

# Coping Strategies for Low Frequency Noise\*

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A small group (n=9), whose complaints of low frequency noise had not been resolved by Environmental Health Officers and related care professionals, were invited to attend a series of intervention sessions led by a psychotherapist. The aims of the sessions were to improve the participants' coping strategies and their quality of life, in order to relieve them from some of the distress caused by their belief that they were exposed to low frequency noise. Prior to the psychotherapy sessions the group was evaluated on a number of self report questionnaires, which measured individual responses for reaction to low frequency noise, quality of life, quality of coping and a personality questionnaire (Insights Discovery Preference Evaluator). A before and after, within group analysis of responses was based upon repeat measures of the three behavioural response questionnaires for noise reactivity, quality of life and coping. A general reduction in the subjects' stress levels was shown, suggesting positive effects of psychotherapy upon symptoms that had, in this group's case, proved resistant to improvement by conventional local authority and specialist interventions. This 'therapeutic' approach to LFN interventions could lead to improved health and effectiveness and fewer demands on local services. Although the techniques of tinnitus management were informative, analogy between the problems of low frequency noise sufferers and those of tinnitus sufferers fails at the point where low frequency noise sufferers believe that an external agency is the cause of their problem.

## 1. EXPERIMENTAL AIMS AND DESIGN

The aim of the study was to examine how long-term LFN sufferers' perception of their quality of life and coping quality responded to group and self-help therapeutic interventions.

To this aim, parameters were selected which supported a before and after, within-subjects comparison. All subjects had agreed to participate in the assessments, both before and after the therapeutic intervention. The sequence of measurements and interventions included:

1. Administration of Questionnaires
2. Therapeutic intervention by psychotherapist
3. Repeat administration of questionnaires

## 2. QUESTIONNAIRES AND PSYCHOLOGICAL MEASURES

The questionnaires were designed to register the before-and-after perceptions of quality of life and coping ability. A further measure was made of personality. The personality measure, using the Insights discovery Preference Evaluator, was introduced for two principal reasons: firstly to be able to place individuals within a typological system in order to examine possible groupings within particular types (e.g. Introverted thinking/Extraverted feeling), as personality has been indicated as an independent variable in sensitivity to noise (Belojevic et al. 2003). Secondly, measurement of personality within this system offered the potential for highlighting communication blind spots (a mismatch of communication styles is likely to

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increase anxiety) associated with personality type.

### 3. CLINICAL GROUP-WORK

The aim of the clinical component of the study was to establish whether group therapy combined with self-help processes could be of benefit to sufferers from low frequency noise related stress (LFNRS). The initial combination of the techniques used was based on a preliminary review of the literature and analogies with treatment of phobic conditions and stress management.

Initially, emphasis was placed upon a combination of multi-modal relaxation and imaginal exposure techniques based upon Cognitive Behavioural Therapy and Group Hypnotherapy. Different techniques were explained and demonstrated to participants and a written handout prepared for them containing a “menu” of possible therapeutic techniques, which could be used as self-help coping skills. In addition, participants were given a relaxation CD Rom based upon the multi-modal relaxation processes used in the group sessions. As the work progressed, individual interventions were combined, and adapted, according to discussion and feedback received from the group.

The techniques discussed with the group included the Neural Linguistic Programming (NLP) rewind (or “fast

phobia”) technique, changing the sound to a visual image and altering its sensory sub-modalities, different forms of visual-kinaesthetic dissociation (VKD), anchoring, different forms of multi-modal relaxation, affirmations, and imaginal exposure. (See Appendix 2). Six group Sessions were held for the project.

### 4. SUBJECT SELECTION AND INITIAL EVALUATION

A database of subjects was available from a survey which had been carried out as part of earlier work (Leventhall, et al. 2003). Those who lived within access of London were telephoned and the project explained to them. Responses varied from “I don’t hear the noise anymore” to “The noise has made me too ill to travel to London”. Some subjects would have liked to take part but were constrained by their work. However, there was a good positive response and subjects were selected as in Table I, including some new contacts. The subjects are typical of low frequency noise sufferers. (Leventhall, et al. 2003).

### 5. LOW FREQUENCY NOISE REACTION QUESTIONNAIRE (LFNRQ).

As an initial assessment, each subject was sent a questionnaire to complete

*Table 1. Subjects who took part in the relaxation sessions. Subject E was self-employed and F was in employment. Subject H dropped out early in the project*

Subject	Age	Sex	Hearing problems
A	76	F	Y
B	65	M	N
C	69	F	N
D	69	F	Y
E	56	F	N
F	59	F	N
G	71	M	N
(H)	75	M	N)
I	72	M	N

before subjects met the researchers. The questionnaire registered subjects' responses with minimal influence from the project while requiring a preliminary effort from the subjects, as an indication of the seriousness of their feelings towards the project. An existing Tinnitus Reaction Questionnaire (Wilson, et al. 1991) was used as the basis for the questionnaire.

The original questionnaire was modified in the following ways:

Each question originally commenced with "My tinnitus has..." All questions were changed to commence with "The noise has..." and the questionnaire was titled "Low Frequency Noise Questionnaire".

An additional question, No. 27, was added at the end to reflect some low frequency noise sufferers' statements that the noise drives them from their homes.

Three further general questions permitted subjects to write down comments on their noise and, fully, subjects were asked to list prescription drugs that they were taking. Four of the original nine subjects were taking anti-psychotic drugs, n one of which was listed in pharmacopia as having auditory illusional effects.

The Low Frequency noise Questionnaire is shown in Appendix 1 and the comparison of outcomes before and after the relaxation sessions is given in section 12.1.

## 6. PSYCHOLOGICAL TESTS.

At their first meeting with the researchers, each of the subjects (n=9), completed questionnaires, which

assessed personality, perceived Quality of Life (current), Quality of Coping (current) and their earlier Quality of Life (as estimated by the subjects before the onset of the noise). The primary aim was to build a profile of their individual subjective experience of, and reactions to, the perceived LFN.

Personality profiles were elicited using the Insights Discovery Preference Evaluator. This is a Jungian based system and provides for an in-depth and easy to read report on personality preferences, interpersonal and communication styles. Subjects each received a copy of their report.

## 7. QUALITY OF LIFE AND COPING

### 7.1 CURRENT QUALITY OF LIFE

The Current Quality of Life questionnaire addressed key areas of physical well-being, coping, anxiety, emotional support and emotional well-being. The Quality of coping Questionnaire registered specific responses to an individual's perceived capacity to manage the noise and other competing demands. The 'Before Noise' Quality of Life Questionnaire provided the subjects with an opportunity to describe how they might have responded to the questionnaire before the onset of the noise problem.

The Quality of Life questionnaire required responses to 15 questions within the categories of Strongly Agree, Agree, Neutral, Disagree and Strongly Disagree for each item. The Quality of Coping questionnaire contained eight questions in the same response format.

Table II. *Quality of Life Questionnaire - key results*

Current Quality of Life and Anxiety		Perceived Coping	
Feel sad	4	Dissatisfied with coping	3
Feel Anxious	5	Cannot accept the noise	6
Unable to have fun (relax)	4	Losing hope	3
Discontent with Q of L	7	In a state of worry	5
Unable to sleep well	5	Worried will get worse	4

Table II. Shows key Quality of Life results from the Questionnaires before therapeutic intervention (number of subjects out of 8).

