



Noise exposure, satisfaction with the working environment, and the wellbeing process

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ABSTRACT

Much of the early research on noise at work was conducted in factories and jobs where noise was often a risk to hearing. More recent research has focused on quieter office noise and a major problem has been the lack of control of other aspects of the working environment (e.g. lighting, layout and density). Research on noise and wellbeing has also failed to control for established predictors such as job characteristics, personality and health-related behaviours. In addition, both positive (e.g. happiness, life satisfaction) and negative aspects (e.g. stress, anxiety and depression) of wellbeing should be measured. The present study rectified the problems with previous research and involved a survey of 215 office workers. They completed questionnaires measuring noise exposure, satisfaction with the working environment, and the wellbeing process. The results showed that exposure to noise predicted negative wellbeing but not positive wellbeing. In contrast, environmental satisfaction predicted positive wellbeing but not negative wellbeing. These effects remained significant when personality, health-related behaviours and job characteristics were included in the analyses.

INTRODUCTION

Research on the effects of occupational noise exposure was initially conducted in factories and other places where the levels of noise were a risk to hearing [1]. The behavioural outcomes measured were either related to safety [2, 3] or productivity [4]. More recently research has focused on noise in open plan offices and the present research investigated the association between perceptions of noise exposure and wellbeing. The next section gives a brief overview of previous research on office noise.

Noise is one of the most common reasons for complaints in open plan offices [5 – 8]. Employees affected by noise and distractions use coping techniques, such as working away from the desk and using headphones [9]. In laboratory studies, office noise has been found to

impair cognitive function and performance [10-11]. Lamb and Kwok [12] classified thermal discomfort, lighting discomfort and noise annoyance as environmental stressors. These environmental stressors reduced wellbeing which led indirectly to impairments of work performance. Decreased wellbeing reduced motivation, alertness, and focus, negatively impacting on performance. Dissatisfaction with temperature, lighting and noise reduced self-reported productivity and objectively measured performance by between 2.4% and 5.8% in most cases. There was a linear relationship between work performance and number of stressors, with the effect of environmental stressors being additive, not multiplicative. A study of academic open plan settings [13] found that the quality of the acoustic environment had the greatest influence on perceived productivity, with conversation noise having the highest negative impact on ratings of satisfaction with the acoustic environment.

Much of the research on open plan offices has been cross-sectional. However, a few intervention studies have shown that noise reduction can improve wellbeing. For example, one study [14] found that enhanced acoustical conditions, created by absorbing tiles and wall absorbents, were associated with lower perceived disturbances and cognitive stress. Although open plan offices have been linked to increased noise, there are few studies that specifically examine which features of open plan offices affect workers' health and wellbeing [15]. A large Danish study found that occupants in open-plan offices had more dissatisfaction with noise, thermal conditions, and air quality, compared to other office types [16]. In addition, open-plan office occupants were more likely to report CNS (e.g. fatigue, headache, and difficulties in concentrating) and mucous membrane symptoms (e.g. irritation of eyes, nose or throat) than occupants in multi-person and private offices.

Lack of privacy and increased noise are common complaints in open plan offices [17-19]. Bridger and Brasher [20] suggested that in situations where lack of privacy increases the need for self-control, mental wellbeing can be affected when doing cognitively demanding work. In a study comparing outcomes between participants in a large open plan building to several smaller buildings with ten people or less per room, they found that in the open-plan layout, mental health was more closely linked to an interaction between cognitive task and self-control demands. One method of dealing with the problem of lack of visual and audio privacy in an open plan environment is the use of partitions. The degree of enclosure of a workstation has been shown in some studies to be related to the perception of privacy and employees' satisfaction with the office in general [21]. However, other research [22] found that workers in open plan offices without partitions have more satisfaction with audio privacy and noise level than workers with high partitions. This finding may reflect the nature of the jobs. For example, if jobs require co-operation then partitions may interfere with work-relevant interactions.

