Teachers' Voice Problems: Exploring a Possible Solution

Teacher Education Advancement Network Journal

Vol 9(2) pages 35-50

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Abstract
A mixed methods or multi-strategy research project considered the vocal demands on teachers in UK classrooms and their ongoing requirement for help. The study was in two parts, the first being a survey through questionnaires and interviews to ascertain the extent of voice problems among teachers and those training to become teachers. The second part collected other first-hand evidence through a detailed exploration with student teachers. It drew on the writings of an actor of the nineteenth/twentieth century, F.M. Alexander, who remedied his own voice problems by considering how they were part of his total approach to activity and what he called his 'psychophysical use'. Considering the potential of this approach is important given the lack of voice training available to many teachers.

The exploratory comparison of voice was conducted in a biomechanical laboratory where it was possible to replicate general vocal demand, to make detailed measures of voice quality, and to collect considerable quantitative data. An outline of the results is given.

The research aims to contribute towards knowledge of the teacher's voice and to inform provision for teachers in the UK and beyond. It demonstrates that further research is warranted and what form such research could usefully take.

Key words
Vocal demand; classroom teachers; voice quality; exploration; evidence-based practice.

Context
On the basis that it seems not uncommon for teachers to experience voice problems, my doctoral research project considered vocal demands in the classroom. As a classroom teacher, later as a deputy head and subsequently as a teacher educator in a UK university, I encountered a number of teachers with voice problems. This paper draws the wider context before showing key detail of the way in which I went on to explore a particular solution introduced in the writings and work of F.M. Alexander. Seeking to solve his own voice problems he alighted upon principles related to improving the underlying psycho-mechanical act of speaking.

The approach adopted with participants in the described exploration is known, by the name of its founder, as the Alexander Technique. Anyone learning the Technique can begin to recognise that, in responding both to our 'own thoughts' (regarded as mental or emotional) or to 'life's work' (the so-called physical demands), we 'quite literally pull ourselves out of shape' by our own efforts because it is the 'same *whole* self' that is involved (Door, 2003:13). Applying Alexander's principles is about learning not to respond in this habitually effortful way, but in a new conscious way (1985:38-39), which today we might refer to as 'mindful'. This study sets out to show that voice quality is measurable in such a way that the benefits of any changes when the Alexander principles are applied by teachers can be verified.

Citation
Mycroft, L. (2017) 'Teachers' voice problems: exploring a possible solution', *TEAN Journal*, 9(2), pp. 35-50.

Reports of voice problems and their implications:
What I saw and heard discussed in schools concerning voice problems may seem familiar to those with knowledge of the profession. Infact such anecdotal observation is borne out in a range of literature identifying how teachers encounter loss of voice, hoarseness, discomfort, and vocal tiredness or fatigue (Smith, 1997; Berry, 2000; Roy et al., 2003; Sliwinska-Kowalska et al., 2006; Seikel, King & Drumright, 2010), in some cases progressing to the point of necessary medical intervention such as surgery for vocal nodules (Aronson & Bless, 2009:233; Elder, 2009).

Even where medical circumstances are not identified, problems may have implications for voice qualities such as clarity and audibility which are necessary for effective speaking, particularly when teaching. Understandably, teachers are concerned about being clear and audible within the large or busy spaces in which they work with learners (Simberg *et al*, 2000; Ilomäki, Mäki and Laukkenen, 2005; Ohlsson et al., 2012).

Voice trainers say it is necessary for teachers to withstand 'the demands of prolonged voice use' (Martin & Darnley, 2004:7). Cicely Berry, speaking as Head of Voice with the Royal Shakespeare Company, says she has met many classroom teachers complaining of vocal fatigue and that their voice 'goes' at the end of a day (2000:127). Such comments are relevant to the impact on individuals and Berry's writing shows her perspective from work with actors who receive considerable voice training compared with the little available to teachers.

The amount and constancy of voice use may be a factor in teachers' ongoing problems (Morrow and Connor, 2011), and it may be that one effect, hoarseness, is associated with these factors. Whether or not this is the case, hoarseness is reported frequently by teachers as affecting the clarity of their voices (Furze, 2008; Neto et al., 2008; Bermúdez de Alvear et al., 2010). Some classroom teachers say they experience hoarseness such that they consider it a 'normal' part of voice use (da Costa et al., 2012:72).

The importance of addressing such problems is apparent also in repercussions for learners; the study by Rogerson and Dodd reports that 'poorer voice quality hinders children's speech perception' and their consequent comprehension of what the teacher is saying (2005:53-54). Resolution of problems appears difficult given that, amongst professional voice users, teachers may be 'unaware of how to maintain or improve their voice' (Hazlett, Duffy & Moorhead, 2011:181).

In order to gain more information first-hand and to establish the scale and detail of the situation as a basis for providing support, my research began with a survey of teachers and student teachers (n = 299). Results accord with worldwide peer-reviewed studies which have ascertained teachers are more likely than other occupational groups to have voice problems. For example, teachers appear more at risk whether this is evidenced in data for clinic attendance (for instance, in the meta-analysis of Williams, 2003) or from the self-reporting of professionals themselves (for example, Sapir, Keidar & Mathers-Schmidt, 1993; Smith, 1998; and Roy et al., 2004). A number of more recent studies serve as comparative to other professions by including 'non-teachers' as a control group (for example, Neto et al., 2008). Garcia Martins et al. (2014), presenting a subsequent meta-review of evidence, confirm that considerable problems occur for teachers.

There are only a few UK-based studies (Martin, 1994; Comins, 1995; Morton & Watson, 1998; Voice Care Network, 2007; Hazlett, Duffy and Moorhead, 2011), but all show that there is a risk of voice problems among UK teachers. It might be thought students being new to the profession would have no or little problem, but anecdotal and research evidence suggests this is not the case; for example, a survey of UK student teachers in one university showed a third reporting some voice problems (Fairfield & Richards, 2007). Questionnaire responses in my survey demonstrated particularly

marked problems among 13% of student teachers and for a third of teachers. Voice problems of some kind were experienced by 60% of the students and 63% of the teachers (Mycroft, 2016:169).

