HermanMiller
Research Summary

The Neurophysiology of Office Design Study: The Objective Findings

Key Insights

- **Setting—which we define as a physical space optimized for a specific kind of work and interaction—affects mood and stress levels.**
- **Happy employees are more productive.**
- **Office plans that have more noise, natural light, openness, and foot traffic ("buzz") increase creativity.**

At Herman Miller, we're always furthering our understanding of the human experience. Scientific research is one of many ways we do that. We know that the design of an office affects behavior; it has an influence on everything from what path we take to the cafeteria to whom we interact with most and how often we have fortuitous encounters.[1] As Winston Churchill said, "We shape our buildings, and afterwards our buildings shape us."[2]

But to what extent? Does the design of an office space actually affect brain activity, as well as behavior? If so, how?

That's what we set out to discover when Claremont Graduate University's Center for Neuroeconomics Studies conducted a comprehensive neurophysiology study on behalf of Herman Miller.[3] The study assessed how different office settings affect physiology by measuring the hormones, cardiac activity, palmar sweat, and respiration of 96 participants as they completed surveys and work tasks in one of three office settings at a Herman Miller facility. The group was roughly split along gender lines, and the average participant age was 43.5 years and represented a range of professions, both technical and non-technical.[4]

Research Summary

All three research locations were open settings in a working office with the kind of furniture found in many office environments. Research participants completed their tasks while workers not participating in the study carried out their work in a normal fashion, working individually, talking quietly with others, and moving about the research setting as their work required.

The three office settings studied were Jump Space, Cove, and Plaza.[5]

We define Jump Space as a space with highly approachable work points that facilitate work for a distinct and discrete period of time between other activities. With workstations around its perimeter and moderate foot traffic, the Jump Space in our study had moderate privacy for its standing-height table and stools and average maximal sound levels of 73 dBs. The natural light entering the space was from high above, or indirect.

Our definition of a Cove is a compact space within proximity to individual work points or common areas that enables people to assemble and engage with each other for a short time. The Cove in our study was semi-private, with workstations to the side of it and behind it and foot traffic around it. Although it was less busy than the Jump Space, it was noisier, with average maximum sound levels of 78 dBs. Participants in the Cove had access to some natural light via windows on the other side of nearby workstations.

A Plaza is an open, welcoming, public space situated at a major intersection and highly trafficked area of the work environment. It encourages mixing and mingling, enables multiple work activities simultaneously, helps broadcast information, and provides amenities as a point of attraction. The Plaza we used in the study was a completely open setting adjacent to the facility's coffee bar, which had continuous foot traffic and was moderately noisy with an average maximum sound level of 92.4 dBs. A bank of large windows flooded the space with natural light.

Participants were studied in groups of four and their physiology was monitored in real time as they completed two tasks. Participants completed the first task (adding 24 two-digit numbers) by themselves. If they completed the task with 75 percent or greater accuracy, they earned a small payment. This simulated the job environment in which people work for money.[6]

The second task was a creative problem-solving task in which participants worked together to reassemble a mechanical apple peeler by using pictures of the assembled device. The task measured how well the group was able to solve a new problem together.

Methods

Researchers measured physiologic activity of participants in several ways. Blood draws were conducted before and after the activities so researchers could measure the hormones oxytocin (OT) and adrenocorticotropin (ACTH) in the blood to see how they affected mood. OT is associated with trust, cooperation, and attachment to others, while ACTH is a fast-reacting measure of arousal and stress. Researchers also used an electrocardiogram (ECG) to indicate participants' peripheral neural activity, monitored electrodermal activity (EDA) via electrodes on the fingers, and conducted an assessment of respiration through a band around the chest. The ECG was used to measure heart rate (HR, arousal) and heart rate variability (HRV, relaxation), while the EDA was used to measure skin conductance levels (SCL), a second signal of arousal.

