Effects of the Office Environment on Health and Productivity 1: Auditory and Visual Distraction

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Abstract. A pilot experiment was conducted to evaluate the effects of visual or auditory distraction in an office environment on productivity, concentration and emotion. Ten subjects performed a simple, standardized computer task in five conditions (undisturbed, 3 variations of auditory distraction and visual distraction). Results showed no effects of visual and auditory distraction on productivity, concentration and emotion. This implies that typical problems of open office environments, like noise and other types of distraction, are of no influence on productivity while performing simple computer tasks. However, it is possible that the used method and factors like habituation, type of distraction and type of task were of influence on the results.

Keywords: health, productivity, office, distraction.

1 Introduction

Developments in Information and Communication Technology and more flexible ways of organizing work processes has changed the work environment of office workers substantially [1]. An example of these changes is the growing number of organizations that move to working in open plan offices. Open plan offices seem to meet the needs resulting from these technological and organizational developments, for example the needs of employees for working in teams. However, many problems of open plan offices have been reported, such as noise, lack of privacy and other kinds of distraction [2]. New office concepts may affect office workers performance, well-being and health [1]. Several studies show negative effects of noise or distraction in open plan offices on work performance, wellbeing and health [2],[3]. Furthermore, distraction is also expected to be related to a negative perception of the physical work environment [2],[3].

Auditory distraction or noise in the office environment is often mentioned as the most problematic distracting factor in relation to concentration [2]. Less is known about visual distraction. Visual distraction is different from auditory distraction, because the responses from the brain differ. The mechanism that helps to re-orientate to the working task again that is presumed to occur after long duration auditory distraction, does not occur after long duration visual distraction [4]. With auditory distraction, a process of three mechanisms is activated. First, the distracting stimulus

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is detected. Then, an involuntary attention switch occurs to the distracting stimulus. Finally, the attention is turned back to the primary task (reorientation), using information kept in the short term memory. This series of mechanisms takes place within 1,5 seconds and is visible in EEG activity. During long duration visual distraction, the first two mechanisms are visible in the EEG, but the mechanism of reorientation does not occur, indicating a difference between auditory and visual distraction. Moreover, this suggest that reorientation after long duration visual distraction may be more difficult than reorientation after auditory distraction [4].

According to Hongisto [5], auditory distraction is particularly a problem of complex tasks. It remains unclear if it applies to simple tasks.

Therefore, a pilot is conducted to study the effect of auditory or visual distraction on simple tasks. The research question was:

Does visual or auditory distraction in the office environment affect performance, concentration and emotion, performing a simple computer task?

Visual distraction was defined as walking through the visual field, auditory distraction was defined as telephone conversations within hearing distance.

2 Methods

Five men and five women participated in the study (age 35 ± 10 years, height 177 ± 12 cm, weight 76 ± 12 kg). All subjects were experienced computer workers. They spent on average 5 (± 1) hours a day computer work.

In five conditions, the subjects performed a standardized typing task with a duration of 15 minutes. In four conditions, the subjects were exposed to different types of distraction: 7 times walking past the visual field of the subject, and telephone conversations of 5, 10 and 15 minutes within hearing distance. In one condition the subjects performed the standardized task with no distraction. In all conditions, performance, emotion and concentration were measured.

Preceding the experiment, subjects gave informed consent. The subjects were informed about the goal of the study: to evaluate the effects of duration of typing tasks on performance and emotion. The subjects were not informed about the distractions they would be exposed to during the experiment.

The standardized task consisted of copying a text as accurate as possible (including punctuation marks like quotation marks, commas and apostrophes) in Microsoft Word 2000. At the same time, lay-out (like bold, italic or tabs) did not have to be copied. It was not allowed to use the mouse.

Typing speed and accuracy were used as performance measures. Typing speed was derived from the number of characters typed during 15 minutes (excluding the characters that were removed with delete and backspace keys). Accuracy was measured by the amount of typing errors, calculated by counting the differences between the original text and the copied text added up with the number of times the delete or backspace key was used. All missing or incorrectly typed characters were counted (letters, commas, full stops, interspacing, quotation marks, etc). To measure

the number of times the delete or backspace key was used, the rest break software Workpace 3.0 was used (Niche Software Ltd.).