Possible solutions:
Three possible solutions are apparent in practical provision and research: voice amplification; learning about healthy voice production as part of a 'vocal hygiene' approach (Carding, Horsley and Docherty, 1999:74); and voice training which may be provided and studied simultaneously (for instance, Martin, 1994; Roy et al., 2003; Ilomäki, Mäki & Laukkenen, 2005; Kovacic, 2005). There are a range of studies on vocal hygiene and training with divergent terms in use; this makes interpretation difficult. Also, two studies, comparing the approaches, denote findings which are contradictory one with the other (Roy et al., 2001 and Pasa, Oates and Dacakis, 2007). Extensive analysis of training provision provides no definitive answer; for example, Hazlett, Duffy a& Moorhead's meta-review reports uncertain outcomes (2011:189).

Minimising strain on the voice by adopting technology to augment the sound electronically appears to suit some circumstances such as the hearing needs of a pupil or a teacher's proven medical requirements, but provision is not common. It is likely that provision on a large scale is impracticable due to the expense and because a sound system cannot fit the practicalities of teachers working in a range of locations, both within and external to the school. Research concludes that there are a multiplicity of other factors not solved by amplification, including the amount and constancy of vocal use (Morrow and Connor, 2011). McGlashen and Howard (drawing on Martin, 1994 & Vilkman, 1998) recommend that the voice, amplified or not, be created with more acoustic energy for less muscular effort (2001:179); they revert to suggesting training is necessary, but it is not clear what form of training would be most effective.

To help teachers solve their voice problems, my research proceeded with detailed exploration of the possibilities of the approach resting on principles set out by F.M. Alexander, an Australian-born actor and reciter who came to the UK at the turn of the twentieth century. Alexander's discovery stemmed from exploring his own voice problem in that he suffered hoarseness and voice loss during stage performances (Staring, 2005). He describes his subsequent change within a concept which he says applies to any human activity, 'psychophysical use' with no separation between what we do and the way we think about it (1985:21); the mind and body are 'inextricably interwoven' in everyday life (Door, 2003: 38). Alexander also defined general principles relating to 'use', including the role of habit, the neural pattern laid down in the brain when an action is performed (Door, 2003:15); it means that we continue to carry out activities (including communication) according to the way we first learn, which may not be the most advantageous. This is not concerned with accent or grammar but with the underlying psycho-mechanical act of speaking.

It is useful to find out more about the potential of this approach in the given context. For instance, a teacher in my survey reported a number of coping strategies (such as a reduction in teaching hours and a change of role) but continuing to struggle with repeated loss of voice, as had Alexander initially. The question is what underlies a recurring voice problem if it appears not to be solved by the usual proposals such as rest and if it does not respond to particular forms of training, which anyway are not readily available (Mycroft, 2016:166-167). Problem-free voice use is possible but it may occur for a minority; for example, only 12% of the teachers in my survey who had been teaching for more than ten years (21 teachers in a total of 174) said they had 'never' had a voice problem (Mycroft, 2016:176). (See also: de Jong et al., 2006; Åhlander, Rydell & Löfquist, 2012). One interview with a newly qualified teacher (NQT) showed also someone with a strong voice who would welcome help to vary the tone and pace, in other words to develop the way her voice could be a more effective part of her teaching (2016:194-195).

Context of the laboratory exploration

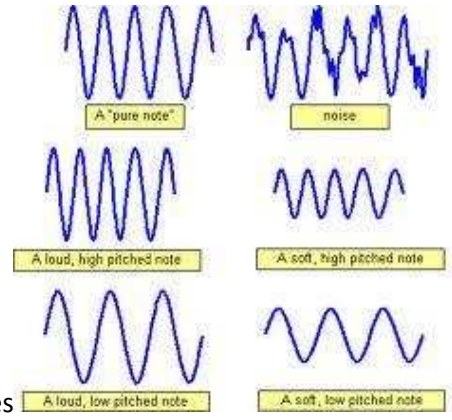
An examination of training for actors, where provision is far more extensive than anything offered to teachers, demonstrates a preponderance of outcome-based exercise approaches. In an evaluation of such training, Walzak (2008) suggests that a process-led approach of 'feedback on technique' is preferable to such exercises. Possibly this links with what Alexander realised: that voice problems are about the whole process and person (1985: 54). The amount of talking required in the job may be a contributory factor, as are the acoustics of the space (Rosenberg and Blake-Rahter, 1995 in Jónsdottir et al., 2002:38; Morrow and Connor, 2011:446), but they are not the total of the situation according to McGlashen and Howard (2001), or according to Alexander's principles of improving one's psychophysical use as a whole (1985:55).

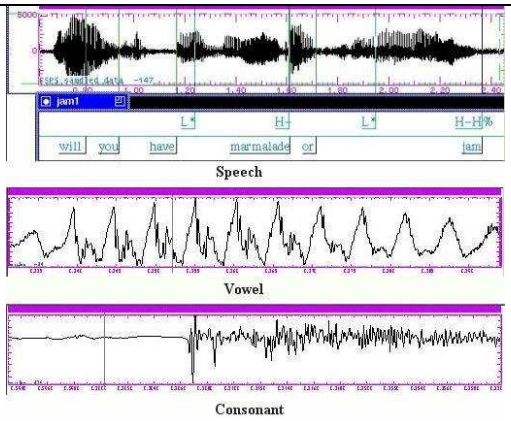
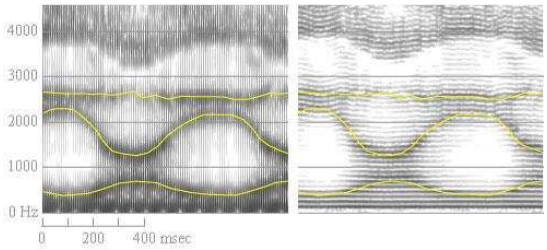
My further research proceeded to plot changes in voice quality (according to pre-determined parameters) in relation to teachers adopting a process-led procedure applying Alexander's inherent principles. In the study, exploration was conducted within a specialist laboratory with facilities for fine-scale measurements.

Terminology:

The technical vocabulary of voice quality and its measurement, necessary to the laboratory exploration, is set out briefly with further tabulated detail for any superscripted terms. The main positive qualities necessary to the vocal demands of teaching relate to the characteristics described as clarity, audibility and sustainability of voice, as set against the negatives that teachers experience of voice loss, hoarseness, discomfort or vocal fatigue.

