about how exposure to nature affects a tremendously important population – high school students – at a time in their development when their academic performance will set them on a life-course.

## 1.2. Explanations for these nature benefits

Researchers have advanced varied explanations for the benefits resulting from contact with nature. Two of the most widely cited explanations are the attention restoration and the psycho-evolutionary theories.

Attention restoration theory proposes that contact with nature has the potential to restore an individual's directed attention capabilities. Directed attention fatigue, or mental fatigue, occurs when the capacity to focus or concentrate is reduced by overuse. An individual experiencing such fatigue not only may have a decreased ability to concentrate, but also may become more irritable, distractible, impulsive, antisocial, accident prone, and stressed. This theory proposes that four sequential stages, which represent greater levels of restorativeness, are experienced during the process of complete mental restoration. These include "clearing the head" of miscellaneous thoughts, resting directed attention abilities, dealing with unresolved concerns, and finally reflecting on priorities, possibilities, values, actions, and goals. Reflection represents the final level of restorativeness, and "is the most demanding of all in terms of both the quality of the environment and the duration required" (Kaplan and Kaplan, 1989, p. 197). Natural environments possess qualities that are supportive of this restoration process (Kaplan and Kaplan, 1989; Kaplan, 1993b, 1995).

In addition, attention restoration theory proposes that restorative environments possess four important components, namely being away, extent, fascination, and compatibility (Kaplan and Kaplan, 1989; Kaplan, 1995). In terms of this study, exposure to greater levels of nature can provide students with enhanced senses of both psychological distance from school (being away) and immersion in conceptual surroundings of sufficient scope to sustain exploration (extent). Such exposure can also provide additional environmental features that are effortlessly engaging (fascination) and supportive of a student's need for mental restoration (compatibility).

Psycho-evolutionary theory posits that natural settings have a stress-reducing and calming effect on an individual. Immediate, subconscious emotional responses play a key role in an individual's initial reaction to the environment. Nature provides a visually pleasant physical surrounding that reduces stress by producing positive emotions, sustaining nontaxing attention, and restricting negative thoughts. Neurophysiological arousal is returned to more moderate levels, fostering an overall sense of well-being (Hartig et al., 1991; Ulrich et al., 1991).

In summary, the attention restoration theory concentrates on cognitive processes while the psycho-evolutionary theory focuses on emotionally based mechanisms. Nevertheless, both theories support the idea that nature functions well as a restorative and stress-reducing environment (Hartig et al., 2003).

## 1.3. Study overview

In light of the limited prior research, this study is necessarily exploratory. Many of the school indoor and outdoor characteristics that were utilized to assess student exposure and access to nature have not been investigated. In addition, this study will not investigate the possible mechanisms explaining how such nature contact improves student performance, but will utilize the explanations posited by researchers in contexts largely other than school settings.

The central proposition of this study is that increased exposure to nature will be positively associated with student performance, including both student academic achievement and behavior. This proposition was tested with the following hypotheses:

1. Higher levels of nature in the views that students have from the school buildings will be positively associated with student performance.
2. Higher levels of nature as determined by objectively measured campus landscape elements will be positively associated with student performance, in support of the more subjective measures utilized to investigate hypothesis #1.
3. Greater ability of students to view or come into direct contact with nature, calculated by investigating building features and school policy, will be positively associated with student performance.
4. A statistical interaction exists between the size of school building windows and the levels of nature in the views afforded with regard to student performance. This interaction effect will be positive with the effect of larger windows increasing across nature levels, and the effect of higher nature levels increasing across window size.

## 2. Method

### 2.1. High schools studied

The high schools studied consisted of 101 public schools located in southeastern Michigan, USA (Fig. 1). The schools were

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