

# Helping sufferers to cope with noise using distance learning cognitive behaviour therapy

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Unresolved noise complaints cause considerable distress to sufferers, and a deterioration in quality of life as a consequence of failure to cope with the noise stress. The environmental noise control structure is directed towards higher frequency noises, which can be assessed by use of A-weighted measurements and this results in some low frequency noise problems receiving an inadequate evaluation. A number of countries now have limits for low frequency noise, but these are not yet well known or widely used. (Leventhall, 2009). Is there a solution to the problem of what can be done to help the small number of people who are adversely affected by perception of a low frequency noise, which it has not been possible to control? This paper describes how Cognitive Behaviour Therapy can be a solution.

## 1. INTRODUCTION

Experience has shown that the following circumstances may arise in the investigation of low frequency noise problems:

- No specific noise can be measured (but there is always some low level noise present, particularly at lower frequencies)
- A noise can be measured, but is within A-weighted limits
- Measurements of the noise do not correlate with a subject's perception of its occurrence
- A noise can be measured and exceeds limits.

If a specific noise cannot be measured there may be an assumption of tinnitus (Van den Berg, 2009), but it is possible that our methods for measuring the noise do not reveal all its characteristics. For example, low frequency noises, especially those originating at a distance, may fluctuate in level. Measurements such as a 10-minute  $L_{Aeq}$  lose information on the fluctuations, which might be an important contribution to annoyance.

(Bradley, 1994; Persson-Waye et al., 1997; Persson Waye, 1996).

The standard deviation of the threshold is typically around 6dB (Watanabe and Møller, 1990), but it has been shown that it may vary in the low frequency region (Kurakata and Mizunami, 2008). Complainants do not necessarily have sensitive low frequency hearing, but lie within the normal range, above and below the median threshold (Moorhouse et al., 2004; Walford, 1983). It is known that the level of a noise is a relatively small contributor to its subjective effects. (Job, 1988). This is especially so for low level low frequency noises, where a level of up to about 10dB above threshold is considered to be a region which, on average, does not normally cause complaint (Inukai et al., 2000). On an individual basis, there is a spread of responses around the average. In particular, those people who have developed a sensitivity to low frequency, or other, noise do not show an onset region, but react negatively as soon as the noise becomes audible to them.

If a noise is measured, but is within limits, the complainant is expected to live with the problem. Several of the subjects in the project were in this category and found adaptation to be very difficult.

When a noise is measured, but its occurrence does not correlate with the complainant's perception of the noise, there may again be the assumption of tinnitus.

If a noise is measured as above limits, and correlates with the subject's perception, then noise control measures should be commenced, but these are not always successful.

## **2. RESPONSES TO NOISE**

The extreme responses which may result from long term exposure to an audible noise (including uncontrolled tinnitus) are the following (Møller and Lydolf, 2002; Nagai et al., 1989)

*distraction; dizziness; eye strain; fatigue; feeling vibration; headache; insomnia; muscle spasms; nausea; nose bleeds; palpitations; pressure in the ears or head; skin burning; stress; tension etc.*

Personal accounts from sufferers have been given by the Low Frequency Noise Sufferers Association (Anon, 1990).

Extreme responses indicate that individuals, far from learning to cope with and, habituate to, the perceived noise, become increasingly sensitive to the noise, with associated elevated anxiety. The common theme across studies assessing the subjective impact of low frequency and other noises has been the tendency for sufferers' annoyance to increase and the quality of life to degrade over time. A noise may operate at the margins of processes that underpin detection, orientation, location and coping, with noise sufferers reporting distress at noise levels close

to, or just above, their hearing threshold (Moorhouse et al., 2004). Low frequency noise may arguably occupy a unique place in noise annoyance as a number of prime psychoacoustic cues, important to adaptive habituation (coping) are attenuated (Benton, 1991).

