NOISE EXPOSURE OF CALL CENTRE OPERATORS

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1 INTRODUCTION

The call centre industry is one of Britain's fastest growing industries as increasing importance is being placed on customer services. Call centres now play a major role in the daily operations of financial, technology, and utility companies, as well as public bodies. The Trade Union Congress[1] concluded that although estimates of the number of call centres and numbers employed vary widely, even conservative figures suggest that there are over 400,000 full time equivalent jobs. This is more than exist in the textile and clothing industry, and more than the combined workforce of coal-mining, steel, and vehicle production. Almost all of these jobs have been created in the last ten years. Local authority enforcement officers, unions, voluntary organisations, employers, and employees have all expressed concern that there are hazards to health and safety unique to this new and developing industry. One of the hazards specifically linked with the call centre industry is the risk of hearing damage from using headsets. The lack of reliable and relevant information on the health effects of prolonged headset use prompted the Health and Safety Executive (HSE) to fund a project to assess the potential noise hazard associated with working in a call centre. The results of this study are reported here.

2 STUDY DETAILS

The Health and Safety Laboratory (HSL) visited fifteen call centres as part of the HSE study. At each call centre the following information was obtained to assess the operators' noise exposure:

- Background noise levels;
- Noise levels generated by the headsets;
- Information on typical working patterns.

2.1 Background Noise Levels

Four Cirrus 701 dosemeters were used in each call centre to measure background noise levels. The dosemeters monitored the noise levels for between 4 and 5 hours at several different positions throughout the call centre to give a representative sample of typical background levels.

2.2 Noise Exposure from Headsets

The main source of noise exposure for call centre operators is likely to be through their headsets. The noise levels from the headsets were measured using the Knowles Electronics Manikin for Acoustic Research (KEMAR) shown in Figure 1. The KEMAR manikin is a head and torso model with average adult dimensions. It has simulated pinnae, which have been designed to give a good acoustic approximation to the average human ear. The small pinnae were used for these measurements. The opening of the ear canal fits onto a Zwislocki ear canal-eardrum simulator with a Brüel & Kjær 4134 half-inch pressure response microphone at the eardrum position.

Figure 1 KEMAR manikin

The noise levels produced by the headsets were measured within the ear of the KEMAR manikin. However exposure limits defined in the Noise at Work Regulations 1989[2] apply to an equivalent level existing outside the ear rather than within the ear itself. An experimentally determined, frequency-dependent transfer function measured by Rice et al[3] was used to convert the level measured within the ear of the KEMAR manikin to the equivalent unobstructed A-weighted field level, referred to as the corrected noise level in this paper. Burkhard and Sachs[4] also measured a transfer function for the KEMAR manikin. Comparisons of these transfer functions by Walles[5] and Lloyd[6] showed that for speech, both gave comparable results.

At each call centre, measurements were made at the workstations of ten operators using a spare headset (and amplifier if appropriate) of the same type as used by the operator. The spare headset was connected into the operator's telephone turret and checks were made to ensure both headsets received exactly the same noise level. Any volume controls were set by the operator to give their normal comfortable listening level. Any changes made to the volume control by the operator during the measurement period were noted.

The spare headset was fitted onto the KEMAR manikin. The microphone at the eardrum position measured the noise levels generated by the headset during the operator's normal work. The output from this microphone was analysed directly into one-third octave bands using a real-time frequency analyser set to linear averaging. The third octave band levels were corrected using the Rice transfer function to give the corrected noise levels generated by the headset. Measurements at each workstation were made over a 15-minute period. Where possible, additional measurements were made to establish the range of listening levels provided by the volume control settings on the equipment used by the operators.

2.3 Other Information

The following information was collected at each call centre:

- Details about the general call centre environment (eg age of the call centre, number of workstations, whether operators hot-desk, main sources of noise, etc.);
- Details of the equipment used by the operators, preferred volume control settings, type of calls typically handled, typical signals received through headsets;
- Details of the operators' work patterns to estimate the duration of their noise exposure.