Voice qualities themselves are best defined within scientific parameters; for instance, Zemlin suggests measurable pitch (or frequency [A]); also loudness/amplitude [B] or intensity linked with power [B] (1998:172). In addition, Zemlin includes resonance [C] as an important aspect of voice quality which is related to its frequency, yet also influences audibility. Martin and Darnley refer to resonance giving the voice 'carrying power' (2004:158; 2004,165). Teachers and others sometimes refer to 'projection' as influencing whether a voice can be heard. In this study, teachers and student teachers introduced that term when describing what they wanted to improve about their voice (Mycroft, 2016: 184-185); underlying the characteristic is vocal power.

[A] Frequency	The perceptual characteristic of a sound is described as pitch whilst the corresponding measurable parameter is termed frequency. This is the frequency of vibration of air particles as they are set in motion by initiation of the voice at the larynx (Behrman, 2013: 21) which is the prime origin of voice within the throat or pharynx. Sound can be represented visually in 'waves'. Higher pitch is represented by greater frequency of recurrence in the sound wave; lower pitch is shown in the lesser frequency of recurrence (Behrman, 2013: 23-24).	Forms of sound waves (Gibbs, 2007) 
[B] Amplitude of a sound	The measurable change in vibrations (Behrman, 2013: 25)	Sound wave of the human voice

	associated the perceptual characteristic of loudness is called amplitude. The *amplitude* in the sound wave is shown in the peak of the wave; the louder the tone, the greater the disturbance of air particles and therefore the more 'extreme' the peaks of the wave. Intensity is a 'measure of energy flow per unit of area per unit of time', said also to represent the 'power' of that sound (Zemlin, 1998: 572 and 415). The intensity of the wave (its power) diminishes with increasing distance from the source of the sound (Behrman, 2013: 25 and 27-28).	 (Non-copyright : Review of the Universe, 2002)
[C]Resonance	The tone emitted at the larynx might have greater or less resonance depending on the length and configuration of the whole vocal tract (the passageway connecting the lungs with the oral and nasal cavities). Dependent on features of the tract are its resonant or 'formant frequencies' which represent 'a concentration of energy around a particular frequency in the acoustic wave' (Zemlin, 1998: 298). Voice production and such elements of voice quality are not just dependent on the structure of the tract but also on influences of the flexible configuration of the whole person (Alexander, 1985: 54).	Spectrograms from recordings of a vowel at a level pitch or steady frequency  (Hagiwara, 2009) The energy in the sound is represented light-to-dark, with lighter indicative of less energy. White represents no energy in the spectrogram with black representing 'lots of energy'.

In the laboratory, I explored voice quality according to the suggested measurable parameters of frequency, power, and resonance, noting that 'good' voice might display lowered pitch and reduced loudness, described by Hollien as 'softer than average vocal intensity' (2000:17; 2000,22). Other aspects of voice quality were taken into account and these more specific details are discussed in the full report (Mycroft, 2016).

A further consideration of the study was the link between posture and voice which has been suggested: for example, Duffy and Hazlett (2004) and Kooijman *et al* (2005) explore the idea, although the term posture can be interpreted in different ways. Alexander proposes '*a coordinated use of the mechanisms in general*' (2004: 100); conversely, use is manifest in the postural configuration of the individual. Alexander's viewpoint can be seen in the basis of my further study. In the mechanics of the situation, maintaining upright posture with minimal muscular effort indicates improved 'mechanical advantage' (The University of Waikatu, 2007): that is, less energy is required to enact activity assuming each part is aligned in an optimal relationship (Basmajian and De Luca,

1985: 255). Any undue muscular activity within the coordinated mechanisms of the whole person can impact on the larynx and be detrimental to vocal characteristics (Alexander, 1985: 54). This may link with McGlashen and Howard's (2001) suggestion of expending less muscular effort in speaking. Posture is seen also as relevant to efficient breathing for speech (Seikel, King and Drumright, 2010: 155-157).

In the laboratory:
The second part of my research drawing on these principles took place in a specialist laboratory at Manchester Metropolitan University (MMU), courtesy of and alongside Professor Ian Loram who works prominently in studies of human movement. The work at MMU concerned exploration with ten participants: mainly student teachers (but one newly-qualified teacher); they were recruited through Keele University and the University of Wolverhampton. The individuals agreed to help us gather data related to voice quality; we asked them to employ changes in stance/use by following simple verbal instructions.

Recording posture dynamically through a system called Vicon, I have been able to incorporate quantitative measures which Kooijman (2005) indicated were lacking in previous work related to posture and voice. Also, technological advances in digital equipment for both sound recordings and postural configuration meant more elaborate data collection was possible than that open to previous researchers, for example Jones (1972).

Methodology:
The overall aim of the study was to find out how to help teachers in using their voices during a teaching career. Having addressed an initial question (via the questionnaire survey and interviews) about perceived vocal demands for teachers in the classroom, other research questions related to a proposed solution. A mixed methods or multi-strategy approach allowed the research to be driven by the 'specific problem to be solved' (Robson, 2011, 62-63), that of defining help for teachers. The research questions could predominate and influence choice of methods (Punch, 2014: 7). Objectives appropriate to the questions were formulated around gaining evidence of changes in voice quality as part of improved psychophysical use (as defined by Alexander) by exploring a related practical procedure with student teachers (Mycroft, 2016: 31). Such exploration was meant to answer the detailed question: can improvement in voice quality be demonstrated by the adoption of a procedure based on Alexander's principles?

The exploration was of voice in habitual stance (what Alexander called 'habitual wrong use', 1985:47) compared with voice in an adjusted stance following the procedure set out by Door (2003:102) on the basis of Alexander. The adjustments bring about a more mechanically advantageous way of standing, which we abbreviated to 'MA stance' in our exploratory work at MMU. The idea is based on beginning with the most fundamental of human activities, that of being upright and learning to respond with less muscular effort than habitually employed (Door, 2003: 26-27). Changing habitual reactions in this basic everyday activity was demonstrated by Alexander to be a way individuals can learn to ensure that they are not mechanically-disadvantaged such as in the everyday act of speaking (1985:47).

