



# The effect of open-office layouts on worker performance

## BACKGROUND

Hoping to imitate the innovative and flexible work environments found at start-ups and organizations like Google, my organization’s Executive Director is considering implementation of a bullpen style, open-plan layout in our office space. Currently, the space is divided into individual workspaces with four-foot cubicle walls. The Executive Director and Controller both have private offices. With 15 employees working in a relatively small space, I worry that the distractions created by a new, open layout may undermine our ability to focus and to be productive at work. In order to draw a more informed conclusion on the effect that such a layout would have at our office, I have gathered and assessed the quality of available scientific evidence, outlined key findings, and summarized their practical implications.

## QUESTION

What is known in the scientific literature about the effect of open-office layouts on worker performance?

## PICOC

|                    |                                |
|--------------------|--------------------------------|
| Population         | Knowledge workers              |
| Intervention       | Open-plan office layout        |
| Comparison         | Separate individual workspaces |
| Outcome/Objectives | Worker performance             |
| Context            | Office space                   |

## CONCEPTUAL FRAMEWORK

Brennan et al. provide a helpful definition of the open-plan office:

In open offices, people who work together are physically located together with the geometry of the layout reflecting the pattern of the work groups. The various areas can be separated by plants, low movable screens, cabinets, shelving, or other furniture.

Thus, within the broad category of open office, fine-grained difference can be rendered....Open offices were designed in the 1950s and reached their height of popularity in the early 1970s, when many companies converted to these types of designs. Original claims by the designers of open offices were that they created flexible space, allowing layout to be more sensitive to changes in organizational size and structure. Workstations can be easily reconfigured at minimal cost to meet changing needs. It was also believed that the absence of internal physical barriers would facilitate communication between individuals, groups, and even whole departments, which consequently, would improve morale and productivity. In addition, there was an estimated 20% savings in costs associated with creating and maintaining this type of office space (280-281).

As Brennan et al. describe, the presumed causal mechanism behind open-plan offices works as follows:

- Breaking down physical office barriers increases one's exposure to teammates
- Increased exposure facilitates communication among teammates
- Facilitated communication increases collaboration
- Increased collaboration increases overall productivity and performance

However, one can also presume that increased exposure to teammates would also cause increases in visual and auditory distractions, counteracting positive benefits to some degree.

## **INCLUSION CRITERIA**

In order to be included in this CAT, studies must fit the following criteria:

- *Peer-reviewed*  
To gather the most credible evidence, only studies that have been peer reviewed following submission will be included.
- *Relevant*  
For maximum applicability to the background situation, included studies must examine effects on reasonably similar populations and in reasonably similar environments.
- *Published in or after 2000*  
In consideration of technological advancements made in soundproofing and other office technology during recent years, only studies published in or after 2000 will be included.
- *Methodologically appropriate and of satisfactory methodological quality*  
In an effort to gather the best available scientific evidence that addresses the target question, this CAT will exclude any studies that fall below level C in terms of both methodological appropriateness and quality.

## SEARCH STRATEGY

| Search of ABI Inform, PsychINFO, and EBSCO Business Source Complete |           |           |     |
|---|-----------|-----------|-----|
| <i>Filters: peer-reviewed</i>                                       |           |           |     |
| Search Terms  | ABI       | PsychINFO | BSC |
| S1: ti("open office")   | 4         | 2         | 3   |
| S2: ti("open plan")   | 14        | 24        | 11  |
| (1 OR 2) AND ab(meta-analy*)  | 0         | 0         | 0   |
| (1 OR 2)  | 18        | 26        | 14  |
| <b>TOTAL</b>  | <b>58</b> |           |     |
| Duplicate exclusions  | 11        |           |     |
| Irrelevant exclusions   | 17        |           |     |
| Published before 2000 exclusions                                    | 9         |           |     |
| Low methodological appropriateness/quality exclusions               | 17        |           |     |
| <b>INCLUDED</b>   | <b>4</b>  |           |     |

## DATA EXTRACTION

See matrix on the next page.

