

The influence of psychological factors on the reporting of IEQ complaints

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ABSTRACT

This paper is a literature review concerning the influence of psychological factors on the reporting of complaints about the indoor environment in office buildings. Sources are laboratory studies, field studies and case studies in indoor environmental quality and literature from general, medical and social psychology. The main conclusions are as follows: There is no evidence that complaints about the indoor environment are to any significant level directly caused by random reporting, malingering or private or work related psychological problems. Evidence to the contrary on closer inspection turns out to be either anecdotal or methodologically flawed. It does, however, turn out that, once the indoor environment is defective and gives rise to complaints, the frequency of complaints and the vigour with which they are reported are influenced by psychological factors. Psychological stress seems to decrease the tolerance for flaws in the indoor environment. More specifically it is found that (1) occupants with high autonomy and/or highly creative jobs will experience and report less complaints and (2) occupants who have the impression that their management does not take their complaints seriously will report complaints more frequently and more vigorously. Finally, differences between women and men in experiencing and reporting complaints are discussed.

INDEX TERMS

Psychological factors; Stress; Job satisfaction; Perceived air quality; SBS symptoms

INTRODUCTION

Both in scientific publications and in anecdotal stories it is more than once stated that workers' complaints about the indoor environment quality (IEQ) are not so much caused by flaws in the indoor environment, as by organizational problems, workers' stress, proneness to complain or even random reporting of complaints or malingering. This paper investigates the question of how far and under what circumstances IEQ complaints are caused or influenced by psychological factors.

METHODS

From journals, conference proceedings and doctoral theses in the field of indoor air quality, thermal comfort, epidemiology, general psychology, medical psychology and social psychology those research results were selected that are relevant to the central issue. This was done on the basis of reading abstracts and full publications, because the relevant information is often hidden in the publications and not detectable by keywords search. The search was restricted to office buildings.

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RESULTS

Inadequate Ventilation as a Cause of Complaints

In an extensive literature review (Seppänen *et al.*, 1999) show a clear negative relation between the level of outdoor air supply in office buildings and workers' IEQ complaints. This is remarkable in so far as the workers were not knowledgeable about the actual indoor air supply, which indicates that the complaints were primarily caused by the lack of air supply and not by workers' expectations or other psychological factors.

Too High Temperatures as a Cause of Complaints

That too high temperatures will cause complaints seems obvious. Nonetheless, with investigations aimed at mitigation, often no relation between complaints and thermal measurements are found. This is because in the case of thermal complaints there are very many relevant variables which all need to be ascertained very accurately. In many investigations aimed at mitigation this is not the case. Funded by ASHRAE, de Dear *et al.* (1998) reanalysed some hundred field studies from all over the world. All these studies included accurate measurements of all relevant variables and workers' responses. During the analysis the smallest details were taken care of—for instance, the type of ventilation and even the thermal insulation of the office chair. All this effort paid off: if all variables were accounted for the relation between measurements and workers' responses was near perfect. The workers were of course unaware of the measurement results and certainly of the complex relations within them. This makes it very improbable that the complaints were caused by expectations or other psychological factors.

Relations between Complaints and Building Characteristics

In the last 20 years there have been a large number of field studies in office buildings which included both a complaint questionnaire among the workers and a survey into building characteristics (e.g. Mendell and Smith, 1990; Groes, 1995). From all these studies it turns out that HVAC systems with recirculation, cooling and/or humidification raise complaint levels. These relations remain after multivariate analyses which correct for the correlations within building characteristics and even for the correlations between building characteristics and workers' personal characteristics. When we keep in mind that workers generally do not know the characteristics of the HVAC in their building, the most plausible explanation is that the building characteristics cause the complaints. The alternative explanation that the complaints are mostly caused by psychological factors and that the relations of complaints with building characteristics are some sort of artefact is totally *ad hoc*.

Findings from General Psychology

An important finding is that people cannot be conditioned to associate any complaint with any situation, because they have innate psychological schemes for what can and cannot cause certain complaints. These schemes are resistant to change (Garcia *et al.*, 1972; Seligman, 1970; Testa, 1974). There is no evidence that there exist schemes that associate physical complaints with the built environment. It is, therefore, not plausible that IEQ complaints can generally be caused by problems that are unrelated to the working environment. It is also implausible that workers will attribute random fluctuations in their health to the indoor environment.

