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*Published in:*

Work: A Journal of Prevention, Assessment & Rehabilitation

*DOI:*

[10.3233/WOR-131798](https://doi.org/10.3233/WOR-131798)

2015

[Link to publication](#)

*Citation for published version (APA):*

Bergstrom, J., Miller, M., & Horneij, E. (2015). Work environment perceptions following relocation to open-plan offices: A twelve-month longitudinal study. *Work: A Journal of Prevention, Assessment & Rehabilitation*, 50(2), 221-228. <https://doi.org/10.3233/WOR-131798>

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3

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# Work environment perceptions following relocation to open-plan offices: A twelve-month longitudinal study

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Received 14 December 2012

Accepted 7 August 2013

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**Abstract.** *Background.* A workplace's design can have various positive or negative effects on the employees and since the 1970s the advantages and disadvantages of open-plan offices have been discussed.

*Objective:* The aim of this study was to investigate perceived health, work environment and self-estimated productivity one month before and at three, six and twelve months after relocation from individual offices to an open-plan office environment.

*Methods:* Employees from three departments within the same company group and who worked with relatively similar tasks and who were planned to be relocated from private offices to open-plan offices were invited to participate. Questionnaires comprising items from The Salutogenic Health Indicator Scale, The Work Experience Measurement Scale, the questionnaire by Brennan et al. about perceived performance and one question from the Work Ability Index were sent to participants one month before relocation (baseline) to open-plan offices and then at three, six and twelve months after relocation. At baseline, 82 questionnaires were sent out. The response rate was 85%. At the follow-ups 77–79 questionnaires were sent out and the response-rate was 70%–81%.

*Results:* At follow-ups, perceived health, job satisfaction and performance had generally deteriorated.

*Conclusions:* The results of the study indicate that employees' perception of health, work environment and performance decreased during a 12 month period following relocation from individual offices to open-plan offices.

*Keywords:* ergonomics, work organization, health promotion, work performance, perceived health

## 1. Introduction

A workplace's design can have various positive or negative effects on the employees and since the 1970s the advantages and disadvantages of open-plan offices have been discussed. The individual's specific work task is a major factor in determining the benefits or otherwise of an open-plan office [1,2]. Apart from the pressures of construction and operational costs, organizations in Sweden often choose open-plan offices for reasons such as; to facilitate a greater flow of information, to increase inter-employee communication, and to enhance creativity and social interaction [1,2,3,4].

One problem that open-plan office employees often experience is the phenomenon of crosstalk, i.e. that information spreads unnecessarily to surrounding but not specifically involved colleagues [2]. It has been reported that employees experience increased stress and that productivity or efficiency decreases due to a decrease in task concentration.

[1,4,6,7,8,9,10]. Furthermore a higher rate of sick leave has been reported for persons working in open-plan offices compared to private offices [2,5]. Reports also indicate that job satisfaction and perceived job well-being may also decrease when employees are relocated from a private office environment to an open-plan office [2,7,11,12,13].

Other negative experiences have been exposure to increased noise levels, increased tiredness after work and an increase in actual number of working hours sitting at the computer [1,3,7,8,9,10,13,14,15,16,17].

Open-plan offices should be designed to accommodate all the employees' work tasks. Secluded rooms should be available for persons to make sensitive phone calls or conversations and the layout should allow employees that share tasks to work in close proximity. If desks are placed face to face the risk of disturbance from one's colleagues will be greater than if they are positioned back to back. Also, if there is too much shielding between desks, communication and social interaction may be hindered [7].

Open-plan offices can vary in size from small open-plan offices, for two or three employees, to large spaces where over a hundred persons work. According to Danielsson [12,18] the lowest well-being for people working in open-plan offices is perceived by those who work in a medium-sized office, with 10–24 individuals. The hypothesis for this argument is that we are social beings, and that 10- 24 persons are too many to oversee but still few enough to make the effort to supervise. Danielsson maintains that one cannot supervise more than 24 employees in an open plan environment. Perceived control over one's work is a significant factor to prevent mental stress and maintain health. Therefore, when employees are relocated from an individual office to an open-plan office, it is important to include them in the organizational change. The implementation of the change process should preferably take place at all levels in the organization [19,20,21,22].

In addition to the physical environment, job satisfaction and enjoyment play a role in perceived health at work. Earlier research has shown that one of the most important parameters to predict future sick leave is perceived health and well-being in the workplace. People who enjoy their work and have a sense of coherence which is associated with their work, have an increased general well-being [21,23,24,25,26,27,28,29,30].

