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# Coping strategies and perceived productivity in open-plan offices with noise problems

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## Abstract

**Purpose** – To study effects of different sources of noise in office environments on perceived productivity, how different types of employees cope with different noise sources, and the perceived effect of different coping strategies on individual productivity.

**Design/methodology/approach** – Data on coping behavior and noise perception was collected through a survey among 150 employees of 3 organizations with an office in the Netherlands. These were analyzed with  $X^2$ -tests and the lift-ratio.

**Findings** – When coping with noise, people are most inclined to either “Make even a greater effort” or “Discuss the noise problem with colleagues,” despite the expectation that this does not have a major positive effect on their productivity. Overall, approach coping strategies were chosen less often than the avoidance coping strategies. There are clear preferences for specific coping strategies when exposed to specific noise sources. Personal differences did not appear to relate to the perception of noise sources but did show differences in coping behavior as well.

**Originality/value** – This study adds insights about preferred coping strategies for specific noise sources, differences in these preferences related to specific personal characteristics, and how successful these strategies are perceived to be with regard to support of individual productivity.

**Keywords** Counterproductive work behavior, Employee well-being, Knowledge workers, Job performance, Generational differences

**Paper type** Research paper

## Introduction

Johnson (1991) already pointed out that the fact that office noise can lead to stress among employees has been discussed in studies since decades ago (see for example Nemecek and Grandjean, 1973). Also, the Leesman office benchmark with over 500,000 respondents worldwide (see [www.leesmanindex.com](http://www.leesmanindex.com) review 27) shows consistently that noise is the 6th perceived most important feature of the workplace (after desk, chair, meeting rooms, temperature control and natural light), while among the physical office design dissatisfiers for employees, it is only surpassed by temperature control, because only 31% indicated to be satisfied with noise levels in their office. Some studies even found noise to be the most unsatisfactory aspect of the office (Kim and De Dear, 2013), and when asked how noise affects the ability to work, only 8.4% reported that the noise in their workplace does not make their work difficult (Oseland and Hodsman, 2018). Additionally, higher sound levels can cause biological changes, such as elevated blood pressure (Oseland and Hodsman, 2017). Apparently despite advances in acoustics design, current work environments are largely unable to solve noise issues for employees. And employees who suffer from noise, are more



inclined to complain about other aspects of the physical office environment as well (Haapakangas *et al.*, 2008). So as Ashkanasy *et al.* (2014, p. 1176) stated, it could be that: "... while organizations spend millions to build more high-density open-plan offices, ostensibly to facilitate improved productivity, it could well be that millions more are lost through inefficiency, legal issues, and lost production occasioned by unwanted noise, distractions, conflicts, and loss of privacy."

When employees cannot withdraw themselves from irrelevant noise in an open plan office, they also feel a loss of privacy (Bodin Danielsson and Bodin, 2009). Such individuals exposed to excessive stimulation, have been shown to respond directly with frustration and anger (which, in turn, may lead to withdrawal) and aggressively mark or defend their workspaces (Ashkanasy *et al.*, 2014). Territoriality and workspace claiming came forward in several studies of employees moving to a more open work environment (e.g. Babapour *et al.*, 2018; Appel-Meulenbroek *et al.*, 2011) and are an employee's way of coping with demands of the open-plan office. Besides the irritation, undesirable behavior and physical health deterioration, noisy conditions at work also have a more long-term indirect effect on job performance via decreased motivation and increased workload (Pindek *et al.*, 2019). As staff costs, including salaries and benefits, typically account for about 90% of business operating costs, this probably costs organizations more money than the workplace design costs. Unfortunately, so far direct costs remain the most important consideration in corporate real estate (CRE) decision making (Feige *et al.*, 2013), sometimes leading to unsupportive work environments.