Given the particular combination of personal and systematic assessment limitations and personal coping demands encountered by individuals, the development of personal strategies for coping may offer a targeted solution to the stress and distress caused by noise. We have responsibility for a group of people, genuinely suffering from perception of noises, for which the sources may not yet have been located. Tracing and controlling noise sources must always be the highest priority, but it is proper to consider some interim means of relieving the problems of complainants. Thus, the question which must be posed is: *What can be done to help the small number of people who are adversely affected by perception of a low frequency noise which it has not been possible to control?*

An earlier project had been carried out for Defra (NANR 125) (Leventhall et al., 2008) This project, which included nine people in group psychotherapy sessions, led by Donald Robertson, showed the promise of Cognitive Behaviour Therapy (CBT)<sup>1</sup> in helping complainants to improve their level of relaxation and to desensitise from noise. The follow-on project, also supported by Defra (NANR 237) was aimed at making the therapy available to a wider range of participants by redesigning it as an internet based course, using the Moodle e-learning package.

## **3. PLAN AND IMPLEMENTATION**

The work was in two phases, both supported by Defra. Phase 1 covered development of the framework for the

<sup>1</sup> A review of Cognitive Behaviour Therapy is given by the Royal College of Psychiatrists on <http://www.rcpsych.ac.uk/mentalhealthinfoforall/treatments/cbt.aspx>

on-line learning system, associated work book and CDs, and their use by subjects.

Phase 2 was a continuation project which included developments from the experience of Phase 1, leading to small changes in how the course was presented and assessed.

**Phase1.** There were a number of aspects to the planning which proceeded in parallel.

- Development of the course material i.e. CDs and material for online workbook
- Development of the on-line learning system
- Recruitment of subjects.

The CDs, recorded by Donald Robertson, were

- Cognitive Therapy for Noise Related Stress
- Desensitisation for Noise Related Stress

A third CD on Tension Release Muscle Relaxation was also provided to participants in Phase 2.

The contents of the online course, written by Donald Robertson, included

- Lesson 1: Introduction & Preparation
- Lesson 2: Building Motivation & Monitoring Progress
- Lesson 3: Desensitisation to Sounds
- Lesson 4: Healthy Thinking about Sounds
- Lesson 5: Learning to Sleep Better

**Lesson 1: Introduction and Preparation** A simple introduction attempted to motivate and reassure participants, while answering key questions. It was emphasised that the study was not meant to replace the continuing need to locate and remove an external source of disturbing sound.

**Lesson 2: Building Motivation and Monitoring Progress** Participant motivation is one of the most important mediating factors determining the outcome of treatment. This is especially true for self-help. There are, however,

some techniques within the field of cognitive and behaviour therapy which have been used to enhance motivation. This section therefore begins by attempting to reinforce motivation by using “task-motivational” instructions, cognitive techniques, and mental imagery.

**Lesson 3: Desensitisation to Sounds** This section focuses on behaviour therapy techniques employing relaxation, which are derived from the clinical and research literature on phobia and anxiety management. These methods can also facilitate sleep onset, which is a problem for many participants. Information on the desensitisation approach is given, along with some initial exercises and instructions on using the desensitisation CD and on monitoring progress.

**Lesson 4: Healthy Thinking about Sounds** This section focuses on cognitive therapy techniques, employing self-disputing and thought monitoring. This approach was expected to be more difficult for our participants to implement in a self-help format, but potentially to contribute more to longer-term improvement. There is some indication from the feedback that participants found this section hard work but some reported significant benefits. Information on using cognitive therapy for self-help is given, along with some taster exercises and instructions on using the cognitive therapy CD and monitoring progress. The technical term “cognitive” seemed unhelpful to one or two participants, which we anticipated, hence we use the expression “healthy thinking” instead of “cognitive therapy” in this section.

**Lesson 5: Learning to Sleep Better** This section was included because it was anticipated that sleep onset and quality would be common issues which might respond well to self-help, and the use of CDs. The feedback from participants lends some support to this assumption. This section also

builds upon relaxation (behavioural) and thinking (cognitive) techniques covered in previous sections, and constituted a natural progression for many participants, many of whom had already reported some improvement in sleep onset while using the desensitisation CD.

On-line participants also had access to discussion forums, which were developed within the Moodle e-learning package, where they received support from each other and from the project team. These forums helped to monitor progress. Some participants reported finding the messages from others to be slightly distracting or disturbing, while some found them helpful. Toward the end of Phase 1, settings were changed so that forum messages ceased being sent out automatically to all participants by e-mail, although they could still be accessed online via the website.