| Author & year                      | Design                          | Sector / Population                           | Main findings  | Effect sizes  | Weaknesses   | Level |
|------------------------------------|---------------------------------|---|--|---|--|-------|
| Varjo et al.; 2015                 | Non-randomized controlled study | Finnish university students (19-29 years old) | After examining the effects of highly intelligible irrelevant speech, high temperature, and low ventilation rate on the performance of cognitive tasks, the researchers found detrimental effects on cognitive performance and subjective experience.  | <b>Medium</b> <ul style="list-style-type: none"> <li>serial recall <math>\eta^2 = 0.08</math></li> <li>response accuracy <math>\eta^2 = 0.06</math></li> <li>typing errors <math>\eta^2 = 0.06</math></li> </ul> <b>Large</b> <ul style="list-style-type: none"> <li>operation span <math>\eta^2 = 0.15</math></li> <li>subjective workload <math>\eta^2 = 0.19</math></li> <li>lack of energy <math>\eta^2 = 0.24</math></li> <li>lack of motivation <math>\eta^2 = 0.24</math></li> </ul> | <ul style="list-style-type: none"> <li>Small sample size (n = 65)</li> <li>Inclusion criteria not clearly defined</li> </ul> | B     |
| Bergstrom, Miller, & Horneij; 2015 | Interrupted time series design  | Swedish company employees                     | In studying perceived health, work environment, and performance of employees before, during, and after an employee transition from private to open-plan offices, researchers found that the intervention had small but negative effects in each of the three areas studied.  | <b>Small</b> <ul style="list-style-type: none"> <li>perceived health <math>avg p = 0.05</math></li> <li>perceived performance <math>p = 0.03</math></li> </ul> <b>Medium</b> <ul style="list-style-type: none"> <li>work experience <math>avg p = 0.22</math></li> </ul>  | <ul style="list-style-type: none"> <li>Small sample size (n = 54)</li> <li>Inclusion criteria not clearly defined</li> </ul> | B     |
| Jahncke et al.; 2011               | Randomized controlled study     | Swedish university students (mean age = 26)   | This study examines the effects of two levels of office noise on basic working memory processes, self-ratings of mood and fatigue, and physiological measures of stress in a simulated open-plan office. Researchers found that a higher noise level had a large negative effect on memory of words, tiredness, and motivation.                              | <b>Large</b> <ul style="list-style-type: none"> <li>memory for words <math>\eta^2 = 0.13</math></li> <li>urinary norepinephrine <math>\eta^2 = 0.47</math></li> <li>tiredness <math>\eta^2 = 0.28</math></li> <li>lack of motivation <math>\eta^2 = 0.21</math></li> </ul>  | <ul style="list-style-type: none"> <li>Small sample size (n = 38)</li> <li>Inclusion criteria not clearly defined</li> </ul> | B     |
| Evans & Johnson; 2000              | Randomized controlled study     | Female clerical workers                       | The researchers investigated effects of low-intensity office noise on workers while (a) reading quietly and (b) completing clerical tasks. They found that low-intensity noise related to increased urinary epinephrine levels, a stress indicator, and that individuals were less likely to make physical adjustments important for musculoskeletal health. | n/a   | <ul style="list-style-type: none"> <li>Small sample size (n = 40)</li> <li>No effect size given</li> </ul>                   | B     |

## CRITICAL APPRAISAL

A number of studies were excluded from this CAT due to their low-level methodological designs and/or quality. A number of cross-sectional studies, for example, surveyed workers on the size and type of their office spaces alongside their feelings regarding distraction and comfort. While providing useful anecdotal information, these types of studies do little to prove any cause-and-effect relationship. I focused instead on studies that included control groups, or at the very least, pre- and post-intervention measurements. The included studies also used reliable and valid measures. In terms of context, while most of the included studies examine foreign populations, I decided that this was acceptable for my purposes. I felt that it would be more applicable to look at knowledge workers in northern European countries than to look at factory or industrial workers in Western countries, as some studies did.

## MAIN FINDINGS

- *Conditions associated with open-plan offices have negative effects on objective measures of performance (level B).*

In several of the included studies, researchers found cause-and-effect relationships between conditions associated with open-office plans and decreases in objective measures of performance. Varjo et al. found that a combination of auditory distraction, higher temperature, and lower ventilation rate had medium to large effects on performance of cognitive tasks testing short-term memory, working memory, the ability to sustain attention, and motor function (25). Research from Jahncke et al. also found that, testing cognitive functions under two noise levels, higher levels of office noise had large negative effects on memory (378). The use of objective measures is important for establishing the reliability of these results, and indicates a strong connection between open-office conditions and decreases in cognitive functions critical to knowledge work.

