

Researching Singing and Vocal Development Across the Lifespan: A Personal Case Study

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Introduction¹

A recent European Science Foundation (ESF) sponsored research workshop², hosted at the University of London's Institute of Education, brought together fifteen researchers from across Europe who shared a special interest in voice, particularly of children and adolescents. These researchers represented a variety of different disciplines and occupations, embracing ear-nose-throat surgeons, voice scientists, logopediatricians, psychologists, electronics engineers and educators. A central reason for the workshop was to review the existing research base and associated literature and to identify areas for prioritised research activity by such a multi-professional team. Critically, two key issues surfaced during the discussions: a necessity for the creation of new assessment instruments and protocols for child and adolescent voice and the generation of robust longitudinal data sets to inform theory, policy and practice. In particular, for these researchers, the onset of puberty and the period of voice change ('mutation') in both males and females raised particular challenges in our customary definitions of 'normal' and 'abnormal', 'function' and 'dysfunction'.

It was clear that each of the contributory disciplines had an overlap in their interests with other disciplines, yet there was also something distinctive about their particular ontological and epistemological views of voice and the customary methodologies that they adopted for research. Nevertheless, for each grouping, the notion of 'normal' was problematic, either because of perceived weaknesses in existing definitions and data or because data was absent.

For the *medical* professionals, a prime interest was in diagnosis of voice disorder and treatment in a clinical setting, recognising that there was no established Europe-wide protocol for voice evaluation (neither for structure nor function). Neither was there common use of the available technological tools for voice quality assessment. These researchers were also aware that their clinical diagnoses would be improved if there was better research evidence available on how lifestyles influenced vocal behaviour and development.

For the *voice scientists* (acousticists and electronics engineers), one major concern was the need to have robust data sets to inform the design of assessment instruments that were better matched to child and adolescent voices. The researchers were acutely aware of possible weaknesses in their data if each country had its own preferred methods of voice assessment, as well as very little data on regional and cultural vocal behaviours. Better quality research was also needed in the evaluation of vocal loudness and into the distinctive psycho-acoustic nature of child and adolescent voice. Much of the standard technology that is used to measure vocal products is predicated on adult male vocal models and does not transfer easily to younger subjects. Robust voice recognition systems, for example, are not yet available for child voice.

For those *educationalists* and *psychologists* that were present at the ESF workshop, there was widespread recognition that voice was an integral component of self-identity and communication, but very little research evidence to support the professional perceptions that they shared. The effect of social and cultural contexts on vocal behaviours and development were also under-researched and standard voice assessment profiles rarely have any psychological component. Sociological research into voice is also conspicuous by its relative absence (Potter, 1998).

So, although these three professional groups each had distinctive research priorities, they also shared a common set of challenges. Each group had a partial view of human voice function. Yet if these views could be put together, such as by greater interdisciplinary co-operation, a more holistic perspective should arise. For example, there is a symbiotic

relationship between an improved understanding of vocal behaviours in a variety of contexts (such as social, cultural, emotional) and the design of new assessment instruments. Each is predicated on the other. Improved basic research data should provide a basis for new applied insights and treatments in clinical settings, as well as underpinning more effective pedagogical approaches in voice education.

Central to such collaboration is a need to understand better each contributory discipline's underlying concepts and how these are applied in the generation of research data (see research section below). The definitions of 'normal', 'abnormal' and 'supranormal' (the highly skilled) need to be understood and interrogated as part of a continuum of vocal behaviour (Figure 1).

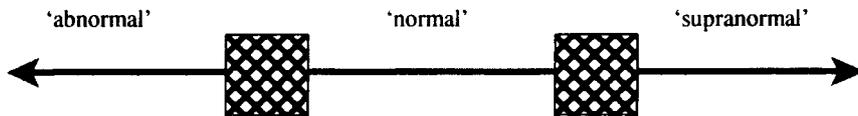


Figure 1: A continuum of vocal ability

The continuum recognises an underlying reality, namely that (a) the boundary regions (indicated by the shading) between these three categories are often blurred, depending on the context and the individual. (b) it is possible to move from 'normal' ability towards either extreme, depending on vocal health and in response to experience (negative or positive) and (c) such movements may be transitory or longer lasting, depending on their underlying etiology.