A problem was that some messages tended to focus on the possible source of the noise, perceived health risks, and other “external” problems in a way which maintained anxiety and was therefore counter-therapeutic.

The course was completed in 6 – 8 weeks, although some participants took longer.

#### **4. ASSESSMENT**

The aim of Phase 1 of the study was to assess the effectiveness of the experimental CBT programme as measured against key predictors of quality of life and personal coping, measures that were successfully developed in the previous group sessions. Effectiveness was assessed by questionnaires including Coping, Quality of Life and a Low Frequency Noise Reaction Questionnaire (LFNRQ).<sup>2</sup>

The Phase 1 LFNRQ consisted of 30 Questions which explored

- How the noise made sufferers feel (emotions)
- How it affected them physically (health)
- How it affected their daily activities and interactions with others (social)

Some of the questions in the LFNRQ paralleled those in the Coping and Quality of Life questionnaires.

In Phase 2 of the project, in order to respond to participant’s suggestions that they were asked to fill in too many forms, the main assessment was by a shortened and modified Noise Reaction Questionnaire, shown in Table 1. Each question had associated tick boxes, from which one was to be selected

Not at all ☐ A little of the time ☐ Some of the time ☐ A good deal of the time ☐ Most of the time ☐

Scoring was

Not at all = 0    A little of the time = 1  
Some of the time = 2  
A good deal of the time = 3    Most of the time = 4

Reference to Table 1 shows that all questions refer to negative aspects of the person’s life, so that a high score is for a stressed and unhappy person, whilst a low score is desirable. As a guide, a score above 60 was considered as highly stressed, 30 to 60 as medium stress level and below 30 as lightly stressed. Maximum adverse score is 100.

#### **5. DESIGN**

The study was a within group repeated measures design. Publicity for the project attracted an encouraging number of enquiries. Participant numbers were:

Phase 1

n = 46 subjects completed the initial Low Frequency Noise Reaction

<sup>2</sup> The LFNRQ questionnaire was developed from a Tinnitus Questionnaire originally designed and verified by Wilson, P. H., Henry, J., Bowen, M., and Haralamabous, G. (1991): Tinnitus reaction Questionnaire: Psychometric Properties of a Measure of Distress Associated with Tinnitus. *Jnl. Speech and Hearing Research* 34, 197 - 201.

*Table 1. Low Frequency Noise Reaction Questionnaire: Assessment questions  
Phase 2*

1	Because of the noise I miss the things I like to do most
2	I feel I'll never cope with the noise well enough to be happy
3	I feel like the noise is "driving me crazy"
4	I feel unable to control my emotions when I hear the noise
5	I have a hard time adjusting to the noise
6	I think people around me are uncomfortable because of my problem with the noise
7	The noise drives me to despair
8	The noise interferes with my ability to work
9	The noise interferes with my quality of sleep
10	The noise leads me to have problems forgetting things
11	The noise lowers my self-esteem
12	The noise makes it hard for me to concentrate
13	The noise makes it hard for me to fall asleep at night
14	The noise makes me feel a burden on my family and friends
15	The noise makes me feel agitated or restless
16	The noise makes me feel angry
17	The noise makes me feel anxious
18	The noise makes me feel depressed
19	The noise makes me feel helpless
20	The noise makes me feel inadequate
21	The noise makes me feel overly-dependent on others
22	The noise makes me feel tired and fatigued
23	The noise makes me feel tormented
24	The noise makes me feel useless
25	The noise prevents me from being able to relax

Questionnaire (LFNRQ)  
n = 40 subjects completed an Insights Evaluator questionnaire (Personality Assessment). This placed participants on an introvert – extrovert scale  
n= 27 subjects completed the final low frequency noise questionnaire  
n= 27 subjects completed both the initial and final coping questionnaires  
Consequently, 40 subjects commenced the Phase 1 course and 27 completed, giving a drop-out rate of about one third.

## Phase 2

In contrast to Phase 1, where all participants started together, Phase 2 participants were enrolled in four groups at approximately three month intervals. Groups 1, 2, 3 and 4 all followed the same course. In Phase 2,

participants were required to complete the LFNRQ three times: before the start of the course, mid way through the course and on completion of the course. Those who completed only one or two of the three questionnaires were considered to have dropped out.

n = 43 participants completed the first LFNRQ questionnaire.,

n = 40 participants completed the second LFNRQ questionnaire

n = 29 participants completed the third LFNRQ questionnaire.