Morris and Kanouse, 1979, 1982 show that patients can change the interpretation of their complaints through suggestion by others, but not the total number of complaints. Pennebaker and Skelton (1981) show that when symptoms are artificially generated in healthy subjects the interpretation of those symptoms can be influenced by suggestion, but that even with

suggestion no symptoms are reported when they are not generated. This makes it implausible that workers can suggest complaints to one another. Further relevant findings from general psychology are to be found in (Vroon, 1990). The conclusion must be that findings from general psychology do not make it plausible that complaints about the indoor environment are caused by psychological factors.

Anecdotal Evidence for Psychological Factors

An often heard line of argument in favour of the thesis that IEQ complaints primarily have psychological causes goes as follows: In a complaint building an investigation aimed at mitigation is conducted. Then, it turns out that the indoor environment complies with legal or generally accepted standards. The conclusion is then drawn that the indoor environment is not to blame, thus the complaints must have a psychological cause. This sounds convincing, but it is not. If more information is gathered concerning such an anecdotal case it will virtually always turn out that measurements have been conducted in a limited number of places and at a limited number of times. Further, it will turn out that measurements have only been tested against legal standards or against generally accepted standards that are only a little more strict. Recent research has shown that legal or generally accepted standards are but a pale reflection of all the relevant factors in the indoor environment and that with such a measurement strategy chances are small that actual flaws in the indoor environment will be detected (Boerstra and Leyten, 1999). The conclusion of psychological causes is, therefore, not valid.

Evidence from Field Studies in Favour of Psychological Causes

There have been several field studies on the relation between IEQ complaints and psychological complaints. Among these the following two are especially relevant. Eriksson *et al.* (1996) matched workers with and without physical complaints. All workers were interviewed and data about their organizations were gathered. It turned out that job anxiety and dissatisfaction significantly increased the risk of physical complaints. A multivariate analysis that corrected for, among others, dampness in the home and ventilation in the workplace shows comparable results. The authors of the present paper submit that this design is too weak to conclude that psychological factors are a major cause of IEQ complaints. First, this design cannot conclude as to causality. Second, only a few relevant variables are accounted for in the multivariate analysis. Third, the effects of the psychological variables are not compared to the effects of indoor environmental variables, so it is not possible to establish their relative impact. Marmot *et al.* (1997) interviewed workers for IEQ complaints, personal characteristics and job satisfaction and conducted indoor environmental measurements. The analysis showed that the personal characteristics and job satisfaction had a stronger relation with the IEQ complaints than any of the environmental measurements. Therefore, they concluded that IEQ complaints are more likely to have psychological causes than causes due to the indoor environment. The authors of the present paper submit that this conclusion is not justified, because the environmental measurements in this study show the same limitations as discussed in the section *Anecdotal Evidence for Psychological Factors* above. They turn out to be a number of standard measurements limited in space and time. The *a priori* chance that these measurements will show a strong relation with indoor environmental complaints is small. Therefore, no conclusions can be drawn about the relative impact of psychological and indoor environmental factors.

Evidence from Field Studies against Psychological Factors as Major Causes

Both Clements-Croome *et al.* (1998) and Thierauf *et al.* (1999) present results from field studies that show that in a real life situation low job satisfaction correlates negatively with IEQ complaints. These studies have their limitations. The buildings were not randomly chosen and only statistical relations are reported. But the results are strong enough to undermine the thesis that, generally, psychological factors are the major cause of IEQ complaints.

Individual Differences in Sensitivity

In the study of Wargocki (1998) subjects performed office work for 4 h in a normal well ventilated work space. During some sessions pollution from a used carpet was added to the supply air. The pollution was non-odorous and the office room was never changed, so the subjects did not know in which condition they were. Before the experiment the subjects were interviewed about their previous experience in office buildings. On the basis of this they were classified into two groups: those who so far had experienced little or no complaints working in office buildings (the non-sensitive) and those who had experienced some complaints doing so (the over-sensitive). Among the dependent variables were physical complaints. In the condition without the artificial pollution both groups had little complaints. In the condition with the artificial pollution the non-sensitive still had little complaints, but the over-sensitive did have, statistically significant, more complaints. Because the subjects did not know in which condition they were, the effect on the over-sensitive must have been caused by the artificial pollution. This indicates that the over-sensitive have some physical over-sensitivity rather than then a tendency to suggest complaints to themselves in certain environments.

