

## How office workers cope with distraction by sounds in the open plan office

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### ABSTRACT

The open plan office is a complex sound environment existing of speech, office equipment sounds, sounds from building services and other background sounds. Each type of sound can have a different influence on the performance or well-being of the office workers. Much research reports which sound sources are perceived to be most disruptive or annoying. To some extent, acoustic measures such as sound absorption and screens can be used to reduce the intelligibility of speech or the sound level of noise sources. Nevertheless, office workers need to deal with the acoustic environment they work in. In this research it is investigated which coping strategies are used by office workers for different sounds and how these strategies are perceived to be effective for improving productivity. Questionnaires were distributed among workers in three different companies that have problems with sound. Results show that ‘discussing the noise problem with colleagues’ is perceived as the most effective strategy when intelligible speech is the problem. Less effective, but more often applied, are so-called avoidance strategies such as ‘put work off’ and ‘interrupt work’, which is striking. Ear plugs are only perceived to be effective when speech is unintelligible or other sounds are disturbing.

Keywords: Open Plan Office, Coping

### 1. INTRODUCTION

Over the last decades, there has been a fundamental shift in the structure of the economy, from a manufacturing based to a more service and knowledge based economy (1,2). Therefore it is becoming increasingly important to establish an office environment that improves the performances of its occupants. In line with this development, we see that health and wellbeing of employees is becoming more and more important (e.g. introduction WELL Building Standard and Fitwel). Corporates are recognizing that employees and staff are not an expense, but can be valued as a capital resource. And that is not strange, as in general staff costs including salaries and benefits, typically account for about 90% of the business operating costs (3). As office employees spend a large proportion of their time at work, it should be self-evident that the physical office environment influences their health and wellbeing (4; 5; 6).

Over the past years, the physical workplace evolved frequently. To date, the open-plan office is a common used office type. There are a lot of economic benefits of an open space, such as: shortening walking distance between desks and promoting communication, information flows, working relationships and fresh and modern architecture. However, with the introduction of the open-plan concept, health and comfort issues, such as improper lighting, bad ventilation (7), lack of privacy (8, 9) and increased workplace noise (9,10) became present.

A supporting workplace environment is said to have the ability to encourage employees with their productivity and task performances. Therefore, the physical office environment is increasingly becoming important for especially knowledge companies. The quality of this physical environment is based on several ambient attributes of the office environment, such as light, air quality, temperature and noise (11, 12). Acoustics are one of the most important ambient attributes of the modern office design, as sound or noise is something that cannot be avoided in an office. However, compared to the

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other ambient factors, there is less known about acoustics. To date, it is known that speech and conversations are one of the most annoying sources in the office environment. Research that has been done focus on the effect of this noise source on task performance, such as proofreading (13, 14, 15) or text typing (16, 17). However, the existing researches seldom focus on the perceived effects.

So sound is something that cannot be avoided in an office environment. Therefore it is important to know how someone perceives noise, as the distinction between sound and noise is very subjective, since noise is a subjective judgement. This is particular to each individual, place and task. To reduce the negative effects of noise, individuals can cope with noise by various types of coping strategies. However, beside some research from (18) about several coping strategies in private office rooms and open-plan offices, not much evidence exists in the field of personal coping strategies. The lack of information about the perceived effect of noise and how people cope with noise, results in the following research objective:

The aim of this research is to provide insights in the effects of different sources of noise in office environments on perceived productivity and how different types of employees cope with it. In addition this research aims to provide insights in the effects of coping behavior on the perceived productivity. To achieve this research objective, the main research question is:

*What is the effect of different types of noise on perceived productivity and coping behavior in the open-plan office environment and which coping strategies are perceived as most effective?*

