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An exploratory baseline study of boy chorister vocal behaviour and development in an intensive professional context

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Abstract

Currently, there is no existing published empirical longitudinal data on the singing behaviours and development of choristers who perform in UK cathedrals and major chapels. Longitudinal group data is needed to provide a baseline against which individual chorister development can be mapped. The choristers perform to a professional standard on a daily basis, usually with linked rehearsals, whilst also following a full school curriculum. The impact of this intensive schedule in relation to current vocal behaviour, health and future development requires investigation. Furthermore, it is also necessary to understand the relationship between the requirements of chorister singing behaviour and adolescent voice change.

The paper will report the initial findings of a new longitudinal chorister study, based in one of London's cathedrals. Singing and vocal behaviours are being profiled on a six-monthly basis using data from a specially designed acoustic and behavioural instrument.

The information obtained will enable us to understand better the effects of such training and performance on underlying vocal behaviour and vocal health. The findings will also have implications for singing teachers and choral directors in relation to particular methods of vocal education and rehearsal.

Introduction

The education of cathedral and major chapel choristers has altered significantly in the last 20 years. They have always had the challenge of giving performances of a professional standard on a daily basis, but there is now an increased workload and the possibilities of increased performance-related stress related to the following factors:

- The average age of the onset of adolescent male voice mutation has been steadily becoming younger; it was observed to be at the age of 14 in the 1940's and is now nearer to 12 years (Gackle, 2000). This can have a significant impact on the top two years of choristers; the senior boys within the choir have responsibilities that are both musical and disciplinary; these are now undertaken by younger boys.
- Choristers are now expected to keep abreast of their non-chorister peers in their academic educational achievements.
- There are now more 'high profile' events, such as live television broadcasts.

The choristers selected for this study are based in one of the busiest choirs in the world. The boys rehearse for up to 14 hours and perform for up to 8 hours in a week. Mainland European and North American boys' choirs tend to have a greater proportion of rehearsal time to performance, although the total number of hours of singing per week is comparable (Williams, 2003).

In order to investigate ways in which the vocal behaviour of these boys may differ from non-professional young singers, it is necessary to generate some sort of model of 'normality'. There are no established benchmarks for 'normal' voice in children's speaking or singing; hence, definitions of 'abnormal' are also contested and there is no agreed protocol, either in Europe or elsewhere, for voice quality analysis.

There is some information on the vocal health and behaviour of 'normal' boys who are not engaged in intensive singing activities. The statistics emerging show that, of boys between the age of 8 and 12, 40% may have dysfunctional voices (perceived as, for example, hoarse/breathy) and between 10 and 15% may have vocal nodules (Bolfan-Stosic, Yliherva, & Welch, 2003; McAllister, Sundberg, & Hibi, 1998; Sederholm, 1995) There are several likely causes of this:

- Faulty habits and vocal abuse. Voice use in the playground or during sporting activities can be a potential cause of vocal strain. Boarding schools have a relatively high level of background noise throughout waking hours (Williams, 2001).
- Environmental context. This includes factors such as pollution levels as well as the acoustic environment (for example, large resonant rooms) (Williams, 2001).
- Allergies and respiratory tract infections (Harris, 1998).
- Psychological profile. It has been demonstrated that there are strong correlations between voice disorders and personality traits (Roy, Bless, & Heisey, 2000). For example, adults with functional vocal dysphonia are more likely to be nervous, sensitive and prone to worry. Individuals with vocal nodules are more likely to be social leaders or have aggressive tendencies.

Any of these influencing factors may become exaggerated if the individual temporarily becomes emotionally unstable: for example, becoming a victim of bullying, or experiencing problems in family relationships.

Methods

Microphone and electrolaryngograph recordings of each chorister have been made at 6-monthly intervals from Autumn, 2003 (Fourcin, 2003; Fourcin & Abberton, 1971; Howard & Welch, 2003). The microphone is attached to a boom fastened to the head of the chorister; the distance between the microphone and lips is constant. Sound pressure level (SPL) has been measured for each recording in order to enable calibration of amplitude. Four sets of data had been collected at the time of this paper going to print.

