



## WELL LIVING LAB RESEARCH: STUDY SUMMARY 5

### Merits of daylight, views and window shading for office workers

Decades of research demonstrate that windows providing daylight and outdoor views are important to employees. Benefits include office workers reporting better moods, improved job satisfaction, longer attention span and improved performance. Providing access to daylight and outdoor views has also been shown to benefit employers through lower absenteeism, increased productivity and improved quality of work. These have been isolated studies without a cohesive picture of the benefits that windows provide.

Now a comprehensive understanding is emerging. The Well Living Lab contributed to this body of evidence by finding that access to daylight and view improves cognitive performance and satisfaction within the office environment. Eyestrain from glare can be reduced with the use of two different modern shading methods, manually controlled motorized shades and automated window tint.

In a 14-week study, 10 employees from a large organization relocated to the Well Living Lab's simulated office space and used it as their regular office. The space had east-and north-facing windows and everyone sat an equal distance from the east-facing windows that provided daylight and view. These volunteers experienced three window conditions: manually controllable motorized mesh shades, dynamically tinted windows and blackout shades that blocked daylight and external views. Participants could adjust the mesh shade height and window tinting level to their preference. Dynamically tinted windows utilized an algorithm to automatically adjust to darker tints during mornings to prevent glare and returned to an untinted state by midday. Thermal conditions, electric lighting and ventilation were kept consistent throughout the study.

### TESTS AND TOOLS USED

**Cognitive function tests** – conducted with the Well Living Lab's Think it Out app. It measured three aspects of executive function:

- **Working memory** – the ability to remember, process and update information
  - Participants solved timed math problems while also remembering a series of letters
- **Inhibition** – the ability to hold back automatic responses
  - Words for colors appeared through the app and participants were to name the color the word appeared in instead of what the word itself was, known as the Stroop test
- **Task switching** – the ability to switch from one activity to another
  - Participants had to switch between answering questions about whether a number was odd or even and whether a number was greater than or less than a certain number, according to the color of the number being displayed

**Chronotype testing** – determination of the time of day when a person is most energetic and alert, known as circadian rhythm or your body clock

**Headache and eyestrain survey** – used to assess eye fatigue, blurred vision, irritability and difficulty focusing. Participants also noted the times of day when they experienced glare

Participants underwent daily cognitive function testing using an in-house developed app containing gold standard cognitive performance tasks. The tests evaluated three executive functions: working memory, inhibition and task switching. Participants also completed surveys to assess eyestrain and environmental satisfaction.

Two aspects of cognitive function improved when participants had access to daylight and window views in their office area: working memory and inhibition. Both the mesh shades and tinted windows resulted in similar improvements on these two cognitive performance tasks compared to blackout conditions. Eyestrain also was reduced with both types of shading. Environmental satisfaction improved with window access, and participants were more satisfied with other aspects of the environment as well, such as light quality and the ability to alter physical conditions.

When the workspace had the windows blacked-out, the number one change that participants wanted was window access. Well Living Lab researchers noted a correlation between satisfaction and perception of importance. When an employee is least satisfied with an environmental element, he/she may also believe it to be the most important.

Based on this study, employers should consider providing daylight and window views for employees, especially in areas designated for individual focused work, and architects and builders should consider windows and modern shading techniques in new and remodeled facilities.

The lab offers these tips for employers and employees who do not have access to windows:

- Bring nature inside, such as plants or a water feature. Decorate with nature scenes such as photos and paintings, digital displays screen savers and even cut-outs from magazines
- Listen to nature recordings on headsets or stream videos showing woods, lakes, flowers or other elements of nature that people find enjoyable
- Use breaks to walk outside
- When remodeling spaces, biophilic elements that resemble nature can be used, such as wood and stone.

## COMPARISON WITH NO ACCESS TO DAYLIGHT AND VIEW

### Windows With Daylight and View (*Motorized mesh shades & Dynamically tinted*)

- + Improved cognitive performance:
  - + Increased working memory
  - + Improved inhibition
- = No change in task switching
- + Reduced eyestrain
- + Increased environmental satisfaction:
  - + Lighting for computer and paperwork
  - + Able to experience daylight and window views
  - + Ability to control and alter physical conditions
  - + Aesthetic appearance (*Dynamically tinted only*)

These results were published in the peer-reviewed journal [Building and Environment](#). An assessment of the indoor environmental quality during this study, including measures of desktop lighting, thermal conditions, and shade/window use by occupants, was published in the peer-reviewed journal [Buildings](#).

## TESTS AND TOOLS USED

**Illuminance and corrected color temperature sensors** — used to measure light on desktops and windows

**Illuminance spectrophotometer** — used to initially set electric lighting levels on desks

**Linear mixed-effects analyses** — used to model variations in how individuals reacted to each experimental condition

**Questionnaires** — used to assess caffeine intake, aerobic exercise, alertness and mindfulness practice, lighting for computer and paper work, air quality and perceived productivity

**Spatial lighting assessment** — used spectrophotometer to measure natural light throughout the workplace under each experimental condition

**Thermal environment sensors** — used to continuously measure temperature and relative humidity on desktops and at windows



## ABOUT THE WELL LIVING LAB

The Well Living Lab, a collaboration of Delos™ and Mayo Clinic, is dedicated to identifying how indoor environments impact human health and well-being. It conducts scientific research with human subjects in a simulated real-world environment and shares practical findings that can be applied to improving indoor spaces where most people spent approximately 90 percent of their time. The lab has 5,500 square-feet of sensor rich, reconfigurable space in downtown Rochester, Minnesota.

Learn more at  
[WellLivingLab.com](https://www.welllivinglab.com)