This continuum also needs to be set in the contexts of the various phases of voice across the lifespan (Figure 2). The transitions between such phases are the product of characteristic changes in the underlying vocal anatomy and physiology as a product of the aging process³ (cf. Kent & Vorperian, 1995) and are linked to maturation. Periods of relative stasis may be interspersed by a relatively rapid change within certain underlying physical components (such as the growth of vocal cartilages with the onset of puberty, or vocal fold tissue degeneration in senescence). These physical changes to the voice are likely to be linked with (affected by/having an effect on) concomitant social and cultural changes, such as within the family, social group, wider community.

Early childhood 0-3 years	Later childhood 3-10y	Puberty 8-14y	Adolescence 12-16y	Early adulthood 15-30/40y	Older adulthood 40-60y	Senescence 60-80+y
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Figure 2: Phases of vocal development across the lifespan

As can be seen by the figure, the indicative ages for each phase often entail an overlap, depending on an individual's rate of maturation and their sex, such as evidenced in the onset of the puberty phase⁴.

Each of these underlying physical changes in vocal anatomy brings about concomitant acoustic changes in the 'character' of the voice. Consequently, vocal identity (both self-identity and how one's voice sounds to others) is likely to undergo a linked transformation. Each new phase may require a period of personal adjustment, particularly in the transitions from childhood to adolescence and through to adulthood. In adulthood there are often significant changes to lifestyle, employment, diet, overall health and the nature of the roles that need to be played at home and outside in the wider world of work. These changes may be accompanied by changing patterns in voice use in response to underlying variations in

emotional states as well as physiological changes. Individual vocal behaviour is closely allied to personal lifestyle (cf. Thurman, 2000; Welch, 2000a).

Researching Singing: Ontological, Epistemological and Methodological Issues

Human communication is mainly (but not only) effected through two distinct, yet related, forms of vocal behaviour: speaking and singing. There is an underlying common anatomical and physiological structure for both these forms of communication, even though the pattern of physical co-ordinations are slightly different (Sundberg, 1999; Welch & Sundberg, 2002). Singing is an integral constituent of the world's musical cultures and, by inference, one of the commonest media for music education, whether this is in formal settings such as in school, or in more informal environments, such as at home, or with peers in the wider community (cf. Farrell, 2001).

The research of singing needs to address the same theoretical challenges faced by the deliberations of those expert researchers that attended the ESF workshop (above). Moreover, voice research, whether focused on speech or singing in particular age phases (such as later childhood and adolescence) has to address the same key philosophical constructs that underpin all research endeavour. These constructs have a variety of different labels, but are commonly viewed as relating to *ontology* (defining the nature of what is 'known', of 'reality'), *epistemology* (the relationship between the researcher and the object of their research enquiry) and *methodology* (the process of research, a selection of methods and procedures) (cf. Guba, 1990). Any (multi-disciplinary) approach to the research of singing would need to make its ontological and epistemological bases clear in order to ensure that the selected methodology and resultant data are fully understood by other users (Figure 3).

Ontological questions	Epistemological questions	Methodological questions
What counts as 'singing'? What would the evidence be for this particular view of singing?	What is the relationship between the researcher and the particular aspect of singing that they are interested in? What is the basis for the researcher's perspective? What role would they like to adopt in the research enquiry?	What procedures are most appropriate for the research methodology, given the researcher's ontological and epistemological position? Does the methodology take explicit account of all of the variables embedded within the researcher's viewpoint?

Figure 3: Mapping the singing research topic and the researcher's basic belief system

For example, a broad framework from which to study how *context* impacts on established 'certainties' (Flyvbjerg, 2001) arises from developments in social science theories (such as the work of Foucault, Habermas, Bourdieu and Giddens). These theoretical advances are related to developments in qualitative research approaches and also to the application of hermeneutics (originally the study and interpretation of human behaviour) to natural as well as social sciences (cf. Kuhn, 1977). "Context-dependence appears to entail an open-ended, dependent relation between contexts and actions and interpretations that cannot be brought under rule-based closure" (Flyvbjerg, 2001, pp. 47-48).