Previously, organizations have devoted much effort solely aimed at illness prevention but now the concept of health promotion has gained focus. Illness prevention has a pathogenic approach while health promotion is considered to adopt a salutogenic approach. With a pathogenic approach the quest is to identify factors that explain why individuals become ill. However, with a salutogenic approach one identifies factors that maintain or increase health [19,23,25,27,28,29,31]. To achieve positive results when working with health promotion in an organization, the whole organization spectrum should be involved in the process [19].

Earlier research has studied effects on employees after relocation to open-plan offices however to the best of our knowledge a long-term follow-up has not been performed [7]. The aim of this study was to investigate perceived health, work environment and self-estimated productivity one month before and at three, six and twelve months after relocation from individual offices to an open-plan office environment.

## **2. Method**

### **2.1 Study population**

Employees from three departments within the same company group and who worked with relatively similar tasks and who were planned to be relocated from private offices to open-plan offices were invited to participate. Initially a verbal request of permission was put to the heads of department. Written information was then sent to both the departmental heads and employees. The presumptive participants were guaranteed confidentiality and were also informed that participation was voluntary and that they could withdraw at any time during the data collection. In accordance with Swedish law, the study complied with

the ethical principles of the Helsinki Declaration. The study was also accepted by the Advisory Committee for Research Ethics in Health Education, Lund University, Lund (VEN 26-12).

## 2.2. Data collection

The test instruments were questionnaires previously tested for reliability and validity. The Salutogenic Health Indicator Scale (SHIS) consists of twelve claims stating salutogenic health indicators during the past four weeks. The rating was performed on a six-point Likert scale, ranging from positive (6) to negative (1), i.e. the higher the value, the better the indication of good health. The questions cover two dimensions of salutogenic health. The first dimension consists of seven questions and describes “Intrapersonal characteristics” (IPC). The second dimension consists of five questions and describes the “Interactive function” (IAF). Index values are expressed as the mean score of the two-dimensional questions (IAF and IPC). The mean score of all questions gives an overall indicator of health (SHIS) [32].

Work Experience Measurement Scale (WEMS) is a questionnaire in which respondents rate their perception of their work and their workplace. The questions have been developed from theories that are linked to models for demand/control/support, sense of coherence and effort/reward. The questions are constructed to be intimately work-related and to measure salutogenic work factors [25,32,33].

The questionnaire consists of 32 statements which are grouped into six dimensions namely (1) “Supportive working conditions”, (2) “Internal work experience”, (3) “Autonomy”, (4) “Time experience”, (5) “Management” and (6) “Reorganization”. Each statement has six responses, where 6 means “Totally agree” and 1 means “Do not agree at all”. A separate score is calculated of the mean for each dimension. High values mean positive experience of work and the workplace.

Perceived performance was measured using a specifically constructed 20 question questionnaire which targets employees who have relocated from traditional offices to open-plan offices [7]. Each question has five scores from “Strongly agree” (1) to “Strongly disagree” (5). The mean value of the 20 questions is calculated and lower mean values indicate higher perceived performance.

Work capacity assessed by one question from the Work Ability Index (WAI). The question “Do you believe, according to your present state of health, that you will be able to do your current job two years from now?” This question has shown to have high predictive validity for future work ability [34,35,36,37,38,39]. Response options were “unlikely”, “not certain” and “relatively certain”.

## 2.3 Procedure

The baseline and all three follow-up questionnaires were coded to enable comparisons. All employees received the coded questionnaires one month before and at the three follow-ups. Throughout the study the questionnaires were anonymous to the authors. At baseline 82 coded questionnaires were sent out. The response rate was 86% (71 persons). The group consisted of 48 men and 23 women aged 21–63 years. 14 people worked in open-plan offices and 57 in individual offices (Figure 1).

At the three month follow-up 79 coded questionnaires were sent out (three employees had moved). The response rate was 81% (64 persons). The group consisted of 44 men and 20 women aged 22–63 years. Forty-five people worked in open-plan offices and 19 in individual offices (Figure 1).

At the six month follow-up 79 coded questionnaires were sent out. The response rate was 75% (59 persons). The group consisted of 42 men and 17 women aged 22–63 years. Forty-four people worked in open-plan offices and 15 in individual offices (Figure 1).

At the twelve month follow-up 77 coded questionnaires were sent out (two more employees had moved). The response rate was 70% (54 persons). This group consisted

of 41 men and 13 women aged 22–64 years. Forty-two people worked in open-plan offices and twelve in individual offices (Figure 1)..