The general reported Quality of Life was shown to be of real concern to the group and of a generally low level, while anxiety was high and sleeping disturbed. These responses, combined with a high degree of worry about the noise and its continued effects, all served to characterise subjects' Quality of Life as poor and point to a likely ongoing and confounding influence on the perceived effectiveness of existing interventions. Clearly, any support for subjects' condition from existing medical and assessment interventions was highly likely to be compromised by the strength of associated anxiety and worry.

**7.2 QUALITY OF COPING QUESTIONNAIRE:**

The second questionnaire completed by the subject group comprised items related to personal coping. Some key results show the responses to items that addressed individuals' assessment of their present state of coping and the quality of their ability to manage living with the noise, as shown in Table III.

Although the general level of coping was not good, the group still displayed a resilient attitude to the situation; indicative of a strong need to re-assert control over their personal environment. The partner/main support relationship was viewed as central to most subjects' coping, probably reflecting a dependency rather like that initiated in response to an illness. However, the broader social network

seems to pose further and unwanted demands upon at least half of the group as shown in Table III.

**7.3 QUALITY OF LIFE: COMPARISON - BEFORE AND AFTER THE NOISE**

All group members completed a questionnaire that allowed them to assess items against their impression of how they would have scored that item before the onset of the noise as in Fig 1. In the 15 Quality of Life (Q of L) questions, the first eight questions relate to negative aspects of their life whilst the remaining questions relate to positive aspects. The questions were:

- |   |     |   |
|---|-----|---|
| N | Q1  | I have lack of energy   |
| E | Q2  | I have nausea   |
| G | Q3  | Because of my feelings of fatigue I have trouble meeting the needs of |
| A |     | My family   |
| T | Q4  | I experience bad headaches  |
| I | Q5  | I feel ill  |
| V | Q6  | I am forced to spend time in bed                                      |
| E | Q7  | I feel sad  |
|   | Q8  | I feel anxious  |
| P | Q9  | I feel close to my friends  |
| O | Q10 | I am able to concentrate at home                                      |
| S | Q11 | My work at home is fulfilling   |
| I | Q12 | I am able to enjoy life   |
| T | Q13 | I am sleeping well  |
| I | Q14 | I am enjoying the things I usually do for fun                         |
| V | Q15 | A am content with the quality of my life right now                    |
| E |     |   |

Table III. *Quality of coping questionnaire - key results*

	Agree	neutral	disagree
Having a hard time adjusting to the noise	5	1	2
Feelings of inadequacy	5	1	2
Will never cope with the noise and be happy	3	2	3
People around them are uncomfortable because of the noise problem	4	1	3

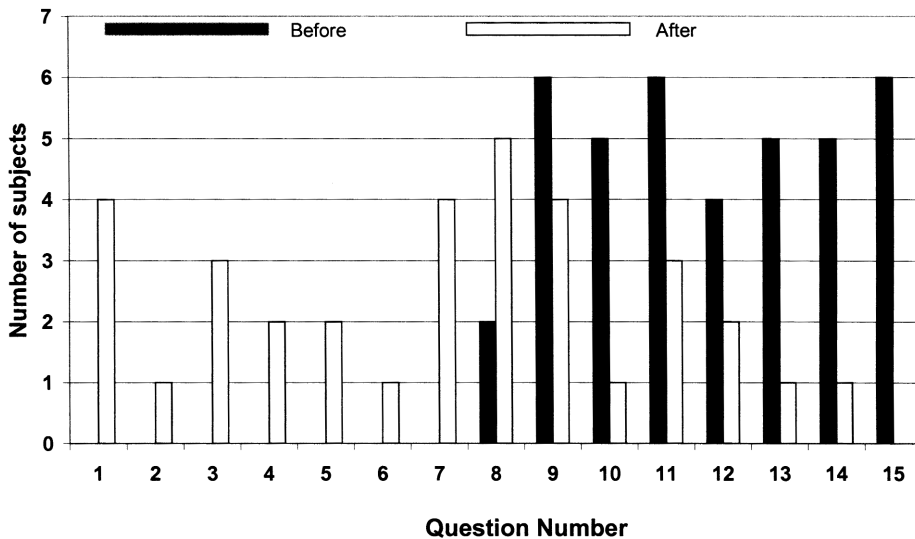


Fig. 1 Quality of Life questions before and after onset of noise

Figure 1 summarises the subjects' responses to these questions and displays them as a comparison of scores 'Before and After' onset of the noise.

Fig. 1 shows the number of subjects who selected 'agree' or 'strongly agree' to the items. For example, when asked to consider their previous level of energy, before the noise onset, -Q1 I have lack of energy - seven subjects selected Strongly Disagree and one selected Disagree giving a zero score for the question before onset of the noise. The first seven questions, relating to negative indicators in their life, all gave zero scores for their memory of their condition before the onset of the noise. Question 8, on anxiety, showed an increase after the onset of the noise. Similarly, the remaining questions, referring to indicators of positive aspects of their life showed a diminished agreement after the onset of the noise. In order to increase the robustness of level of data, any neutral scores were not included as evidence for an item. This means that, in fig 1, the number of responses to a question is less than the number of subjects.

Whilst their memories of their situation before the noise may be idealised, the differences illustrate the subjects' belief in the way that the noise

has affected them, which is a major contributor to their current levels of stress and perceived levels of 'Quality of Life', e.g. "I was so happy before the noise started". Indeed, the comparison of ratings shows a picture of a home environment being stripped of control, relaxation and enjoyment. The loss of sleep and degraded capacity to concentrate are just two items which, when combined, create an interactive and corrosive process that inhibits recuperation, whilst elevating anxiety and thereby further undermining the individual's sense of well-being. Clearly the quality of mood-state was perceived as deteriorating as both the sadness and anxiety items (Q 7 and 8 in Fig 1) display marked increase across the before and after noise onset conditions.

Perhaps the strongest aspect of these findings can be found in the recognition of the chronic nature of the situation within which individuals find themselves. As the key Quality of Life elements are distorted and fail, the individual may start to lose hope, which exacerbates the already eroded quality of emotionality. The general trend is pronounced, with the key indicators for self-rated Quality of Life showing a marked decline when compared with the Quality of Life as remembered by

subjects before the noise onset. Even allowing for an element of idealisation in subjects' perception of their lives before the onset of noise, the noise produces a clear shift towards the less favourable indicators in their lives, which lie at the left of Figure 1.

### 8. PERSONALITY QUESTIONNAIRE. INSIGHTS DISCOVERY EVALUATOR

For the purpose of this study, the Insights Discovery Preference Evaluator (IDPE) was used to locate individuals within one of the Jungian Types. The Jungian system is comprised of two attitudes (introversion and extraversion) and two rational functions (thinking and feeling) and two irrational functions (sensing and intuition). The IDPE provides a bipolar two factor space mapped as a wheel around which individuals are located as shown in Fig. 2, which shows the placing of the subjects on the wheel of the Insights bi-polar quadrants.

All but two of the subject's scores placed them in the introverted quadrants.

It can be noted that subjects C and

D, who appear in the extroverted section, showed high scores on the LFN Reaction Questionnaire. Subject C was sensitive to all noise and very distressed at the start of the sessions. Subject D, who said that her normal personality was outgoing and ebullient, had been driven to tears by the noise and had become prone to panic attacks. The remaining subjects, in the introverted section, were more subdued in their responses, although felt just as keenly.