Furthermore, and perhaps more controversially for some, "...the purpose of social science is not to develop theory, but to contribute to society's practical rationality in elucidating where we are, where we want to go and what is desirable according to diverse sets of values and interests" (Flyvbjerg, 2001, p. 167).

It is evident that such contemporary positions concerning social science are somewhat removed from the traditional research practices of natural scientists, who customarily seek to understand the workings of the world according to immutable 'natural laws', such as with methodologies that favour forms of empirical experimentalism (Guba, 1990, p. 19)².

However, hermeneutics challenges such ontological and epistemological positivism by suggesting that reality is socially constructed³. For qualitative researchers, this leads to a recognition that

Behind these terms [ontology, epistemology, methodology] stands the personal biography of the gendered researcher, who speaks from a particular class, racial, cultural and ethnic community perspective. (Denzin & Lincoln, 1998, p. 23)

With regard to research into *singing*, it is clear that each of the traditional main approaches (whether medical, acoustic scientific, psychological or educational, or other less represented approaches such as ethnomusicological or historical) has favoured particular ontological, epistemological and methodological positions in the organisation of its research base. Consequently, depending on the standpoint, identifiable strengths and weaknesses arise in the available research data.

...the first stage in any assessment of singing is a recognition that the activity *is* singing rather than something else [author's italics]. However, this is not always a simple judgement because singing is defined by a complex web of interacting factors, embracing perception, cognition, physical development, maturation, society, culture, history and intentionality. In the case of the young child, for example, the distinction between speech and song, and our adult perception of such vocal acts, is often blurred by a relative linguistic and musical immaturity and by our own (adult) desire to make sense of the vocalisations. (Welch, 1994, p. 3)

The definition of singing will depend on a particular ontological and epistemological position. First of all, singing involves a musical 'instrument' that cannot be observed directly unless modern advanced imaging technology is used and, even then, such imaging will not reveal anything about the *musical* behaviour of the instrument because music is created in the mind (cf. Welch, 2001). In order for such behaviour to be recognised as 'singing', there has to be an application by the mind of the listener (and/or performer) of their own concept of what counts as singing. There is likely to be a surface recognition that (a) such sounds appear to originate from the human voice – that they have a human vocal quality – and (b) the sounds have recognisable musical features, i.e. that the acoustic information is perceived by the auditor as being organised according to pitch range, temporal proximity and similarity of timbre (Krumhansl, 2002).

However, the nature of the perception is often framed by the conceptualisation of a particular research discipline. For example, the musician/musicologist may focus on underlying musical structures, comparing the vocal products to known and established musical examples within the culture and the composition rules that are believed to govern such structures. The ethnomusicologist is likely to be equally interested in an ethnographic study of the singing, the study of singing '...in culture and as culture' (Farrell, 2001, p. 39), whereas the clinician may be more focused on the extent to which the perceived underlying physical behaviour is functioning in a healthy manner. The acoustic scientist is likely to be more focused on generating an accurate map of particular acoustic features, whereas the psychologist may be interested in the performer's own view of their singing, on how this changes over time, or on why this particular behaviour is perceived by others *as* singing. Alternatively, an educator may be focused on how such behaviours can be shaped so that they meet more 'expert' or 'ideal' criteria, but an early childhood educator may concentrate instead on celebrating the perceived vocal behaviour of the child in its own right, without reference to adult models, as much as how such behaviours might can be extended in a variety of ways. For each of these professionals, there will be underlying ontological and

epistemological bases (and biases) that are being applied in the generation of their particular categorical perception.

In turn, these differing perspectives influence the type of methodology that is selected for the research activity. For example, case study data is common in clinical settings, usually on the assumption that there is a 'normative' database that can contextualise a particular case. However, unless there is an obvious cause for a particular vocal behaviour (such as a physical disorder), the clinical setting may not reveal the ecology of a perceived disorder in singing behaviour that arises in actual performance settings. The clinician will be reliant on self-report which may or may not reflect accurately the nature of the behaviour. The cause could be a psychogenic disorder (Neemuchwala, 1998) that is manifest during performance, but not at other times.