Based on Lazarus and Folkman's (1984) appraisal theory, the Stimulus-Response Theory of Coping (SRTC) states that when an event is negatively appraised, coping mechanisms are enacted in order to reduce stress levels or to increase the individual's adaptation to the appraised situation (Johnson *et al.*, 2016). So, as organizations seem persistent about moving towards more open office environments, it seems important to address how employees are coping with noise; especially since negative coping is found to have a long-term effect on work and well-being (Johnson *et al.*, 2016). Most existing studies on acoustics and noise focus on sound levels (e.g. Keränen and Hongisto, 2013), types of noise (e.g. Jahncke *et al.*, 2016) or noise effects in different office concepts on satisfaction (e.g. Kim and De Dear, 2013). From those studies, we know that speech and conversations are one of the most disturbing sources in office environments in terms of both annoyance and productivity-related disruption. Previous research also showed detrimental effects of this noise source on task performance, such as proofreading (e.g. Halin *et al.*, 20014) or text typing (e.g. Balazova *et al.*, 2008). Research on how to deal with office noise focuses on acoustical design (e.g. Aliabadi *et al.*, 2016) and lately noise-cancelling technologies (e.g. Yadav *et al.*, 2017), but ignores how office use (coping) can influence productivity. To reduce the negative effects of noise, individuals can cope with noise by various types of coping strategies. However, besides Kaarlela-Tuomaala *et al.*'s (2009) study of coping strategies in private office rooms and open-plan offices, not much evidence is available on personal coping strategies related to noise. It remains unclear how people cope with the noise and whether they perceive their coping behavior as supporting their own productivity. Therefore, the aim of this study is to provide insight in the effects of different sources of noise in office environments on perceived productivity and how different types of employees cope with them. In addition, it addresses the perceived effect of different coping strategies on individual productivity. Data on coping behavior and noise perception was collected through a survey among 150 employees of three Dutch organizations, working in three office with noise problems and a lack of sufficient acoustical measures.

The next section will discuss literature on noise and coping behavior, after which the research approach is explained. Next, the findings are discussed, followed by conclusions and recommendations.

### Noise and coping

Average noise levels in open plan offices range from 46 to 58 dB(A), and generally ambient levels exceeding 45 dB(A) are associated with lowered acoustic satisfaction (Navai and Veitch, 2003). Generally, four categories of office noise are distinguished, namely speech and conversations, office equipment, installations and background noise (e.g. Pan and Cheung Chan, 2007). For three of these categories it is assumed that the level of decibels affects the working conditions, but regarding speech and conversations it is not so much the level of speech that affects productivity in offices, but the speech intelligibility. From the four categories of noise, speech has been identified as most annoying and distractive (Haapakangas *et al.*, 2008). Hongisto (2005) examined the relation between task performance and speech intelligibility theory (based on the STI=Speech Transmission Index). He found that performance on complex tasks is reduced by 7% when unattended speech is highly intelligible ( $STI > 0.6$ ) but has no effect when speech intelligibility is low ( $STI < 0.20$ ). But in typical open plan offices with sound absorbing ceilings only and no acoustic screens, the STI is above 0.50 over a large distance (up to 18 m) and  $STI < 0.20$  is not achieved when there is a low background noise (Wenmaekers and Van Hout, 2019). A review by Venetjoki *et al.* (2006) showed that effects of intelligible speech levels on productivity include, amongst others, a decrease of working memory and reading capabilities, and it makes mental arithmetic and prose memorizing more difficult. But also a ringing telephone appears to have a negative effect on cognitive performance, which indirectly affects an employee's productivity (Mouri *et al.*, 2001). So, typical office tasks are negatively influenced by various categories of office noise, which has a negative effect on productivity. According to Demarco and Lister's (1999) theory on "the state of flow," performance on complex tasks during the workday requires a state of concentration that once disrupted can take 15 or more minutes to reach again. Although habituation to speech could occur after approximately 20 minutes of sound, it is quickly broken again after only 5 minutes of silence (Banbury and Berry, 1997). As sounds fluctuate continuously in offices, employees cannot permanently habituate to the noise that is present. Therefore, they need to cope with the different fluctuating noise sources.

The term coping generally refers to the way someone adapts to stress or problems. It concerns dealing with stressors or problems in someone's surrounding environment(s) in order to minimize, tolerate or master stress and conflicts (Weiten *et al.*, 2008). Or as Lazarus and Folkman (1984) state, it is a "process of attempting to manage the demands created by stressful events that are appraised as exceeding a person's resources." Coping efforts can be adaptive or not, and the form of coping affects how successful the resolution of a stressor will be (Taylor and Stanton, 2007). 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 patterns and have better physical and psychological health (Arya, 2017). Kaarlela-Tuomaala *et al.* (2009) showed that when negative effects of the acoustic environment increased significantly, such as increased distraction, reduced privacy and increased concentration difficulties, the use of coping strategies also increased. Lazarus and Folkman (1984) first defined two general types of coping: problem- or emotion focused coping. Since then, many other categories have been introduced, and there is no clear consensus on which one is the best. Skinner *et al.* (2003) reviewed studies on three different classifications of coping, comparing the problem- or emotion focused typology with the approach versus avoidance distinction and with the most common action-types coping theory. They argue that the problem/emotion-focused coping categories are not conceptually clear, mutually exclusive, or exhaustive. For the approach versus avoidance way of coping they also state that there is some disagreement about what qualifies as approach and what as avoidance. They conclude that the action types category is the best one, but also state that it is very complex, because it incorporates behavior but also requires simultaneous consideration of

individuals' emotions, attention, and goals. Perhaps therefore the approach versus avoidance categorization is used most often in studies, which is also used here.