## 2. Literature

To be able to recognize what causes noise in the office environment and to understand the relation between noise and productivity, it is important to dive deeper in concepts such as acoustics, sounds and noise in the office environment. Employees indicate that noise is the second biggest cause of distraction and dissatisfaction in the office environment, after lack of temperature control (19). The literature distinguishes four categories of office noise, including speech and conversations, office equipment, installations and background noise (20, Canada Safety Council, n.d.). In the case of speech and conversations, it is not the level of speech that has effect on productivity, but it is the speech intelligibility that affects an employee's productivity. In all other cases, it is assumed that the level of decibels affects the working conditions. Noise has not only a negative effect on productivity in its broadest sense, but can also have effect on a particular task, such as text reading or typing. Intelligible speech decreases working memory and receptive reading (21, 22), while a ringing telephone appears to have a negative effect on cognitive performances, which indirectly affects an employee's productivity (23). In other terms, typical office tasks are negatively influenced by various office noises, hence these have a negative effect on productivity.

If employees perceive that their productivity is influenced by office noise, they can adapt strategies or skills to deal with the noisy circumstances. This is called coping behavior (25). Coping behavior focuses on controlling the situation despite the noise or aim to neutralized the noise. Coping can be conceptualized and distinguished as approach and avoidance, which refer to respectively seeking treatment for a stressor or ignoring and avoiding the stressor (26). People with good coping skills tend to have better adjustment in life. People with positive coping behavior are better motivated, are able to push through, can successfully tackle challenges, are more likely to achieve goals, have better sleeping patters and have better physical and psychological health (25). Oseland and Hodsman (27) examined the relation between noise and coping behavior, but did not succeed to define various types of coping behavior, like Kaarlela-Tuomaala et al. (18) did. As a result, eleven coping strategies could be defined and described:

1. Discussed the noise problem with colleagues
2. Made an even greater effort
3. Put the work off till another time
4. Done their work more slowly than usual
5. Put on some music or earphones
6. Interrupted their work or left their desk
7. Tried to be quieter in the hope that colleagues did the same
8. Changed your work station or did the work home
9. Made a proposal to management to improve the acoustic conditions
10. Used earplugs or hearing protectors
11. Do nothing

Some of the strategies above are combined in this research, for example *interrupted their work or left their desk*. Interrupt your work or leave your desk are two different ways of coping with noise. In some situations, it could be that an employee would leave his or her desk, while in other situations he or she would interrupt his or her work, but would not leave his or her desk. Therefore this coping strategy is in the conceptual model divided into *interrupt your work* and *change your workstation or location*. To clarify the difference between some coping strategies, some strategies are described in more detail. To illustrate, the coping strategies *put work off till another time* and *interrupt your work* could be seen as the same coping strategy. That is why to the latter strategy has been added *seek some distraction and resume your work afterwards*. This ensures that the respondents could see the difference between the two strategies. At last it is worth mentioning that the coping strategy *do nothing* is added to the conceptual model. Do nothing and ‘accept’ the noise conditions is one way to handle the noise and therefore a coping strategy that will be measured during the survey.

### 3. Research approach

A questionnaire was distributed in order to gather data about preferences and attitudes related to coping strategies and effects of various noise sources. The questionnaire contained questions about the various noise sources for which the respondent had to indicate to what extent these sources affected the perceived productivity. It included statements about coping strategies and their effect on perceived productivity. The questionnaire was distributed between the 3rd of September and 10th of October 2018 among three companies which had to deal with acoustic problems in their office environment. In total 461 people received the online questionnaire. Thereof 150 people filled in the questionnaire (64 men and 86 females), which results in an acceptable response rate of 33 percent. However, the generalizability of the sample is questionable, because the variables gender, age and educational level differ significantly when compared with figures of CBS (Dutch national statistics agency). The sample represents ages varied from 22 till 66 years, with an average age of 41 years and a fairly high standard deviation of 11 years. In general, it can be seen that the majority of the sample has a vocational educational level with a percentage of no less than 82.0 percent. 12.0 percent is in the possession of a Master’s degree or PhD. One of the respondents stopped education after primary school.