Measures were taken in both habitual and MA stance through digital voice recordings (with the position of the microphone at a standardised distance from the lips as part of a head set) and in records of postural configuration gained with Vicon digital camera images tracking small sensors attached to strategic parts of the head, neck, torso and legs (Figure 1.). A force platform was used to ascertain whether the centre of pressure indicated the normal sway of an individual (Basmajian and De Luca, 1985:253) or indicated possible stiffening through excessive muscular activity, for example in the legs. Unnecessary muscle activity is part of the pattern of misuse (Door, 2003:98); in the

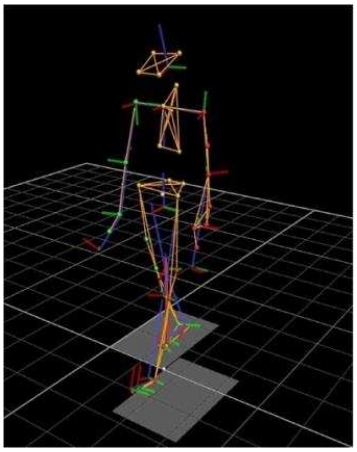
laboratory, muscle activity in the legs and elsewhere was monitored through electromyography (EMG). Participants walked on to the platform and recordings began when they came to rest and began to speak.

There was time for individuals to become familiar with the laboratory setting at the start of a session and all other ethical considerations were observed. For instance, there was opportunity to ask questions throughout and it was made clear that anyone was free to withdraw at any time. Participants were not given advance detail of the procedure, because we wanted them to approach the work as exploratory. However, each individual knew they would be 'talked through' the procedure and that after the laboratory session we would give them further information on Alexander's thinking.

Markers such as those attached to the legs, head and torso of each participant during the (note: at MMU we did not have markers on the arms)

(Murnau Trauma Center, 2014)

Computer screen image of markers with vector lines joining each one



(University of Malaya, 2008)

Figure 1. Vicon System.

The evidence made it possible to observe the relationship between voice quality and the two stances (habitual and MA) for each individual. Movement traces were stored to a computer programme called Matlab which allowed detailed analysis (Mathsworks.Inc, 2015). Voice recordings were stored in digital format in Matlab and another programme called Praat (see Boersma and Weenink, 2011). Praat enabled me to analyse pitch, factors affecting loudness such as those expressed as power, and also harmonic content relating to resonant features of voice. There could also be comparisons with data from all other measures.

During the procedure, each participant was asked to say the same sentence, which comprised a few lines taken from Shakespeare*.

* Sentence used by all participants (taken from the Prologue to *The Life of King Henry the Fifth*, William Shakespeare):

O! for a Muse of fire, that would ascend
The brightest heaven of invention;
A kingdom for a stage, princes to act
And monarchs to behold the swelling scene.

This was meant to create a demand in terms of articulation over a range of different speech sounds and was material unrelated to people's everyday speaking experience so that familiarity was not at issue. The voice quality results were taken as mean or average values because there are different acoustic characteristics in consonants and vowels, particularly as occur in whole words and running or contextual speech (Behrman, 2013:295-298; 234-235; Zemlin, 1998:308). Our expectation was that with changes in postural configuration and reduced muscular effort, there might be improvement in overall voice quality.

Interpretation of findings rested on using the mean values of results to conduct analyses of variance and determine whether any data demonstrated statistical significance (Punch, 2014:257). From common-usage statistical tables, p values equal to or smaller than 0.05 indicated a greater than or equal to 95% certainty of the model being accurate as a predictor of future results. Outcomes in a few measures demonstrated an even higher level of certainty: $p \leq 0.01$ indicating ≥ 99% likelihood of the model as a predictor of future results (Punch, 2014:270-271).

The survey comprised a range of people working or training in relevant establishments (299 teachers and student teachers) at a particular point in time. This is described as a 'purposive' sample appropriate to a specific purpose (Robson, 2011:275; Cohen, Manion & Morrison, 2011:156-157). Evidence may not be replicable elsewhere but it provides insight, through its numerically descriptive approach (Punch, 2014:268), to what might appertain for the profession in that location and more widely.

In the circumstances of our procedures in the laboratory, ten or less participants is viable and common (Loram, 2009) given that work is detailed and precise and therefore not accessible to larger numbers. It was again possible to form a purposive sample. Both primary and secondary teacher students were involved; it was assumed that the vocal demands in terms of teaching role are broadly similar. There was no intention to represent gender equally within the sample. The range of quantitative data and levels of significance noted in this part of the study demonstrated results were not just chance but indicative of likely outcomes for other similar groups.

Findings

There is a large body of quantitative evidence available from the laboratory, but only principle outcomes are included here, leaving readers to consider the fully referenced work for in-depth analysis (Mycroft, 2016). I will discuss results in sufficient descriptive detail to demonstrate the overall conclusions which were drawn.

Alexander showed by systematic and scientific methods of observation that his principles work in practice; this was corroborated at the time by the American philosopher and educationalist, John Dewey (Alexander, 2004: xxviii). The MMU data for postural configuration and muscle activity was collected mainly to demonstrate that participants followed the procedure as intended, so in my study the results for posture are secondary to the importance of the linked comparisons with voice quality.

Results

Measures of voice quality demonstrated some statistically significant changes related to adoption of MA stance. From the four voice recordings for each participant (one for each condition interspersed with a repetition of each), it could be shown that the effect of the procedure was greater than the effect of repeating the trial; that is, improvement was not because the participant's voice improved on a second attempt when they were more familiar with what to do and possibly more 'at ease'.

The quantifiable data for pitch/frequency showed a lowering of pitch associated with the MA stance. In Figure 2, mean frequency for saying the sentence shows the third and fourth columns (MA stance) with most participants having lowered frequency values compared with results for habitual stance ($p = 0.0098$).

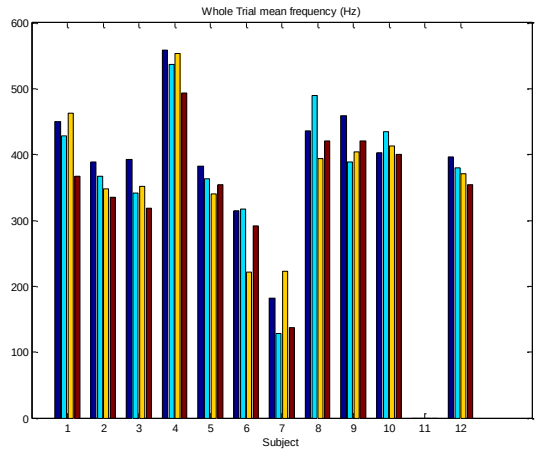


Figure 2. Mean frequency.