Please insert Figure 1 about here

#### 2.4 Dropouts

Between the first and final assessments, five persons had dropped out. Throughout the study there were internal dropouts on separate questions within a category or on an entire category. In those cases, the categories were not included in the analysis. In this study, results are presented only for respondents who worked in a private room at baseline and who worked in an open-plan office at all three follow-ups. Depending on the variable/category, twenty to twenty-seven participants met the above inclusion criteria.

#### 2.5 Analyses

Comparisons between baseline and three-, six-, and twelve-month follow-ups were analyzed with paired t-test. For ordinal data the Wilcoxon signed rank test was used. The Bonferroni method was used to correct for type I errors [40]. Only those questionnaires and variables that were answered at all four follow-ups were included in the analyses.  $P < 0.05$  was considered to be statistically significant. Data were analyzed in SPSS 19.0 for Windows (SPSS Inc, Chicago).

### 3. Results

#### 3.1 Perceived health (SHIS)

Rated health perception deteriorated between baseline and all three of the follow-ups. Intrapersonal characteristics (IPC) showed a significant difference at three and twelve months compared to baseline, i.e. perceived health had deteriorated. Interactive function (IAF) was significantly lower in the three-month follow-up compared to baseline however at six and twelve months there were no significant differences. The SHIS total was significantly lower at the three- and twelve-month follow-ups compared to baseline (Table 1).

Please insert Table 1 here

#### 3.2 Perception of work environment (WEMS)

“Supportive working conditions” and “Individual experiences” were the only subcategories that showed significant differences between baseline and follow-ups. Both categories significantly deteriorated at the three-month follow-up and “Individual experiences” was also significantly lower at the six- and twelve-month follow-ups. The other four subcategories showed no significant differences between baseline and follow-ups (Table 2).

Please insert Table 2 about here

#### 3.3 Perceived performance.

Perceived performance decreased significantly between baseline and the three- and six-month follow-ups (Table 3).

Please insert Table 3 about here

#### 3.4 Work capacity (WAI)

There was a marked decrease in the percentage of participants who answered “yes” to the WAI question if they thought that they would remain in their current work for another two years. At baseline 71% answered yes, at the twelve-month follow-up, the percentage had decreased to 41 %. Those who believed that they would not remain in their current work had increased from 7% at baseline to 18% after twelve month. (Table 4).

Please insert Table 4 here

## 4. Discussion

Health, work environment and performance perceptions are multifactorial, complex and can be studied from different perspectives. This study focused on the perception of health, work environment and performance for employees who were relocated from individual offices to open-plan offices. Questionnaires were sent out one month before relocation, and three, six and twelve months after relocation. To our knowledge, no previous studies have followed changes in the perception of health, work environment and performance after relocation to open-plan offices from single offices for such a long time [7].

Originally, the purpose was that employees who were still working in individual offices and who were not relocated to open plan offices should serve as controls. However, due to the rigorous inclusion criteria for the statistical analysis, dropouts have been extensive. Only data from those participants who worked in private offices at baseline and in open-plan offices at the three follow-ups and who also answered all the separate questions in the specific questionnaires were included in the analysis.

### 4.1 Perceived health (SHIS)

The rated perceived health deteriorated after employees had moved from a private office to an open-plan office. Both at three and twelve months after relocation, the differences were significant. At six months there was no significant difference. One possible explanation for this could be an adaptation after six months to the new working environment. However, if that was the case, the improvement should have been maintained even at the twelve-month follow-up. Prime vacation time in Sweden is the July-August period. A more likely explanation is that the six-month follow-up occurred in September just after the summer vacation which may have influenced the employees answers to perceived health. Studies have shown that the perception of health may vary during the year [41,42,43]. This could explain why the values were lower again at the fourth assessment in February, one year after relocation. In the present study, both the first (baseline) and the last (twelve months) assessments were carried out at the same time of the year, i.e. in February, which speaks against the outcome at the twelve-month follow-up in this study being affected by season. In our opinion there was a true deterioration of perceived health between the first and the last assessment.

### 4.2 Perception of work environment (WEMS)

At the three-month follow-up the experiences of work and working conditions had deteriorated compared to baseline concerning dimensions “supportive work conditions” and “individual experiences”. The scores for “individual experiences” were also lower at the six- and twelve-month follow-ups. The dimension “supportive working conditions” addresses issues of whether employees are happy in their workplace, whether there is a good working atmosphere and whether they get feedback on their performance. Three months is not long when it comes to adapting to a change [21,22]. At six and twelve months there were no longer any significant differences in the experience of supportive work conditions, which can be interpreted as showing that employees had adapted to the

new conditions. After twelve months, however, the values tend to be lower than at baseline ( $p=0,054$ ).

