



News

Green office environments linked with higher cognitive function scores



Researchers controlled indoor environmental quality from a space underneath the testing environment to simulate conventional and green building conditions.

For immediate release: October 26, 2015

Boston, MA – People who work in well-ventilated offices with below-average levels of indoor pollutants and carbon dioxide (CO₂) have significantly higher cognitive functioning scores—in crucial areas such as responding to a crisis or developing strategy—than those who work in offices with typical levels, according to a new study from the Harvard T.H. Chan School of Public Health’s [Center for Health and the Global Environment](#), [SUNY Upstate Medical University](#), and [Syracuse University](#).

The researchers looked at people’s experiences in “green” vs. “non-green” buildings in a double-blind study, in which both the participants and the analysts were blinded

to test conditions to avoid biased results. The findings suggest that the indoor environments in which many people work daily could be adversely affecting cognitive function—and that, conversely, improved air quality could greatly increase the cognitive function performance of workers.

The [study](#) was published October 26, 2015 in *Environmental Health Perspectives*.

“We have been ignoring the 90%. We spend 90% of our time indoors and 90% of the cost of a building are the occupants, yet indoor environmental quality and its impact on [health](#) and productivity are often an afterthought,” said [Joseph Allen](#), assistant professor of exposure assessment science, director of the Healthy Buildings Program at the Harvard Center for Health and the Global Environment, and lead author of the study. “These results suggest that even modest improvements to indoor environmental quality may have a profound impact on the decision-making performance of workers.”

Researchers wanted to look at the impact of ventilation, chemicals, and carbon dioxide on workers’ cognitive function because, as buildings have become more energy efficient, they have also become more airtight, increasing the potential for poor indoor environmental quality. Building-related illnesses and “sick building syndrome” were first reported in the 1980s as ventilation rates decreased. In response, there has been an emphasis on sustainable design—“green” buildings that are energy efficient and are also designed to enhance indoor environmental quality. The researchers designed this study to identify the specific attributes of green building design that influence cognitive function, an objective measure of productivity.

In the new study, researchers utilized a double-blinded, repeated measures design to look at the decision-making performance of 24 participants—including architects, designers, programmers, engineers, creative marketing professionals, and managers—while they worked in a controlled office environment at the Total Indoor Environmental Quality (TIEQ) Laboratory at the Syracuse Center of Excellence in Environmental and Energy Systems.

For six days in November 2014, while the participants performed their normal work, the researchers exposed them to various simulated building conditions: conventional

conditions with relatively high concentrations of volatile organic compounds (VOCs), such as those emitted from common materials in offices; green conditions with low VOC concentrations; green conditions with enhanced ventilation (dubbed “green+”); and conditions with artificially elevated levels of CO₂, independent of ventilation. At the end of each day, they conducted cognitive testing on the participants.

They found that cognitive performance scores for the participants who worked in the green+ environments were, on average, double those of participants who worked in conventional environments; scores for those working in green environments were 61% higher. Measuring nine cognitive function domains, researchers found that the largest improvements occurred in the areas of:

- crisis response (97% higher scores in green conditions and 131% higher in green+)
- strategy (183% and 288% higher)
- information usage (172% and 299% higher)

In addition, when researchers looked at the effect of CO₂—not normally thought of as a direct indoor pollutant—they found that, for seven of the nine cognitive functions tested, average scores decreased as CO₂ levels increased to levels commonly observed in many indoor environments.

Other Harvard Chan School authors of the study included [John D. Spengler](#), Akira Yamaguchi Professor of Health and Human Habitation, doctoral student Piers MacNaughton, SM '14, and project engineer Jose Vallarino. Suresh Santanam, associate professor at Syracuse University and associate director of the Syracuse University Center of Excellence, also was an author.

Funding for the study came from United Technologies Corp. and from NIEHS environmental epidemiology training grant 5T32ES007069-35 to MacNaughton.

“Associations of Cognitive Function Scores with Carbon Dioxide, Ventilation, and Volatile Organic Compound Exposures in Office Workers: A Controlled Exposure Study of Green and Conventional Office Environments,” Joseph G. Allen, Piers MacNaughton,

Usha Satish, Suresh Santanam, Jose Vallarino, John D. Spengler, *Environmental Health Perspectives*, October 26, 2015, doi: 10.1289/ehp.1510037

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