To measure the effects of distraction on emotion, the EMO-cards were used [6],[7].This method was developed to measure emotion in relation with products. In this pilot study, the method was used to measure perception of the office environment. The EMO-cards measure two dimensions of emotion: 'pleasantness' and 'arousal' (Fig.1).

Concentration was measured by using a Visual Analogue Scale (VAS). Subjects were asked to place a mark on a line, ranging from 0 (extreme poor concentration) to 10 (extreme good concentration).

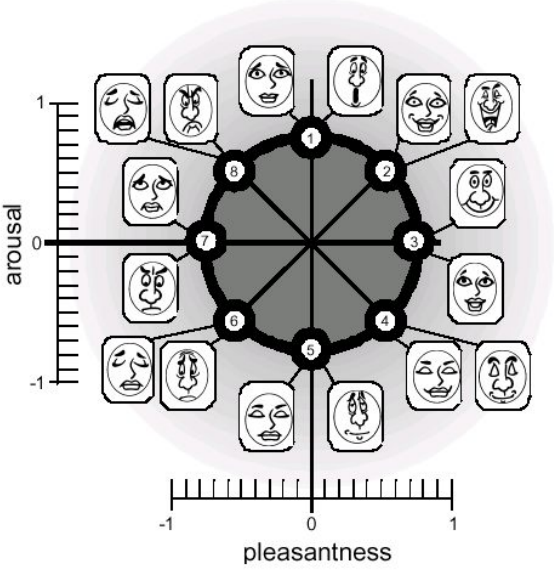

Fig. 1. EM O-cards

Differences in performance and concentration between the conditions without distraction and visual distraction were tested with a T-test for repeated measures. Differences in performance between the condition without distraction and the conditions with auditory distraction were tested with ANOVA for repeated measures, followed by a posthoc test (Bonferroni).

Differences in emotions were tested non-parametric. A Friedman test was used to evaluate differences in emotion (divided in 'pleasantness' and 'arousal') between the condition without distraction and the conditions with auditory distraction. The Wilcoxon signed ranks was used to evaluate differences between no distraction and visual distraction.

Also, the frequency of occurrence of emotions (combinations of 'pleasantness' and 'arousal') was determined for the five conditions. The frequency was not statistically tested.

Significance level was set at 5% (two-sided).

3 Results

No effects of auditory distraction on typing speed (Fig. 2) and accuracy (Fig. 3) were found. For visual distraction (walking through the visual field) comparable results were found.