Pitch/Frequency measures for participants 1 to 10 For each participant there are four columns giving average or mean value for pitch – one relates to speaking in habitual stance; the second is a repetition of this; the third column shows the result for speaking in MA stance; the fourth is a repetition of this.

Columns at 12 show averages across all participants

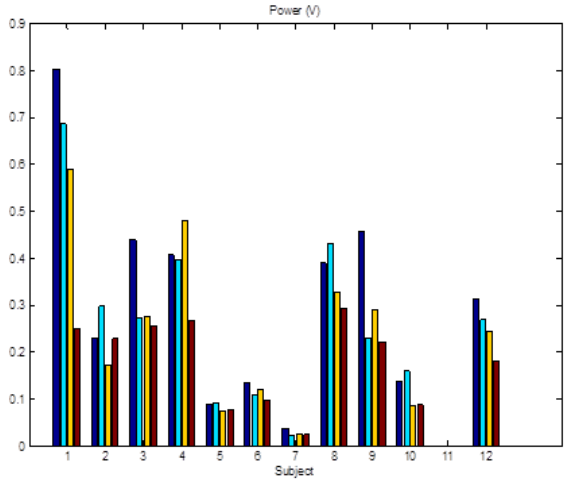


Figure 3. Power.

There is a reduction in mean power for all participants in MA stance shown by results at 12 (the yellow and red blocks on the graph); some individuals had a particularly marked reduction in power (shown at 1, 5, 8 and 10)

Measures of power (Figure 3.) revealed mean values being reduced across the whole group (column 12), and for some individuals in particular, for example, participants 8 and 10. Power relates to acoustic energy in a sound, so measuring power and noting any lessening in acoustic energy appears

to offer a means to applying a criterion for vocal effectiveness where less energy is being transported, e.g. over the distance from the speaker on the force plate to the person sitting at the laboratory computer. Yet the speaker was not difficult to hear. If the voice was quieter in MA stance, in the sense of reduced power or effort, it was not inadequate to the situation; all participants could be said to have spoken with sufficient carrying power, discussed previously in terms of resonance. These results were in line with Hollien's criterion for 'good' voice, where he proposed 'average to softer than average vocal intensity' (2000:22) and with ideas about increased resonance (Zemlin, 1998:294; Behrman, 2013:45). What was found in the MMU exploration followed the expected trend but might benefit from further investigation.

The effect of stance was greater than the effect of repetition in other detailed analyses; that is, improvements occurred during MA stance. Although some very short extracts of the recordings were considered, those most in line with the expectation that adjusted or MA stance is influential in voice quality were those for the whole sentence. Ten out of ten variables assessed taking these whole sentence recordings had a lower p value for stance than for repetition, indicating 100% match and therefore statistical significance with a probability level of p = 0.001. These variables again included pitch or frequency.

Finally, further brief detail can be reported for postural configuration and other measures related to psychophysical use, corroborating that people followed the procedure, as in the positioning of the feet (Figure 4.).

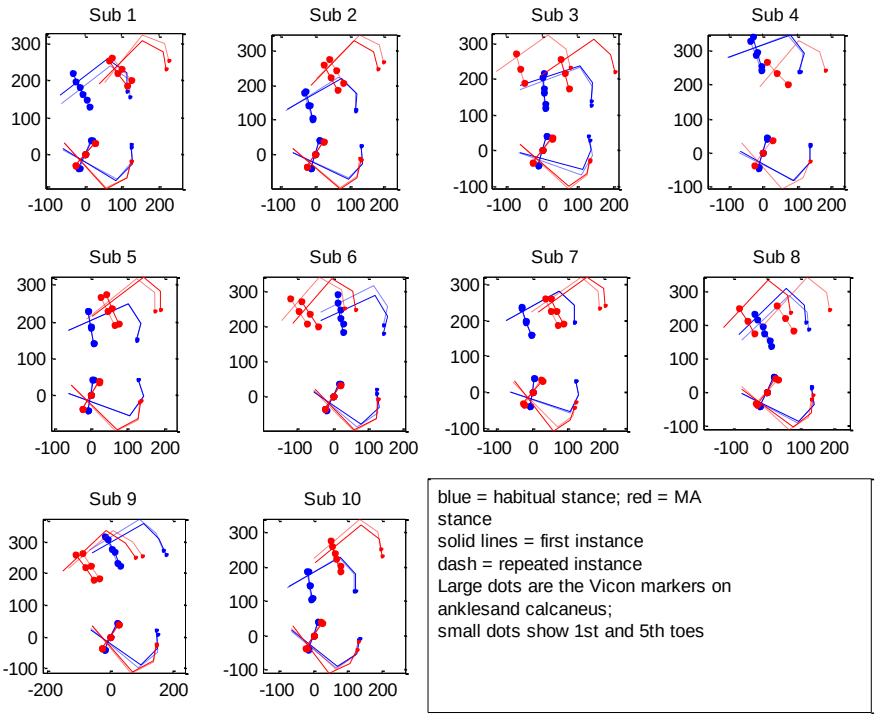


Figure 4. Postural configuration: positioning of feet at start of recording in habitual/MA stance

Whole body images gained for each participant demonstrated changes occurring in MA stance with many people swaying back at the ankles. For the two individuals shown in Figure 5., differences in postural configuration between MA and habitual stance were most evident for S10. Data for eight out of ten individuals confirmed our expectations of swaying back in adjusted stance, probably because a participant is doing less muscular work (for example, at the ankles) to remain upright when a more stable base is adopted in following the procedure (Figure 4.).

