INVESTIGATION AND ASSESSMENT OF DOMESTIC NOISE

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1. INTRODUCTION

When a complaint about noise nuisance is made to a local authority it must take such steps as are reasonably practicable to investigate the complaint, gathering evidence to decide whether the noise has caused a noise nuisance or conditions that are prejudicial to health. Interviews are often used as part of this investigation, but no universally recognised guidance or structured methods are currently available.

A 'Standardised Interview to Assess Domestic Noise Complaints and their Effects' (SIANCE) has been developed to provide improved guidance on how to assess domestic noise complaints.

The SIANCE was field tested in a sample of 45 noise complaints from eight London Boroughs. The results of the field study demonstrate that the SIANCE is psychometrically reliable and valid. Use of the interview will enable local authorities to take a more structured approach towards investigating noise complaints. A means of gathering standardised information from noise complainants is essential if local authorities are to be able to deal with complaints consistently, allowing comparison of complaint statistics. The interview can be used to distinguish between individual cases and assess the severity of the self-reported effects of domestic noise. It is most appropriate for use with long-term chronic complaints, and the structured nature of the information collected may help in making decisions as to whether the noise is prejudicial to health.

Noise measurements were taken in a small number of case studies. The results from the case studies suggest that there is a lack of association between noise measurements and annoyance and activity disturbance. This lack of association would suggest that current noise guidelines cannot reliably be used to assess whether domestic noise and noise from amplified music is acceptable or not.

2. REVIEW OF LITERATURE AND PREVIOUS WORK

Research on the effects of domestic noise is sparse and limited. Few previous studies have specifically addressed the health effects of domestic noise. However, reactions provoked by exposure to domestic noise are often stronger than other types of noise.

Environmental noise can seriously affect people's quality of life and social well-being. Noise can affect domestic activities such as interference with sleep and rest, disruption to speech communication and listening, concentration and habitation. A World Health Organisation (WHO) task force identified a number of health effects including behavioural effects and annoyance, interference with communication, sleep disturbance, psychophysiological effects and mental health effects. (Berglund & Lindvall, 1995).

For those people who are involved in domestic noise investigations, the psychological effects of domestic noise are well known. Domestic noise can make people's lives a misery and can cause psychological distress. For example, people seriously affected by domestic noise often report:

- serious annoyance,
- emotional effects such as changes in mood, feelings of depression and stress,
- behavioral effects such as drinking alcohol, taking sleeping tablets or taking medication for depression.

- Activity disturbance such as disturbance to concentration and disturbance to sleep.
- Performance effects such as long-term tiredness and inability to perform tasks.

The effects on mental health and physical ill health are less clear. These uncertainties are caused by the lack of research as much as anything else. Despite the lack of clear scientific proof, it is suspected that domestic noise can cause stress that can lead to physical ill health and can cause or exacerbate mental ill health. Even though there are uncertainties, the possibility of these effects cannot be dismissed.

A paper- Noise and Health- specifically considers the effects of domestic noise on health:

'The effects of domestic noise on those who are subjected to it are numerous and in extreme cases, have the potential to be devastating. For example, during the six-year period to December 1994, 17 fatalities that were purportedly associated with domestic noise complaints were documented. Other sources suggest that there may be as many as 10 to 20 cases a year in which suicide can be attributed to noises from neighbours. Such cases are obviously the exception, but even at the more mundane level, domestic noise can severely disrupt the lives of those affected, reducing the quality of life and having an adverse impact on mental and physical well being, causing annoyance, and disturbing sleep and daily activities. The World Health Organisation defines health as 'not merely the absence of disease but a state of complete physical, psychological and social well being'. In light of this definition, neighbourhood noise, given its prevalence in the urban environment, is quite clearly a threat to the health of the nation. Whether domestic noise causes more serious health effects is unknown.' (Stansfeld et al, 2000)

3. DEVELOPMENT OF THE INTERVIEW

The interview is shown in Appendix 1. Focus groups of Environmental Health Officers, drawn from the Pollution Study Group of the Chartered Institute of Environmental Health, informed and reviewed the interview design. The research team collaborated with BRE to make appropriate sections of the standardised interview comparable with the national data from the 1999/ 2000 National Noise Attitude Survey (Grimwood, 1999).