Consequently, 43 subjects commenced and 29 completed, giving a drop out rate of about one third. However, 93% completed the first half of the course, which was the less demanding part.

Phases 1 and 2 combined had 83 participants who started and 56 who completed, a completion rate of about 67%. The gender distribution was 32 M

and 51 F, a percentage of male to female of 39% to 61%. The age distribution of participants peaked in the 45 to 65 year range.

Contact with participants was maintained by e-mail and telephone. Some of those who dropped out expressed appreciation for the CDs, which they had found helpful. The Moodle e-learning program, on which the on-line course was based, monitored participant use. It was known that some who did not complete the final LFNRQ questionnaire, continued with the course, as use was logged within the Moodle program through a user name and password.

Several potential participants, who believed that they knew the source of the disturbing noise, were not able to reconcile themselves to work towards acceptance of this external problem (the disturbing noise) , which they strongly

resented, and felt that it was not appropriate for them to be expected to learn to live with the noise.

6. RESULTS

The results of the Phase 1 and Phase 2 project are similar, so only the Phase 2 results are given here.

6.1. GROUP RESULTS

The average results, over all Phase 2 participants, are given in Fig 1, which shows the before and after scores on the 25 question Low Frequency Noise Reaction Questionnaire of Table 1. (The equivalent questionnaire in Phase 1 had 30 questions). The main problems are shown by the vertical dotted lines and relate to questions 5, 9, 13, 15, 17, 22, 25 which are as follows:  
5 I have a hard time adjusting to the noise