Regarding the dimension “Individual experiences”, there was a significant deterioration at three, six and twelve month follow-ups. “Individual experiences” illustrates issues as whether the persons perceive their work as meaningful, whether they go to work with joy, or whether they feel that it is possible to develop their skills at work. According to Hanson [19], the perception of meaningfulness in life and at work is one of the most important factors when it comes to maintaining health. Also, according to Antonovsky [23] and Frankl [44], perceptions of life and work as meaningful are important if one is to maintain health. There is a risk of increased future sick leave if the perception of work is low [21,25,26,27,45,46,47,48].

#### 4.3 Perceived performance

“Perceived performance” declined significantly between baseline and the three- and six-month follow-ups. After twelve months “Perceived performance” was lower than at baseline. However, the difference was not significant. This might suggest that the employees performed less well in open-plan offices than, when they worked in a private office. In the long run, this probably will be noticed by the organization in terms of decreased productivity and/or lower quality of work products. Employees’ perception of not being able to produce in an optimal way may also lead to less motivation and job satisfaction [7,21,26,45,46].

#### 4.4 Work capacity (WAI)

There was a transition for the worse in the scoring of perceived work capacity. At the twelve-month follow-up, 18% of the employees did not believe that they would remain in their existing job positions after two years, compared to 7% at baseline. Several studies have shown that perception of one’s work capacity and one’s health are two of the most important predictors of future sick leave and return to work after sick leave [47,49,50,51].

Since perceived health also had deteriorated during the last year, the findings from this study point at that there is an increased risk of future sick leave among employees within the company. If this is merely due to relocation to open-plan offices from a private office, or if other factors come into play cannot be answered in this study, but should preferably be tested in further studies with a comparable control group.

## 5. Conclusion

The results of the study indicate that employees’ perception of health, work environment and performance decreased during a 12 month period following relocation from individual offices to open-plan offices.

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## 7. Tables

**Table 1**

Variable	Baseline	Three months after relocation	Six months after relocation	Twelve months after relocation
IPK	28.3 (±7.3)	23.7 (±7.4) p=0.004*	26.8 (±5.7) p=0.337	23.5 (±5.9) p=0.002*
IAF	21.2 (±5.0)	17.3 (±4.2) p<0.000*	19.3 (±4.3) p=0.128	19.0 (±7.8) p=0.154
SHIS	49.6 (±12.1)	41.0 (±11.1) p<0.000*	46.0 (±9.5) p=0.214	41.5 (±9.5) p=0.002*

p=p-value before Bonferroni correction. \*p<0.05 after Bonferroni correction

**Table 2**

Variable	Baseline	Three months after relocation	Six months after relocation	Twelve months after relocation
Supportive working conditions n=26	29.19 (±5.9)	26.0 (±5.9) p=0.009*	27.3 (±6.7) p=0.134	26.5 (±6.9) p=0.054
Internal work experience n=26	27.1 (±6.2)	24.4 (±6.8) p=0.002*	24.3 (±7.3) p=0.014*	24.0 (±6.4) p=0.001*
Autonomy n=26	15.6 (±3.2)	14.9 (±2.9) p=0.353	14.5 (±3.8) p=0.168	14.6 (±3.5) p=0.189
Time experience	9.2 (±3.4)	9.0 (±3.4)	10.1 (±3.4)	9.2 (±3.5)

n=25		p=0.688	p=0.145	p=1.000
Management n=25	24.3 (±6.0)	22.1 (±6.3) p=0.164	21.7 (±6.9) p=0.114	20.9 (±7.5) p=0.039
Reorganization n=25	19.3 (±6.4)	18.4 (±6.6) p=0.490	18.8 (±7.7) p=0.646	16.6 (±7.5) p=0.047

p=p-value before Bonferroni correction. \*p<0.05 after Bonferroni correction

**Table 3**

Variable	Baseline	Three months after relocation	Six months after relocation	Twelve months after relocation
Perceived performance	44.0 (±9.0)	53.8 (±15.1) p=0.013*	54.1 (±15.1) p=0.009*	52.1 (±12.9) p=0.026

p=p-value before Bonferroni correction. \*p<0.05 after Bonferroni correction

**Table 4**

Variable	Baseline (%)	Three months after relocation (%)	Six months after relocation (%)	Twelve months after relocation (%)
Relatively certain	71	56	52	41*
Not certain	22	37	44	41*
Unlikely	7	7	4	18*