The tests consist of the following range of voice activities (Table 1):

	Activity	Purpose
1	Counting backwards from 20 to 1 normal, loud, very loud and quiet	This demonstrates comfortable, customary fundamental frequency (Fo) at varying degrees of loudness, and the effect of 'projecting' the speaking voice on voice quality
2	Reading aloud the first paragraph of the standard passage "Arthur the Rat" (see Appendix)	This text has a carefully distributed selection of phonemes, enabling a thorough perceptual evaluation of voice quality
3	Singing a sustained single pitch; beginning quietly, increasing and then decreasing the loudness. On both D4 and D5	This demonstrates technical vocal control, maintaining stable pitch with variable intensity
4	Singing a pitch glide starting on G4; to slide up as far as possible, down as far as possible and to return to the starting note	This demonstrates total pitch range and alterations in voice quality with pitch changes
5	Singing a two-octave major scale, from G3, up and down	This demonstrates changes in voice quality over controlled pitch changes and register transitions
6	Singing one verse of the hymn "Jesu, the very thought of thee" unaccompanied (see Appendix)	This melody has a relatively small pitch range and a mainly stepwise melodic contour

Table 1: Acoustic recording protocol for choristers 2003 - 5

The recording data has been linked with background information from questionnaires:

- Health (past and current);
- Personality type (Eysenk junior test) (Brandell, 1982);
- Individual vocal progress from both the director of music and the singing teacher;
- Chorister self-rating of singing ability and that of other choristers.

Two comparison groups have been selected for audio recording to provide comparative data on young voices and professional singing workload impact: non-specialist boys from a boys' boarding preparatory school and professional adult sopranos.

A voice profile assessment method has been devised (Voice Profile Assessment in Singing Protocol, VPASP, see Appendix), based primarily on the Voice Profile Analysis Protocol (Laver, Wirz, Mackenzie, & Hiller, 1981) and incorporating GRBAS (Grade [overall level of dysphonia], Roughness, Breathiness, Asthenia, Strain) (Carding, Carlson, Epstein, Mathieson, & Shewell, 2000; Hirano, 1989) This has been applied perceptually to each audio recording of the boys. A sample of these (10%) is being assessed by a panel of three further voice clinicians/singing teachers to ensure reliability of the resulting scores.

A number of recordings have been selected for acoustic analysis (Howard & Angus, 1996, second edition 2001). This investigates the electrolaryngograph signal, frequency spectrum and long term average spectrum (Barlow & Howard, 2002). It has been used to ascertain if there are links between perceptual ratings and any evidence of irregularity in the vocal fold action from the acoustic measures.

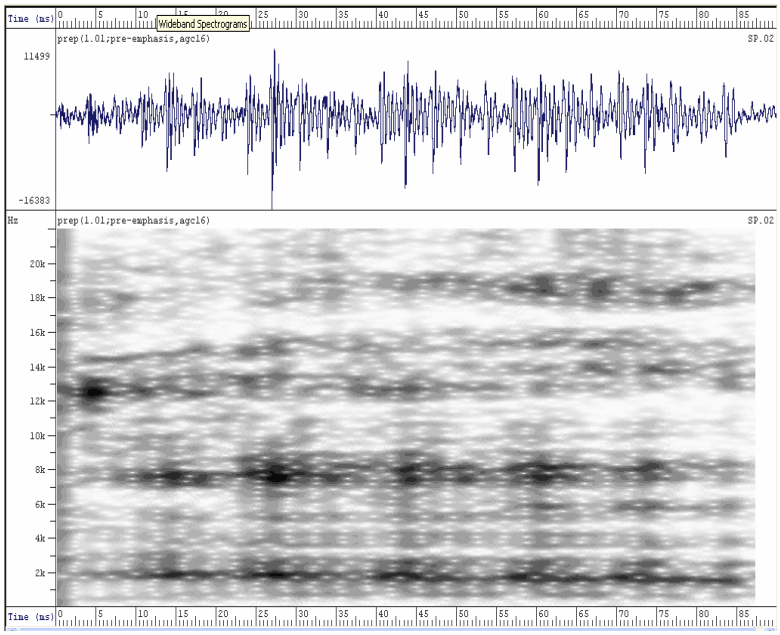

Figure 1: a wideband frequency spectrum from a recording of a chorister's speaking voice with a moderate degree of roughness and breathiness

