

# OCCUPANT FEEDBACK USING A QUESTIONNAIRE RATING LIKING AND IMPORTANCE OF UP TO 24 FACTORS

## Abstract

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## Abstract

As well as assessing the Building Sickness Score and a measure of stress, the questionnaire uses a double-Likert section rating the liking and importance of up to 24 environmental and organisational and human factors. It has been used primarily in offices to date. This paper discusses the results from 600 occupants from 8 offices that are air conditioned and naturally ventilated. Scores ranged from +19% (greatly liked by the occupants) to -15% (greatly disliked) for a modern deep-plan naturally ventilated building, and were more indicative and sensitive than Building Sickness Scores. The most important factors for the occupants were;

- colleagues
- health
- daylight
- space
- temperature.

The least important were colour, appearance, attractiveness and privacy.

## Symbols and abbreviations

FLS = average liking score for all the occupants in a group, normalised to a percentage, for a particular factor in the questionnaire, e.g. noise. The fingerprint is a graph of the 22 or 24 FLS's.

OLS = overall liking score, normalised to a percentage, for a group of occupants for all 22 or 24 factors in the questionnaire.

ILS = overall liking score, normalised to a percentage, for an individual occupant in a group for all 22 or 24 factors in the questionnaire.

NV = naturally ventilated

AC = air conditioned

p = significance level for correlation, as a probability.

**1) Introduction**

Although there is much guidance on the design of buildings and building services, there is often a lack of feedback on the occupants' satisfaction and liking of their building. When feedback is obtained it is often by a questionnaire survey. This may well entail detailed statistical analysis making understanding for management and users difficult. This paper discusses a questionnaire form that can elicit a liking score and a fingerprint and also questions occupants on what are important factors in the design of their ideal office.

**2) Questionnaire used**

In this questionnaire there are 5 sections, (A, B, C, D, E), the first dealing with personal information, and work details, hours at work, PC use etc. Section B deals with summer and winter comfort using semantic differential rating questions.

Section C is the novel feature of the questionnaire in that it is a double Likert scale for liking and importance of 22 to 24 factors relating to the interior environment and the organisation. A seven point scale for like and dislike is used for the questionnaire, shown below;

Do you like the...

How important is this in the design of your ideal office?

	dislike	like	unimportant	important
	-----	-----	-----	-----
<b>1. noise level</b>	-3 -2 -1 0 1 2 3	-3 -2 -1 0 1 2 3	-3 -2 -1 0 1 2 3	-3 -2 -1 0 1 2 3

Comments: \_\_\_\_\_

A like, dislike scale rather than a scale of satisfaction and dissatisfaction is used to reduce the 'fog index' and ease understanding, which is important for a self-administered questionnaire.

Alongside the seven point like/dislike scale is another seven point scale for the respondent to indicate how important he/she considers the factor should be in designing his/her ideal office.

From this a score and fingerprint can be calculated to simplify the results and enable its use in management feedback

and commissioning. This paper will concentrate on the results from this section.

The organisation factors are in two questions asking about colleagues and the management. The initial inclusion of these questions was justified in that colleagues are often considered the most liked and the most important factor. The 24 factors are;

- noise level
- electric lighting
- daylight
- glare level in the room
- office temperature
- ventilation
- draught level
- freshness of your room
- humidity
- smell in the building
- colours of the room
- attractiveness of the room
- the Management
- your office in general
- \*control you have over your local environment
- working space you have in the room
- your privacy in the room
- your immediate colleagues
- outward appearance of your building
- glare level around your desk or VDU
- your state of health when in the building
- your distance away from the window

\*This question was replaced in later questionnaires by three questions;

- the control you have over the ventilation
- the control you have over the lighting
- the control you have over the heating

From these questions a fingerprint and score can be derived [1]. The score is expressed as a percentage and most occupants' scores range between +30% and -30%. A positive score indicates a degree of liking and a negative score the degree of disliking. Most overall scores from respondents in a building have ranged between +19% and -15%. Fingerprints are discussed later, suffice it to say that Figs 2 to 6 give examples.

Section D is a Sickness Symptoms questionnaire for deriving a Building Sickness Score and is discussed in another paper, [5]. Section E is a new section on stress and has been derived from Cooper's work, [8]. These sections are not discussed further in this paper.

Results to date, from 13 buildings, including a comparison with results from PROBE surveys, which included Section C, [3,4], suggested that the score and fingerprint give useful results.

