

---

# TREES & TEST SCORES

---

## Impact of Window Views on Recovery from Mental Fatigue & Stress

William Sullivan and Dongying Li



Figure 1. Millions of students in America attend schools that have barren, treeless landscapes (left above). The results of this study indicate that the costs of attending such schools are considerable. Students recovery from mental fatigue and stress more quickly when they learn in schools that have views to trees.

---

### Significance

U.S. test scores have dropped in recent years and are lower than the average for many developed countries. This crisis has led researchers, educators, and policy makers to seek solutions to improve academic performance. Most focus on improving curriculum, training teachers, and increasing accountability, but some focus on creating environments that are more conducive to learning. Characteristics of the physical environment—such as lighting, noise, and maintenance—can greatly impact academic performance.

Unfortunately, very few studies have examined the impact of school landscapes on student performance. Research shows that schools with greener landscapes—that is, landscapes with trees and other forms of green infrastructure— are associated with improved academic performance, but we do not understand why students perform better when they are exposed to landscapes that include urban forests. How do landscapes with trees help students perform better at school? The cost of not answering this question is that millions of children may be learning in settings that are significantly less supportive than they could be.

We answered this question by conducting an experimental study, funded partially by the U.S Forest Service's National Urban and Community Forestry Advisory Council and the Forest Service's Northern Research Station. Results point policy makers, architects, and educators to a simple, cost effective way to boost academic performance: school landscapes that contain many trees seen through school windows.



**Figure 2. Students who attend schools without access to trees are at risk of experiencing higher levels of mental fatigue and stress than their peers who have access to nature, especially trees.**

**stress recovery.** Sustained attention is the most important resource for learning. Landscapes with trees have been shown to restore our ability to pay attention, which may explain why students perform better when exposed to nature. Exposure to nature also helps people recover from stress. Students who experience high levels of personal or school-related stress have lower academic performance. Since nature has been shown to reduce stress, exposure to green landscapes may improve student performance.

We tested these ideas in an experiment that exposed students to classrooms with or without window views of nature and examined how the window conditions impacted students' attentional capacities and stress levels. We also explored whether the impact of green landscapes was stronger when the students were engaged in classroom activities or when they were taking a break.

## Study procedure

94 students from five different high schools in central Illinois were randomly assigned to three different window conditions: a) a classroom with no window, b) a classroom with a window view of a barren space, and c) a classroom with a window view of a treed space. Students were positioned so that they faced the window (or the blank wall) during the experiment.

To simulate classroom conditions, each participant underwent a modified Trier Social Stress Test (TSST) procedure. The procedure consisted of 30 minutes of classroom activities including a proofreading task, a public speaking task, and a mental subtraction task. After finishing the TSST, participants rested for 10 minutes in the classroom.

Students self-reported their stress and attention levels at three points: before the classroom activities, directly after the activities, and after the 10-minute break. After the classroom activities and after the 10-minute break, they also took the Digit Span Forward and Backward tests of attentional functioning. Physiological measures of stress (heart rate variability, blood volume pulse, body temperature, and skin conductance) were collected continuously.

## How do window views of school landscapes impact academic performance?

Even though research has shown that high school landscapes with trees are positively correlated with academic performance, we do not know if views to trees cause better performance, how views to trees impact academic performance, or why students perform better when they are exposed to views of trees.

Two promising pathways may explain why landscapes rich with trees are associated with improved academic performance: **attention restoration** and



Figure 3. Examples of classroom window view conditions: no window view (left), windows opened on to built space (middle), and windows opened on to green space with trees (right).

## Results

Across all three groups, students' capacity to pay attention decreased during class activities; stress levels increased during class activities and decreased during and after the break. Attention and stress levels were similar across all three groups before the classroom activities, during the classroom activities, and directly after the activities.

After the 10-minute break, however, students in the green window view condition experienced significantly greater attention restoration and recovery from stress than the students assigned to rooms without green views (see Figures 4, 5, & 6).

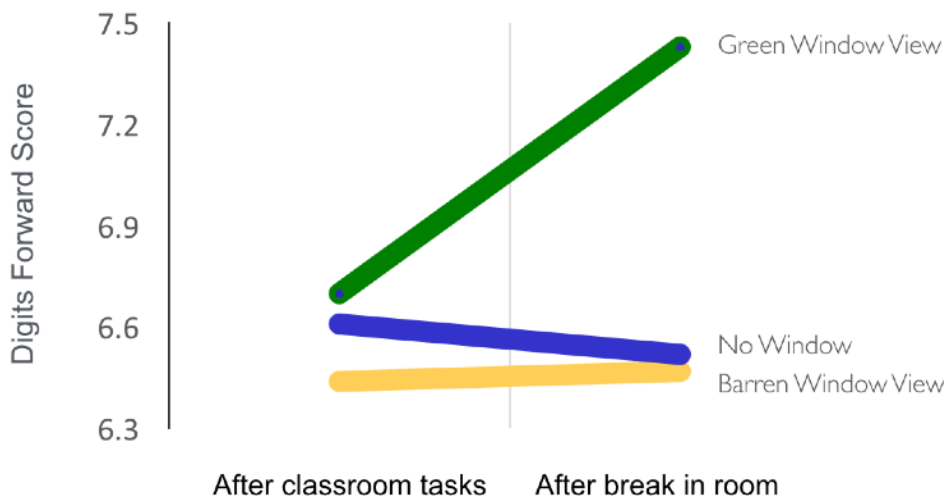


Figure 4. Attention scores from the Digits Forward test at the end of class activity and break periods.