In contrast, a participant observer approach is likely to be evidenced by the insightful ethnographer who is interested in understanding how the performer (or fellow performer) makes sense of their particular situation, such as in rehearsal or performance.

In the performance of The Who's 'rock opera', *Tommy*, at The Rainbow Theatre in 1975 the chorus of classical session singers gave the work a certain legitimacy and set up certain expectations for some sections of the audience. The choir was part of what made it possible to call the work an 'opera'. The singers themselves (of which I was one) were considered to have performed their task professionally and adequately. The meanings that they made for themselves were strongly influenced by the fact that they were performing with a hugely successful pop group, that the music was very loud (an amplified choir over an amplified London Symphony Orchestra), that some would not call it music at all, but most of all by the fact that the money they would earn seemed out of all proportion to what they were asked to do and that there was a free back-stage bar... None of this would have been transmitted to the audience, yet had we felt any differently about the music and the circumstances of its performance, our performance would have been a different one, but any perceptible difference would have been filtered by the audience to produce the same outcome. (Potter, 1998, p. 166)

One outcome of such differences in the adopted research approach is that there are gaps in the available research literature. Depending on the discipline, there is an under-representation of studies concerning children, females and ethnic minorities, as well as studies that are multi-disciplinary, large scale, longitudinal, cross-cultural, ecologically valid, non-Western or popular music focused.

In addition to the generic research issues (Figure 3), any specific research into singing will also need to take account of the variables contained in figures 1 and 2. Specifically, the researcher needs to decide on which phase or phases of vocal development are the prime focus, as well as the general type of singing ability (see Figure 4).

	Early childhood 0-3 years	Later childhood 3-10y	Puberty 8-14y	Adolescence 12-16y	Early adulthood 15-30/40y	Older adulthood 40-60y	Senescence 60-80+y
abnormal							
normal							
supra-normal							

Figure 4: Mapping possible areas for singing research – deciding the research focus

One example of how different disciplinary research perspectives link to definitions of 'normality' is to be found in the literature on vocal pitch accuracy in children's singing. At one time, children who sang 'out-of-tune' were regarded as musically disabled and

'abnormal' singers. Normal behaviour was defined in terms of majority adult models. More recently, however, research suggests that (a) 'in-tuneness' is both a socio-cultural and a psychological construct and (b) it is normal for children to exhibit variable vocal pitch accuracy as part of their singing development (Welch 2000c, 2001).

Similarly, early researchers believed that it was normal for boys to experience difficulties with singing during adolescence and suggested that singing should cease until early adulthood. More recent research, however, has demonstrated that there is a pattern to adolescent voice change and that it is possible for males to continue to sing successfully and without voice strain if an appropriate music curriculum is provided (Cooksey & Welch, 1998). Any 'difficulties' in singing are often associated with inappropriate pedagogy and/or negative comments from family, peers or other adults. Unless addressed sympathetically, such difficulties can persist into adulthood as part of a wider self-labelling of musical disability (cf. Knight, 2000).

An example of a more problematic area of research concerns adolescent voice change in females. Because this has been a relatively under-researched area until recently, the definitions of 'normal' are still being constructed. It is now recognised that the peak of mutation for adolescent girls is often associated with an instability of vocal pitching, particularly with upper sung pitches (Pedersen, 1997). Given such instability, the medical researcher may have difficulty in determining whether an adolescent female singing behaviour has an underlying pathology or is just part of a 'normal' phase of development. This is an example of where more longitudinal studies are essential of larger numbers of participants, using robust methodology.

Similarly, White (2000), a voice scientist, undertook a study of formant frequencies (resonance areas) in the speech and singing of eleven-year-olds. Using inverse filtering⁷, the data suggest that girls have higher formant frequencies than boys at this age and that the differences were more marked on certain vowels, as well as being linked to the mode of production (speech or song). However, White readily recognises that any study of formant frequencies using inverse filtering works best at pitches in the lower part of the vocal range. Higher sung pitches are not accessible using this method and so an alternative method needs to be found to research formants for upper pitches to confirm her findings.