Few studies measure psychological wellbeing outcomes. One of the psychological outcomes measured is mood. Lamb and Kwok [12] found that environmental stressors, such as noise, lead to a more negative mood and increase the risk of headaches and feeling "off", causing indirect deterioration in productivity. Wellbeing is difficult to conceptualise and our approach is given in the next section. The "wellbeing process model" we use is a holistic approach which attempts to provide a theoretical framework that has led to the development of a questionnaire that could be useful in policy and practice. The approach was initially based on the Demands-Resources-Individual Effects (DRIVE) model which was developed from research on occupational stress [23-27]. This model included job characteristics, perceived stress, individual characteristics such as coping styles and negative outcomes such as anxiety and depression. The next version of the model [28-30] included measures of psychological capital such as self-esteem, self-efficacy and optimism, and also positive appraisals (e.g. job satisfaction) and outcomes (e.g. positive affect and happiness). Positive appraisals and

outcomes, such as life satisfaction and happiness, form the basis of many approaches to subjective wellbeing. However, it is important to include both negative and positive features of wellbeing, as they are not the end points of a single dimension but involve different CNS mechanisms. One problem with the wellbeing process model was that it required measurement of many variables, measured using long scales. This led to a survey that was lengthy and not very acceptable to the participants. Short scales were then developed and these were found to be significantly correlated with the longer measures from which they were derived [31-35].

The general rationale behind the present study was to examine whether the perceptions of noise in open plan offices were associated with positive and negative wellbeing. Established predictors of wellbeing were statistically controlled, as was the general satisfaction with the working environment.

METHODS

Participants were 215 office employees (108 females, 107 males) recruited from a Qualtrics research panel. The inclusion criteria required participants to be over 18 years old, residing in the United Kingdom, and working in an office for a minimum of one month prior to participating in the study. Participants received a financial incentive for completing the questionnaire. The majority of participants (95%) worked 35 hours a week or more. There were only two participants in a private office, and the remainder were in shared (17%) or open-plan offices (82%). More participants were allocated fixed desks (78%) rather than flexi-desks, or hot desking (21%).

The Questionnaire

Twenty-nine environmental satisfaction questions were included. They were derived from a literature review, a questionnaire used in environmental satisfaction research, and also from a previous study conducted by the authors. An example question was, 'What is your degree of satisfaction with the following: areas in your workplace for meetings'. Items were rated on a 7-point Likert scale from 1 'very unsatisfactory' to 7 'very satisfactory'.

Wellbeing was measured using the Smith Wellbeing Questionnaire (SWELL; [36]) and the WHO-5 wellbeing scale [37]. The SWELL includes 21 items, some of which are predictors of wellbeing (e.g. job demands), and others which are outcomes of wellbeing (e.g. work-related anxiety and depression). Furthermore, the scale measures both positive and negative wellbeing, resulting in four wellbeing components: positive predictors, positive outcomes, negative predictors, and negative outcomes. Seventeen items are rated on a 10-point Likert scale, three are binary response items (yes / no), and one is a scale response item. An example question is, 'Thinking about the last 6 months: Are you anxious or depressed because of work?' rated on a scale from 1 'never' to 10 'very often'.

The questions used in the present analysis were:

- Noise exposure – rated on a scale of 1-10
- Environmental satisfaction (total score)
- Healthy Lifestyle – rated on a scale of 1-10
- Positive Personality- rated on a scale of 1-10
- Job Demands – rated on a scale of 1-10

- Job Control and Support – rated of a scale of 1-10
- Positive wellbeing – sum of job satisfaction and happiness ratings
- Negative wellbeing - sum of stress, anxiety/depression and fatigue ratings
- WHO-5 total score

Procedure

Participants were recruited from the Qualtrics panel. Ethical approval was granted by the School Research Ethics Committee (SREC) of Cardiff University, School of Psychology. An online questionnaire was used, which consisted of the questionnaire, information about the study, informed consent, and a debriefing statement. Participants were asked to indicate their consent by clicking on a button, which stated ‘I consent, begin the study’, or ‘I do not consent, I do not wish to participate’ In addition, there were five screening questions, which ensured only participants meeting the study criteria completed the questionnaire. At the end of the online questionnaire, the participants were shown a debriefing statement.