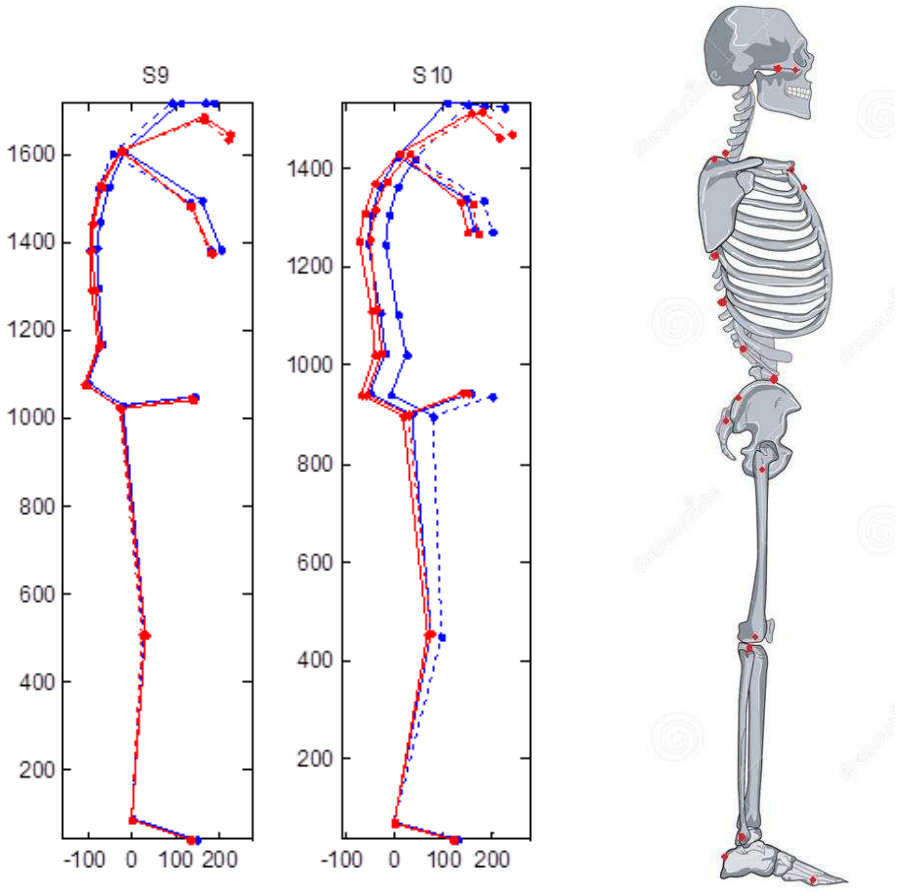


Figure 5.
Whole body images for two participants [S9 & S10]
blue line = habitual stance; red = MA stance
solid = first instance; dash = repeat
Denoted positions of markers on the skeletal form are shown on the right

Other improvements in use were attained; for example, there was a proven lengthening of the back in all participants when MA stance was adopted; an average increase of six millimetres ($p = 0$). This can be interpreted in the context that excessive muscular activity exerted in our maintenance of upright posture against the force of gravity leads to the bodily framework being distorted (Door, 2003: 27) and so 'shortened'. With lessened unnecessary muscle activity, this improves.

The force plate results for variations in the centre of pressure showed far less fluctuation in the line of gravity in MA stance than in habitual. This demonstrated more stability when stance was adjusted. It could only be determined whether the stability was being achieved by 'fixing' (that is, unnecessary contraction of muscles) if viewed in combination with EMG readings for the leg muscles. Checking of muscles demonstrated reduced activity in both legs in MA stance compared with recordings in habitual stance. In summary, these EMG findings corroborate the idea that there can be less activity in muscles in the leg when MA stance is adopted. Also, less activity in muscles was demonstrated elsewhere with a statistically significance difference shown ($p = 0.0092$) for a muscle of the neck and shoulder.

Results representing breathing, through expansion of the rib cage in millimetres (taking a distance between markers on the back and on the anterior chest wall), showed the distance being less for MA stance than for habitual stance, indicative of a quieter level of respiration. As participants did not appear short of breath for speech, possibly the result equates with more efficient breathing in MA

stance, which accords with improved posture (as psychophysical use) assisting improved breathing for speech (Seikel, King & Drumright, 2010).

Discussion:
The research provides a considerable amount of quantitative data for the ten participants showing what happened when they were asked to speak a demanding sentence in laboratory conditions. Although valid within this sample, scope to generalise any findings is limited at this stage given further work is required.

The research design was to compare the two stances. From the voice measures we were able to confirm improved voice quality such as lowered pitch and power as well as some improvement in resonant characteristics. It may be claimed that quantitative measures derived from voice science (Zemlin, 1998; Hollien, 2000) and other literature are shown to be an effective means of assessing vocal differences with improvement for individuals during the change of stance. In other words, by using a procedure based on principles set out by Alexander, it is possible to demonstrate improved voice with measurable results worthy of further investigation.

Links between all discrete measures have been drawn into interpretation of findings. It is important that my overall study is not confined to consideration of quantitative data; if we reduce everything to numbers we miss out important detail of the situation in its real-life context. The survey in the early stages provided a qualitative view of what it is like for current-day classroom teachers and students, for instance it shows that most (86% of teachers) are offered little voice training, yet may experience considerable problems.

The survey demonstrated real concerns among teachers and student teachers, for instance regarding their capacity to 'project' the voice and be heard. Although this term does not appear in the literature of voice science, it is used colloquially to refer to the carrying power of the voice. Some voice teachers give set exercises for its improvement (Martin & Darnley 2004:165). Berry suggests focusing on different distances and allowing time for sound to reach that space (2000:110-111) and a clinician, Levbarg, indicates a process of fastening the gaze where we intend to speak in order that the voice will reach that place (1919:421). In other words, it is about thought, not just 'the mechanical viewpoint'; this aligns with my exploration being rooted in the acknowledgement of speech and voice as psychophysical (or psycho mechanical) processes.

Conclusion
There were notable outcomes which addressed the two research questions regarding improvement in voice quality for teachers and attention to improving use by applying Alexander's ideas. Any activity is not just a mechanical act because of the thought processes involved (Door, 2003: 36); small changes as occasioned by participant teachers were shown possibly to link with positive voice qualities. Yet, the study is just a starting point as a basis for further exploration of voice with a procedure demonstrating potential for teachers in the classroom and beginning with that most fundamental human activity, upright posture.

Currently, I am proceeding with information for teachers, school leaders and teacher educators showing the practical outcomes of my research. Also, I shall seek opportunity of extending this evidence-based practice by offering short courses for groups of teachers who, in association with their learning, might be willing for me to study further any possible impact on voice. This could take a mainly qualitative (perceptual) approach through questionnaire, video and sound evidence, which might enable a view of whether teachers with improved use meet the demands of speaking in the classroom more effectively.