The irregularity of the vocal fold collision can be seen as a periodic strong signal, followed by four or five weaker ones (illustrated in fig.1 as vertical stripes in the lower of the two displays).

The same chorister was assessed using the same protocol six months later. This sample (fig.2) is from the same portion of the vowel from the text in test 2 (table 1).

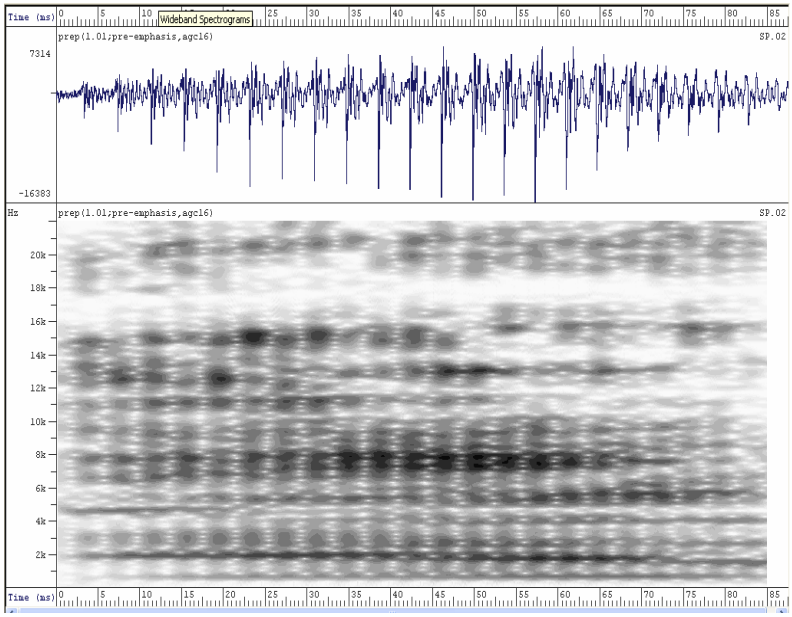

Figure 2: a wideband frequency spectrum from a recording of a chorister's speaking voice with no observable irregularity in the vocal fold action

The vocal fold collisions can be seen as much more regular, as indicated by an even distribution of darkness in the vertical stripes (fig.2).

Results

Initial perceptual observations from the VPASP indicate that 17% of the recordings present no evidence of vocal abnormality, such as fatigue, whereas 65% have slight perceptual disturbances, 17% moderate perceptual disturbances and 1% have perceived severe dysphonia (fig. 3).