A questionnaire was used to collect this information to ensure consistency between the different call centre visits.

3 RESULTS AND DISCUSSION

3.1 Call Centres

Noise measurements were made in fifteen call centres across a wide range of industry sectors, including: call centre outsourcing, financial services, retail, leisure, telecommunication and IT and utilities. The call centres varied in size, employing between 70 and 1450 operators. They had been operating from their premises for between one month and sixteen years, although the older call centres had generally been refurbished within the last five years and therefore had a similar layout and design to the new centres. The call centres were generally large open-plan rooms with low reverberation; they had carpeted floors and low ceilings, some ceilings were covered with noise-absorbing acoustic tiles. They contained between 36 and 650 workstations. Occupation of these workstations during the measurement visits varied from 20% to 100% (mean occupation 70%). There was 1 - 3 m between adjacent workstations. Approximately half of the call centres used partitions to separate individual workstations.

3.2 Headsets and Associated Equipment

Two different types of headset were used at the call centres in this study:

- Supra-aural headsets - these have either one or two earpieces with a headband and foam pads that fit against the external ear(s). In this study, 85% of the headsets were supra-aural monaural devices (one earpiece) and 10% were supra-aural binaural (two earpieces).
- Insert headsets - these either have small earpieces that are positioned in the concha of the external ear or ear tips that fit into the entrance of the ear canal. Individuals should chose ear tips that fit their particular ear size. Only 5% of the headsets seen in this study were insert monaural devices.

In general, the headsets used incorporated acoustic shock protection, which limits the output of the headset's receiver to meet the requirements of the DTI specification 85/013[7]. In the UK, this limiter ensures that any noise above 118 dB is not transmitted through the headset. At all but one call centre, the headsets were issued to individual operators.

The headsets were connected either directly to a telephone turret, to a telephone turret via an amplifying unit, or directly into a computer-based telephone system. All of the systems enabled the operators to adjust the incoming calls transmitted through the headset to a comfortable listening level. The difference between the listening levels at the minimum and maximum volume control settings was between 4 and 22 dB, depending on the type of equipment in use. The operators were generally satisfied with the level at which they listened to calls through their headsets, although more than two thirds were listening with all the available volume controls set at maximum. These results suggest that many volume controls are set too low for listening to speech. The operators commented that it was sometimes difficult to hear callers when background noise levels were high or if callers were quietly spoken.

3.3 Training

Induction training was provided for new operators at all the call centres. This generally included training on use of the headsets and the available volume control features. None of the call centres provided regular training after the induction course. Consequently many of the operators did not change the level of incoming calls because either they had forgotten how to, or it did not occur to them to do this, even when there was a need for it. The operators were generally not given any advice on how to clean and maintain their headsets.

3.4 Background Noise

Background noise levels in the call centres were between 57 and 66 dB(A); mean 62 dB(A), standard deviation 2 dB. These levels were not included in estimates of the operators' personal daily noise exposure ($L_{EP,d}$) because they were more than 10 dB below the corrected noise levels generated by the headsets. The main source of background noise was general conversation with callers and colleagues.

3.5 Headset Noise

The main source of noise exposure for call centre operators was speech transmitted through their headsets. The corrected noise levels generated by the headsets fitted on the KEMAR manikin were between 65 and 88 dB(A); mean 77 dB(A), standard deviation 5 dB. Although the measured values were spread across a 23 dB range, 70% lay within the mean ± one standard deviation, ie between 72 and 82 dB(A).

In addition to speech, operators received a variety of other noises through their headsets which included: fax tones, carrier tones used to alert operators of an incoming call, holding tones, holding music. Limited measurements of the levels of noise generated by these different tones were made at some of the call centres. At maximum volume, the corrected noise level was 83 dB(A) for a fax tone, 95 dB(A) for a carrier tone, and 88 dB(A) for a holding tone. The duration of exposure to these events is likely to be very short and they are therefore unlikely to have a significant effect on the operator's overall noise exposure.