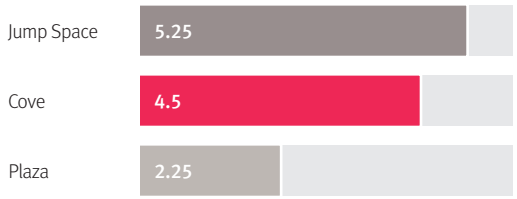
Research Summary

Findings

1. Setting Affects Mood

All three settings tested showed positive increases in the mood of participants after they completed the individual and group tasks. Participants in the Cove and Jump Space had statistically significant increases in mood. The participants who were tested in the Plaza setting had the highest baseline happiness (before completing any tasks), and, while they experienced an increase in mood after completing the tasks, it was not statistically significant.[7]

Percent Change in Positive Mood [8]



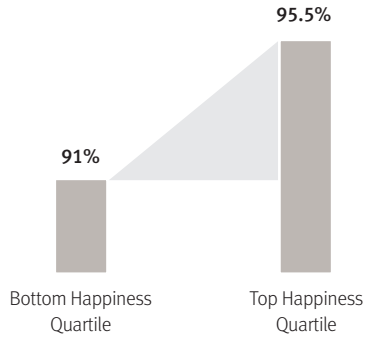
In all three settings tested, work performance, mood, and morale were high and physiologic stress was low.

2. Happy Employees Are More Productive

While individual performance was not correlated with technical expertise or location satisfaction ratings, it was correlated with positive mood before and after completing both tasks.[9]

Our research also found that there's a positive correlation between positive mood (happiness) and performance. That correlation was strongest in the Plaza setting.

Performance in Individual Task in Bottom vs. Top Happiness Quartile Plaza Setting



Because setting affects mood (Finding 1) and mood affects performance (Finding 2), we can conclude that office design affects individual work performance insomuch as it affects mood.

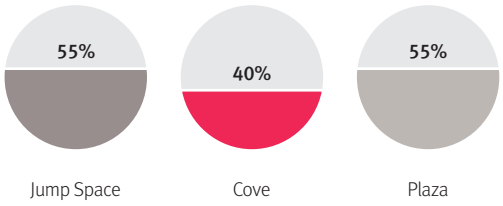
In addition, the research found that trust in a colleague (measured by levels of oxytocin in participants' blood) increased baseline happiness,[10] and therefore also contributes to individual work performance.

Research Summary

3. High-Buzz Office Plans Increase Creativity

Office plans that have more noise, natural light, openness, and foot traffic (buzz) increase creativity. Participants showed greater ability to solve a unique problem as members of a group in settings with more buzz. The ability to solve the mechanical assembly problem was highest in the Plaza and the Jump Space and lowest in the Cove. Although the task was technical in nature, the results held true even when researchers controlled for the technical background of group members.

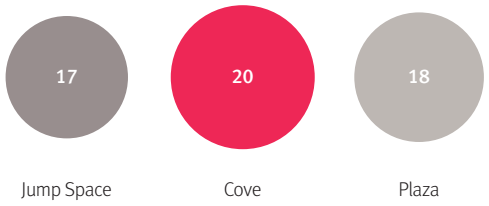
Performance in Creative Problem-Solving



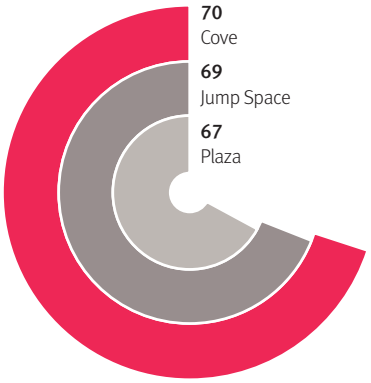
4. Setting Affects Stress Levels at the Outset and Over Time

Researchers gathered information on participants' stress levels by measuring adrenocorticotropin (ACTH), palmar sweat, and heart rate. Again, the lower the ACTH and/or heart rate, the less stress a participant is experiencing. Participants' basal adrenocorticotropin was highest in the Cove and lower for the Jump Space and Plaza. The participants' baseline heart rate was higher in the Cove and Jump Space. Participants in the Plaza had the lowest initial heart rate.