The Jungian model, which generates this classification, posits how individuals prefer to organise and cope with incoming information. The dimension along which this preference is measured is that of 'sensing'. According to Jung, individuals who score highly along this dimension, tend to be comfortable organising information around specific examples and on a 'here and now' basis. Moreover, these individuals would tend to perceive what is going on or happening to them, based upon the concrete experiences available to them from the senses. There is a predicted dependence upon the senses for perception, rather than internalised abstraction. The Jungian model predicts that such individuals are

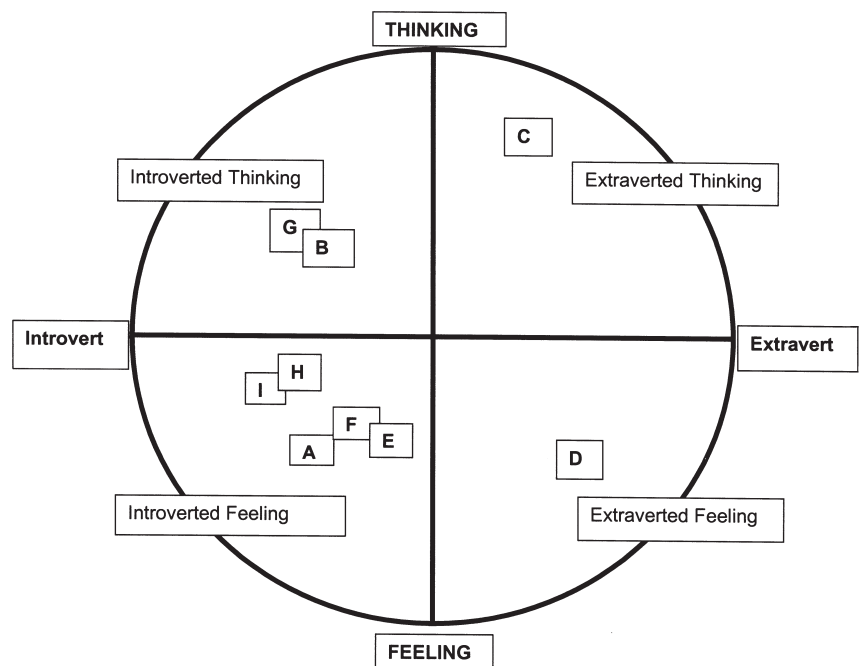


Fig. 2 Illustrating the location of subjects in terms of Introversion and Extraversion



heavily inclined to build models of the world based upon a need for 'trustworthy' information, from which coping follows. For these individuals, trustworthy information, from which coping follows. For these individuals, trustworthy information is strongly influenced by the quality of the sensory information available. Any decline in the level of 'trustworthy' sense-based information (for whatever reason), undermines their fundamental reliance upon their preference to verify, based upon access to and use of concrete information.

The majority of subjects (seven from nine) are located within the introverted sensing and feeling quadrants. Failure to be able to control sensory information is probably disturbing for most types of individuals. However, for this group the Jungian model suggests that failure to control such sense-based events tends to undermine the personal strategies preferred by these individuals when seeking to cope with environmental demands.

The inability to establish control over the sensory environment inhibits any accommodation to changes in the composition of the noise situation within which they found themselves; the ability to "simply get used to it" would be inhibited and remote. For these types, accommodation to changing sense data is conditional upon re-establishing control and their sensitivity to the noise impact will likely increase over time, as duration prompts further evidence of unwanted intrusion, almost irrespective of the sound level.

## **9. RATIONALE FOR TREATMENT PLAN**

It was hypothesised that the stress reaction to the sound could be treated by a combination of three basic therapeutic (personal coping) strategies. 1) Reassurance, explanation, and

support.

2) Relaxation therapy techniques.

3) General stress management advice and exercise (coping skills).

It was also hypothesised, based on the clinical analogy with phobia treatment, that some form of imaginal exposure therapy might help participants to desensitise, i.e. habituate to the sound. Hence, a fourth strategy is:

4) Imaginal exposure using "anchoring" of relaxation.

The final intervention constituted a later phase of treatment, developing out of the subjects' acquisition of basic relaxation skills.

The intervention methods are described in Appendix 2.

## **10. GROUP STRUCTURE AND ATTENDANCE.**

The initial group of participants was composed of nine sufferers from low frequency noise related stress (LNRS). One subject was accompanied by her husband. She requested his presence for emotional support, as she was subject to panic attacks, making a tenth participant. He took part in the exercise and provided useful feedback and comments from the perspective of someone observing a sufferer at close quarters. However, as he was not himself a sufferer, he was not included in the formal assessment of the group.

Most group members attended each workshop session. Some members missed sessions, however we anticipated that this would happen in the design of the project and had integrated much into the sessions that reconsolidated materials and practices, such that participants should still have been in a position to benefit sufficiently from their cumulative attendance at the other workshops, provided they had maintained their commitment to the homework assigned. One subject dropped out at an early stage, leaving eight subjects for before and after

intervention comparisons.

The therapeutic interventions used in the project were delivered by means of a series of six two-hour group workshops. During the workshops, participants were assigned time to discuss their feelings about LFNRS and related issues, were given information and advice about heightening understanding of their symptoms and taught coping skills. A range of coping skills were discussed and practised, but the key intervention was a version of the Benson Relaxation Response Method (Benson 1975; Benson and Stuart 1996). This is an evidence-based relaxation therapy technique, widely used in stress management and psychotherapy. The Benson Method was taught and rehearsed in each session, supported and reinforced with other relaxation techniques derived from psychotherapy and self-hypnosis. Participants were given handouts explaining it as a protocol and assigned the homework of practising it twice daily for twenty minutes and then feeding back on their experiences at the start of each subsequent session. Participants were also given a generic stress management CD, recorded by Donald Robertson, containing a number of common relaxation exercises to supplement their use of the Benson Method. Participants were asked to use those which they felt helpful, as regular “home work”.

## **11. GROUP DYNAMIC AND CHARACTERISTICS**

One of the most interesting aspects of the project has been the opportunity to informally observe how members of the group interacted with each other during the exercises they were given, and with the workshop facilitator. Discussions related to issues such as difficulties dealing with noisy neighbours, local authorities, as well as health issues. It was necessary for the group to feel that they had been listened to and given an

opportunity to air their concerns, as to prohibit such discussion may have caused them to feel undervalued or ignored.

The number and variety of potentially stress-related symptoms among the group was notable. For example, group members complained of, or exhibited behaviour, which might be interpreted as paranoia, sleep problems, anger management problems, panic attacks, tremors, and headaches. We also noted that several group members reported a range of other hearing-related issues, e.g. tinnitus, hyperacusis and hearing impairment. The group also contained a number of members who had either resorted to, or considered, litigation in relation to their low frequency noise problem. Many of the group had also had acoustic measurements taken to locate the low frequency noise, but without a positive outcome.

Another interesting development was that, when group members were encouraged to discuss and compare their symptoms, it became clear that they experienced LFN in a number of ways. Of note was the fact that three group members said that they were more distressed by feelings of vibration, which they associated with LFN and other sounds, than by the sound itself. It is highly unlikely that LFN of the levels encountered could directly cause a physical vibration of this kind. Sometimes, not surprisingly, participants found it quite difficult to explain the stimulus or its effects and expressed frustration with the inability of non-sufferers to comprehend their experiences.