The interview is structured in five parts. Wherever possible, existing standard questions are used in order to increase overall reliability and validity. The first part gathers information on the complainant and the noise source(s). Noise annoyance is measured using the semantic scale proposed by Fields et al (1998): not at all annoyed; slightly annoyed; moderately annoyed; and extremely annoyed. Then a series of questions deal with different categories of activity disturbance and sleep disturbance. A series of questions are included on the range of emotional responses that are reported by people who are disturbed by domestic noise. The final parts of the main interview gather responses about noise sensitivity characteristics of the complainant and the various environmental factors that may influence the effects of domestic noise. Three optional appendices provide:

- A measure of psychological distress,
- Characteristics of the complainant including the perceived level of control and ability to cope with the noise, and
- Noise measurements.

4. VALIDITY AND RELIABILITY OF SIANCE

For any measure to be useful it must be psychometrically valid and reliable. Detailed analysis of the validity of SIANCE and results from the field study can be found in the Department of Health Report 'The Development of a Standardised Interview to Assess Domestic Noise Complaints and their Effects' available on the Department of Health website www.doh.gov.uk/airpollution/noisereport.

The interview was field tested in a sample of 45 noise complainants by officers from eight London Boroughs. In order to test whether the interview can be used consistently and reliably, inter-rater reliability test-retest were assessed. Intra-class correlation coefficients in excess of .90 demonstrated an excellent level of inter-rater reliability both at the global level and for

individual sections of the interview. Test-retest reliability was good for the interview overall and for most individual sections of the interview. However, given the highly volatile nature of domestic noise environments it must be questioned whether test-retest is an appropriate measure of reliability.

5. CASE STUDIES

Noise data were obtained in 8 case studies. An independent consultant, Andrew Colthurst, was employed to analyse existing tape recordings supplied by a small number of local authorities. Noise levels were measured directly in a small number of cases.

The noise levels recorded were generally low. Tables 1 to 3 illustrate that the noise levels, with intruding noise, were below the, now superceded, 1980 WHO guideline of 35 dB (A), for night noise to protect against sleep disturbance, in half the sample even though most of the noise recordings were taken during the day or evening. In three cases, the noise levels were at or below the more recent 1999 WHO guideline of 30dB(A) for bedrooms inside. And, half of the cases were well within the 'reasonable' noise guidelines (less than 40 dB(A)) for living rooms recommended in BS8233:1999.
However, paired samples t-tests reveal that there is a significant difference between noise levels with and without the intruding noise for: Leq ($t = 4.33$, d.f. 1,7, $p = .003$); L10 ($t = 5.27$, d.f. 1,7, $p = .001$); L90 ($t = 2.83$, d.f. 1,7, $p = .025$); and Lmax ($t = 6.49$, d.f. 1,7, $p < .0001$). This suggests that perhaps it is the difference between the ambient noise level and noise levels when the intruding noise is present that will determine whether nuisance is experienced. It should be noted that the sample size is too small to infer a direct relationship between noise level differences and whether nuisance is experienced. This is particularly true since average noise levels could be dominated by a few cases resulting in bias. It is also worth noting that discreet events, such as vehicle pass-bys, were excluded from the ambient noise.

Table 1
Distribution Characteristics of Average Noise Levels: mean; median; range.

	Mean	Median	Range
L_{eq} with intruding noise	38.8	36.5	27.6-53.4
L_{eq} without intruding noise	33.1	29.2	23.7-49.0
Difference in L_{eq} with/without noise	**6.1**	**4.4**	**1.5-15.4**
L_{10} with intruding noise	40.1	38.1	28.5-54.4
L_{10}without intruding noise	34.1	30.7	24.1-49.2
Difference in L_{10} with/without noise	**6.5**	**5.3**	**2.2-16.5**
L_{90} with intruding noise	35.1	29.7	24.0-52.1
L_{90} without intruding noise	31.9	27.5	23.1-48.7
Difference in L_{90} with/without noise	**3.3**	**2.5**	**0.6-11.6**
L_{max} with intruding noise	48.9	47.8	36.8-64.1
L_{max} without intruding noise	38.5	27.5	29.8-52.2
Difference in L_{max} with/without noise	**11.0**	**10.0**	**6.0-17.9**

In addition to noise levels, other salient features of the noise were evaluated on a five-point scale: 1. *Tonality* (0 = No tonal content to 5 = Dominant tone); 2. *Intelligibility* (0 = Completely

unintelligible to 5 = Completely intelligible); and 3. *Frequency of occurrence* (0 = No occurrence to 5 = Constantly on).