After data description and preparation, further analyses could be examined. The Chi-Square test (X<sup>2</sup>-test) is used to determine whether there is a significant difference between the expected variables and the observed variables in one or more categories. This test has been performed to examine the relation between noise sources and coping behavior. In case of small expected counts, a Fisher’s exact test is used. Additionally, the Lift-ratio is used to analyze to what extent the choice for a specific coping strategy differs between the various noise sources in more detail. By doing this, it can be analyzed if a particular coping strategy is a specific coping reaction to a particular noise source.

### 4. Results

Table 1 provides an overview of the distribution of noise sources that affects the respondents’ perceived productivity. It needs to be mentioned that in this stadium it provides no information to what extent a noise source is influencing the productivity, it only indicates if a particular noise source affects the perception of productivity of the respondents. It says something about how many respondents indicate that a particular noise source influences productivity and not to what extent. In conclusion, 80.7 percent of the respondents indicate that intelligible speech conversations (near one’s desk) is influencing perceived productivity. Intelligible speech from telephone conversations (74 percent) is the second most common noise source that is influencing self-estimated productivity. The two noise sources that are least often selected as having effect on productivity are installations and music, with respectively 18.7 percent and 16.7 percent.

Table 1 Overview of distribution noise sources

Noise source		N	Sample
<b>Speech and conversations</b>	<i>Intelligible speech conversations (near one's desk)</i>	121	80,7 %
	<i>Intelligible speech conversations in adjacent rooms</i>	60	40,0 %
	<i>Intelligible speech conversations at common facilities (e.g. coffee rooms or coffee machine)</i>	44	29,3 %
	<i>Intelligible speech from telephone conversations</i>	111	74,0 %
	<i>Unintelligible background conversations</i>	72	48,0 %
<b>Office equipment</b>	<i>Telephones ringing</i>	89	59,3 %
	<i>Printers/ fax/ shredder/ coffee machine</i>	44	29,3 %
<b>Installations</b>	<i>Ventilation or air-conditioning system</i>	28	18,7 %
<b>Background noise</b>	<i>Music (radio or piped-in)</i>	25	16,7 %
	<i>People passing-by, entering or leaving the office</i>	54	36,0 %
	<i>Noise from outside the office building</i>	34	22,7 %
	<i>Sound of a particular colleague</i>	65	43,3 %

As employees start coping with office noise, it seems that they most often choose for the avoidance coping strategy *make even a greater effort* (49.8 percent of respondents indicate to use this coping strategy), followed by the approach coping strategy *discuss noise problem with your colleagues* (43.6 percent of respondents indicate to use this coping strategy). Also in total, the avoidance coping strategies are more often chosen in comparison with the approach coping strategies. Surprisingly, despite that the respondents choose more often for the avoidance strategies, the approach strategies are perceived to be more effective in to boost perceived productivity. So they know that approach is better than avoidance, but do not as often choose such a strategy. The approach coping strategy *discuss the noise problem with your colleagues* is perceived to be the most effective coping strategy to boost perceived productivity, followed by *continue work at home*. The least effective coping strategy is the avoidance strategy *try to be more quiet in the hope that your colleagues do the same*. It is worth mentioning that the coping strategies *change your desk or location* and *continue work at home* cannot be used by every respondent because they have an allocated work location or do not have the possibility to work at home. Analyses that are performed including only the respondents that are actually able to use these two coping strategies, *continue work at home* is perceived to be the most effective coping strategy followed by *change your desk or location*.

The Lift-ratio is used to analyze to what extent a noise sources triggers a specific coping strategy. The results of the Lift-ratio show interesting findings, see table 2. The results in table 2 show that there are specific coping strategies in relation with the noise sources, see green column. This means that when it is known which coping strategies are present in an office environment, this can be an indication is for the noise sources that are present and have influence on the perceived productivity of the employees. If it is know which noise sources are present, one can act on this. For example, if employees tend to interrupt their work, this is an indication that there is too much intelligible speech that affects the perceived productivity of the employees.