- *Conditions associated with open-plan offices have negative effects on subjective measures of performance (level B).*

While the research question focused on effects of open-plan office layouts on performance, not on effects of open-plan office layouts on *perceived* performance or worker experience, this line of inquiry may have implications for staff retention, and should also be considered before implementing an open-plan office. Bergstrom, Miller, and Horneij administered self-report questionnaires to participants and found that relocation to an open-plan office had small to medium negative effects on perceived health, perceived performance, and work experience even twelve months later (224). A subjective self-report questionnaire distributed by Varjo et al. also found that open-

office conditions had large negative effects on workload, energy, and motivation (26). Though these effects address the research question from a different angle, they represent additional considerations that any manager must take before implementing an open-office layout.

- *Conditions associated with open-plan offices have negative effects on the physical health of workers (level B).*

Research from Evans and Johnson found an additional effect of note. Clerical workers performing tasks amid low-intensity noise were less likely to move and make physical adjustments while doing work than their comparison group counterparts. As Evans and Johnson point out, this has implications for worker health, explaining that “Occupational stress from various sources, including noise, could contribute to musculoskeletal disorders as well by suppressing use of adjustable ergonomic features in the immediate work environment” (782). Like subjective measures, while this effect does not address worker performance per se, worker health may have larger implications for retention and turnover.

## **CONCLUSION**

Of the studies found, I was pleasantly surprised by their methodological appropriateness and quality, given that no meta-analyses were available. I was also surprised to see that so few of those that met my inclusion criteria were conducted in North America. As I mentioned earlier, I think the included studies are still applicable as they focus on knowledge work in western countries, but I was still surprised to find that they largely focused on northern Europe. This might suggest that further research on the effects of open-plan office layouts on American business culture and organizational performance is warranted. I also observed that some studies focused on just one condition associated with open-plan offices, such as noise, while others incorporated multiple conditions. This indicates that, should one need a deeper investigation of a single condition, a more specific search would yield additional includable studies.

## **PRACTICAL REFLECTIONS**

As a practitioner, I would consider my priorities before implementing an open-plan office. If the Executive Director’s main goal is the cost savings that will result from fitting more people into a smaller space, I would recommend that he take action to mitigate some of the negative effects that an open layout may have. Installing soundproof panels, using white noise machines in certain locations, and making sure that employees have access to quiet meeting rooms, for

example, may prevent some of the distraction that these studies have shown can lead to decreased performance. If the Executive Director's main goal is to increase intra-office collaboration and communication, I would recommend that he investigate some alternative interventions before implementing an open-plan layout. Dedicating more meeting time to collaborative brainstorming, for example, may create the atmosphere he is looking for, while allowing workers to maintain focus outside of meeting hours. I would also note to the Executive Director that an open-plan layout may be more appropriate for certain types of work and certain departments than for others. For more targeted information, I would recommend that we conduct deeper research into some of the specific conditions associated with open-office layouts, including the effects of auditory and/or visual distraction on worker performance. Implementing an open-plan office layout would not necessarily ruin the organization's productivity, but these studies do point out some specific effects that one must take into consideration before moving forward.

## REFERENCES

- Bergstrom, Jessica; Michael Miller; and Eva Horneij. "Work environment perceptions following relocation to open-plan offices: A twelve-month longitudinal study." *Work*. 50(2). 2015: 221-228.
- Brennan, Aoife; Jasdeep S. Chugh; and Theresa Kline. "Traditional Versus Open Office Design: a Longitudinal Field Study." *Environment and Behavior*. May 2002: 279-299.
- Evans, Gary W. and Dana Johnson. "Stress and Open-Office Noise." *Journal of Applied Psychology*. 85(5). 2000: 779-783
- Jahncke, Helena; Staffan Hygge; Niklas Halin; Anne Marie Green; and Kenth Dimberg. "Open-plan office noise: Cognitive performance and restoration." *Journal of Environmental Psychology*. 31 (2011): 373-382.
- Varjo, Johanna; Valtteri Hongisto; Annu Haapakangas; Henna Maula; Hannu Koskela; and Jukka Hyona. "Simultaneous effects of irrelevant speech, temperature and ventilation rate on performance and satisfaction in open-plan offices." *Journal of Environmental Psychology*. 44 (2015): 16-33.