Other specific comments, made by participants on feedback forms, included the following. Three people said they found the Neural Linguistic Programming (NLP) technique known as Visual-Kinaesthetic Dissociation (VKD) to be helpful. Group members were introduced to this technique as



apart of a “menu” of possible coping skills for their evaluation. Four specifically mentioned that they found the Benson method helpful. Two noted that the stress management CD had been helpful. Three commented on the importance they placed on actually identifying the external source of the sound. Four mentioned that they found it helpful to meet and speak with other sufferers. Two mentioned that they found the use of white noise or pleasant background sounds useful for masking the LFN.

The small number of subjects limits the reliability of statistical deductions, but anecdotal evidence, based upon subjects’ comments and responses to questions during the sessions, suggest that the majority of group members, felt significant improvement in their levels of stress associated with LFN. The high levels of adherence to the programme and attendance at sessions was surprising, and indicated that the participants placed considerable value upon the treatment they were receiving. Only one group member dropped out from the project, at a very early stage, due to illness (subject H).

## 12. COMPARISON OF BEFORE AND AFTER OUTCOMES

### 12.1 LOW FREQUENCY NOISE REACTION QUESTIONNAIRE

The questionnaire, which is shown in

Appendix 1, contains questions which all relate to negative effects of the noise. It was scored in the following way. Each question answered was given a score from 0 to 4, where:

Not at all = 0

A little of the time = 1

A good deal of the time = 3

Most of the time = 4

The maximum score for the 27 questions is 108 and actual scores were expressed as a percentage of this.

Most subjects answered all of the LFNQR questionnaire statements, but one very stressed subject, H, did not respond to 11 of the statements and he subsequently dropped out of the study. Two others missed either one or two statements. The results are summarised in Figs. 3 and 4. A question not answered was left blank in the scoring.

#### Figure 3 commentary:

The bar score in Figure 3 indicates the overall level of impact experienced by each of the subjects, the higher the score the greater the adverse effects of the noise. The level of impact is shown in terms of a percentage of the ‘amount’ of impact. The results show that Subjects C and D displayed the highest overall unwanted reaction to their LFN experience. The remaining subjects are more moderately affected, as they typically score 30% to 50%, which is, on average, between “A little of the time” and “Some of the Time”.

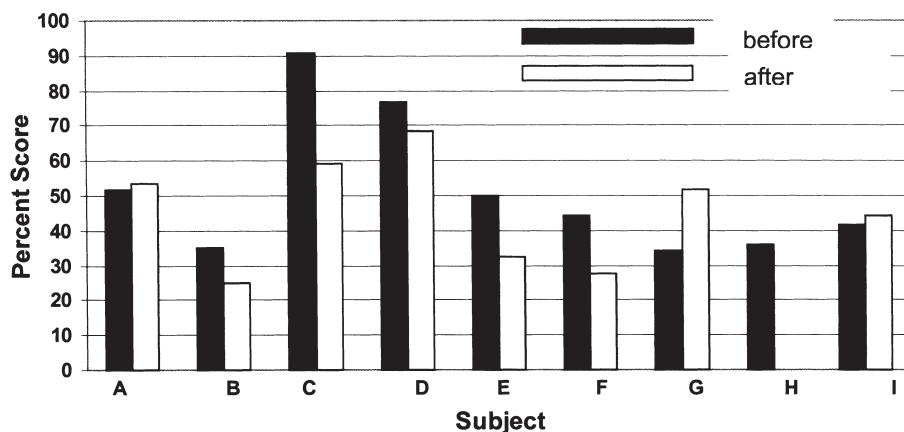


Fig. 3. Subject's overall LFNQR scores before and after the therapeutic sessions

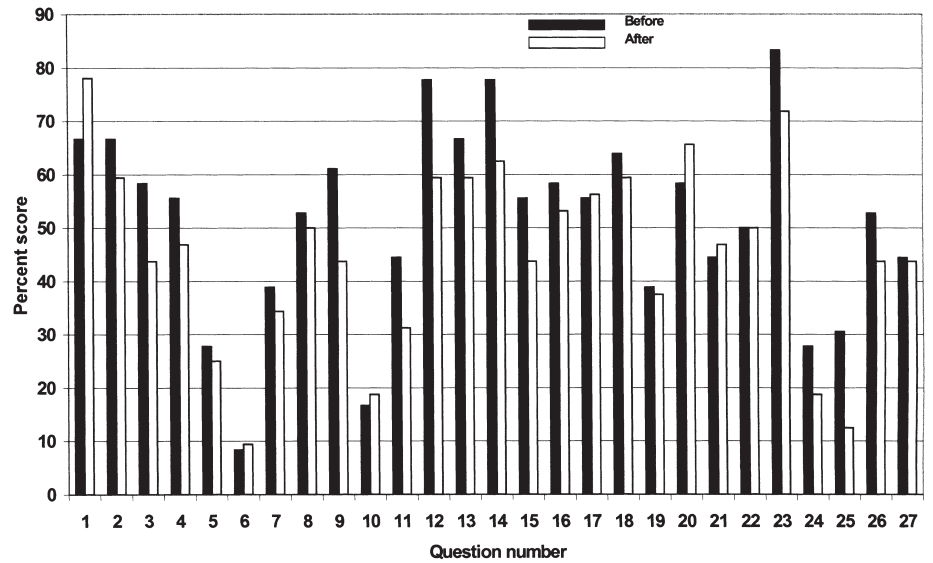


Figure 4 Total scores for the before and after therapeutic intervention shown for each question

Consider Subject C, who showed a percentage reduction of about 30%. Overall, this subject's score, before and after intervention, dropped by more than 30 steps in the 0 to 4 scoring range of the answers, which is a good result.

For most other subjects, the overall trend suggests that the unwanted reactions to noise had been reduced relative to pre-intervention scores.

Results from the LFNRQ are shown in Figure 4, where the percentage of the total possible scores across subjects for the before and after therapy conditions are shown in question-specific scores. A lower score after the intervention indicates an improvement in the subjects' conditions.

Figure 4 commentary:

The strongest indicators of impact can be found from the questions;

- Q. 23 (sleep disturbance) 83% reducing to 72% after therapy,
- Q. 12 (interference with enjoyment of life) 78% reducing to 59% and
- Q. 14 (made hard to relax) 78% reducing to 62%.

These are followed by:

- Q. 1 (made worry) 67%

- Q. 9 (annoyed) 61% reducing to 44%
- Q. 2 (made tense) 67% reducing to 59%
- Q. 16 (made feel helpless) 58% reducing to 53%
- Q. 13 (hard to concentrate) 67% reducing to 59%
- Q. 20 (made avoid noisy situations) 58% increasing to 67%
- Q. 3 (made irritable) 58% reducing to 44%
- Q. 18 (interfered with work) 64% reducing to 59%
- Q. 4 (made angry) 56% reducing to 47%

The least adverse effects in terms of percentage scores were

- Q. 6 (led to avoid quiet situations) 8% increasing to 9%
- Q. 10 (made feel confused) 17% increasing to 19%
- Q. 5 (made cry) 28% reducing to 25%
- Q. 24 (made think of suicide) 28% reducing to 19%
- Q. 25 (made feel panic) 28% reducing to 13%

Consequently, the strongest effects relate to sleep disturbance, interference with enjoyment, relaxation, concentration and work, whilst leading to annoyance, anger, irritation, helplessness and avoidance of noise.

