

# VOICE PROBLEMS AND ACOUSTICS IN SCHOOLS- AN ONLINE SURVEY FOR TEACHERS

N Durup	London South Bank University and Sharps Redmore Acoustic Consultants
B Shield	London South Bank University
S Dance	London South Bank University
R Sullivan	Sharps Redmore Acoustic Consultants

## 1 INTRODUCTION

Previous studies<sup>1</sup> have indicated that teachers experience voice problems at a significantly higher rate than the general population (making up 1.5% of the working population but 12% of those attending voice clinics), and that a majority of teachers will suffer from voice problems at some point in their career.

London South Bank University is undertaking an online questionnaire for teachers with the aim of gathering more detailed information on their experiences of acoustics in schools, of voice and other health related issues, and how the two areas may interact.

In addition field measurements of teachers' voice levels are being undertaken as part of the study to look at possible variations in speech levels for teachers working in different acoustic conditions, particularly in relation to different internal ambient noise levels and reverberation times.

This paper gives details of the online questionnaire and field work along with initial findings from the research.

## 2 METHODOLOGY

### 2.1 Online Questionnaire

The online questionnaire for UK teachers is currently being carried out to investigate their experience of voice strain and other voice-related problems, as well as perceptions of general noise and room acoustics in schools. The online questionnaire has been active since January 2014 and has been publicized via The National Union of Teachers (the largest teaching union in the UK) and Voice – The Union for Educational Professionals.

The questionnaire comprises 57 questions covering perceptions of classroom acoustics, suitability of noise levels and past experiences with voice and hearing problems. The questionnaire has been designed to gather more in-depth data on acoustics-related factors than previous general surveys relating to voice problems. The survey also includes a section on general health and wellbeing. It is anonymous and takes around 15 minutes to complete.

The anonymous nature of the questionnaire and the means of distributing the survey link means that the origins of the respondents are not known. Therefore it is reasonable to consider that there is a degree of bias in the self-selection process, in that those who are more interested in the topic of voice problems or classroom acoustics, perhaps as a result of personal experience of the issue, may be more likely to respond to the questionnaire. Despite this it is felt that the questionnaire can provide useful additional information on the topic where little has been known previously.

### 2.2 Voice and Acoustics - Field Measurements

In addition to the online questionnaire the study is also measuring voice parameters for teachers working in a range of classroom types, representative of the general current UK classroom stock.

A method for field measurements has been developed. This methodology is described in detail in reference 2<sup>2</sup>. In summary a number of sets of data are captured for each teacher studied including:

- 1) Acoustic measurements of the empty classroom or classrooms in which the teacher works. These include measurements of unoccupied internal ambient noise levels and mid-frequency reverberation times,  $T_{mf}$ , that is the average of the reverberation times at 500, 1000 and 2000 Hz (to be consistent with the current UK standard, Building Bulletin 93 (BB93)<sup>3</sup>).
- 2) Measurements during lessons of general noise levels in the classroom including those due to the teacher's voice and all other noise sources.
- 3) Measurements of the teacher's voice level only whilst teaching during lessons using an ambulatory phonation monitor (APM). This is a device which measures vibrations from speech using a small accelerometer fixed to the skin over the speaker's sternal notch.

The APM is calibrated prior to the measurements by using a microphone mounted at a fixed distance from the mouth. The participant provides sample speech utterances whilst the accelerometer is in place and a transfer function is then calculated allowing a speech level to be extrapolated for the measurement period.

Following calibration the participant wears the accelerometer for their working day attached to a small unit on their waist. The APM monitors a number of speech parameters including equivalent A-weighted sound pressure level (LpA) and the fundamental frequency of the voice (f0). In addition the APM measures the total speaking time during the measurement excluding pauses.

The participants measured in this study taught in a broad range of acoustic conditions, the  $T_{mf}$  values varied from 0.3 seconds to 1 second in the classrooms and the unoccupied internal noise levels from 23 to 38 dB  $L_{Aeq}$ . Occupied noise levels ranged from 54-76 dB  $L_{Aeq}$ , 30 minutes.