Table 2. Overview of specific coping reactions\*

Noise source	Specific coping strategy	Least chosen strategies
<i>Intelligible speech (near one's desk)</i>	<ul style="list-style-type: none"> <li>- Interrupt work (seek distraction)</li> <li>- Try to be more quiet</li> </ul>	<ul style="list-style-type: none"> <li>- Do nothing</li> </ul>
<i>Intelligible speech at common facilities</i>	<ul style="list-style-type: none"> <li>- Proposal to management</li> </ul>	<ul style="list-style-type: none"> <li>- Put work off (change to a less demanding task)</li> <li>- Try to be more quiet</li> </ul>
<i>Intelligible speech telephone conversations</i>	<ul style="list-style-type: none"> <li>- Put work off (change to a less demanding task)</li> <li>- Interrupt work (seek distraction)</li> </ul>	<ul style="list-style-type: none"> <li>- Try to be more quiet</li> </ul>
<i>Unintelligible background conversations</i>	<ul style="list-style-type: none"> <li>- Use earplugs or ear protectors</li> </ul>	<ul style="list-style-type: none"> <li>- Interrupt work (seek distraction)</li> </ul>
<i>People passing by, entering or leaving</i>	<ul style="list-style-type: none"> <li>- Do nothing</li> </ul>	
<i>Sounds of particular colleague</i>	<ul style="list-style-type: none"> <li>- Try to be more quiet</li> </ul>	<ul style="list-style-type: none"> <li>- Interrupt work (seek distraction)</li> </ul>

\*the outcomes of specific coping strategies are only related to offices

## 5. Conclusions and recommendations

The intention of this research was to reduce the research gap of existing scientific knowledge, including the perceived effects of noise, coping behavior in relation to noise and the effects of coping behavior on perceived productivity.

In conclusion, this research examined the effects of office noise on perceived productivity and coping behavior. Based on the analysis and the results, it can be concluded that a distinction can be made between the noise sources and their effect on perceived productivity. Speech and conversations are most often indicated as affecting the perceived productivity, including intelligible speech near one's desk and from telephone conversations. Employees choose different coping strategies to respond to these noise sources. The effect of these coping strategies on perceived productivity differs per strategy, but in general it can be stated that *discuss the noise problem with your colleagues* and *continue work at home* are perceived to be the most effective strategies. In addition, it appears that a number of noise sources trigger a specific coping reaction. When employees are exposed to a noise source which affect their perceived productivity, they cope with a specific coping reaction.

This research contributes to the knowledge in the research field of ambient factors in the office environment. Many studies focus on light, temperature or air quality, while less is known about acoustics and noise in the office environment. Additionally, a lot of these studies focus on individual task performance, while the existing studies seldom focus on the perceived effects. Concerning the coping behaviors, there were studies that examined coping behavior, but just a few conducted a research on the effect of coping behavior on noise. Hence, not much is known about the effect of coping strategies on perceived productivity.

Recommendations for further research were based on several limitations of this research. This research is conducted in perspective of individual focused work, desk based in offices. Additionally, the coping strategies are also analyzed in perspective of individual focused work. The stimuli that affect perceived productivity depend on the type of work an individual performs. Future studies could focus on the perception of noise sources and how employees cope with these noise sources during different working activities. Also, personal characteristics of the employees should be included, to

find out their relevance in explaining coping behavior. The companies that participate in this research were all dealing with acoustic problems in their office buildings. An additional recommendation would be to do the same research with another focus group with less acoustic problems. Further research could analyze for instance what the effects are of coping strategies on perceived productivity in less noisy conditions. Furthermore, an interesting field for future research would be the effect of coping strategies on perceived productivity per noise source. A last recommendation, is to perform further research on the actual effects of coping strategies on productivity instead of the perceived effects.

A full version of the research report can be found in the master thesis by the first author (28).

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