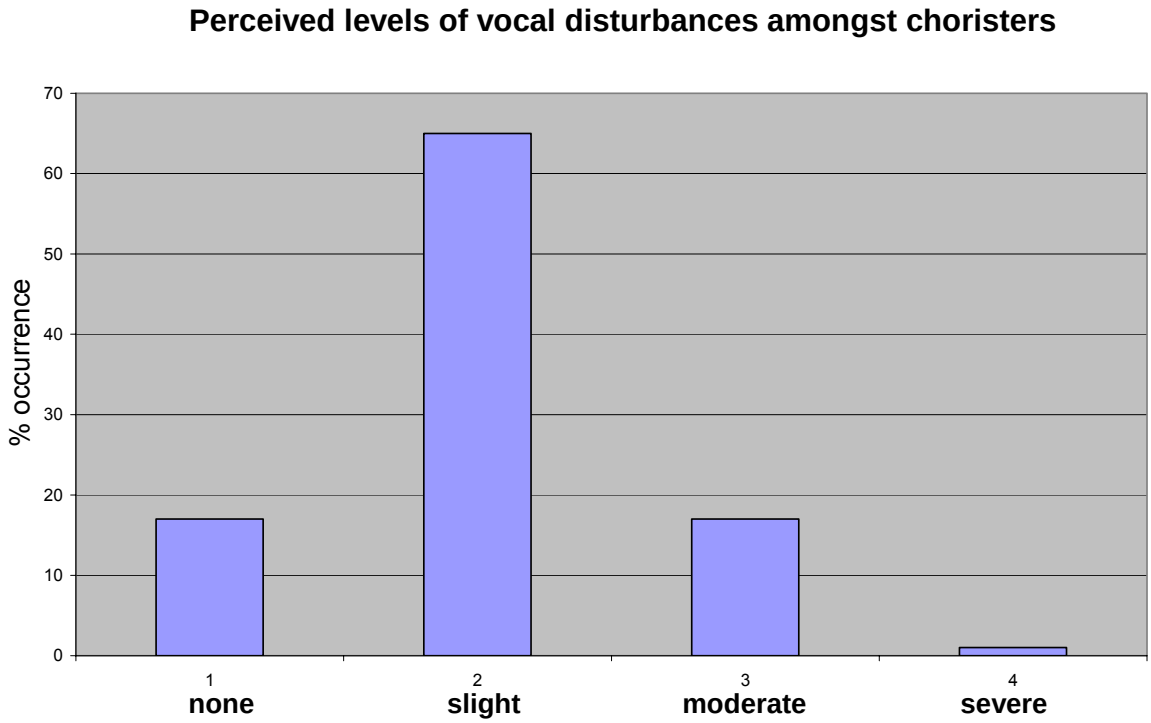

Figure 3: A chart to show the distribution of levels of perceptual vocal disturbances among choristers

Perceptual evaluation from the VPASP also provides evidence of vocal behaviour, change and possible development over time, demonstrating the level of musical and technical control in the voices. For example:

- An ability to maintain a stable pitch in exercise 3 (Table 1) is never present in a new chorister and is, in all cases, acquired in the first year of training.
- An ability to sing with an even vocal tone through the upper passaggio (vocal register transition, usually in the region of B4 to D5 in a child of this age (Wurgler, 1990) is generally good, despite any evidence of vocal fatigue. The level of control evidenced tends to be greater in the two octave scale rather than in the pitch glide.

- The pitch range of the choristers in the glide activity is usually about two and a half octaves, from G3 to C6.
- Control of breathing sufficient to enable musical phrases to be sung is established by the end of the first year of training and improves further over time.

Discussion

The chorister recordings made have mostly been made in the early evening, after a day of vocal activity. This may result in a greater level of temporary vocal fatigue. In order to ascertain whether time of day is a factor, a small sample of boys will be recorded at intervals through the day to assess levels of vocal fatigue and recovery time. The latest set of recordings were made on the first day of the school summer term, after a three week holiday and have yet to be analysed. These may give an idea of the effect of vocal loading in the school and choir environment.

The position of Cathedral Organist and Choirmaster for the choristers was subject to a new appointment one-third of the way through this longitudinal study. This should reduce the possibility for the data to be significantly influenced in the long-term by the training methods of one individual.

It will be possible to build up an individual profile of each chorister, combining the data from all parts of the protocol. Statistical evaluation may provide evidence of any links between perceptual evaluations of voice quality and the information on health and personality type.

It was observed by chance, during the first set of recordings, that the electrolaryngographic signal was much more stable when the chorister was singing with another individual. During their daily singing activities, the choristers habitually sing in a group. A recording protocol that enabled the choristers' vocal activity to be observed while in a group was considered to have a greater environmental consistency with their habitual vocal use. It was decided to put the choristers into groups of four for the second set of recordings. These were multichannel recordings of the activities (see Table 1) performed in a group of four and also individually[1]. The data giving comparisons between these two situations has yet to be analysed.