Table 2 Average LAeq with and without intruding noise for individual cases

Report No.	Mean L_{eq} with	Mean L_{eq} without	Difference
R1	31.9	27.5	4.4
R2	41.0	30.9	10.1
R3	49.6	43.9	5.7
R4	30.3	27.1	3.2
R5	48.6	36.0	12.6
R6	53.4	49.8	3.6
R7	28.2	26.7	1.5
R8	27.6	23.7	3.9

Table 3. Average Short Period A-weighted Noise Measurements with Intruding Noise

Sample	Date and Time	L_{eq}	L_{10}	L_{90}	L_{max}	Description of the intruding noise source
1	Day Evening	27.6	28.5	24.0	42.8	Children, voices, thuds
2	Day	31.9	34.7	28.6	37.7	Music
3	Evening	28.2	29.4	26.6	43.2	Thumping, children, stairs
4	Evening	53.4	54.4	52.1	56.0	Loud disco music
5	Day	48.6	50.7	44.2	52.7	Music with beat dominant
6	Day	49.6	49.9	46.4	64.1	Music, voices, singing
7	Day + Night	41.0	41.5	30.7	58.4	TV, voices, shouting, singing
8	Evening	30.3	31.8	28.3	36.8	Children, voices, music

Relationship with Annoyance
In order to clarify whether loudness has an impact on responses to noise, we examined the degree of correlation (Spearman's) between physical noise levels and ratings of annoyance. For the most part, no relationship was found, however, a significant correlation was found when we looked at the difference between: 1. L10 with and without the intruding noise and verbal and numerical ratings of annoyance from the most disturbing noise($r = .845$, d.f. 1,8, $p = .008$); and 2. Lmax with and without the intruding noise and verbal and numerical ratings of annoyance from the most disturbing noise ($r = .732$, d.f. 1, 8, $p = .039$). This indicates that it is the difference between ambient and intrusive noise levels that causes nuisance, rather than the loudness of the intrusive noise per se.
Tonality, Intelligibility and Frequency of occurrence did not have an impact upon ratings of annoyance.

Relationship with Activity Disturbance
The extent of activity disturbance experienced was not significantly affected by noise levels nor other features of the intrusive noise.

Noise exposure measurements were low in absolute terms in, at least, half of the case studies. Generally, noise levels were not high and 'only a few of the tapes show extreme noise levels'. However, a significant difference was found between noise levels with and without the intruding noise for all noise parameters, suggesting that the difference between the ambient noise level and noise levels when the intruding noise is present could be

important. A significant relationship was found between verbal and numerical ratings of annoyance from the most disturbing noise and the difference between noise levels with and without the intruding noise for L10 and Lmax. The amount of activity disturbance experienced did not appear to be affected by actual noise levels nor other features of the noise. These results may suggest that current noise guidelines cannot reliably be used to assess whether domestic noise and noise from amplified music is acceptable or not. This is in agreement with the findings of a review by BRE (Raw & Hamilton, 1995) which found that 'there appear to be no studies in which disturbance due to noise has been related directly to the sound level entering dwellings'. The case studies demonstrate that intruding noises such as voices, TV, shouting, singing and children were often partially intelligible even at very low levels and the intruding noises were often intelligible to such an extent that there was a significant loss of acoustic privacy. However, it should be noted that there was an interval between noise measurements and completion of the standardised interview. This interval may have influenced the lack of association. There is also some doubt as to whether short period tape recordings can adequately represent overall long-term noise exposure.

6. FINDINGS

With regard to the most intruding source of noise, the greatest proportion of complaints (42.2%) arise because of noise from radio, television or music. The next most common cause for complaint, accounting for 22.2%, are noises of origins other than those listed in the interview, in particular the sound of furniture dragging across the floor in flats above, or from next door, and banging noises of an unknown source. Following these, there is a fairly even spread of complaints relating to noise from: teenagers/adults voices (8.9%); DIY (6.7%); footsteps (6.7%); children(4.4%); doors banging (4.4%); dogs (2.2%); and, cars/motorbikes etc. (2.2%).