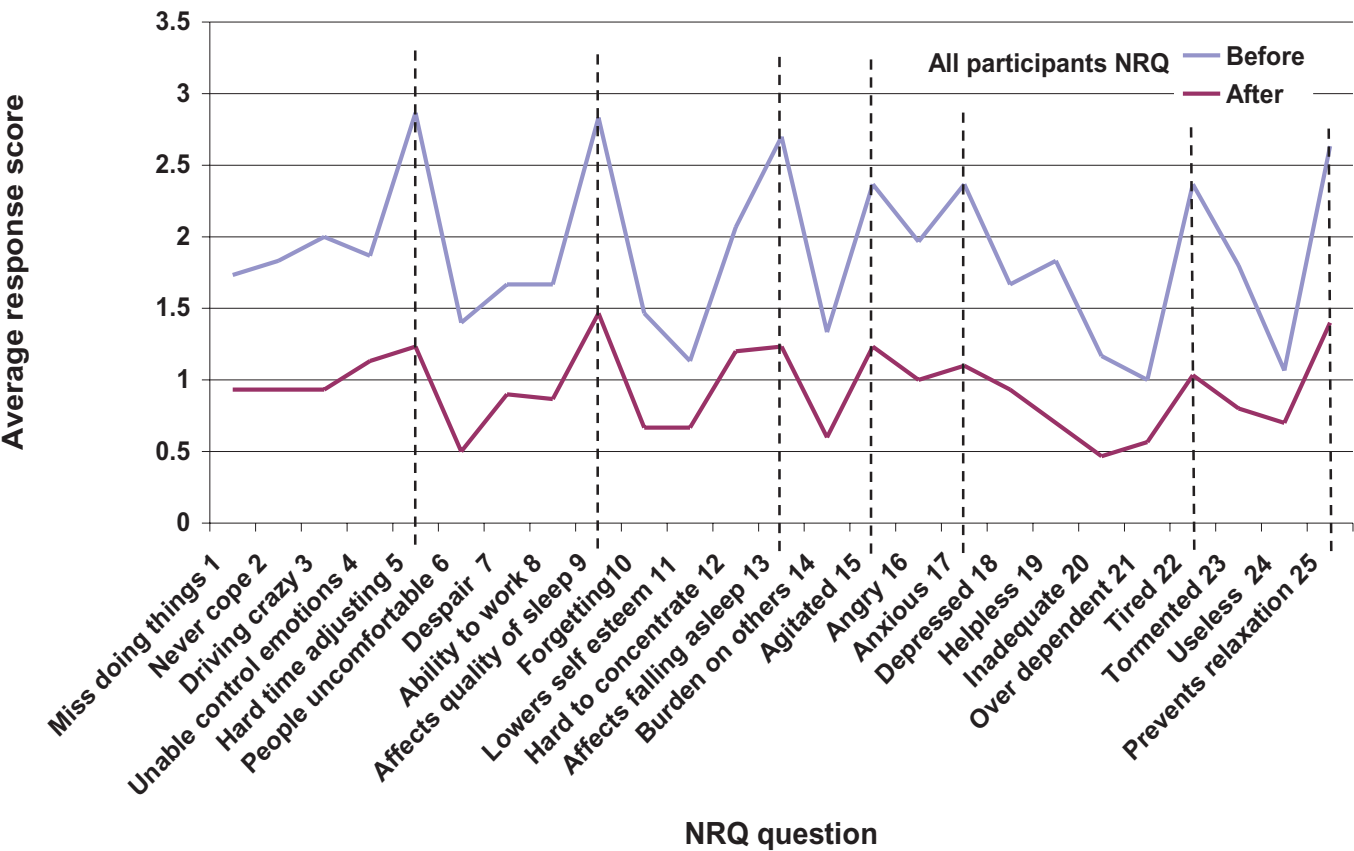


Figure 1. Average NRQ scores over all participants in Phase 2 Improvements in sleep problems are from an initial score of 2.5 to 3 – which is nearly most of the time, down to a final score of 1.5 or lower, which is between a little of the time and some of the time. There are also improvements of about a score of 1.0 in emotional and related feelings about the effects of the noise.



- 9 The noise interferes with my quality of sleep
- 13 The noise makes it hard for me to fall asleep at night
- 15 The noise makes me feel agitated or restless
- 17 The noise makes me feel anxious
- 22 The noise makes me feel tired and fatigued
- 25 The noise prevents me from being able to relax

The main problems are seen to be sleep/tiredness and anxiety/tension. The reduction in each of these was by 1 to 1.5 points on the response scale, as described in the caption to the figure

## 6.2 INDIVIDUAL RESULTS

The results for each of the 29 participants who completed Phase 2 are shown in Fig 2, which gives the LFNQR scores before, during and on completion of the course. The High, Moderate and Low stress levels are indicated, leading to the following changes before the course started and

after its completion. There is a clear shift to reduced participant stress levels

Stress	Before	After
High	9	3
Moderate	12	5
Low	8	21

## 7. NON-COMPLETERS.

Fourteen from the 43 people who started the Course and filled in the initial and mid-course NRQs did not complete the Course. Their data is shown in Fig 3. Fig 3 indicates that five of the 14 were highly stressed at the start of the Course. The general progress at the mid point was mostly slight, whilst four were worse.

The second bar in Fig 3 can be compared with the middle bar in Fig 2. Drop out number 10 is of interest as, despite dropping out, this person returned very positive comments on the help given by the course.