3.6 Operators' Daily Personal Noise Exposure

Estimates of the operators' $L_{EP,d}$ were calculated using the corrected noise levels generated by the headsets and the call handling time, ie the amount of time the operators spend listening to the noise from their headsets.

All the call centres in the HSE study collected detailed statistics relating to the type of calls (eg the duration of a typical call and the call rate per hour) and the operator's performance (eg how long the operator spends dealing with incoming calls). The call handling time across the different call centres was obtained from a range of different parameters including the following: talk time, wait time, working time, speak time, call duration and call rate per hour, total sign on time, productive time, and time-on-line. The call handling times ranged from 36% to 94%, ie operators spent between 36 and 94% of their time at work exposed to the noise generated by their headsets. The call handling times varied significantly between different call centres, even those in the same industry sector.

The mean and maximum corrected noise levels were used to calculate the $L_{EP,d}$ estimates shown in Table 1 for each industry sector. The $L_{EP,d}$ estimates using the mean corrected noise levels were between 67 and 84 dB(A); mean 74 dB(A), standard deviation 4 dB. The $L_{EP,d}$ estimates using the maximum corrected noise levels were between 67 and 87 dB(A); mean 79 dB(A), standard deviation 5 dB.

Table 1 Daily personal noise exposure estimates summarised for each industry sector

Industry Sector	Range of daily personal noise exposures dB(A)	
	Using mean corrected noise level generated by headset	Using maximum corrected noise level generated by headset
Business/other services	73 - 77	75 - 79
Outsourcing	67 - 69	67 - 70
Financial	73 - 84	78 - 87
Leisure	69 - 72	73 - 76
Public/voluntary sector	68 - 70	71 - 73
Retail	69 - 72	75 - 78
Telecommunications/IT	68 - 82	74 - 87
Utilities	68 - 70	73 - 75

Individual $L_{EP,d}$ estimates using the maximum corrected noise levels reached 87 dB(A). However the maximum $L_{EP,d}$ estimates exceeded the 85 dB(A) action level defined in the Noise at Work Regulations for only 3 out of 150 operators. In all three cases, the operators were listening to a caller with a particularly loud voice at maximum volume. Despite the high noise levels transmitted through the headsets, the operators made no attempt to reduce the volume of the incoming call. These results highlight the importance of regular training for call centre operators.

4 CONCLUSIONS

Noise measurements at fifteen call centres across a wide range of industry sectors showed that the mean daily personal noise exposure of call centre operators is unlikely to exceed the 85 dB(A) action level defined in the Noise at Work Regulations 1989. The risk of hearing damage is therefore considered minimal. Exposure to higher noise levels is possible, for example from fax tones, holding tones, and high-pitched tones from mobile telephones. However, the duration of these events is likely to be short and although they may shock or startle the operator, they should not cause hearing damage as assessed by conventional methods based on the noise exposure limits defined in current legislation.

5 FURTHER WORK

HSE remains interested in the health effects related to noise exposure in call centres in three specific areas: acoustic shock and the devices designed to limit exposure to these events; simple methods for measuring headset noise exposure; and implications for the industry of the new Physical Agents (Noise) Directive[8] which was adopted in February 2003.

5.1 Acoustic Shock

Acoustic shock (also referred to as acoustic interference or trauma) is defined as a sudden increase in high frequency noise heard at the ear. Although operators may be shocked or startled by these unexpected noises, exposure to acoustic shocks should not cause hearing damage as assessed by conventional methods. Rates of exposure to acoustic incidents vary from country to country and from call centre to call centre. These incidents are poorly documented. None of the operators who took part in the HSE study had been exposed to noise they considered as exceptionally loud; none had experienced noises through their headsets that had resulted in ringing in the ears, dulled hearing, or any periods of sick leave. The main complaints received from these operators were about calls made from mobile telephones, and calls made from noisy environments (eg factories, homes with crying children and barking dogs, busy main roads).