The classrooms ranged from those constructed in the late 19th century with high ceilings, large volumes, single glazing and no acoustic treatment, to classrooms refurbished to current BB93 standards in recent years.

The data collection phase is ongoing for the field measurements, and will include new classrooms built to comply with BB93, but preliminary data are briefly discussed in section 3.7.

## 3 INITIAL RESULTS

### 3.1 Online Questionnaire Initial Results

The online questionnaire is scheduled to remain open for responses until the end of 2014. To date it has been completed by 127 respondents who comprised current (82%), former (7%) and retired (11%) teachers.

The respondents were 75% female which closely reflects the current gender balance of the profession as a whole of 74% female<sup>4</sup>. This is important as previous studies<sup>5</sup> have indicated that female teachers appear to be twice as likely to experience voice problems as their male counterparts.

The respondents taught mainly in secondary (49%) or primary schools (22%), predominantly in the state sector (95%) and either in Local Authority (62%) or Academy schools (28%), with only one respondent teaching in a Free School.

Class sizes were typically in the 21-30 pupil bracket (70%).

As noted earlier the respondents were self-selecting and therefore may not be representative of the teaching population as a whole.

The full data analysis will be undertaken once the questionnaire is closed, however some initial findings are discussed below:

### **3.2 Voice Strain**

79% of respondents considered voice problems to be a significant issue for teachers, with 69% having experienced voice problems during their teaching career.

A significant proportion sought help from a General Practitioner (35%), with smaller numbers seeking help from an Ear Noise and Throat Specialist (11%) or Speech Therapist (11%).

From an occupational health point of view 54% of respondents had remained at work while experiencing voice problems, and 65% of respondents said that their voice feels tired at the end of their working day.

In terms of strategies to cope with noise, when teachers found it difficult to be heard these included talking louder (43%) and trying to talk more clearly (45%) both of which would indicate changing from a normal speech style which could add additional risks of voice problems.

65% reported having to raise their voice frequently, 17% having to shout frequently and 50% having to talk over loud noise such as others talking or equipment noise.

These initial results would appear to support the thesis that voice problems are a significant risk for teachers.

### **3.3 Voice Training**

It is notable that in the UK there is no requirement for courses to include any voice training whatsoever. Given the central role of the voice in teaching this is perhaps surprising.

Of the respondents 57% had never received voice training in any form. 21% of the respondents had received only a one-off session during teacher training, and 13% had only had training which they had arranged themselves.

94% of respondents stated that training should be included in all teacher training courses.

### **3.4 Reverberation Times in Classrooms**

In relation to teachers' perceptions of room acoustics in classrooms; 61% stated that there were particular rooms in their school where it was difficult to make their voice heard by pupils; 39% considered that this was due to the room being too reverberant, with only 13% considering the problems were due to the room absorbing too much sound from their voice (i.e. too low a reverberation time or poor speech transmission in the room).

19% of respondents teach in open plan spaces, but only around 11% of those that teach in open plan spaces do so for more than 25 hours per week.

From a room finishes perspective, it was interesting to note that 70% of the respondents' main teaching rooms were carpeted and 65% had ceiling tiles (presumed to be acoustic tiles). This would indicate that some sound absorption is present in over 65% of classrooms covered by the questionnaire. This would still leave a sizeable proportion of classrooms which may not meet current reverberation time standards, and therefore may result in unfavorable speaking and listening conditions.

### 3.5 Internal Noise Levels and Sound Insulation

When asked about internal noise levels affecting their voice in the classroom, the primary difficulty reported by the teachers was caused by internally generated noise from students in the same classroom (32%), students in the corridors (18%) and in other classrooms (16%) or classroom equipment such as projectors etc. (20%).