Following the therapeutic intervention, subjects' scores indicate improvement in the quality of their reactions to LFN, and this is not incompatible with elevated awareness of the noise.

## 12.2 QUALITY OF LIFE QUESTIONNAIRE

Subjects were again asked to complete the Q of L Questionnaire after the series of therapeutic sessions. Scoring was the same as in Fig. 1, using the five point scale Strongly Disagree: Disagree: Neutral: Agree: Strongly Agree. The numbers for Strongly Disagree and Disagree are combined into one group, as are the numbers for Agree and Strongly Agree. The numbers who responded as Neutral are a single group.

The answers to the questions are shown in Figure 5, which gives subjects' responses under the three headings:

1. Agreement with the Q of L questions
2. Disagreement with the Q of L questions
3. Neutrality - unable to make a decision either way.

Figure 5 displays subjects' responses to questions which reflect the quality of their emotional and physical well-being, before and after relaxation therapy. Reading vertically down the three bar charts shows how agreement, disagreement and neutrality changed from before and after the relaxation sessions. The 15 Q of L questions are shown above, in section 7.3.

In figure 5 questions 1 to 8 cover negative aspects of the subject's life, so that a reduction in subject numbers after the therapy is a positive outcome. Similarly, questions 9 to 15, cover positive aspects of the subject's life, so

that an increase in the subject numbers after therapy is a positive outcome. There are eight replies to each question.

The subjects' pre and post therapy Quality of Life scores show that a number of questions have elicited stronger positive scores. If the ratings can be taken as a commentary on subjects' quality of life, it can be seen that a number of aspects of their lives have improved. Subjects report that, in general, their physical well being (Q3, Q5, Q6, Q7 and Q8) showed signs of improvement, increasing or decreasing as appropriate. For example, consider Q8 - I feel anxious - see section 7.3. Prior to intervention, five of the group agreed with this statement, one disagreed and two were neutral. After intervention two agreed, three disagreed and three were neutral. This showed a trend away from the negativity in their lives also shown by responses to other questions. For example, when ratings for questions 1-8 are examined together, there is a trend towards decreasing negatives, although some of the improvement is in neutrality rather than disagreement e.g. Q7 (I feel sad). An increase in neutral response coupled with a decrease in negative response is a positive outcome.

Subjects report a continual battle against the noise and its intrusions. Many of the subjects have a long-term history with the noise and so it is against this well-established tendency that encouraging gains have been recorded.

The impact upon subjects' quality of emotional life, as recorded by the scores to questions 7 and 8, indicate improvement. The capacity to reassert control over the impact of unwanted stimuli is central to effective coping. The more effective the individual's coping the more likely that their mood will improve and confidence increase, leading to a lowering of anxiety.

The responses to question 11 (My work at home is fulfilling) were not

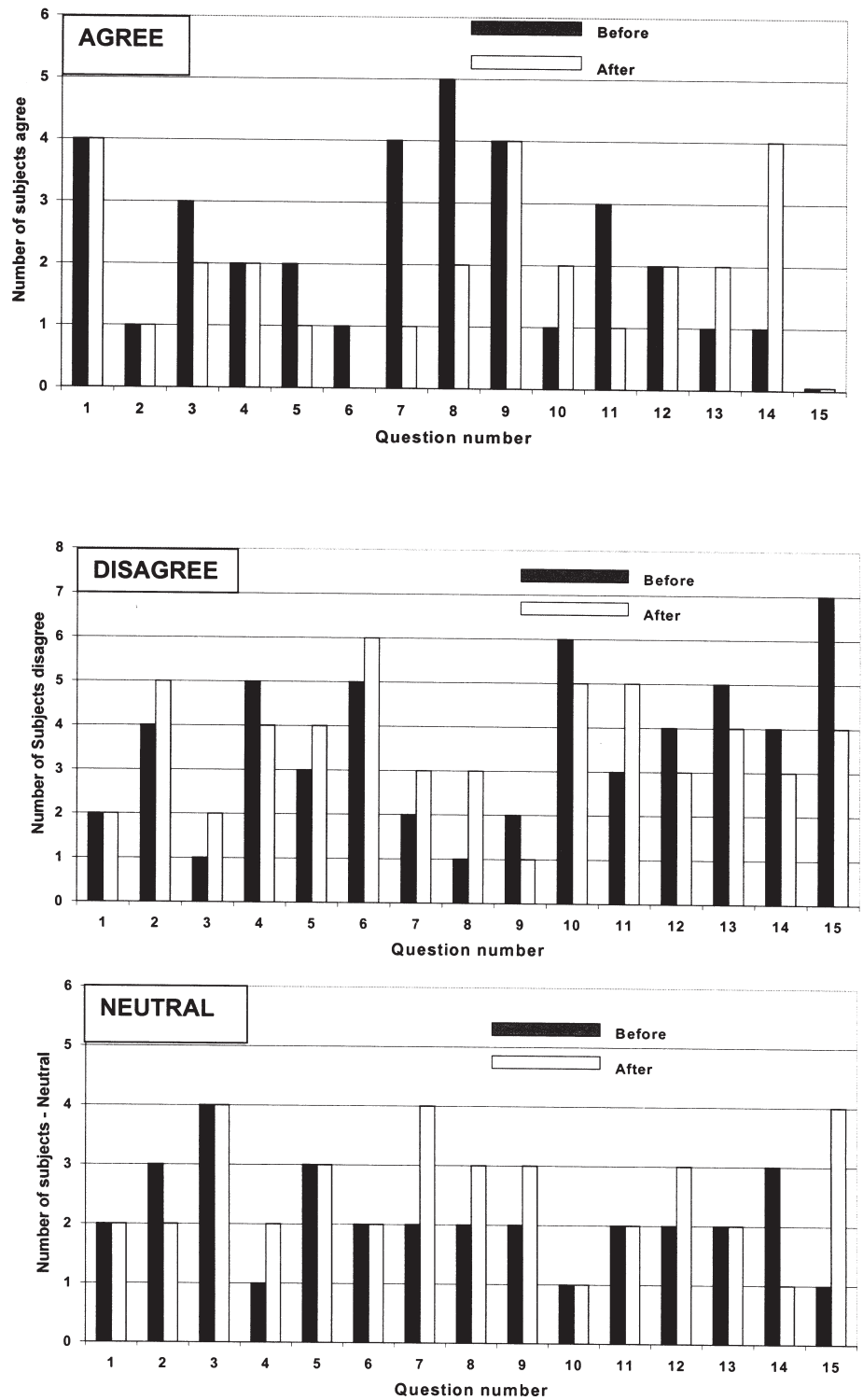


Figure 5 Quality of Life Scores before and after therapeutic intervention

consistent with the general trend towards improvement as, prior to intervention, three subjects agreed, compared with one subject after intervention. It is possible that the therapy roused increased expectations in this area.

Subjects' reports suggest evidence for an increased capacity to relax and to

replenish energy levels - questions 12 - 14. This is a move towards breaking the downward pressure upon subjects' quality of life, a pressure that characterizes LFN complaints and accentuates stress. However, none of the subjects were experiencing a general level of quality of life with which they were content. The general level of well-

being seems to have responded favourably as illustrated by scores of Question 14 (I am enjoying the things I usually do for fun) which shows particular improvement, where agreement rose from 1 subject to 4 subjects, caused by a drop of one in disagreement and a drop of two in neutral. None of the subjects are content with the quality of their life before and after intervention, but there is a move of three from disagreement to neutral.