When students were completing class activities, there were no significant differences in attentional functioning and stress level among the students in the three conditions. But by the end of the break, students in the green window view condition performed significantly better in attention tests and had significantly greater stress recovery than students in the classrooms without a green view. This suggests that access to a green window view is most beneficial during breaks when students are not focusing on classroom activities. Because such breaks happen in classrooms and in other parts of schools, we recommend green views be available throughout the school.

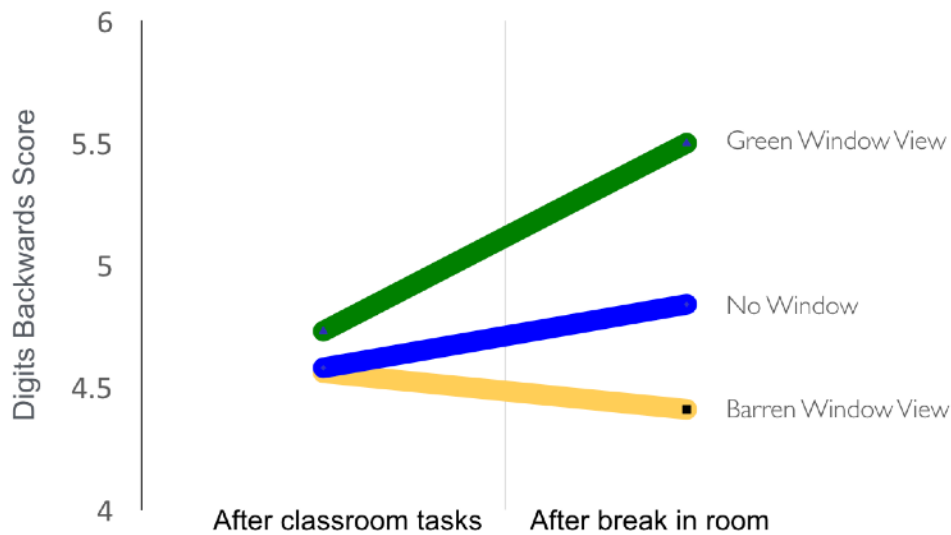


Figure 5. Attention scores from the Digits Backwards test at the end of class activity and break periods.



Figure 6. Stress levels at the end of the break period. Only students in the Green Window condition had less stress after the break.

## Conclusion and recommendations

We found that classroom views to green landscapes produced better attentional functioning and greater recovery from stress. Placing trees and shrubs on school ground where students can see them is a low-cost intervention that will have long-lasting effects on generations of students. We make the following recommendations for planners, designers, policy makers, school administrators, parents, and educators seeking to create more supportive environments for learning:

1. When selecting sites for new schools, planners should prioritize sites that have mature trees and other forms of vegetation.
2. If a site is chosen that lacks vegetation, budget should include money for planting and on-going maintenance of trees and shrubs.
3. It is not enough to have classrooms with windows; those windows need to provide views of green spaces. Architects and landscape architects should work together to ensure that every classroom provides a view to a green space.
4. The spaces where students take breaks (e.g., hallways, cafeterias, gyms) should have green views.
5. School schedules should be modified to include breaks. A 10-minute break in a space with access to nature can significantly restore students' attentional capacities and help them recover from stressful tasks.
6. If a 10-minute break in a classroom with a window view of trees is enough to significantly enhance attentional capacities and stress recovery, a more immersive experience with trees may produce an even greater effect. Outdoor recess and physical activity in spaces that have trees can provide this immersive experience and are vital to students' health and well-being.

This study adds to the growing body of literature suggesting that we need nature at every doorstep—and through every window. So plant trees in your community and help create a healthier human habitat.

## Products associated with this work

We have produced a variety of products to help people understand this work and its implications. These products include scientific journal articles, video lectures in which we explain the findings, PowerPoint slides that are available to download from William Sullivan's [website](http://willsull.net) ([willsull.net](http://willsull.net)) and abstracts from conference presentations. Our articles include:

Li, D., & Sullivan, W.C. (2016). [Impacts of views to school landscapes on recovery from stress and mental fatigue](#). *Landscape and Urban Planning*, 148, p. 149-158. Available at <http://willsull.net/publications/>

Li, D. Access to nature and adolescents' psychological well-being. Dissertation deposited at the University of Illinois at Urbana-Champaign, Department of Landscape Architecture.

For more information, please contact William Sullivan, Department of Landscape Architecture, University of Illinois at [wcsulliv@illinois.edu](mailto:wcsulliv@illinois.edu).

The University of Illinois is an equal opportunity employer.