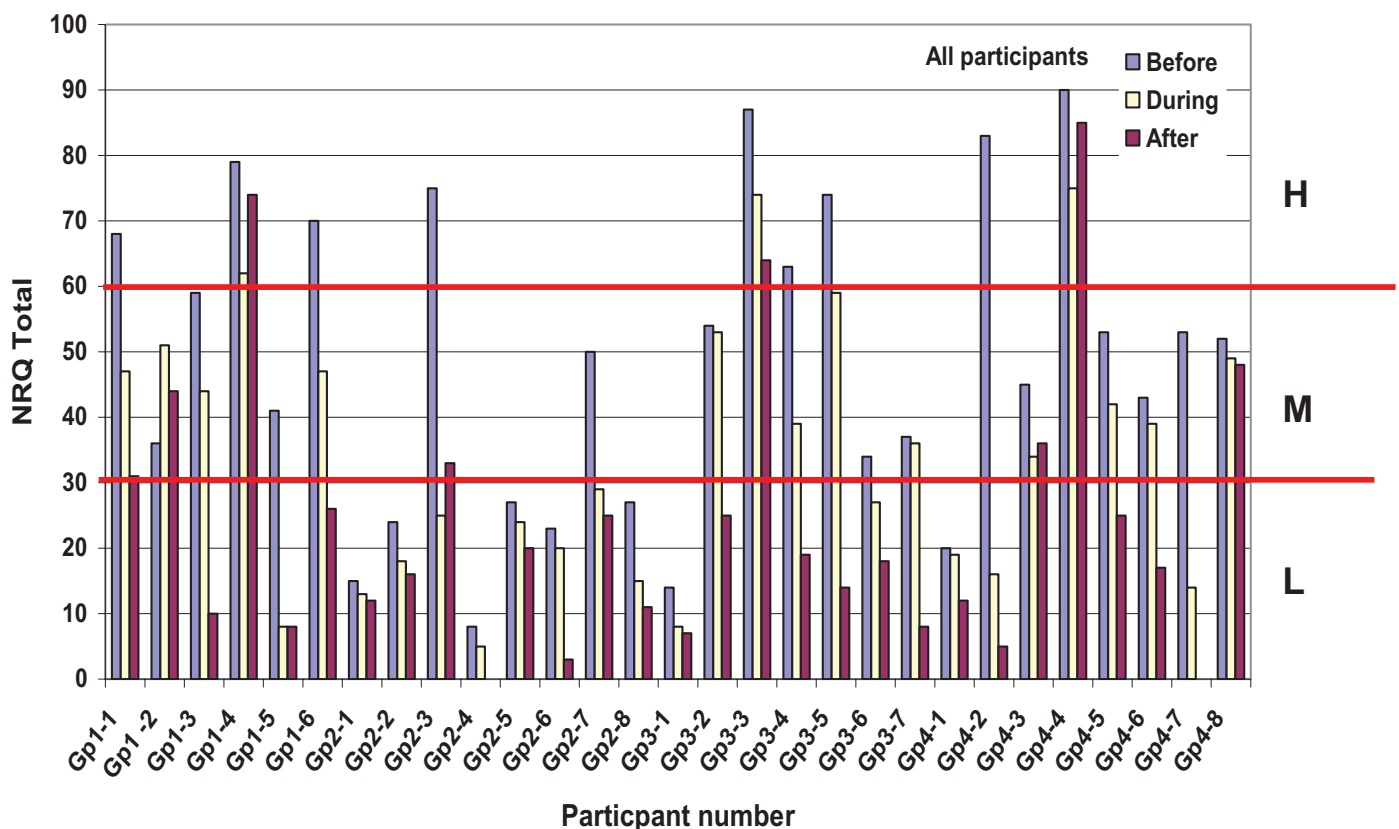


Figure 2. Total scores for the 29 participants in Phase 2 who completed the three LFNQR questionnaires, showing pre-start, mid-course and final results.

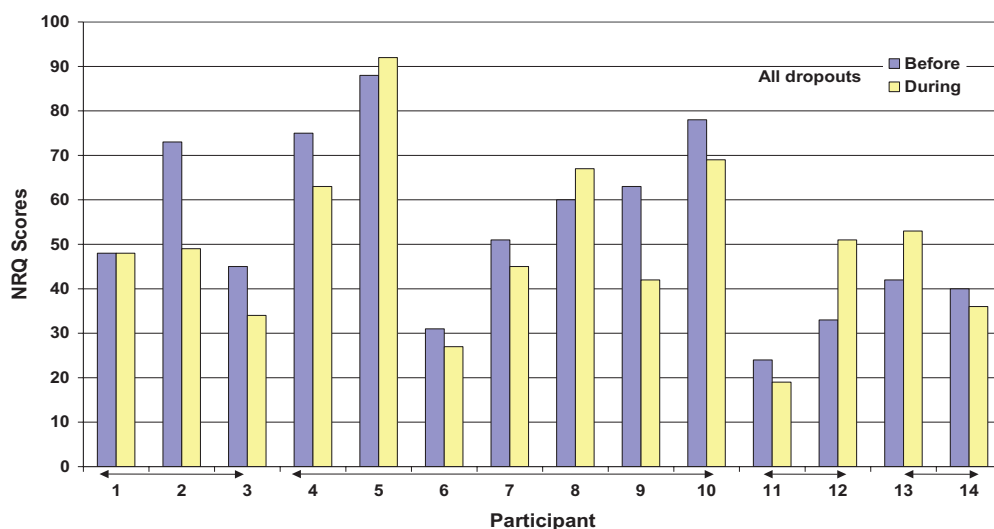


Figure 3. Before and mid-course scores of the 14 drop-outs. The arrows show Groups 1, 2 3 and 4.