Thanks are due to the many teachers and student teachers who willingly took part in the doctoral research. Also, I would like to acknowledge the considerable help given by Brian Door, Dr Rose Whyman, Professor Ian Loram, Dr Victoria Door and other colleagues in the Professional Association of Alexander Teachers

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References

Åhlander, V.L., Rydell, R., Löfquist, A. (2012) 'How do Teachers with Self-reported Voice Problems differ from their Peers with Self-reported Voice Health?', *Journal of Voice,* 26 (4), pp. 149-161.

Alexander, F.M. (1985, original date of publication, 1932) *The Use of the Self.* London: Victor Gollancz.

Alexander, F.M. (2004) *Constructive Conscious Control of the Individual*. 3rd edn. Edited by Fischer, J.M.O. London: Mouritz.

Aronson, A.E., Bless, D.M. (2009) *Clinical Voice Disorders.* New York: Thieme Medical Publishers Inc.

Basmajian, J.V., De Luca, C.J. (1985) *Muscles Alive: Their functions Revealed by Electromyography.* 5th edn. Baltimore: Williams & Wilkins.

Behrman, A. (2013) *Speech and Voice Science*. 2nd edn. San Diego: Plural Publishing.

Bermúdez de Alvear, R.M., Martinez-Arquero, G., Javier Barón, F., Hernández-Mendo, A. (2010) 'An Interdisciplinary Approach to Teachers' Voice Disorders and Psychosocial Working Conditions', *Folio Phoniatrica et Logopaedica,* 62, pp. 23-34.

Berry, C. (2000) *Your Voice and How to Use It.* 2nd edn. Reprint, London: Virgin Books Ltd, 2007.

Carding, P.N., Horsley, I.A., Docherty, G.J. (1999) 'A Study of the Effectiveness of Voice Therapy in the Treatment of 45 Patients with Nonorganic Dysphonia', *Journal of Voice,* 13 (1), pp. 72-104.

Cohen, L., Manion, L., Morrison, K. (2011) *Research Methods in Education.* 7th edn. Abingdon, UK: Routledge.

Comins, R. (1995) 'Voice in the Curriculum', *Voice,* 1, pp.67-73.

da Costa, V., Prada, E., Roberts, A., Cohen, S. (2012) 'Voice Disorders in Primary School Teachers and Barriers to Care', *Journal of Voice,* 26(1), pp. 69-76.

de Jong, F.I.C.R.S., Kooijman, P.G.C., Thomas, G., Huinck, W.J., Graamans, K., Shutte, H.K. (2006) 'Epidemiology of Voice Problems in Dutch Teachers', *Folia Phoniatrica Logopaedica*, 58, pp. 186-198.

Door, B. (2003) *Towards Perfect Posture*. London: Orion.

Duffy, O.M., Hazlett, D.E. (2004) 'The impact of preventive voice care programs for training teachers: A longitudinal study', *Journal of Voice*, 18 (1), pp. 63-70.

Elder, F. (2009) 'Taking the mike', *Report* Magazine (December 2009), p. 17.

Fairfield, C., Richards, B. (2007) 'Reported Voice Difficulties in Student Teachers: A Questionnaire Survey', *British Journal of Educational Studies*, 55 (4), pp. 409-425.

Furze, P. (2008) 'Value your voice', *Report* Magazine (June/July 2008), p. 24.

Garcia Martins, R.H., Neves Pereira, B.R.B, Bosque Hidelgo, C. , Mendes Tavares, E.L. (2014) 'Voice Disorders in Teachers. A Review', *Journal of Voice,* 28 (6), pp. 716-724.

Gibbs, K. (2007) *Sound waves.* Available at: http://schoolphysics.co.uk/teachers/ OHT%20sheets/ Sound/Sound_waves/index.html (Accessed: 12 November 2008).

Hagiwara, R. (2009) *Sources and filters.* Available at: http://home.cc.umanitoba.ca/~robh/ howto#introhttp://home.cc.umanitoba.ca/~robh/howto#intro (Accessed: 14 March 2015).

Hazlett, D.E., Duffy, O.M., Moorhead, S.A. (2011) 'Review of the Impact of Voice Training on the Vocal Quality of Professional Voice Users: Implications for Vocal Health and Recommendations for Further Research', *Journal of Voice*, 25 (2), pp. 181-191.

Hollien, H. (2000). The Concept of Ideal Voice Quality, in Kent, R.D. and Ball, M.J. (editors) (2000). *Voice Quality Measurement*. San Diego, California: Singular Publishing Group. pp. 13-24.

Ilomäki, I., Mäki, E., Laukkenen, A. (2005) 'Vocal symptoms among teachers with and without vocal education', *Logopedics Phoniatrics Vocology*, 30 (3-4), pp. 171-174.

Jones, F.P. (1972) 'Voice production as a function of head balance in singers', *Journal of Psychology*, 82 (2), pp. 209-215.

Jónsdottir, V.I., Boyle, B.E., Martin, P.J., Sigurdottir, G. (2002) 'A comparison of the occurrence and nature of vocal symptoms in two groups of Icelandic teachers', *Logopedics Phoniatrics Vocology*, 27 (3), pp. 98-105.

Kooijman, P.G.C., de Jong, F.I.C.R.S., Oudes, M.J., Huinck, W., van Acht, H., Graamans, K. (2005) 'Muscular tension and body posture in relation to voice handicap and voice quality in teachers with persistent voice complaints', *Folia Phoniatr Logop*, 57, pp 134-14.

Kovacic, G. (2005) 'Voice investigation in teacher training: an investigation into the knowledge about the voice and voice care in teacher-training students', *Journal of Education for Training*, 31 (2), pp. 87-97.

Levbarg, J. J. (1919) 'Voice and vocal projection', in *The Laryngoscope,* 29, Issue 7, pp 419-421, July 1919. Available at: *http://onlinelibrary.wiley.com/doi/10.1002/lary.5540290705/ abstract* (Accessed: 09 May 2017).

Loram, I. (2009) Conversation with Ian Loram, 30 July, 2009.

McGlashen, J. A., Howard, D.M. (2001) 'Theoretical and practical considerations in the occupational use of voice and amplification devices', in: Dejonckere, P.H. (ed.) *Occupational Voice: Care and Cure.* The Hague: Kugler Publications. pp. 165-185.

Martin, S. (1994) 'Voice Care and Development for Teachers: survey report', *Voice*, 3, pp. 92-98.

Martin, S., Darnley, L. (2004) *The Teaching Voice.* London: Whurr Publishers Ltd.