\*p<0.05 after Bonferroni correction

## 8. Table captions:

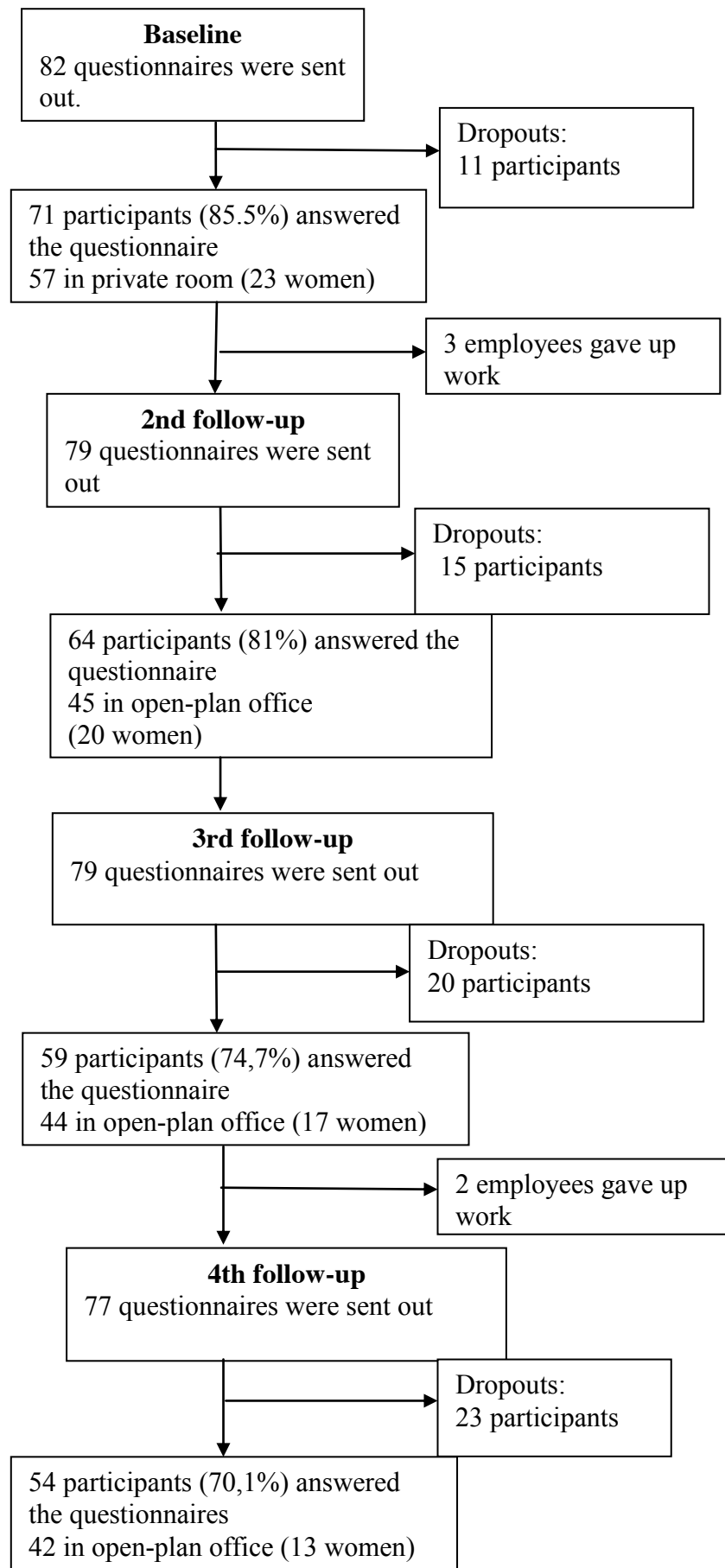
Table 1. Perceived Health. Intrapersonal Characteristics (IPC), Interactive Function (IAF) and Salutogenic Health Indicator Scale (SHIS) at baseline and three, six and twelve months after relocation. The higher the value, the better the perceived health. Mean (±sd). n=26.

Table 2. Work Experience Measurement Scale (WEMS) at baseline and three, six and twelve months after relocation. The higher the value, the better the perceived work environment. Mean (±sd).

Table 3. Perceived performance at baseline and three, six and twelve months after relocation. The higher the value, the lower the performance. Mean (±sd). n=21

Table 4. Question 7 from Work Ability Index (WAI), at baseline and three, six and twelve months after relocation. n=27

## Figure 1.



10. Figure caption

Figure 1. Study profile