## 8. WHAT PARTICIPANTS SAID ABOUT THE COURSE

Noise problems are problems for one or more individuals, whilst low frequency noise problems are often limited to a single person at a location. Consequently, in addition to the Group averages above, it is useful to know how individuals feel. Feedback from participants after the completion of the course included the following, selected to avoid repetition, from the large number received. Each comment is from a different participant.

*"I have been feeling much less stressed over the past week and the quality of my sleep has improved greatly. The Cognitive CD is very useful. I listen to it before going to sleep and several times have used it if I have woken up very early in the morning and managed go back to sleep successfully."*

*"Reached a breakthrough yesterday. I had been concentrating on masking noise with no success. Last night in bed concentrated on relaxing and trying to accept it. Still constantly awoken through night but felt calmer."*

*"Unbelievably stressful week and I*

*haven't attempted any areas - surprised at how well I've coped without, love knowing that the help is there and that I must find time to use it. Despite the stressful situation, I love the confidence I have that I have the tools to solve the problem, though annoyed I'm not managing to use them to their full capacity. But I no longer have the hopelessness and despair of the past."*

*"Overall I would say that I am feeling far less stressed than three months ago and I am sleeping much better."*

*"I have found a great improvement on my stress levels after the course. I had had a very stressful year .....can still hear the hum within my home and other places. However I find that I cope much better and that the noise problem has been put into the background.....Thank you for the course and the CDs as it has helped me stay sane! I also no longer require sleeping tablets as I go to bed relaxed."*

*"I'm pleased to say I am doing really well. I have managed to maintain my final low score, as I seldom get disturbed by the sounds that used to*



*practically drive me crazy. I have continued to make progress in relaxing by attending regular yoga classes. I still also use the CDs every few weeks; I find them truly valuable, in that, they help me to 'stop' when I feel I'm getting uptight, long before I get into that 'spiral' state I was in when I started the course. All my friends and relatives also see the tremendous difference. Being more relaxed and in control I can see life more clearly and not panic headlong into things. I am so grateful to you all for all your help. Life is good again".*

*"I am coping very well since the end of the course, so much so that I am rarely troubled now and when I am aware of it I am better able to cope with it. The low frequency noise that used to really bother me seems to have disappeared and I am left with a constant high pitch that is probably a symptom of tinnitus from loud music at clubs etc and from working in a loud factory.....I think the course was very helpful and the CDs are still used by both myself and my wife to help us get to sleep."*

*"The course has reinforced my resolve to cope as there seems no where I can go to get away from this at the moment. Thank you for the Course, I am looked at as if I have two heads when I mention LFN."*

*"Yes! The course was most helpful to me. I was really relaxed for ages after taking it, and I slept well. Unfortunately now I think I'll have to go onto the relaxation tapes again as the "buzz" has got so loud especially if I wake up in the night and hear it, it takes a good while to get back to sleep. I must thank you also for the very helpful CDs. Really appreciated them".*

*"As far as the actual noise the strength of it is still the same, mainly in the*

*night, however it has much less annoyance value than before the course last year and I pay much less attention to it. I have continued to use the relaxation exercises especially the final cognitive therapy one quite often at night time through my iPod. I find this helps me fall asleep, and as the added bonus of helping me with other problems in my life."*

*"Yes, I believe the course has had lasting benefit. Though I am aware of noise still, it is only actually problem to me (i.e. makes me feel angry or stressed) on rare occasions. This is better than before. Thank you for all your help."*

*"I am coping very well at this moment in time and have now stopped using the sleeping pills. I can now sleep with a window open and any outside sounds do not bother me. I have found that I am in control of the situation rather than the situation controlling me"*

*"Getting on very well, course was very beneficial. The noise still the same but coping very well with it. Thank you very much for everything and your continued interest."*