Approach coping strategies include engaging with the pain and its causes, while avoidance coping strategies refer to strategies of engaging efforts away from pain or stress, such as ignoring the pain or attempting to avoid increasing stress (Reid *et al.*, 1998). According to Taylor and Stanton (2007), approach coping strategies in general have shown positive psychological and physical health outcomes in stressful circumstances, while avoidance coping strategies can be successful in the short-term but are generally linked to increased distress and chronic disease progression and even mortality. Roth and Cohen (1986) also summed up that approach coping has more benefits, while avoidance coping has more costs. In the long run, the positive consequences of avoidance coping are mostly its beneficiary effects towards facilitating a consecutive approach coping strategy (Roth and Cohen, 1986).

Kaarlela-Tuomaala *et al.* (2009) and Oseland and Hodsman (2018) questioned in which way employees cope with sound in the office environment but did not relate this to literature on coping. In Table 1 coping strategies from those papers are therefore assigned to the approach-avoidance distinction. Their strategy "interrupt your work or leave your desk" has been split, as these seem 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. Also, in an activity-based office, one could switch workstations, which is not the same as working from home. Additionally, some coping strategies are described in more detail in Table 1 to clarify differences with others. To illustrate, Kaarlela-Tuomaala *et al.*'s coping strategies "put work off till another time" and "interrupt your work" could be seen as the same coping strategy. That is why "seek some distraction and resume your work afterwards" has been added to the latter strategy. Last, "do nothing" seems a way to handle the noise and was therefore added as a coping strategy, resulting in twelve different coping strategies.

Personal characteristics also influence disturbance by noise and coping, such as gender, age and personality. Females use more coping factors compared to males, because they are more noise-sensitive and disturbed by noise (Kaarlela-Tuomaala *et al.*, 2009). The acceptance of background noise of males is 6 dB higher compared to females (Rogers *et al.*, 2003), but men did rank acoustic conditions as more important compared to women (Choi *et al.*, 2009). Regarding age, most studies on irrelevant speech so far have failed to support the intuitive theory that older people have more problems ignoring noise due to their difficulty in keeping irrelevant information out of working memory (Murphy *et al.*, 2018). But undoubtedly age

Personal coping strategies for noise	Approach	Avoidance
1. Discuss the noise problem with colleagues	X	
2. Make an even greater effort		X
3. Put the work off till another time		X
4. Do your work more slowly than usual		X
5. Put on some music or earphones	X	
6. Interrupt your work, seek some distraction and resume your work afterwards		X
7. Change your workstation or location	X	
8. Try to be more quiet in the hope that colleagues did the same		X
9. Do your work at home	X	
10. Make a proposal to management to improve the acoustic conditions	X	
11. Use earplugs or hearing protectors	X	
12. Do nothing		X

**Table 1.**  
Coping strategies  
for noise

influences hearing loss and the ability to hear noise (Connelly *et al.*, 1991). Also, regarding coping behavior (not noise related), research showed that older adults engage in more proactive coping to deal with minor hassles in their daily lives (Neubauer *et al.*, 2018), but are less likely than younger adults to use problem-focused coping (Chen *et al.*, 2018). So perhaps coping with noise will also differ by age. Last, some personality types are probably better skilled at coping with noise. Shepherd *et al.* (2015) showed that all the Big Five personality dimensions (neuroticism, extroversion, openness, agreeableness and conscientiousness) had an independent effect on noise sensitivity, but extroversion-introversion had the biggest effect. Extroverts and introverts perform equally well in silence, but during noisy conditions (at 60 db) extroverts performed similar, while the performance of the introverts decreased (Standing *et al.*, 1990). People who are predominantly extrovert are coping better with noise than those who are more introverted (Oseland and Hodsman, 2018). Neuroticism is relevant as well, as performance of neurotic personalities is affected by noise more compared to non-neurotic personalities (Matthews *et al.*, 2004). Not office noise related coping studies showed that neurotics are more likely to choose avoidance coping strategies (Pereira-Morales *et al.*, 2018). So, all these personal characteristics were included in the study.