Conclusion

This research project is mid-way through the anticipated duration. Results so far have shown that choristers probably have higher levels of temporary and low-level vocal fatigue and lower levels of severe dysphonia than the ‘normal’

[1] Recording engineer Evangelos Himonides, Institute of Education, University of London

non-professional singing boy. These may be compatible with those of professional adult sopranos.

Further analysis of the data may ascertain how the training affects the particular nature of observed dysphonia and recovery time.

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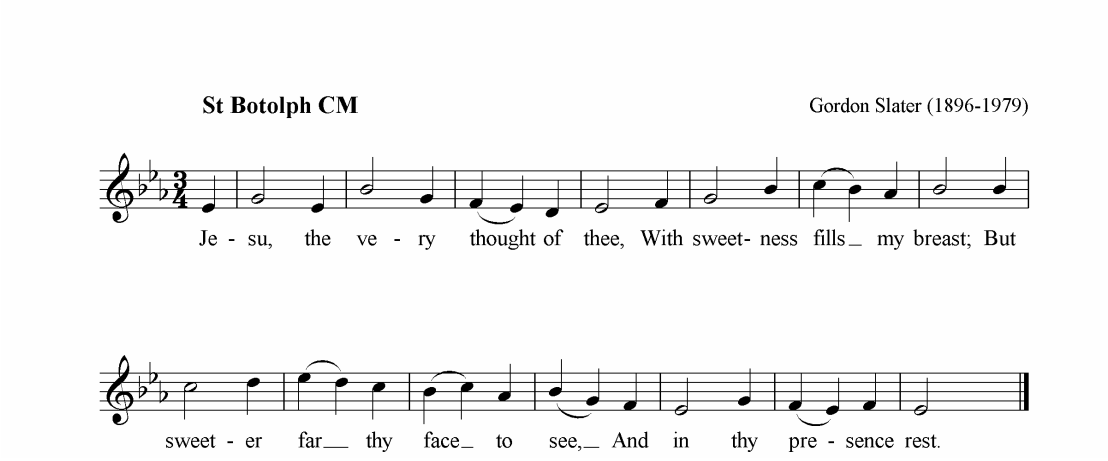
Appendix

Arthur the Rat

There was once a young rat named Arthur who would never take the trouble to make up his mind. Whenever his friends asked him if he would like to go out with them, he would only answer, "I don't know". He wouldn't say "Yes" and he wouldn't say "No" either. He could never learn to make a choice.

Jesu the Very Thought of Thee



Voice Profile Assessment in Singing Protocol (VPASP)

Name **Date recorded**

Voice Profile Assessment in Singing

Contexts	**Categories**	**Normal/ Neutral**	**Sub-categories Perceived as *'non-normal'* features**	1	2	3	**Comments (e.g. singing *vs* speech)**
Observations in performance ☐	Phonation Type		Harshness				
			Whisper				
			Creak				
			Modal → Falsetto				
			Asthenia				
	Velo-pharyngeal		Nasal				
			Denasal				
Observations in rehearsal ☐	Excess tension		Pharyngeal constriction				
			Laryngeal constriction				
			Supralaryngeal - general				
	Larynx position		Raised				
			Lowered				
	Jaw		Minimised range				
	Tongue		Lisp				
			Backed				
Observations in special test ☐	Pitch range		High mean				
			Low mean				
			Wide range				
			Narrow range				
	Pitch control		Pitch instability				
			Pitch stability				
	Loudness		High mean				
			Low mean				
			Wide range				
			Narrow range				
Observations from recording of special test ☐	Breath support		Pushed				
			Weak				
			Audible inhalation				
	Passaggio		Upper obvious				
			Upper well-managed				
			Lower obvious				
			Lower well-managed				
	Frequency ratio		Too high (shrill)				
			Too low (hooty)				

Other comments
Health
Lx / LTAS
Self-rating of singing voice by Chorister
Vocal ability/progress in choir

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