Another area which requires further investigation concerns emotion and singing. Emotion is recognised as an integral element of performance. Yet, from the point of view of performer, there is a need to interpret the composer's emotional intentions, to translate these for the audience, but not to compromise the quality of the vocal production. Research into emotion in musical performance (e.g. Gabrielsson, 1999; Juslin 2001) indicates that emotion is conveyed by the type of performance practice, such as articulation and timing. Juslin (2001, p. 322) argues that emotions are 'encoded' by the performer and 'decoded' by the listener according to a limited number of 'basic' emotion categories (such as fear, anger, sadness, happiness).

The grounding for these 'basic' categories is likely to be the infant's early experiences of voice, as six primary emotions – fear, anger, joy, sadness, surprise and disgust – are all commonly expressed vocally (Titze, 1994) and are differentiated by strong acoustic variation (Scherer, 1995). It has been hypothesised elsewhere (Welch, 2001) that the mother's vocal behaviours (singing and speech) pre-birth into early infancy are central in the development of early musical abilities, the development of a musical identity and our emotional biasing towards vocalisation and vocal timbres (see figure 5). During the final trimester, the developing foetus demonstrates a particular sensitivity to the pitch inflection of the mother's voice in speech and singing (Thurman & Grambsch, 2000), as well as a (lesser) sensitivity to external sources of music of the maternal culture – the music that the mother listens to during infancy (Woodward, Fresen, Harrison, & Coley, 1996). One aspect of pregnancy is that the mother's neuroendocrine condition produces related reactions in the foetus through an interconnected bloodstream. Consequently, the mother's emotional state when vocalising (speaking or singing), or listening to music, is capable of being transmitted to the foetus and is likely to produce sound-associated affects.

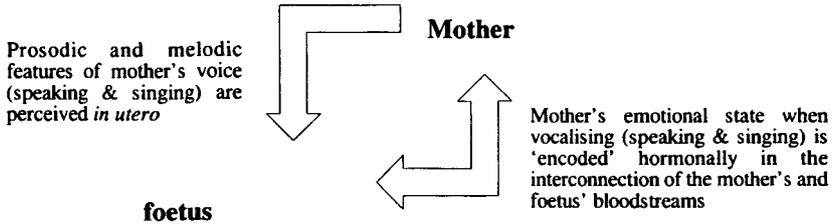


Figure 5: Mother-foetus bodymind relationship and the integrated encoding of vocalisation and emotion

The outcome is that we enter the world with an emotional 'biasing' towards certain vocal sounds (prosodic and melodic), based on two interconnected inputs from the mother (emotional and sonic). Consequently, these form the basis of our first 'preferences' (positive and negative) towards music, including singing. Arguably, everyone is uniquely musical because of this early bodymind integration of voice and emotion that arises from the interconnection between mother and foetus.

In a very real sense, this neuropsychobiological developmental biasing within the womb in terms of a combined and integrated influence from mother's emotional and sonic worlds should be viewed as 'emotional capital' (Welch, 2004; *pace* Bourdieu's concept of 'cultural capital' that is accumulated in the home and which provides access to educational success – Fowler, 1997, p. 23). Indeed, it can be argued that 'emotional capital' is more pervasive and more omnipresent than 'cultural capital' because it is part of a human design inheritance that allows us to have emotional as well as cognitive and social engagement with the musics experienced at home and in the local socio-cultural community. But it also provides us with a basic feelings framework with which to access (positively and negatively) *all* musics, whether this be at a most basic level related to the perception of psycho-acoustic features (such as pitch, loudness, timbre) or underpinning our perceptions at more sophisticated level concerning a particular music's syntactic and communicative elements (related to the potential for musical sound to be understood as a form of language) (Welch, 1998; 2002).

Whilst there is considerable actual and inferential evidence to support the link between emotion and singing in the early stages of life, the research literature on such links across the lifespan is limited. There have been a few studies, such as in children (Adachi & Trehub, 1998) and adult performers (Behrens & Green, 1993; Baroni & Finarelli, 1994; Salgado, 2003), with the available data suggesting that the perception of emotion is dependent on the type of musical instrument and the intended emotion. Culture is also likely to be significant.