## Methodology

### *Participants and measures*

To gather data on coping behavior, a questionnaire was spread among employees to ask about their personal characteristics and preferences and attitudes regarding coping strategies and various noise sources. It was spread through purposive sampling of three companies dealing with noise problems in their office environments with poor acoustics conditions (two offices did not even have sound absorbing ceilings and none of the offices had acoustic screens), identified by the second author of the paper. He arranged with the HR managers of all three organizations to spread an email with a weblink to the survey among their employees. One of the companies was a large international shipping container transport organization with one Dutch office ( $n = 270$ ), while the other two were a small Dutch consultancy firm ( $n = 65$ ) and a small Dutch insurance and realty firm ( $n = 126$ ). Respectively 62, 51 and 35 employees participated in the survey, so 150 in total (of the 461 targeted employees, which is an average response rate of 33%). All three occupied buildings have an open-plan office concept, in which 70% of the employees in the sample had an allocated seat (which does not allow the coping strategy change your workstation) and 55% was allowed to work at home (one of the coping strategies). Most employees in the sample (77%) worked in large open plan offices, with 7 up to 50 people working in the same room.

The questionnaire started with the personal characteristics (age, gender). Then personality traits extravertedness and neuroticism were measured with two statements each, to which respondents answered on a seven-point scale to ensure sufficient spread in the dataset on questions like this which tend to be answered close to the neutral score (1 = Disagree strongly, 2 = Disagree moderately, 3 = Disagree a little, 4 = Neither agree nor disagree, 5 = Agree a little, 6 = Agree moderately, 7 = Agree strongly): I see myself as:

- (1) Extraverted, enthusiastic
- (2) Reserved, quiet
- (3) Anxious, easily upset
- (4) Calm, emotionally stable.



The inter-item correlations (resp. 0.555 and 0.348) were high enough to add the first two into an extravertedness score, and the last two into a neuroticism score.

Next, the questionnaire contained questions about the various noise sources (see Table 2 in the results section for a list of sources used), for which the respondent had to indicate to what extent these noise sources were affecting their (perceived) productivity during individual desk-based focused work on a five-point scale (1 = No effect, 2 = Minor effect, 3 = Neutral, 4 = Moderate effect, 5 = Major effect). The subdivision between terms like performance and productivity has led to a lot of discussion, and many studies use performance and productivity as redundant items. Following Feige *et al.* (2013), who provide a clear discussion of the distinction between both constructs, the survey contained this subjective productivity measurement to evaluate the individual employee performance. The next question was posed in the form of a table in which respondents had to indicate with yes/no which coping strategies they would apply when a particular noise source would affect their perceived productivity (multiple coping strategies could be selected for each noise source). To keep this part of the survey workable, from here on only human generated noise was considered, as this is proven to be the most annoying and it is also the most fluctuating noise source (see Table 2, the five forms of intelligible or unintelligible speech in the first category of noise sources, plus the bottom two human-generated background noise sources: the movement of employees through the office and sounds from a specific colleague). After the respondent had indicated which coping strategies he or she would use to cope with human generated noise, the expected effect of each coping strategy on their productivity in dealing with the noise was asked. They had to indicate the expected effect on a 5-point scale (1 = No effect, 2 = Minor effect, 3 = Neutral, 4 = Moderate effect, 5 = Major effect) in response to the following statement: "If I would apply the following coping strategy, then it would reduce the negative effects of noise on my productivity compared to doing nothing"...

### Procedure

Chi-Square tests ( $X^2$ -tests) were used to determine whether there were significant differences in coping behavior regarding specific noise sources and regarding personal characteristics, respectively. In case expected counts were too small to meet this test's preconditions, a Fisher's exact test was used. Additionally, the Lift-ratio was calculated to measure the associations between specific coping strategies and the various noise sources. This method is very useful to evaluate association strengths, but not for making statistical statements about the relationships. But that is already done with the  $X^2$ -tests.