RESULTS

Three regressions were performed, the first with the negative outcomes as the dependent variable and the second and third with positive outcomes and the WHO-5 as dependent variables. Each regression included noise exposure, environmental satisfaction, job demands, job resources, positive personality and healthy lifestyle as independent variables. The results from the first regression are shown in Table 1.

Table 1: Predictors of negative outcomes

Model	Unstandardized Coefficients		Standardized Coefficients		Sig.
	B	Std. Error	Beta	t	
(Constant)	24.818	2.899		8.560	.000
Lifestyle	.167	.262	.038	.635	.526
Positive personality	-.845	.269	-.193	-3.138	.002
Noise	.754	.204	.198	3.696	.000
Job Demands	2.087	.212	.526	9.851	.000
Job Control	-.578	.261	-.132	-2.215	.028
Environmental Satisfaction	-.026	.019	-.080	-1.362	.175

High noise exposure was significantly associated with high negative outcome scores. High job demands, low control and low positive personality scores were also associated with high negative outcome scores.

The second regression had positive outcomes as the dependent variable and the results of the regression are shown in Table 2.

Table 2: Predictors of Positive Outcomes

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	-.825	2.141		-.386	.700
Lifestyle	.642	.194	.182	3.317	.001
Positive personality	1.101	.199	.313	5.539	.000
Noise	.086	.151	.028	.574	.566
Job Demands	-.011	.156	-.004	-.073	.942
Job Control	.968	.193	.275	5.022	.000
Environmental Satisfaction	.061	.014	.234	4.313	.000

Noise had no significant effect on positive outcomes. High positive outcome scores were associated with a healthy lifestyle, positive personality, high job control and greater satisfaction with the working environment.

The final regression had the WHO-5 scores as dependent variables. These results are shown in Table 3.

Table 3: Predictors of WHO-5 scores

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	.583	1.835		.318	.751
Lifestyle	.444	.166	.175	2.674	.008
Positive Personality	.678	.170	.267	3.983	.000
Noise	.084	.129	.038	.648	.518
Job Demands	-.324	.134	-.141	-2.420	.016
Job Control	.388	.165	.153	2.351	.020
Environmental Satisfaction	.033	.012	.175	2.717	.007

High WHO-5 wellbeing scores were not predicted by perceived noise exposure. Significant predictors were a healthy lifestyle, positive personality, high job control, high satisfaction with the working environment and lower job demands.

DISCUSSION

The results from the present study showed that perceptions of noise in open plan offices were associated with negative wellbeing. This effect remained significant when established predictors of negative wellbeing (job demands, job control and positive personality) were adjusted for. Environmental satisfaction was also included in this analysis and it is important to note that the effect of noise remained significant even when satisfaction with the office environment was controlled. This is the first result to show an effect of noise per se rather than a combination of environmental stressors. Such effects have been shown before when much louder noise has been examined (e.g. research on rail staff – [38]). In contrast, environmental noise exposure, where the noise would have been at a lower intensity, had little effect on the wellbeing of a student sample [39].

Few studies examine both negative and positive aspects of wellbeing. This was done here and noise exposure had no significant effect on positive outcomes or the WHO-5 index. Established predictors of positive wellbeing (lifestyle; positive personality and job control) were found to have their usual significant effects. Environmental satisfaction was also a significant predictor of positive wellbeing. Indeed, the overall pattern of the results confirmed the usual pattern of results from studies of predictors of wellbeing, namely that negative predictors predict negative outcomes, and positive outcomes predict positive outcomes. The exception to this appears to be positive personality, where high scores go with greater positive wellbeing, and low scores with greater negative outcomes [40].

The results from this study suggest that office noise is associated with greater negative wellbeing. This topic now requires further research, preferably using longitudinal designs with interventions aimed at changing noise levels. Studies are also required to determine the underlying mechanisms. These may involve structural equation models aimed at showing the pathway(s) through which noise has an effect. Research including objective physiological measures will also be important in understanding the biological mechanisms underlying such changes in wellbeing.

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