For all sources of noise, complainants were most likely to report being very or extremely annoyed.

Table 4 shows how often activities are disturbed by the intruding noise.

Table 4

	Never	Seldom	Sometimes	Often	Very Often
Listening to TV, radio, music	5	2	11	15	12
Having a conversation (including on the telephone)	6	7	13	12	7
Reading, writing or other quiet activities	7	1	8	9	20
Concentrating	2	0	13	11	19
Sleeping	6	0	4	8	27
Resting	2	0	8	6	29
Getting children to sleep	29	2	4	4	6
Using the whole house	11	2	7	15	10
Spending time in the garden	27	6	5	2	5
Having windows or doors open	18	3	8	9	7
Having guests or visitors	13	5	14	4	9
Spending time in the home	8	4	11	11	11
Having meals	16	2	13	5	9
Any other activity	40	1	2	1	1

N = 45

Activity disturbance is most likely to occur for those activities that require a quiet environment, with the most disturbed being: resting; sleeping; reading, writing and other quiet activities; and concentrating. Conversely, a relatively large proportion of complainants' report that spending time in the garden or having meals is not disturbed by the noise.

Table 5 shows the frequency of emotional responses experienced when hearing the intruding noise.

Table 5

	Never	*Seldom*	*Sometimes*	*Often*	*Very Often*
Irritated	3	0	5	18	19
Tense	0	2	5	15	23
Anxious	5	3	8	12	17
Startled	16	4	11	9	5
Annoyed	1	0	6	9	29
Stressed	2	0	5	8	30
Bothered	3	0	6	9	27
Tired	8	0	7	11	19
Angry	4	1	7	5	28
Frightened	25	4	13	2	1
Worried	13	7	6	9	10
Depressed	13	2	5	12	13
Upset	4	1	8	14	18
Fed up	6	2	6	8	23
Unhealthy/ill	15	1	7	8	14

N = 45

Three underlying factors within the *Emotional Response* scale were found. The first factor appeared to reflect an outwardly directed, aggressive emotional response, the second an inwardly directed, passive response and the third a more neurotic response. Several interesting relationships were found between scores on these sub-scales and ratings of annoyance, the most notable being a significant correlation between scores on the outwardly directed aggression scale and verbal and numerical ratings of overall annoyance. In addition, as expected, a significant correlation was found between a neurotic emotional response and scores on the GHQ.

Several characteristics of the complainant were considered important. The first of these was *perceived contro*l. The majority of complainants believed that they have control over what happens in most situations both inside and outside of the home, which is in sharp contrast to the small number who believe that they have any control over the level of noise from their neighbours. It was expected that the level of perceived control would negatively correlate with reported annoyance but this hypothesis was not supported.

The type of *coping strategy* employed in trying to deal with the noise was also examined and factor analysis revealed the presence of three types of coping strategy: denial/avoidance; problem-focused/action-directed; and palliative/comforting cognitions.

Noise sensitivity was assessed using a two-item (numerical and verbal) scale. It was anticipated that highly noise sensitive individuals would report higher levels of annoyance but no support was found for this. However, this may be due to the bias in our sample, which is comprised entirely of individuals
who have reached a point where they have been driven to complain.

7. DOMESTIC NOISE AND MENTAL HEALTH

The General Health Questionnaire (GHQ: Goldberg & Williams, 1988) was chosen because it is a widely used and well-validated measure of psychiatric disorder and psychological distress (Goldberg & Williams, 1988).

An extremely high proportion of the complainants in this sample can be considered psychiatric cases, as measured by the General Health Questionnaire. This is particularly true of the male group. However, it is not possible to determine whether psychiatric disorder existed prior to, and in some way predisposes to, the noise complaint or whether it arose as a result of noise exposure. It is not possible to infer the direction of causality and it could be

equally true that exposure to domestic noise causes psychiatric disorder or that psychiatric disorder increases susceptibility to such noise.