Noise source		N	%
Speech and conversations	Intelligible speech conversations (near one's desk)	121	80.7
	Intelligible speech conversations in adjacent rooms	60	40.0
	Intelligible speech conversations at common facilities (e.g. coffee rooms or coffee machine)	44	29.3
	Intelligible speech from telephone conversations	111	74.0
	Unintelligible background conversations	72	48.0
Office equipment	Telephones ringing	89	59.3
	Printers/fax/ shredder/coffee machine	44	29.3
	Ventilation or air-conditioning system	28	18.7
Installations	Music (radio or piped-in)	25	16.7
	Noise from outside the office building	34	22.7
	People passing-by, entering or leaving the office	54	36.0
	Sound of a particular colleague	65	43.3

**Table 2.** Number of individuals who indicated that their productivity is affected by certain noise sources

The lift ratio is defined as:

$$LR = \frac{P(Co_i|No_j)}{P(Co_i)}$$

where  $P(Co_i|No_j)$  is the conditional probability that coping strategy  $i$  is chosen, given the exposure to noise source  $j$ , and  $P(Co_i)$  is the unconditional probability that coping strategy  $i$  is chosen. Thus, a lift ratio larger than one indicates a positive association between the strategy and the source (the coping strategy is chosen more often with that noise source). A lift ratio smaller than one indicates a negative relationship (the strategy is chosen less often with that noise source). A value of one indicates statistical independence.

### Results

The sample contains 43% males and 57% females, with an average age of 41 (SD = 11). Regarding personality, generally a medium to high extravertedness ( $X = 4.99$ ) and medium to high neuroticism ( $X = 5.65$ ) could be observed. For further analyses the sample was split in two equally sized groups for each personality trait based on their score; showing a medium and a high extravert group (resp. sum scores between 2–5 and 5.7–7) and a medium and a high neurotic group (resp. sum scores between 2.5–6 and 6–7).

Table 2 provides an overview of the noise sources that respondents experienced as noise affecting their productivity during individual desk-based focused work. As expected, 80.7% of the respondents indicated that intelligible speech conversations (near one’s desk) affects their productivity. Intelligible speech from telephone conversations (74%) is the second most disturbing noise source. The non-human sources are at the bottom of the ranking (e.g. installations and music, with respectively 18.7% and 16.7%).

#### Choice for coping strategies

The total number of times different coping strategies were mentioned and the average expected impact on productivity across noise sources is shown in Table 3. This shows that the coping strategies “Make even a greater effort” and “Discuss the noise problem with your colleagues” are by far used most (resp. 49.8% and 43.6% of the employees). “Try to be more

Coping strategy		N	Used for coping		Impact on productivity	
			Sample (N/805)	Sum	Mean	SD
Approach coping behavior	Discuss the noise problem with your colleagues	351	43.6%	911	3.49	0.99
	Put on some music or earphones	162	20.1%		3.00	1.25
	Make a proposal to management to improve the acoustic conditions	127	15.8%		[1]	
	Change your desk or location	102	12.7%		2.94	1.15
	Use earplugs or hearing protectors	96	11.9%		3.01	1.05
	Continue your work at home	73	9.1%		3.44	1.18
Avoidance coping behavior	Make even a greater effort	401	49.8%	980	3.29	0.86
	Do nothing	168	20.9%		Reference	
	Do your work more slowly than usual	150	18.6%		2.66	0.98
	Interrupt your work	135	16.8%		3.26	0.96
	Put the work off till another time	79	9.8%		3.04	1.12
	Try to be more quiet in the hope that your colleagues do the same	47	5.8%		2.11	0.94

**Table 3.** Coping strategies and perceived impact on productivity compared to doing nothing



quiet in the hope that your colleagues do the same” is used the least (5.8%) and also “Put work off till another time” (9.8%) and “Continue work at home” (9.1%) were not applied often. Overall, approach coping strategies were chosen less often than the avoidance coping strategies, although their expected impact on productivity compared to doing nothing was higher. People expected most from the two strategies that were used most, but very few respondents (maximum 10.7%) stated that any one of these two coping strategies would have a major effect on productivity compared to doing nothing. Only for “Continue to work at home,” 18% thought this would be a highly effective strategy, although this strategy was not chosen very often. Not choosing to work at home might be explained by the fact that almost half of the sample does not have the possibility to work at home. The 82 respondents that were able to work from home expected even more effect of this coping strategy (mean = 3.76) than the “best” coping strategy in the whole sample. Also, not everybody was able to change their desk. The 46 respondents that did not have an allocated workstation indicated that the effect of change your desk on their perceived productivity was higher (mean = 3.58) compared to the whole sample. According to these respondents, this coping strategy would thus have the most effect on their productivity; again even more than the “best” coping strategy in the whole sample.