Milhinch[9] carried out a study in Australia to document the nature of acoustic shock as an injury. She examined the case records of 103 people working for a telecommunications organisation who had been exposed to acoustic shocks that had resulted in loss of time from work. Available evidence suggests that acoustic incidents are frequently a tone between 2.3 and 3.4 kHz, at levels varying from 82 to 120 dB (as measured at the eardrum position), with a rise time of 0 to 20 ms and varying durations. Operators reported a wide range of physiological and psychological symptoms immediately following an acoustic incident. These included: pain; tinnitus; headaches; facial numbness; a burning feeling in the ear or face; hearing loss but with no characteristic pattern; severe vertigo; anxiety and depression; and feelings of vulnerability and prolonged anxiety about loud sounds and/or a return to headset use.

Patuzzi et al[10] recognises that in general the levels of noise transmitted through the headsets used in call centres are incapable of damaging the ear directly. It is more likely that the trauma is caused by excessive middle-ear contractions, which are triggered by stress and anxiety. Additional stress can make the situation worse by lowering the threshold for these contractions. For this reason, Patuzzi thinks that headset limiters (and similar systems) will not solve the problem, and that stress management strategies will be essential for controlling the situation. Further research is needed.

HSE continues to gather information on acoustic shock through contacts with major interested parties in the UK and international experts, with a view to producing guidance. HSE's initial advice is that call centres should implement a traceable reporting system for headset users exposed to acoustic shock incidents. Operators should be trained to recognise these incidents and how to report them. The following information should be reported:

- The date and time of the incident;
- A description of the noise including the source and duration of exposure;
- Details of the headset and telephone equipment used;
- Details of any recordings made of the incident (a copy should be kept for future reference);

- Details of the symptoms experienced by the operator following exposure to the incident.

Several devices are available that have been designed to reduce exposure to acoustic shock incidents while minimising the possible distortion of speech. These devices provide frequency-dependent limiting of the noise transmitted to the headsets; they can differentiate between wanted sounds, such as speech and unwanted high-frequency sounds, so that each is processed differently. This helps to maintain the clarity and quality of speech, which is vital for call centre operators. Acoustic shock protection devices are currently being trialed in some UK call centres.

5.2 Simple Methods for Measuring Headset Noise Levels

Another area of interest to HSE is the methods used to measure the noise levels generated by headsets. When a person receives significant noise exposure from sources close to the ear, such as from headsets, the current measurement methods use either miniature microphones positioned in the ear or a head and torso simulator (HATS). Both methods require specialist equipment and expertise. HSE has commissioned development of an in-line monitor, which will measure the operator’s noise exposure from the headset and the background noise in the call centre. The work has been extended so that the device can also be used to capture acoustic shock events.

5.3 Physical Agents (Noise) Directive

In 1993, the European Commission put forward a proposal for a Physical Agents Directive that introduced provisions for protecting against workplace noise exposure. The new Physical Agents (Noise) Directive was adopted in February 2003. The UK, as all other Member States, will have three years to bring in new regulations to enable implementation of the Directive. When new regulations are introduced in 2006 they will replace the existing Noise at Work Regulations.

The exposure limit values and exposure action values defined in the new Directive are:

- Exposure limit values: 87 dB(A) and 200 Pa (140 dB(C))
- Upper exposure action values: 85 dB(A) and 140 Pa (137 dB(C))
- Lower exposure action values: 80 dB(A) and 112 Pa (135 dB(C))

Once these limit/exposure values are reached or exceeded, certain actions are required. The HSE study showed that it was possible for the daily personal noise exposure of call centre operators to exceed 80 dB(A). The reduction of the lower exposure action value to 80 dB(A) could therefore have a significant impact on the call centre industry. It will be necessary for employers to assess, and if necessary, measure the levels of noise to which workers are exposed in order to decide whether the exposure action or limit values have been reached or exceeded. The new Directive also addresses the provision of health surveillance. A worker whose noise exposure exceeds the upper exposure action values will have the right to a hearing check by a suitably qualified person. Preventative audiometric testing will also be available for workers whose exposure exceeds the lower exposure action values, where the risk assessment indicates a risk to health. Call centre managers will need to be aware of the implications to their industry of future changes in noise legislation.

6 REFERENCES

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