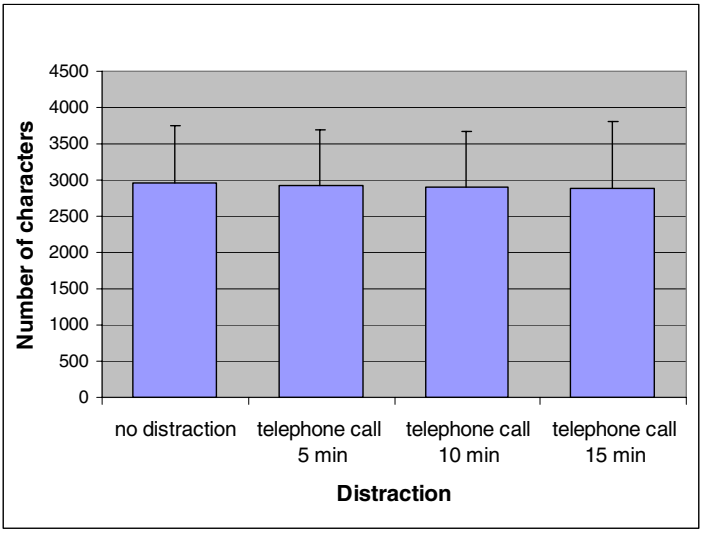

Fig. 2. Typing speed auditory distraction

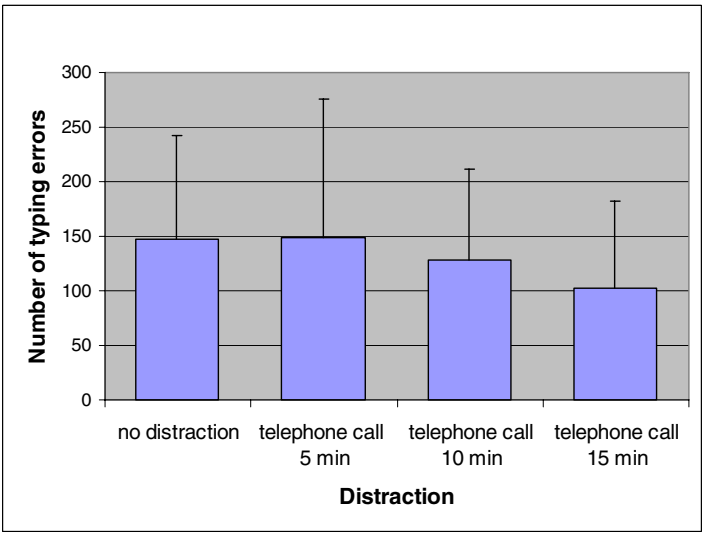

Fig. 3. Accuracy auditory distraction

No differences were found in self reported concentration between the conditions with distractions and the condition without distraction. These results were found for visual distraction (Fig. 4) as well as for auditory distraction.

Fig. 4. Self reported concentration visual distraction

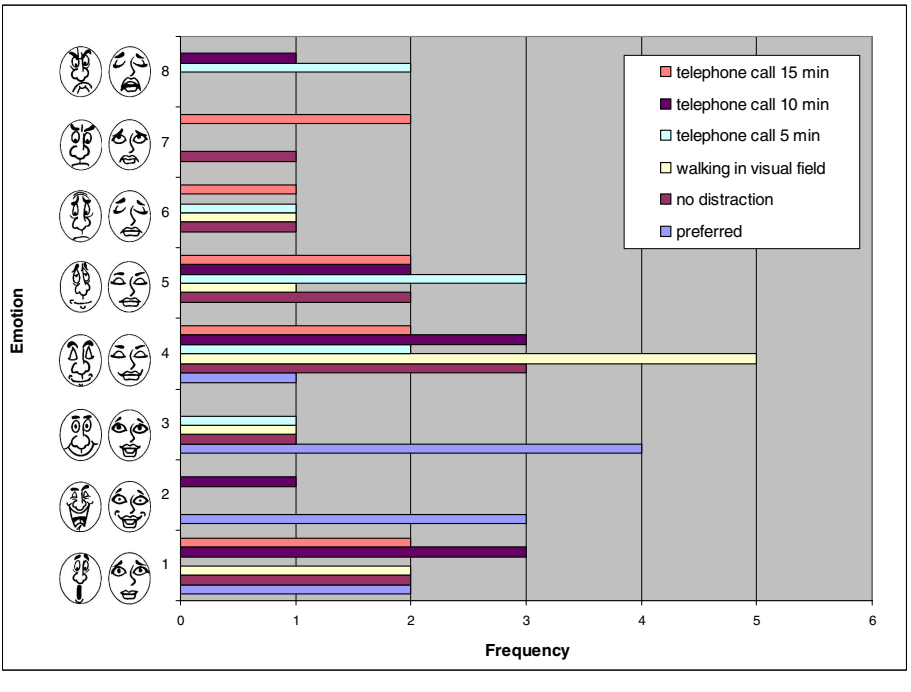

Fig. 5. Frequency of occurrence of emotions

Figure 5 shows the frequency of occurrence of emotions. Visual and auditory distraction were not of influence on the degree of 'arousal' and an 'pleasantness'. A notable result is that emotion 2 and 3 are rated as most preferable emotion. The subjects were asked to report the most important factors affecting their emotions at work. The following factors were reported:

- Task (boring, interesting text, remembering and searching through text) n=7
- Distraction (because of telephone conversation or wandering thoughts) n=6
- Interior/ design (keyboard, desk, reflections) n=4
- Physical discomfort (stiff muscles, pain) n=4
- Fatigue (because of task or early morning hours) n=3

4 Discussion

Subjects were mainly workers or students familiar with planning and performing research projects. Some subjects indicated that they suspected the real goal of the pilot study during the experiment (evaluating the effect of distractions). This may have influenced the results; it is not known in what way. On the one hand, subjects may have paid more attention to suspicions of the real goal of the study, in stead of concentrating on the task. On the other hand, subjects may have ignored the distractions more easily, suspecting the real goal of the study.

The experiment did not take place in a laboratory setting, but in a real office to simulate practice as much as possible. However, the situation was not completely comparable to a real office, because the room where the pilot study took place was not accessible for other employees than the subjects, to be able to control the distractions. The fact that the simulated office was not completely comparable to real practice may have been of influence. For example, noises in a laboratory setting may have another meaning for a person than the same sound in a real office setting, according to Banbury and Berry. Where subjects try to neglect a noise in a laboratory setting, they may tend to focus on the same noise in a real office setting [3].

Furthermore, subjects may have become more or less habituated to the distractions they were exposed to. In addition, most of the subjects are used to working in an open office space. Hongisto [5] reported that, to some degree, habituation to noise is possible, especially when someone has been exposed to it shortly before the experiment. However, because sounds in an open office space are usually unpredictable and of varying intelligibility, it is assumed that it is not possible to permanently habituate to office noise. Banbury & Berry [3] found no proof of habituation to noise in the office. On the basis of (inconsistencies in) literature, it remains unclear if habituation effects occurred in this pilot study.

In a telephone call certain topics of conversation may distract more than others, because it has a special meaning or is of special interest to someone. Literature shows that noise with relevant information has more influence on performance than irrelevant information. Especially background speech affects concentration, to a lesser degree distinctive or salient sounds and not so much the level of noise [5],[3]. In this pilot study, the speech intelligibility was high in the conditions with auditory distraction with telephone conversations. Therefore, it is not likely that the way the telephone conversations were performed influenced the results in this pilot study.

Less is known about visual distraction in offices. No studies were found evaluating effects of visual distraction in offices. Probably, visual distraction is less present than auditory distraction in open office spaces. Berti & Schröger [4] describe different reactions to visual distractions compared to auditory distraction. However, in this study, no differences were found between no distraction or visual distraction. Further research on visual distraction is needed.

No effects on performance were found. It is assumed that copying a text is a simple task and demands little concentration. Hongisto [5] reported that for simple tasks, performance may even increase with background noise, compared to the absence of background noise. The results of this pilot study suggest that the distractions in the work environment are less important in relation with productivity when simple tasks are performed. Moreover, this indicates there are no adverse effects on performance of open plan offices.

In addition, situational and personal factors may play a role in responses to distracation [8]. Some behavioural strategies to compensate effects of noise lead to a decrease in performance, while other strategies do not.

In literature, distraction is related to a negative perception of the work environment [2]. In the study of Banbury & Berry [3], noise is associated with irritation. In this pilot study, no effects of distraction were found on emotion. To measure emotions, EMO-cards were used [6],[7], which measures two dimensions of emotion: pleasantness and arousal. Possibly, the level of distraction was too low to measure effects on emotion. Perhaps, pleasantness and arousal are not emotions associated with distraction. In addition, EMO-cards are developed to measure emotions in relation with products and might not have been applicable for the purpose in this pilot study. In future research, it is important to pay attention to methods which measures other aspects of perception (e.g. irritation), as other studies did find effects of distraction on perception [2],[3].

5 Conclusion

Visual or auditory distraction in the office environment does not seem to affect performance, concentration and emotion, while performing a simple computer task. This implies that performing simple tasks in open office environments have no negative effects on performance. In future research, it is important to study the effects of distraction in complex tasks. In addition, is it important to study the effects of exposure to combined types of distraction and to study effects on a larger variety of emotions.

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