Given the relatively short duration of the relaxation sessions in relation to long-term problems, it does seem that subjects were able to build an improved quality of life as a result of the therapeutic intervention. Overall, subjects' ratings indicate decreased sensitivity to the noise, and improved coping. The quality of home life appears to have also benefited, given the trend for improvement found in questions 7, 8, 13 and 14.

It is possible that benefits may have occurred as an artefact, a consequence of being able to share their feelings and experiences with other co-sufferers within a supportive group. However, results from the quality of coping questionnaire (shown below) suggest that subjects were able to apply control techniques, drawn from the group sessions, as scores on active coping questions also indicated improvement.

### 12.3 QUALITY OF COPING QUESTIONNAIRE

Overall, as the quality of life measures were showing improvement, the underlying mechanism supporting this was likely to be that of improved coping. Subjects' scores on the coping questionnaire, shown for each question in Figure 6, indicated stronger positive perceptions. (Answers were given on the same five-point scale as for the Quality of Life Questionnaire). The techniques acquired by subjects from the therapy sessions seem to have initiated an awareness of how to manage 'unwanted'

responses, which supported them in countering the negative effects of failed coping. When asked to consider their longer term capacity to cope with the noise (Q.7) seven subjects, compared with three subjects pre-session, thought that they would now be able to regain happiness.

Figure 6 shows the Subjects' scores under three headings

1. Agreement with the coping questions
2. Disagreement with the coping questions
3. Neutrality - unable to make a decision either way

The coping questionnaire required response to the following eight questions, all of which, except Q.6, refers to inadequacy in coping.

#### Coping Questions

1. I have a hard time adjusting to the noise
2. Because of the noise I miss the things I like to do most
3. The noise makes me feel useless at times
4. The noise has made me more dependent on others than I want to be
5. The noise has made me a burden on my family and friends
6. The noise does not make me feel inadequate
7. I will never cope with the noise well enough to make me happy
8. I think that people are uncomfortable around me because of my problem with the noise

Consider Figure 6. Reading vertically down the three bar charts shows how agreement, disagreement and neutrality changed from before and after the therapy sessions.

For example, Q.1 - I have a hard time adjusting to the noise - changed from 5 subjects agreeing to 2 subjects agreeing. Disagreement rose from 2 to 3 subjects, but there was a rise in Neutral from 1 subject to 3 subjects, showing a

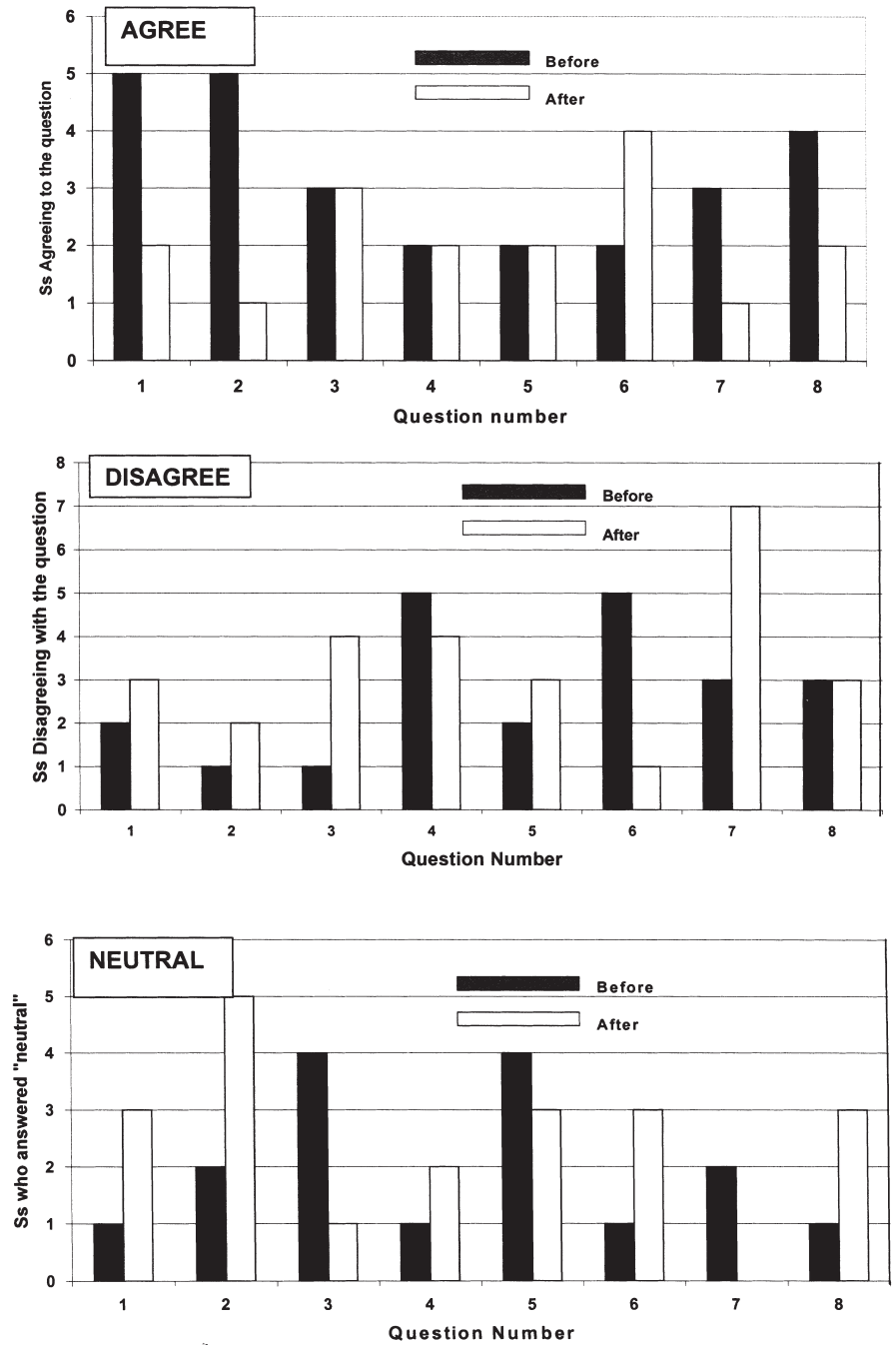


Figure 6 Subjects who scored agreed, disagreed or were neutral on the coping questionnaire

move towards disagreement, even though some subjects were not able to go all the way.

Q2 - Because of the noise I miss the things I like to do most - showed a marked change from agreement to neutrality.

Q3 - The noise makes me feel useless at times - showed no change in the number agreeing, but a reduction in neutrality leading to a rise in disagreement.

Q4 - The noise has made me more dependent on others than I want to be - showed little change.



Q5 - The noise has made me a burden on my family and friends - also showed only small changes.

Q6 - The noise does not make me feel inadequate - here there is a clear change towards agreeing with the question or to neutrality.

Q7 - I will never cope with the noise well enough to make me happy - Again a clear change towards disagreement and with no neutral answers after intervention.

Q8 - I think that people are uncomfortable around me because of my problem with the noise - therapy led to a reduction in agreement and increase in neutrality.