Every organization consists of individuals with their own characteristics and possibly their own perception of noise and ways of coping with it. However, the  $\chi^2$ -tests showed no significant difference in perception of the noise sources between medium and high extroverts, nor between medium and high neurotic respondents. Regarding coping, they did show different preferences in choosing a strategy. The high extroverts were more inclined to use the coping strategy “Try to be more quiet” while the medium extroverts more often chose to “Interrupt work” or “Do nothing” ( $\chi^2$  (df = 11,  $N$  = 150) = 23.1,  $p$  = 0.017). In general (see Table 3), both these strategies are not used a lot and are not expected to have much effect on perceived productivity. The test on neuroticism just missed the threshold ( $\chi^2$  (df = 11,  $N$  = 150) = 18.9,  $p$  = 0.063), where “high” neurotic people were more likely to “Continue work at home” and less to “Make a proposal to management.”

Regarding gender, males and females also did not perceive noise sources differently but did show differences in coping strategies. Males had a stronger preference to “Put on music” and “Change your desk,” while women preferred to “Discuss noise problem with colleague” or “Try to be more quiet” ( $\chi^2$  (df = 11,  $N$  = 150) = 48.70,  $p$  = 0.000). After dividing respondents in age groups (15–25, 26–35, 36–45, 46–55), tests showed that these did not perceive noise sources differently either, but again did show significant differences in how to cope with them. The respondents between 26–35 chose more often to “Put on music” and “Change your desk,” while those between 36–45 are more inclined to “Use earplugs/protectors.” The oldest group (46–55) is a lot less likely to “Put on music” or “Change desk,” while they are more inclined to “Discuss the noise problem with colleagues” ( $\chi^2$  (df = 33,  $N$  = 150) = 162.8,  $p$  = 0.000). However, there was a significant effect for age on having an allocated seat and thus the option to change your desk,  $t$  (df = 148) = 5.130,  $p$  = 0.000, where the average age of those in a flexible workspace is lower ( $M$  = 35) than those with an allocated seat ( $M$  = 44).

#### *Coping with specific noise sources*

Respondents do not randomly choose a coping strategy but have a preference for a specific coping strategy when exposed to a specific noise source ( $\chi^2$  (df = 66,  $N$  = 150) = 121.90,  $p$  = 0.000). The Lift-ratios (see Table 4) give an insight in to what extent a noise source triggers a specific coping strategy. As there is no statistical significance test related to the lift ratio, it was chosen to mark the biggest ( $LR > 1.4$ ) and smallest ( $LR < 0.6$ ) ratios italics in the table for easier interpretation. Overall, it is visible that there are more marked high and low ratios between noise sources and specific coping strategies among the avoidance strategies

Table 4.  
Lift ratios

Noise source	Discuss noise problem with colleague	Approach strategies					Avoidance strategies					
		Put on music	Continue work at home	Change your desk	Proposal management	Earplugs/protectors	Make greater effort	Put work off	Do work more slowly	Interrupt work	Try to be more quiet	Do nothing
Intelligible speech (near one's desk)	1.15	0.79	1.33	0.80	0.72	0.69	0.96	1.29	1.26	1.51	1.85	0.33
Intelligible speech adjacent rooms	1.03	1.10	0.68	1.25	1.29	1.04	0.92	0.81	1.09	0.90	0.91	0.89
Intelligible speech common facilities	0.91	0.94	0.94	1.27	1.44	1.19	0.98	0.58	0.81	0.90	0.48	1.31
Intelligible telephone conversations	1.04	0.95	0.93	0.97	0.78	0.84	0.91	1.80	1.15	1.46	0.53	0.74
Unintelligible background conversations	0.71	1.39	0.91	0.82	1.05	1.48	1.20	0.74	0.72	0.56	0.71	1.39
People passing by, entering, leaving	0.86	0.93	0.92	1.24	0.93	0.96	1.01	0.74	0.95	0.81	0.72	1.70
Sounds particular colleague	1.17	1.04	1.15	0.75	0.96	1.03	1.08	0.68	0.81	0.45	1.46	1.13