*"I have been meaning to write and give an update on my success. I have been thrilled with the results. About 80% improvement. I am starting to get more low frequency noise with the change of weather so time will tell. Thanks for making my life bearable".*

*"I am very happy to say that I still benefit from the effect of your noise coping course. I have learned to adapt in a relaxed way to the noise(s) I sense and hear. When the sound/vibrations last for more than 24 hours though, I lose my patience/ability to cope. I learned that a stroll in the woods or another quiet environment works very well to regain the strength to keep on coping."*

*Thanks again to you and your team for building the course. I hope many people may benefit from your good work."*

*"I am doing absolutely fine. I try to stop myself from tuning into the noise, distract myself, and if that fails I play the CD. No problems at all at the moment. Also I think the different mental attitude is the best thing. Very negative feelings about the person making the noise was making it worse for me. I keep asking myself - how does that help. Thank you again. .... It was totally ruining my life, but now I have got my life back."*

*"Just want to thank you and your study for assisting me tremendously on my sensitivity to noise. I have seen great strides in the last two months. I wish I could give your group a big hug! I plan on continuing to use the techniques especially the recordings. It is amazing how much stress has been taken away from me by listening to these."*

*"The Coping with Noise course was the biggest help in my life as I truly was at my wits end. The course made me realise I wasn't going out of my mind as there were other people experiencing the same problems..... Without your initial help I would not be where I am today. It helped me get through some very dark times and I cannot thank you and your team enough for what you did for me. Contact with people was invaluable as were the tapes but more importantly knowing I was not alone. As you say right at the beginning of the course, a lot of the "symptoms" will not disappear but if you can learn to cope with them and deal with them in the right way then life very much goes on. The more calm and relaxed I can be at all times, the better.....I now very much look forward to the future. I am indebted to you. Thank you."*

## 9. CONCLUSIONS

The project has shown that an on-line e-learning program of Cognitive Behaviour Therapy will help some sufferers from noise to improve their coping capacity. The Coping Course led to a clear reduction in stress levels for many of the participants as shown in Fig 2, leading to improved quality of life and better sleep (Fig 1).

## ACKNOWLEDGEMENT

The authors and participants wish to express their thanks to the UK Department for the Environment, Food and Rural Affairs (Defra) for supporting this project (NANR 237)

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#### IBERDROLA FACING LAWSUIT IN N.Y. OVER WIND NOISE

A group of 60 residents in three upstate New York towns have filed suit against Iberdrola, claiming the noise from the wind farm there is making them ill and forcing them to leave their homes. Iberdrola, the Spain-based company that is the second-largest wind-energy operator in America, had the support of many residents in rural Herkimer County, N.Y., when it brought its 37-tower, \$200 million Hardscrabble Wind Power Project online in 2011, according to reports. But in a 49-page complaint filed last month, the plaintiffs, who live within a mile or two of the wind farm in Fairfield, Middleville, and Norway, N.Y., are charging the Iberdrola companies with negligence, private nuisance, trespass and product liability violations for building the project without adequately considering the impact on residents. Plaintiffs said the 476-foot turbines are bigger and noisier than developers promised residents. As a result, they say, residents near the wind farm are dealing with loud noise each day. In the complaint, many said the noise is causing headaches and added stress. Some claimed the project has caused sediment in their drinking water. One plaintiff said the cows at her dairy farm have been less productive since the turbines began turning. Others claim they can't sleep with the noise.

#### **STATE CAN MAKE ALL THE NOISE IT WANTS**

Residents of Westfield NJ have complained to their local council about the noise from street resurfacing work, much of which is undertaken at night. Residents want the council to enforce its noise ordinance. But the council's response is that because the work is a State project, being carried out by NJ DOT, it has no standing in the matter, and cannot control or prevent the state of its agencies from making excessive noise.

#### **INDIAN FIRECRACKERS ALL BREAK REGULATIONS**

All commonly available sound emitting firecrackers exceed permissible decibel levels, show the tests conducted by India's Petroleum and Explosives Safety Organisation (PESO). The organization had tested samples from 846 sound emitting firecrackers from 144 manufacturers in Sivakasi, Tamil Nadu. Sivakasi is the hub of fireworks manufacturing activities, catering for 90% of demand of the entire country.