Hedge and Erickson (1999) investigated an office building with marked indoor air complaints. The occupants were classified as non-sensitive or over-sensitive. Both groups were asked to keep a diary of indoor air complaints five times a day for 1 week. The results show that the non-sensitive had far less complaints than the over-sensitive, but that the fluctuations of the complaints over time show a similar pattern. This also indicates that the complaints of the over-sensitive are caused by the environment rather than by self-suggestion.

Negative affectivity is a sort of neuroticism featuring a combination of, among other traits, pessimism, guilt feelings and a tendency to make reproaches (Pennebaker and Skelton, 1978). Negative affective people not only have a tendency to see problems in the world surrounding them. They also have a tendency to experience physical complaints, not only in case of medical problems, but also with psychological tensions. One can, therefore, suppose that negative affective people are more prone to experience physical complaints in the indoor environment, maybe even more so if they have psychological tensions. In three Swedish housing blocks with indoor air complaints, a questionnaire was administered among the occupants (Berglund and Gunnarson, 2000). Questions dealt with physical complaints, indoor environmental complaints and indicators of negative affectivity. The results were as follows: in the same environment, negative affective persons had no more physical complaints than others. More strikingly, in the same environment, negative affective persons on average had *less* indoor environmental complaints than others. Berglund and Gunnarson explain this by assuming that people, in general have a limited capacity to process signals from inside and outside the body. Negative affective persons direct more attention towards signals from within the body. Therefore, they have less attention left for signals from outside the body. These are unexpected and in a way paradoxical results, but they do not indicate that people with a personality that implies proneness to complain have more indoor air related complaints.

Job Type

Wargocki (1998) shows that in the same indoor environment workers with jobs involving high autonomy and creativity, like management or research, are less prone to report IEQ complaints than workers with jobs that are more based on procedures and routines, like administration, word processing or programming.

Management Style

In practice, it often turns out that in the case of IEQ complaints workers' proneness to complain increases when management does not take complaints seriously. Social psychological *equity theory* explains this fairly well: Problems with the indoor environment are experienced as a lack of distributive fairness. This need not decrease job satisfaction, as long as procedural fairness is experienced as adequate, that is as long as management treats the complaints correctly and attentively. But when complaints are not taken seriously, both distributive and procedural fairness will be experienced as inadequate and workers' loyalty to the organization will diminish and proneness to complain will increase (Whitley *et al.*, 1995).

Sex

Many studies show that, on average, women report about twice as many complaints as men. Brasche *et al.* (2001) show that this effect remains when corrected for objective differences in working conditions. It appears that the differences in proneness to complain are due to medical and/or psychological differences between women and men.

DICUSSION, CONCLUSIONS AND IMPLICATIONS

The thesis that IEQ complaints in office buildings are generally totally or primarily caused by psychological factors has to be rejected for the following reasons:

- In field studies IEQ complaints show consistent relations with indoor environmental measurements, when done state of the art, and with building characteristics.
- Correlational studies that show a statistical relation between IEQ complaints and psychological factors cannot argue in favour of causality.
- Some field studies show a negative relation between IEQ complaints and job satisfaction.
- Individual differences in sensitivity to the indoor environment turn out to be of medical rather than of psychological nature.
- Finally, the findings of general psychology prove the thesis to be implausible.

The conclusion must be that IEQ complaints are primarily caused by flaws in the indoor environment. There is no evidence that complaints about the indoor environment are to any significant level directly caused by private or work related psychological problems or even random reporting or malingering. But the empirical correlations between job dissatisfaction and IEQ complaints need to be taken seriously. So far the most plausible hypothesis seems to be that psychological factors, including stress and job dissatisfaction, cannot cause IEQ complaints directly, but when IEQ problems have already risen they can increase the frequency and the vigour with which these complaints are reported, as is shown by the effects of job type and management style. This may also be a clue to the nature of the differences in reporting between women and men. It is submitted that women are not inherently more prone to complain regardless of the situation, but that they are more prone to experience and report complaints once the indoor environment is already flawed.

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