compared to the approach strategies, indicating that the avoidance strategies are applied more specifically to specific noise sources. Moreover, there are no marked low ratios between the approach coping strategies and noise sources, indicating that none of the approach strategies are assumed irrelevant for a noise source. For the noise source experienced by most of the respondents-intelligible speech near one's desk (81%) - the respondents seem particularly inclined to use avoidance strategies such as "Interrupt work" ( $LR = 1.51$ ) and "Try to be more quiet" ( $LR = 1.85$ ), but not to "Do nothing" ( $LR = 0.33$ ). When the intelligible speech is from adjacent rooms there are no strong preferences, while intelligible speech from common facilities, motivates people to choose "Proposal to management" ( $LR = 1.44$ ) and not "Try to be more quiet" ( $LR = 0.48$ ) or "Put work off" ( $LR = 0.58$ ). Intelligible telephone conversations are tackled by the decision to "Put work off" ( $LR = 1.80$ ) or "Interrupt work" ( $LR = 1.46$ ) and again not by "Try to be more quiet" ( $LR = 0.53$ ). For unintelligible background conversations people choose "Earplugs/protectors" ( $LR = 1.48$ ) and do not often "Interrupt work" ( $LR = 0.56$ ). Regarding noise from people passing by respondents generally "Do nothing" ( $LR = 1.70$ ), and for sounds from a particular colleague they tend to "Try to be more quiet" ( $LR = 1.46$ ) and do not "Interrupt work" ( $LR = 0.45$ ).

## Discussion

This study showed that when coping with noise, people are most inclined to either "Make even a greater effort" or "Discuss the noise problem with colleagues," although very few of the respondents believed that it would have a major effect on productivity compared to doing nothing. Overall, approach coping strategies were chosen less often than the avoidance coping strategies, despite the idea that their expected impact on productivity compared to doing nothing would have been higher. Respondents prefer a specific coping strategy when exposed to a specific noise source. Personal differences did not appear to relate to the perception of noise sources but did show differences in coping behavior as well.

### *Implications for theory and practice*

Previous studies have shown that intelligible speech is the most annoying noise source in the office workplace. The results above add insights to existing theory about preferred coping strategies for specific noise sources, differences in these preferences related to specific personal characteristics, and how successful these strategies are perceived to be with regard to support of individual productivity. First of all, the results confirm [Kaarlela-Tuomaala et al. \(2009\)](#) that in open-plan offices the coping strategies to make even a greater effort and to discuss the noise problem with colleagues are used most. On the contrary, [Oseland and Hodsman \(2018\)](#) found that moving away from the source of noise by working outside the office was the primary coping mechanism, but that was an activity based open-plan office. In the sample of the present study not everybody was allowed to work from home. Also, [Babapour et al. \(2018\)](#) showed that people do not like to withdraw themselves from the work floor, being afraid of leaving the group and missing out. Unlike previous studies we do not find that wearing headphones is a popular strategy. Possibly, the difference may be due to characteristics of the sample. Compared to the other studies, the average age of the sample is a bit higher; that might explain the differences, given the found relationship between age and choice of coping strategy.

It is remarkable that approach coping strategies were chosen less often than the avoidance coping strategies, although their expected impact on productivity compared to doing nothing was higher. This suggests that although employees know what they should do, something is preventing them to do so. In some cases this might be company policy (not being able to work

from home), while in other cases employees might feel resistance to speak up within their social work environment. Especially in cases where the source of noise was definitely clear (intelligible speech near one's desk, sounds of a particular colleague) people chose more for avoidance strategies and did not confront these colleagues. This might have made more sense if the source was unclear (e.g. from adjacent rooms), but then there was no preference for a certain strategy. The fact that making even a greater effort (so trying to ignore the noise) is the most chosen way of coping with this most disturbing noise source suggests, in light of the Stimulus-Response Theory of Coping itself and Person-Environment fit theory in general (Edwards *et al.*, 1998), that these environments are still perceived as stressful despite the coping behavior portrayed. Kaarlela-Tuomaala *et al.* (2009) showed that despite an increase in the use of coping strategies the level of negative feelings did not change, and employees still felt irritated, stressed and dissatisfied, which is likely to be the case here as well.

Furthermore, the results indicate that some noise sources trigger a specific coping reaction. Noticeably, when a specific coping strategy was triggered by a specific noise source, this was often an avoidance strategy and thus a less effective one. Even for the most disturbing noise source (experienced by most of the respondents), being intelligible speech near one's desk, approach coping strategies were chosen relatively less often. When employees are confronted with intelligible speech at common facilities they choose more often to approach management. A possible explanation is that it may feel relatively simple to let the management solve this problem and, in that way, one does not have to confront colleagues personally about the noise. Unintelligible background conversations, which might be present the whole day, are managed by putting on music or earplugs, perhaps because many respondents indicated that there are no concentration spots available at their workplace.