At present, there is very little empirical evidence to support an association between noise from neighbours and mental ill-health and, although it is widely accepted that such an association is likely to exist, as demonstrated in the current study, the direction of causation is not clear. It may be that those people with existing ill health, either physical or mental, are more likely to complain about noise than people who are well. Or the converse could be true: that domestic noise is actually a cause of ill health.

There is a clear need for better information on the relationship between domestic noise and health and a greater understanding of those factors that may have an impact on this relationship. A better understanding would help to identify ways that domestic noise can be tackled.

An intervention study could also help to clarify the relationship between noise and health. For example, the Standardised Interview could be used to assess participants before and after a major refurbishment project in order to determine whether an improvement in the noise environment is reflected in a corresponding improvement in health.

8. GUIDANCE ON ASSESSMENT AND SOLUTIONS

New directions and solutions are needed to tackle the problem of domestic noise. Further studies and guidance are needed on how domestic noise can be assessed and dealt with, in terms of best practice for interacting with the complainant, mediation strategies and methods of investigation used by Environmental Health Officers. There is a good case for better collaboration between Environmental Health Services and mental health practitioners.

The Standardised Interview to Assess Domestic Noise Complaints and their Effects (SIANCE) provides a useful tool to investigate whether effects of noise on an individual are prejudicial to health. The interview can be used to distinguish between individual cases and assess the severity of the self-reported effects of domestic noise. The interview is most appropriate for use with long-term chronic complaints and for making decisions as to whether the noise is prejudicial to health. Further research will enable benchmark scores to be developed to aid the decision making process.

SCIANCE is only part of the full tool kit. A comprehensive model should be developed on the investigation and assessment of domestic noise complaints. Such a model would provide guidance on the assessment of noise complaints, especially where the noise case is chronic.

Noise measurements should be used with caution in the assessment of domestic noise, especially when the intruding noise contains vocal content, other pronounced acoustic features or has other connotations with respect to loss of acoustic privacy. Nevertheless, noise measurements may fulfil a limited role. For example, noise measurements may provide a useful record of the intruding noise and may be used to check the overall noise assessment.

It is recommended that further work is needed to compare the consistency and reliability of subjective judgements made by different investigating officers.

9. CONCLUSIONS

To conclude, the results of this study demonstrate that the ‘Standardised Interview to Assess Domestic Noise Complaints and their Effects’ is a psychometrically reliable and valid measure.
Use of the interview will enable Local Authorities to take a more structured approach towards investigating domestic noise complaints. A means of gathering standardised information from noise complainants is essential if Local Authorities are to be able to deal with complaints consistently across the country, allowing meaningful comparison of complaint statistics. In addition, the use of a structured interview may be particularly beneficial in helping both

complainants and investigating officers' focus on specific aspects of the noise, thereby eliciting information that may, perhaps, otherwise be forgotten in the emotionally charged situation under which complaint investigations are often conducted.
The results also suggest that there is a relationship between domestic noise complaints and mental ill-health, as indicated by the high percentage of psychiatric cases in our sample, and that this relationship needs to be explored further.

Noise exposure measurements were low in absolute terms in, at least, half of the case studies. Generally, noise levels were not high and 'only a few of the tapes show extreme noise levels'. However, a significant difference was found between noise levels with and without the intruding noise for all noise parameters, suggesting that the difference between the ambient noise level and noise levels when the intruding noise is present could be important. A significant relationship was found between verbal and numerical ratings of annoyance from the most disturbing noise and the difference between noise levels with and without the intruding noise for L10 and Lmax. The amount of activity disturbance experienced did not appear to be affected by actual noise levels nor other features of the noise. These results may suggest that current noise guidelines cannot reliably be used to assess whether domestic noise and noise from amplified music is acceptable or not. This is in agreement with the findings of a review by BRE (Raw & Hamilton, 1995) which found that 'there appear to be no studies in which disturbance due to noise has been related directly to the sound level entering dwellings'. The case studies demonstrate that intruding noises such as voices, TV, shouting, singing and children were often partially intelligible even at very low levels and the intruding noises were often intelligible to such an extent that there was a significant loss of acoustic privacy. However, it should be noted that there was an interval between noise measurements and completion of the standardised interview. This interval may have influenced the lack of association. There is also some doubt as to whether short period tape recordings can adequately represent overall long-term noise exposure.

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