### **3) The liking score**

From an occupant's liking and importance vote for each factor a score can be derived. Each importance vote is transformed, (by adding 4 to all values to make a positive value), and multiplied by the corresponding liking vote. This yields a score between +21 and -21. The overall liking score for an individual, ILS, is the average of all the 22 or 24 multiplications normalised by dividing by the maximum possible score and expressing as a percentage, [1]. The fingerprint shows the 22 or 24 factors' normalised scores for the group of individuals as explained in more detail in [1]. The group overall liking score, OLS, is the average of the ILS's for the group.

#### **3.1) Distribution**

For each respondent there are over 400 possible values of ILS. The distribution of ILSs for 7 buildings, (395 respondents), is close to normal as the cumulative distribution in Fig 1 shows. The individual scores for these seven buildings are given in Table 1

<b>Building</b>	<b>Type</b>	<b>Score (%)</b>
<b>1</b>	Full AC	+ 19
<b>2</b>	AC atrium openable windows	+ 17
<b>3</b>	AC	+ 2
<b>4</b>	Shallow plan NV vent	+ 1
<b>5</b>	Part AC part NV	- 11
<b>6</b>	Full AC	- 12
<b>7</b>	Shallow plan NV	- 14

**Table 1**

Other independent surveys have been conducted on Buildings 1,2 and 3, and further details are given in references [2,3,4].

For Building 4, an academic office and lecture block, some students were surveyed in addition to the staff whose score is shown in Table 1. Two groups of students, (40 students in total), were resurveyed to test the robustness of the scores. One group were resurveyed a week apart and the other group two hours apart. The resurvey scores were not significantly to their original scores, ( $p < 0.001$  two tailed t-test), [5].

### 3.2) Fingerprint

In addition to the liking score the individual factor scores (FLSs), can be shown as a fingerprint as in Fig 2 for Building 1. The factors have been ranked for ease of viewing. Building 1 has one of the best scores achieved by a building which is not surprising as it is a prestige HQ building. An independent survey confirms a number of the findings here, [2]. Privacy is the greatest dislike of this open plan office. Control is also disliked as well as noise.

In contrast Fig 3 shows one of the worst fingerprints, (overall score = -14%). This is for Building 7, an old, small office with high ceilings and large windows and an inadequate convective heating system. The ventilation and associated factors, draught and freshness, cluster at the end of the scale along with temperature. However, it is noteworthy here that the management is in a low position, although immediate colleagues are liked almost to a level of Building 1.

Fig 4 shows an equally poor fingerprint, (OLS = - 15%) and this is for Building 8 a very modern, deep plan naturally ventilated building with atria. This fingerprint has the added control factors. Two of these control factors are greatly disliked. This is not surprising as the control strategies for day and night ventilation and also heating were still being improved when it was surveyed. However, glare on the PC screens was the second greatest dislike. Unlike Building 7 the occupants here liked the management.

Fig 5 shows another modern building, number 2, which also has atria, but it has underfloor VAV and openable windows. This is much better liked, (OLS = +17%). This building has also been assessed in the PROBE Study, [3].

Fig 6 shows the fingerprint of Building 4, an academic office and classroom block. This fingerprint is from the staff occupying the offices. Although it has an almost neutral score, (OLS = +1%), the respondents here had an average building sickness score almost identical to that of Building 1, but with a very different score, ( OLS = +19%)

#### **4) Importance score**

The importance vote, or score, gives an indication of the importance of the 22 or 24 factors in the design of an occupant's ideal office. Over 90% of votes by occupants to all factors were greater than or equal to 0, i.e. a large majority of respondents did not consider that the factors were unimportant, [6].

##### **4.1) Ranking by occupants**

Fig 7 shows the average importance votes, in rank order, for the first seven buildings. This has colleagues as the most important factor, about which building services engineers can do little. Daylight is also high ranking although distance from a window is ranked 6/22. Temperature is ranked 6/22 and ventilation 7/22. Control is rather low in importance although the control occupants have is often disliked. This was explored further with the addition of control factors in two later surveys, one of which was Building 8. In the latter control of ventilation was ninth most important of 24 factors with control of lighting and heating close behind.