Only coping behavior displayed significant individual differences related to person variables, not the perception of noise. The gender differences found confirm the findings by Lim and Theo (1966) that females tend to seek social support and talk to others when they experience stress, while men tend to suppress their emotions and deal with problems in a logical and unemotional manner (in this case of noise by putting on music or changing desks). The differences related to age that we found show a more proactive coping approach by older adults as suggested by Neubauer *et al.* (2018), as they are more likely to discuss noise with their colleague(s). On the other hand, there might be confounding variables like type of work and hierarchical position in the organization, which caused these older adults to be more proactive. This could not be tested with the data that was collected. As for personality traits, it was expected that people who are predominantly extrovert are coping better with noise than those who are more introvert (Oseland and Hodsman, 2018). This was however not found here: the high extraverts only used some coping strategies more, which in general were not used much and not expected to have much effect on perceived productivity. Also, not office noise related coping studies showed that neurotics are more likely to choose avoidance coping strategies (Pereira-Morales *et al.*, 2018), but no significant differences came forward in this study.

### *Practical implications*

Overall, it seems that noise remains an issue that is hard to cope with, as many respondents indicated being negatively influenced by it. The problem of acoustics is still recognized too little by management. Bad acoustic conditions in office environments are not taken into account at strategic decision moments in the accommodation process, or at least do not get the same level of design attention as thermal, ventilation and other architectural and engineering considerations that have more clearly specified norms and cultural preferences.

Besides attention for design quality, introducing an open-office concept requires more managerial attention to noise as well. Following Johnson *et al.*'s (2016) suggestion on change

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in general, managers need to have more dialogue around concerns leading to a negative perception of an ongoing/upcoming change, or at least acknowledge and address employees' coping reactions. If the change towards an open concept is inevitable or desired for other reasons than supporting individual desk-based, focused work, at least more positive employee perceptions of their future workplace might enforce more effective coping strategies. Additionally, providing dedicated training to employees how they would best deal with noise sources, could help make them feel more in control and therefore less dissatisfied with the work environment. It would also teach them how to create a better fit between their own needs and the demands and resources at the office where they need to do their work.

Both calls for more attention (for design quality and for change management) would benefit in their execution from a well-informed start of intervention/change processes. Workplace managers could survey their user population with short surveys like used in this study, to identify what is perceived as disturbing the individual productivity the most. Insights in personalities and age could further inform the best approach to noise alleviation. If (part of) the disturbance by those sources can be resolved, people are likely to feel more appreciated and thus positive towards their work environment.

#### *Limitations and future research*

The present study has several limitations that could be addressed in future research. This study focused on disturbance by noise during individual desk-based focused work in three Dutch offices with noise issues. The stimuli that affect productivity depend on the type of work an individual performs, so future studies could focus on the perception of noise sources and how employees cope with these noise sources during different work-related activities and in different work environments (e.g. hospitals, schools, factories). An additional recommendation is to replicate the present study with another type of office sample, such as cellular offices and activity-based offices. Such comparative research of office concepts could also shine further light on whether zoning in activity-based flexible offices increases satisfaction with noise and/or coping possibilities with different noise sources. Also, the companies that participated in this research were all dealing with noise problems in their office buildings under (extremely) bad acoustic conditions, so further research could analyze coping strategies in offices with less noise problems and/or different acoustic conditions. Although there are many such offices worldwide, the sample might not represent the general office workforce in the Netherlands.

Another limitation is that a hypothetical noise situation was presented to elicit a coping response. Although respondents could indicate multiple coping strategies per noise source, possible relationships between strategies were not studied. According to [Skinner et al. \(2003\)](#), approach and avoidance strategies are complementary and perhaps through synergy between coping processes people can cycle repeatedly between them. So future research could repeat the survey using a longitudinal approach. Also, it would be interesting to observe actual coping behavior in real life offices during different noise conditions and work-related activities.

Last, the study focused on coping through the resources offered by the physical work environment and available through certain personal characteristics. As [Peng et al. \(2010\)](#) put forward, the choice of coping strategies and their effects (in their case on exhaustion of flight attendants) also depends on available job resources such as supervisor support. Future research could address how supervisor support and noise policies on the work floor could increase (perceived) resources and thus decrease the necessity to cope. As [Ohly \(2019\)](#) stated, a challenging situation is appraised as more challenging than threatening when employees have more means available to control how to cope with demands.

## Note

1. The impact on productivity for this coping strategy was not measured in the survey.

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