Externally generated noise (excluding school noise such as playgrounds) was not subjectively considered to be a factor by the majority, with 34% finding it acceptable and 56% not noticing these sources. This indicates that the sound insulation of internal walls, floor and corridor doors may benefit from enhancement over existing performances.

### 3.6 Hearing Loss and Tinnitus

22% of respondents reportedly had hearing loss with 2% wearing hearing aids.

36% of those with hearing loss reported that they felt it was made worse by their teaching.

Some respondents reported that they suffered from tinnitus occasionally (29%), frequently (9%), or constantly (5%).

Of those with tinnitus symptoms 22% felt that their tinnitus was made worse by their teaching either infrequently (11%) or frequently (11%).

Of those experiencing tinnitus this was higher in those individuals teaching in open plan spaces. Of those teaching in open plan spaces 13% reported suffering from tinnitus frequently, compared with a prevalence of 8% in those teaching in traditional classrooms. Constant tinnitus was experienced by 17% of those teaching in open plan spaces compared with 2% of those teaching in traditional classrooms.

There was no apparent relationship between hearing loss and type of classroom.

### 3.7 Voice and Acoustics Field Measurements - Initial Results

At the time of writing measurements have been undertaken of 14 participants, 10 female and 4 male. Four teachers were in secondary schools and 10 in primary schools.

Although there is only a small sample of voice level measurements to date, the voice level data has been compared with the unoccupied ambient noise levels and mid-frequency reverberation times for the rooms. There was significant correlation between voice levels and unoccupied ambient noise levels (Spearman's  $r = 0.62$ ,  $p < 0.01$ ) but no correlation between voice level and reverberation time<sup>6</sup>.

It has previously been found that lesson noise is related to unoccupied noise level<sup>7</sup>, with higher unoccupied noise levels resulting in higher classroom noise levels. Hence it may be assumed that higher unoccupied levels will lead to teachers needing to increase their vocal effort to be heard in higher classroom noise levels.

The study is ongoing with additional participants being measured to gather more data. This will then be subject to further analysis.

## 4 CONCLUSIONS

The online questionnaire for teachers indicated that the respondents considered voice problems to be a significant issue for teachers, with 69% having experienced voice problems themselves.

There was felt to be a need for compulsory voice training to be integrated into teacher training in the UK. 94% of respondents stated that training should be included in all teacher training courses.

In terms of room acoustics, internally generated noise and excessive reverberation times were highlighted as affecting the ability of teachers to make themselves heard.

Initial analysis of the field measurements of voice levels indicated a significant correlation between voice levels and internal ambient noise levels in the classrooms, but no correlation between voice levels and classroom reverberation times.

The study is ongoing throughout 2014 and further data will be gathered during that time, allowing fuller analysis.

## **5 REFERENCES**

1. Comins, D. Survey of UK voice clinics 2001/2. Voice Care Network UK; 2002.
2. Durup N, Shield B, Dance S, Sullivan R. Vocal strain in UK teachers: An investigation into the acoustic causes and cures. Presented at International Congress on Acoustics, Montreal, 2013. ASA Proceedings of Meetings on Acoustics 19, 040141; 2013.
3. Department for Education and Skills. Building Bulletin 93 Acoustic Design of Schools – A Design Guide. London: The Stationary Office; 2004.
4. Department for Education. School Workforce in England November 2013 (Online). Available at:  
[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/335413/sfr11\\_2014\\_updated\\_july.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/335413/sfr11_2014_updated_july.pdf). (Accessed 1.8.14).
5. Russel A, Oates J, Greenwood KM. Prevalence of voice problems in teachers. *Journal of Voice* 1998; 12:4: 467-79.
6. Durup N, Shield B, Dance S, Sullivan R. Vocal problems for teachers and school acoustics-a field study. *Proc Internoise 2014*, Melbourne; 2014.
7. Shield B, Conetta R, Cox T, Mydlarz C, Dockrell J and Connolly D. Acoustics and noise in English secondary schools. *Proc Internoise 2013*, Innsbruck; 2013.