#### **5) Conclusion**

The novel part of this questionnaire has been found to be useful in that a score and fingerprint can be calculated which are readily understandable, compared to statistical data. The score and the fingerprint have great sensitivity, there being over 400 possible scores for each respondent. The scores follow a normal distribution with 68% being between +31% and -25%. The best and worst scores for buildings, (OLSs), are between +19% and -15%. The scores are robust when a resurveys have been conducted.

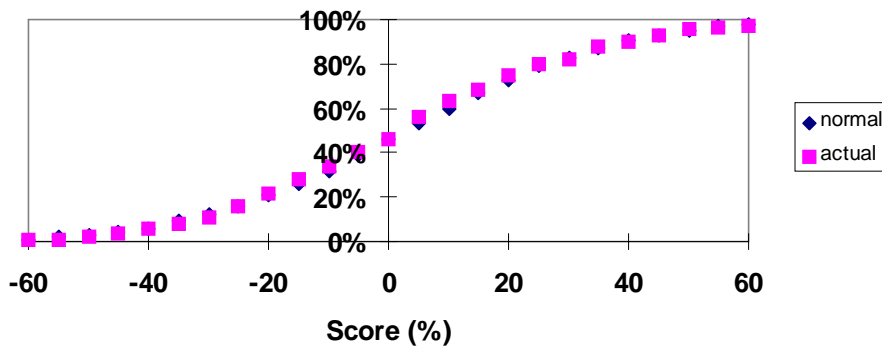
The novel part of the questionnaire has been combined with other questionnaires and the questionnaire used in its own right for many buildings now. Indeed the double Likert liking importance methodology has been used independently by Lowry to assess users' satisfaction with building energy management systems, [7].

Hopefully, occupant feedback will eventually be used as the last component of the commissioning of new and refurbished buildings and that it will become a useful tool for Facilities Managers and managements in general.

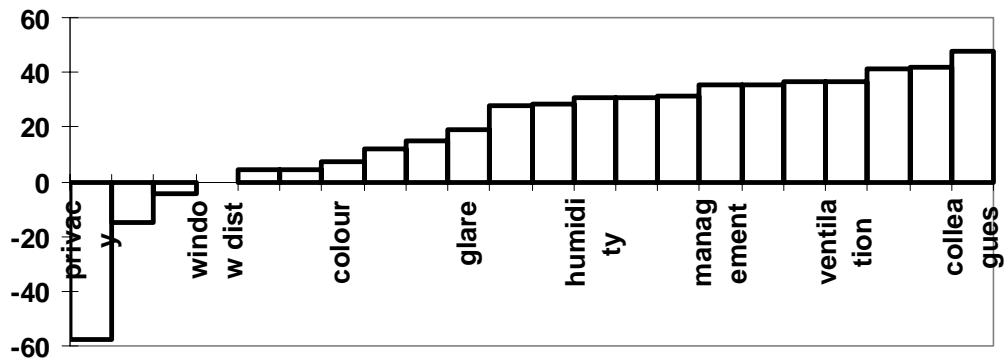
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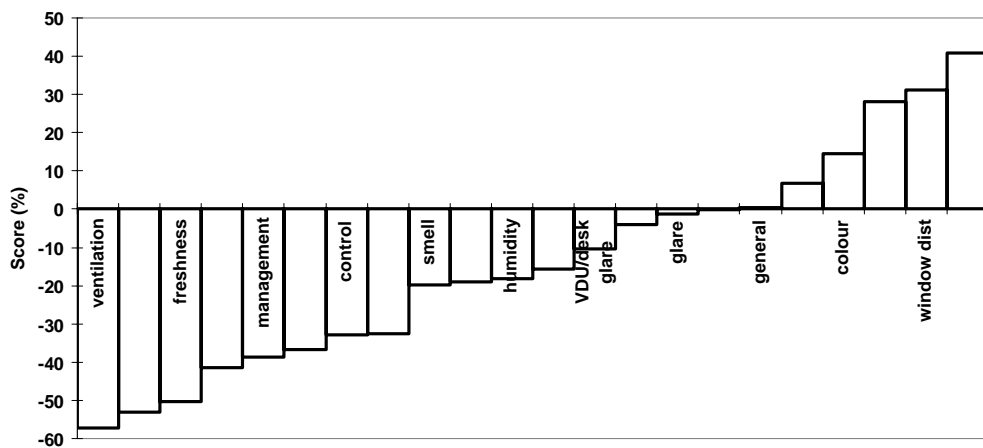
**Fig 1 Actual scores from 395 responses compared to a normal cumulative distribution**