The scores show an overall improvement in the Quality of Coping. There is an improvement in the scores on questions of a positive and forward looking nature, for example, (Q.7) which is a key element in building positive behaviours, and which can provide a future - oriented source of goal directed reinforcement, rather than that commonly described by sufferers, which is firmly anchored in the past. In this past context, failed coping is a self-fulfilling and self-perpetuating process, the cycle repeats and learning only serves to reinforce the original view, leading to a restricted and distorted range of response options. It is possible that the therapeutic interventions were able to provide subjects with a wider range of response options, breaking with learned behaviours and thereby countering previously acquired responses and associated negative emotions.

The responses to Q.6 (inadequacy) are evidence of an increased capacity to meet the emotional demands placed upon them by LFN. The more effective an individual's strategies are for managing the impact of noise, the more likely they are to experience the noise as less intrusive and annoying. This would support reduced anxiety levels; associated reduction in anxiety and

negative mood states.

One of the most telling aspects of individual's experience of trying to cope with LFN is the gradual yet apparently remorseless growth of disconnection between them and others who do not have their noise experience.

The post therapy ratings for Q.8 indicate that subjects have reduced concerns about how their responses to the noise may impact upon their relationships with others. Given the general trend towards improved coping, this may be taken as evidence that the noise is less of a concern to the subject and therefore figures less in their lives with others. If subjects were beginning to feel the benefits of improved coping and associated quality of life, they may perceive themselves as placing fewer demands upon their partners/others and consequently be more at ease with the relationship. Again, this would be a significant development, as many LFN sufferers describe a focus that frequently dominates relationships with others.

Figure 6 illustrates that the relaxation therapy has led to an improvement in coping capacity for subjects whose experience is that of living with LFN at home.

The group had also been invited to make written comments on their perceptions of the therapy. The following comment from one member summarises what the group generally found to be helpful:

"Focusing awareness on the *choices* one has to assist in coping. Greater detachment from the noises and from one's own stress reactions. Letting go of negative feelings towards the people making the noise and trying to deal with only the noise.

Having "somewhere to go" via the visualisation, which gives a sense of power and control.

Sharing the group with fellow sufferers."

### **13. CONCLUSIONS**

A group of subjects, long term complaints of noise, and in particular of low frequency noise, were introduced to relaxation and related therapies as a means of relieving the worst symptoms consequent on the noise. Nine subjects commenced the therapy, but one dropped out due to illness, so that deductions have been based on the same eight subjects before and after the therapy sessions.

Subjects responses to 'their noise problem' were elicited by questionnaires administered before and after the therapeutic sessions. There is a clear trend in the overall results that suggests is insufficient for meaningful statistical deductions, but a review of the comments of the subjects on changes in their personal situations showed that, whilst all reported benefits, some felt that they had derived considerable benefit.

Relaxation and other psychotherapeutic techniques have been shown to be useful interventions in reducing the stress caused by noise problems, such as those from some low frequency noises for which a technical noise control solution was not available.

At the time when this work was in progress, it was not known to the authors that the UK National Health Service was investigating two computerised cognitive Behavioural Therapy (CCBT) programs, one for use in cases of mild to moderate depression and the other for anxiety/phobia problems. See <http://guidance.nice.org.uk/TA97>.

Primary Care Trusts were required to make these packages available to patients from 31 March 2007.

This supports the case that the CCBT has promised as a means of helping those who suffer from a variety of problems, including noise which cannot be solved technically, and who exhibit symptoms of both depression and anxiety. These people are often widely dispersed and it may not be

possible to give them individual or group attention. The next requirement is to develop computerised Cognitive Behaviour Therapy for use by noise sufferers.

### **ACKNOWLEDGEMENT.**

This work was carried out under contract for Defra and the Devolved Administrations.

### **14. APPENDIX 1 LFN REACTION QUESTIONNAIRE.**

The following questionnaire was completed by the subjects before the start of the relaxation sessions to be returned by post. It was completed again at the end of the sessions with modification to the final three questions. Each question was answered by ticking off one of the following choices.

Not At All    A little of the time  
Some of the time  
A good deal of the time    Most of the time

- 1 *The noise has made me worry about it*
- 2 *The noise has made me feel tense*
- 3 *The noise has made me feel irritable*
- 4 *The noise has made me feel angry*
- 5 *The noise has made me cry*
- 6 *The noise has led me to avoid quiet situations*
- 7 *The noise has made me feel less interested in going out*
- 8 *The noise has made me feel depressed*
- 9 *The noise has made me feel annoyed*
- 10 *The noise has made me feel confused*
- 11 *The noise "drives me crazy"*
- 12 *The noise has interfered with my enjoyment of life*
- 13 *The noise has made it hard to me to concentrate*
- 14 *The noise has made it hard for me to relax*
- 15 *The noise has made me feel distressed*
- 16 *The noise has made me feel helpless*
- 17 *The noise has made me feel frustrated*

*with things*

18 *The noise has interfered with my ability to work*

19 *The noise has led me to despair*

20 *The noise has led me to avoid noisy situations*

21 *The noise has led me to avoid social situations*

22 *The noise has made me feel helpless about the future*

23 *The noise has interfered with my sleep*

24 *The noise has led me to think about suicide*

25 *The noise has made me feel panicky*

26 *The noise has made me feel tormented*

27 *The noise has forced me out of my home*

*Please write a few words in response to the following questions. Use a separate sheet if necessary.*

28 *Do you believe that you know the source of the noise?*

29 *Have you tried to have it reduced, and with what result?*

30 *Give any other comments which you wish.*

And finally, are you taking prescription drugs? Some of the standard prescription drugs may have side effects on hearing. If you are taking any, could you have a look at the pack and write the name below.

## **15 APPENDIX 2. BASIS OF THE THERAPEUTIC INTERVENTIONS**

### **15.1 THE BENSON RELAXATION RESPONSE**

In 1960, at Harvard Medical School in the US, the cardiologist Herbert Benson developed the "Relaxation Response" approach to stress therapy. Benson's research into human physiology showed that, in addition to the established 'fight or flight' response, the body possessed the ability to deliberately induce a counterbalancing state of physical rest and emotional calm which he labelled the 'relaxation response'.

When the mind is focused, whether through meditation or other

repetitive mental activities, the body responds with a dramatic decrease in heart rate, breathing rate, blood pressure (if elevated to begin with), and metabolic rate - the exact opposite effects of the fight-or-flight response. (Benson, 1975: 9)

Benson discovered that the relaxation response could be elicited in a number of ways, using established relaxation techniques from yogic meditation to progressive muscle relaxation. Once he had established the existence of a measurable and clinically significant relaxation mechanism, Benson proceeded to search for the simplest possible protocol capable of inducing it. He concluded that the relaxation response could be elicited by a combination of two essential factors:

1. A monotonous mental stimulus. That is, a sound, word, phrase, or prayer repeated silently or aloud, or a fixed gaze at an object.
2. A passive mental attitude. Not worrying about how well one is performing the technique and simply putting aside distracting thoughts to return to one's focus. (Benson, 1975: 10).

Consequently, Benson developed his own protocol, which generally involves the subject sitting in a comfortable chair, with eyes closed, repeating a simple word, such as "one" or "peace", on each exhalation of breath. This is usually done for 10-20 min. twice per day, on an ongoing basis.

The group of low frequency noise sufferers were taught how to use the Benson method by means of group exercises facilitated by Donald Robertson. They practised the technique at home and discussed their experiences at the start of each session, where time was allocated to coach them through any difficulties in technique and to answer their questions and offer emotional support, reassurance and encouragement.