Baseline Stress Hormone (ACTH) Level



Baseline Heart Rate/Minute



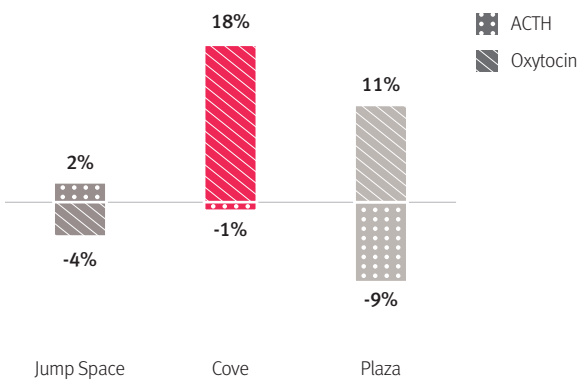
Research Summary

5. Stress Over Time Indicators

Researchers also measured stress over time. ACTH increased in participants in the Jump Space but decreased in participants in the Cove and decreased significantly for those in the Plaza. Meanwhile, levels of oxytocin decreased in the Jump Space and increased in the Cove and Plaza.

By obtaining multiple objective measures of brain activity and associating them with active measures of productivity, this study reveals the complexities of the human experience. We'll use what we learned from the study to better design office environments that enable people to do their best work, naturally. We hope our customers will use the findings, as well, to make informed decisions about including high-buzz spaces in their landscapes. Rather than being seen as a luxury or diversion from work, high-buzz settings like Plazas can deliver a higher return on investment by improving mood, which affects performance.

Percent of Change in ACTH and Oxytocin



Research Summary

1. Steve Henn, "Serendipitous Encounters Key to Tech Firm's Workplace Design," NPR, March 13, 2013, ‹http://www.npr.org/blogs/alltechconsidered/2013/03/13/174195695/serendipitous-interaction-key-to-tech-firms-workplace-design› (accessed May 6, 2014). There's an inverse relationship between distance between employees and likelihood they'll interact, according to research conducted by Mary Jo Hatch, from San Diego State University, who wrote, "Physical Barriers, Task Characteristics, and Interaction Activity in Research and Development Firms," ‹http://www.jstor.org/discover/10.2307/2392911?uid=3739728&uid=2&uid=4&uid=3739256&sid=21103322559957› (accessed May 6, 2014).

2. ‹http://www.winstonchurchill.org/learn/speeches/quotations› (accessed May 6, 2014).

3. Paul J. Zak and Veronika Alexander, "The Neurophysiology of Office Settings," October 31, 2013.

4. Standard deviation of age was 11.36.

5. Herman Miller, "Ideal Settings," WHY, ‹http://www.hermanmiller.com/why/ideal-settings.html› (accessed May 6, 2014).

6. Participants who worked at the Herman Miller location where the study was being conducted earned $25; those who came from offsite earned $40. All participants were paid the money although four participants were below the required level of accuracy.

7. Baseline mood was measured using the Positive And Negative Affect Scale (PANAS), a five-point scale. Baseline mood was significantly higher in the Plaza compared to the Cove (3.3 vs. 2.92, p = .0073), and compared to Jump Space (3.3 vs. 3.08, p = .0835), but not significantly different for the Jump Space vs. the Cove (p = .1310).

8. The percent change in positive mood was significantly different from zero for the Jump Space (p = .0317) and the Cove (p = .0446). The percent change in positive mood in the Plaza wasn't significantly different from zero (p = .2494). None of the percent changes were significantly different from each other from setting to setting.

9. Before completing task: r = .20, p = .05; after completing task: r = .27, p = .01.

10. r=.22, p=.07.