**Fig 2 Prestige HQ air conditioned office. Fingerprint of ranked liking scores (overall score = +19%)**

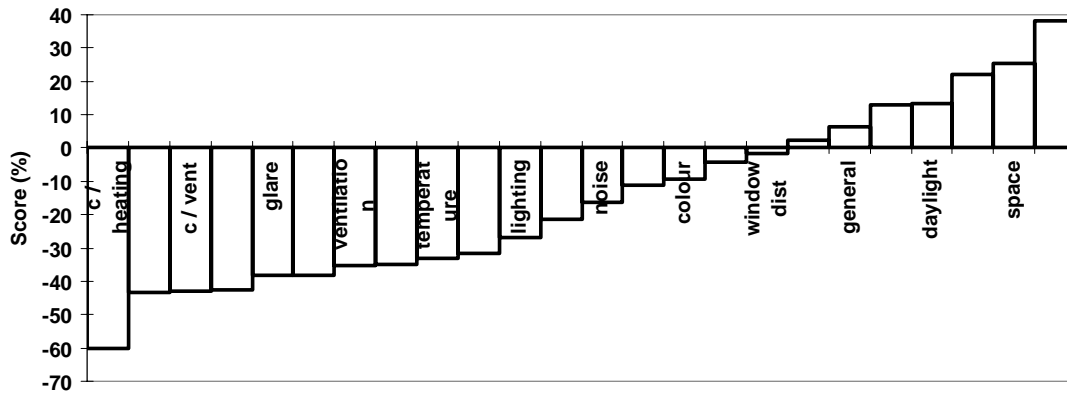


**Fig 3 Old, naturally ventilated, small office. Fingerprint of ranked liking scores (overall score = -14%)**

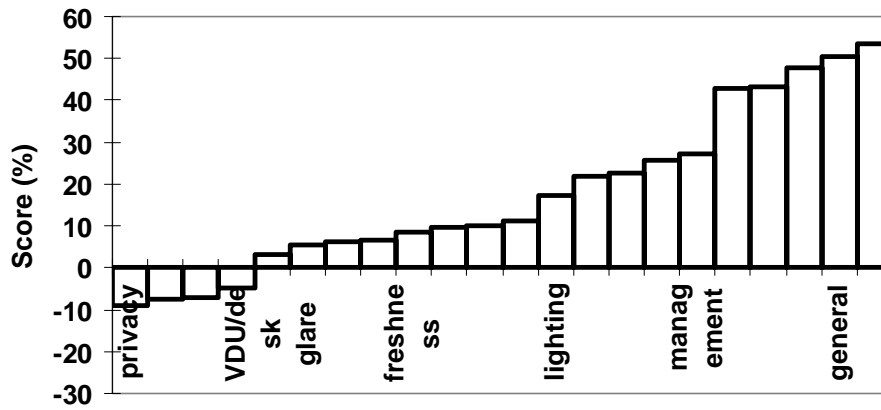




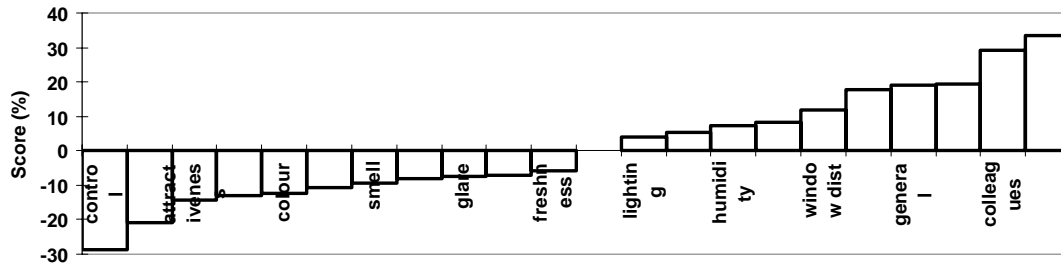
**Fig 4 Deep plan, modern, naturally ventilated building.  
Fingerprint of ranked liking scores (overall score = -15%)**



**Fig 5 Deep plan office with atrium and underfloor ac.  
Fingerprint of ranked scores (overall score = +17%)**



**Fig 6 Naturally ventilated academic building.  
Fingerprint of ranked liking scores ( overall score = +1%)**



**Fig 7 Average importance votes, ranked**