The Relaxation Response protocol,

sometimes known as the “Benson Method”, is currently one of the most popular relaxation techniques in modern stress management and psychological therapy. It is often used in conjunction with cognitive-behavioural therapy (CBT) (Beck 1976) and other solution-focused and evidence-based interventions in psychological therapy.

A recent clinical literature review published in the British Medical Journal (BMJ) outlines some of the most reliable research evidence on the effects of relaxation techniques like the Benson Method and self-hypnosis.

There is good evidence from randomised controlled trials that both hypnosis and relaxation techniques can reduce anxiety, particularly that related to stressful situations [...]. They are also effective for panic disorders and insomnia, particularly when integrated into a package of cognitive strategy [...] (Vickers and Zollman 1999)

Anxiety, panic attack, and insomnia are typical stress-related symptoms, which were found to be particularly common among the sample group of LFNRS sufferers, and which are believed to be frequently encountered among LFNRS sufferers in general.

## **15. PRINCIPLES OF RELAXATION THERAPY**

“Relaxation therapy” is a broad term that encompasses a range of different therapy interventions. However, most of these techniques are essentially highly directive and systematic processes which exhibit measurable physiological results, and can therefore be considered as a form of behaviour therapy. Most forms of relaxation therapy are evidence-based and reasonably well accepted - though that does not mean widely practised - within mainstream medicine. In that respect they can legitimately be considered as a branch

of “orthodox” therapy rather than “complementary and alternative medicine” (CAM). That is, “Relaxation” and “Stress Management” are found to a certain extent within conventional medicine (Vickers and Zollman 1999). The BMA define “relaxation techniques” as follows:

Methods of reducing muscle tension to achieve mental calm. Can assist people with anxiety, help reduce hypertension, and relieve stress. (BMA 2002).

Most forms of relaxation therapy entail teaching specific coping skills designed to induce the relaxation response in the body. There are a number of different ways of achieving this, e.g., progressive muscle relaxation, guided visualisation, meditation, self-hypnosis, breathing exercises, contemplative meditation, etc.

When relaxation techniques are taught by a facilitator or therapist, the results tend to be more pronounced. This is partly because simple processes, such as the Benson Method, can be combined with longer and more sophisticated exercises facilitated by the group leader. For instance, the LFN group were “talked through” lengthy progressive muscle relaxation exercises and visualisation techniques which led into the practice of the Benson Method, which they were instructed to use at home. This meant that they were already in a fairly relaxed state before commencing the part of the exercise which they were to repeat at home. When they then practised the Benson Method between sessions, they could recall the relatively deep levels of relaxation which they were coached into during the sessions, making it easier for them to make progress in developing their coping skills for relaxation.

The effects of deep relaxation are numerous. For example, in their advice book on stress, the British Medical Association asserts that systematic relaxation “Improves sleep, increases

mental and physical performance, combats tiredness, decreases anxiety and tension” (Wilkinson 2004). Essentially, it evokes a physiological and psychological state which is the opposite of, and mutually exclusive with, the state of stress, including the kind of stress that appears to result, in certain cases, from exposure to LFN.

One advantage of this approach is that it is well suited to group work as well as individual therapy. This obviously makes it easier to carry out research on efficacy, and renders the therapy more cost-effective to deliver.

In addition to dealing with the symptoms of low frequency noise stress, an attempt was made to induce the process of habituation to the low frequency noise stimulus by means of a process of “imaginal exposure” otherwise known as systematic desensitisation, described as:

A technique of behaviour therapy, developed in the 1950s by the south African-born US psychiatrist Joseph Wolpe (1915-97) for treating phobias in particular, in which each member of a hierarchy of increasingly anxiety-provoking imaginary situations involving the phobic stimulus is repeatedly paired with a response that is physiologically incompatible with fear and anxiety, such as deep muscular relaxation[...] (Colman 2001).

The clinical analogy with phobia treatment was assumed, as many of the sufferers described their reactions to LFN in terms which resembled phobia. Once group members had mastered the basics of relaxation therapy, an element of imaginal exposure was introduced by guiding them through the process of imagining themselves to be in the place where the sound typically occurs and remembering the sound and any accompanying sensations (often described as “vibrations”), while maintaining and reinforcing their sense

of emotional calm and physical relaxation. This was done repeatedly, in an attempt to neutralise the anxious and stressful feelings associated with LFN by pairing it with the relaxation response.

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### ORDINANCE UPDATE FOR OLYMPIA (WS)

Some changes could be made to Olympia's (Washington State) proposed noise ordinance as city leaders prepare to hold a public forum in August to answer questions about the controversial measure. Councilman Jeff Kingsbury said he wants more restrictive noise-limits to take effect at 11 p.m. Fridays and Saturdays instead of 10. Other change also might e made in committee before the ordinance goes to the full City Council for consideration sometime after the August forum. The public forum is scheduled for August 6th. Kingsbury proposed the ordinance which would limit commercial establishments to a sound level that would register at 60 decibels outside a residence or other commercial use between 10 p.m. and 7 a.m. The allowable sound would increase to 65 decibels between 7 a.m. and 10 p.m. under the current ordinance but Kingsbury suggests stretching that to 11 p.m. on Fridays and Saturdays. City employees would take sound readings only if there was a complaint and the sound level would be measured at the property line where the sound is received not the source. Supporters of the ordinance including some downtown residents say they deserve protection from noisy bars. They say it would benefit largely the mostly low-income residents who live downtown and be in place as downtown attempts to draw more housing. Opponents of the proposed law - including bar owners and musicians - say the ordinance would force some bars to close and hurt the city's music scene.

### ANTHROPHONY INTRUDES

Bernie Krause listens to nature for a living. The 69-year-old is a field recording scientist: he heads into the wilderness to document the noises made by native fauna -crickets chirping in the Amazon rain forest, frogs croaking. But Krause has noticed that the natural sound of the world is vanishing. He could be deep inside the Amazon, recording that cricket, but when he listens carefully he also hears machinery: the distant howl of a 747 or the dull roar of a Hummer miles away. Krause' argument is simple. In the wild, animals divide up the acoustic spectrum so they don't interfere with one another's voices. His spectrogram of a wilderness recording, in which all the component noises are mapped according to pitch, looks like the musical score for an orchestra, with each instrument in its place. No two species are using the same frequency. "That's part of how they coexist so well," Krause says. When they issue mating calls or all-important warning cries, they aren't masked by the noises of other animals. But what happens when man-made noise-anthropony, as Krause dubs it-intrudes on the natural symphony? Maybe it's the low rumble of nearby construction or the high whine of a turboprop. Either way, it interferes with a segment of the spectrum already in use, and suddenly some animal can't make itself heard. The information flow in the jungle is compromised. Krause has heard this happen all over the world. For example, the population of spadefoot toads in the Yosemite region of the Sierras is declining rapidly, and Krause thinks it's because of low-flying military training missions in the area. The toad calls lose their synchronicity, and coyotes and owls home in on individual frogs trying to rejoin the chorus. And as Krause has discovered, it doesn't take much to disrupt a soundscape. California's Lincoln Meadow, for example, has undergone only a tiny bit of logging, but the acoustic imprint of the region has completely changed in tandem with the landscape, and some species seem to have been displaced. The area looks the same as ever, "but if you listen to it, the density and diversity of sound is diminished," Krause says.