Morrow, S.L., Connor, N.P. (2011) 'Voice Amplification as a Means of Reducing Vocal Load for Elementary Music Teachers', *Journal of Voice*, 25 (4), pp. 441-446.

Morton, V. and Watson, D.R. (1998) 'The teaching voice: problems and perceptions', *Log Phon Vocol*, 23, pp. 133-139.

Murnau Trauma Center (2014) *Vicon image.* Available at: http://bgu-murnau.de/de-De/medizin/biomechanik/arbeitsbereiche/bewegungsanalyse/austattung.php (Accessed: 14 March 2015).

Mycroft, A.L. (2016) 'An exploration of teachers' voice problems and their possible solution', a thesis submitted to the University of Birmingham for the degree Doctor of Philosophy. Available at: http://etheses.bham.ac.uk/6764/ (Accessed: 09 May 2017).

Neto, F.X.P., Freire, J.V.C., Damasceno, L.A.A., Ferreira, R., Fernandes, V.H.A. and Palheta, A.C.P. (2008) 'Incidence of Hoarseness in Students of the last year of Degree Courses', *International Arch.Otorhinolaryngol., Sao Paulo*, 12 (2), pp. 246-252.

Ohlsson, A-C., Andersson, E.M., Södersten, M., Simberg, S., Barregård, L. (2012) 'Prevalence of Voice Symptoms and Risk Factors in Teacher Students', *Journal of Voice*, 26 (5), pp. 629 – 634.

Pasa, G., Oates, J., Dacakis, G. (2007) 'The relative effectiveness of vocal hygiene training and vocal function exercises in preventing voice disorders in primary school teachers', *Logopedics Phoniatrics Vocology*, 32, pp. 128-140.

Punch, K.F. (2014) *Introduction to Social Research: Quantitative and Qualitative Approaches.* 3rd edn. London: Sage

Review of the Universe (2002) *Sound waves*. Available at: http://www.universe-review.ca (Accessed: 12 November 2008).

Robson, C. (2011) *Real World Research.* 3rd edn. Chichester: John Wiley.

Rogerson J., Dodd B. (2005) Is There an Effect of Dysphonic teachers' Voices on Children's Processing of Spoken Language? In: *Journal of Voice,* 19(1), pp. 47-60.

Roy, N., Gray, S.D., Simon, M., Dove, H., Corbin-Lewis, K., Stemple, J.C. (2001) 'An Evaluation of the Effects of Two Treatment Approaches for Teachers with Voice Disorders: A Prospective Randomized Clinical Trial', *Journal of Speech, Language, and Hearing Research*, 44, pp. 286-296.

Roy, N., Merrill, R.M., Thibealt, S., Gray, S.D., Smith, E.M. (2004) 'Voice Disorders in Teachers and the General Population – Effects on Work Performance, Attendance, and Future Career Choices', *Journal of Speech, Language, and Hearing Research*, 47 (2), pp. 542-551.

Roy, N., Weinrich, B., Gray, S.D., Tanner, K., Stemple, J.C., Sapienza, C.M. (2003) 'Three treatments for teachers with voice disorders: a randomized clinical trial', *Journal of Speech, Language, and Hearing Research*, 46 (3), pp. 670-688.

Sapir, S., Keidar, A., Mathers-Schmidt, B. (1993) 'Vocal attrition in teachers: survey findings', *European Journal of Disorders of Communication*, 28 (2), pp. 177-185.

Seikel, J.A., King, D.W., Drumright, D.G. (2010) *Anatomy & Physiology for Speech, Language, and Hearing*. 4th edn. NY: Delmar.

Simberg, S., Laine, A., Sala, E., Rönnemaa, A. (2000) 'Prevalence of Voice Disorders among Future Teachers', *Journal of Voice*, 14 (2), pp. 231-235.

Sliwinska-Kowalska, M., Niebudek-Boguez, E., Flazer, M., Los-Spychalska, T., Kotylo, P., Sznuorowska-Przygocka, B., Modrzewska, M. (2006) 'The Prevalence and Risk Factors for Occupational Voice Disorders in Teachers', *Folio Phoniatrica et Logopaedica*, 58 (2), pp. 85-101.

Smith, E., Gray, S.D., Dove, H., Kirchner, L., Heras, H. (1997) 'Frequency and effects of teachers' voice problems', *Journal of Voice*. 11(1), pp. 81-87.

Smith, E., Lemke, J., Taylor, M., Kirchner, H.L. and Hoffman, H. (1998) 'Frequency of Voice Problems among Teachers and other Occupations', *Journal of Voice*, 12 (4), pp. 480-488.

Staring, J.F. (2005) *Frederick Matthias Alexander 1869 – 1955: The Origins and History of the Alexander Technique.* Nijmegen: Integral.

The University of Waikatu (2007) *Mechanical advantage.* Available at: http://sciencelearn.org.nz/Contexts/Sporting-Edge/Sci-Media/Images/Mechanical-advantage (Accessed: 12 July 2015).

University of Malaya (2008) *Motion Analysis.* Available at: http://cmsad.um.edu.my/index1.php?pfct=cab&modul=Facility&pilihan=Laboratory&subpilihan=MotionAnalysis (Accessed: 14 March 2015).

Voice Care Network (2007) '*Teacher survey*'. Available at: http://www.voicecare.org.uk/vcn/research-surveys/atl-voice-survey-032008 (Accessed: 03 February 2012).

Walzak, P., McCabe, P., Madill, C., Sheard, C. (2008) 'Acoustic Changes in Student Actors' Voices After 12 Months of Training', *Journal of Voice*, 22(3), pp. 300-313.

Williams, N.R (2003) 'Occupational groups at risk of voice disorders: a review of the literature', *Occupational Medicine*, 53 (7), pp. 456-460.

Zemlin, W.R. (1998) *Speech and Hearing Science – Anatomy and Physiology.* Massachusetts: Alyn & Bacon.

ICT Software used in this study:

Mathsworks Inc. (2015) Matlab® Available at http://uk.mathworks.com/products/ matlab/

Boersma, P. and Weenink, D. (2011) *Praat*. Available at http://www.fon.hum.uva.nl/praat/

Vicon Motion Systems (2015). *Vicon motion capture system.* Available at http://www.vicon.com/motion-capture/life-sciences