Explicating a Research Framework for Singing Research: A Case Study

With regard to my own research, looking back over twenty-five years suggests that a number of different perspectives have been adopted, within a variety of epistemological frameworks. In common with many young researchers who pursued their studies before the advent of formal research training in masters and doctoral programmes, my adopted approach was within the current paradigms available to me. Because I have always had a particular interest in individual development (a likely product of thirteen years elementary school teaching, allied to a curiosity about the bases for individual differences, to 'success' and 'failure'), my initial research activities were primarily psychological in focus and experimental – seeking to understand how possible variables might influence children's

singing behaviour. These experimental studies, however, followed two literature reviews which demonstrated to me how specific concepts were socially and temporally located – a product of a particular researcher working at a particular time in a particular location. Once these differences were ‘mapped’ (Welch, 1979a; 1979b), I began to understand more clearly why certain pedagogical practices could lead to the inappropriate musical behaviours⁸.

Since that time, I have had to spread my research ‘net’ to include aspects of voice acoustics, anatomy, physiology and socio-cultural factors. These have been essential ingredients for my developing understanding of the phenomenon of singing. Without such a broad perspective, my understanding was always likely to be partial and liable to inhibit pedagogical effectiveness when such understanding was applied in the classroom, concert hall or studio. I needed a multifaceted perspective in order to generate a more holistic understanding, not least because education, as an applied social science, tends to begin where the other disciplines tend to stop⁹.

Accordingly, the research into singing has embraced many different approaches. These include experimental work, the use of ‘impartial’ judges, surveys, case studies, longitudinal and comparative studies, literature-based enquiry, observation, introspection, structured and semi-structured interviews and questionnaires, as well as various acoustic measures (such as measures of vocal fold activity using an electrolaryngograph and vocal tract patterning using xeroradiography). Each of these research methodologies has had to take account of the age and experience of the participants. It has also been important (wherever possible) to address issues of ecological validity, i.e. to ensure that the observed behaviour is as ‘real’ as possible. Recordings have been made in places where the participants usually sing and feel ‘at home’. The exceptions have been rare occasions when the observations have needed to use large immovable specialist equipment.

Collaboration has been an essential component in order to access specific areas of knowledge and expertise, such as being inducted into the conceptual frameworks that inform the design of special voice technology and their underlying models. It has been essential to play a variety of roles – leading, following, supporting, managing, being supported, being managed – in order to maximise the talents available within the collaborative group.

An overview of certain key elements within this research journey is contained in Figure 6, clustered under the three continuum headings of ‘abnormal’, ‘normal’ and ‘supranormal’. Case studies have been used to understand individual singing behaviours. These were often classified as ‘abnormal’ in some way and usually contextualised by other ‘normative’ data from a supposedly ‘normal’ population. These case studies have included individual professional singers that have been referred for some form of psychological diagnosis and rehabilitation following trauma (physical or psychological). In contrast, the ‘supranormal’ studies have focused on understanding how the trained singing voice functions and in what circumstances.

The ‘normal’ studies in figure 6 have included the design of special research protocols to determine longitudinal changes in the perceived singing development and abilities of young children during their first three years at primary school. The singing focus for this research was deliberately ‘school-centred’ and this was reflected in the research design, such as in the choice of singing tasks and the close involvement of the children’s class teachers.

The three illustrations within figure 6 are (a - top) a xeroradiograph (soft-tissue x-ray) showing a lateral view (from the left) of the vocal tract of a soprano at rest (Welch & MacCurtain, 1986), (b) a high-resolution 3D brain reconstruction as seen through a semi-transparent skull (Courchesne & Plante, 1997 - left) – a reminder that singing behaviour originates from an integrated neuropsychobiological ‘bodymind’ (Thurman & Welch, 2000), and (c) a top-down view of the vocal folds of a professional countertenor, showing the adducted folds in the centre, framed by the arytenoids cartilages at the top of the image and the epiglottis at the bottom (Welch, unpublished data – right).

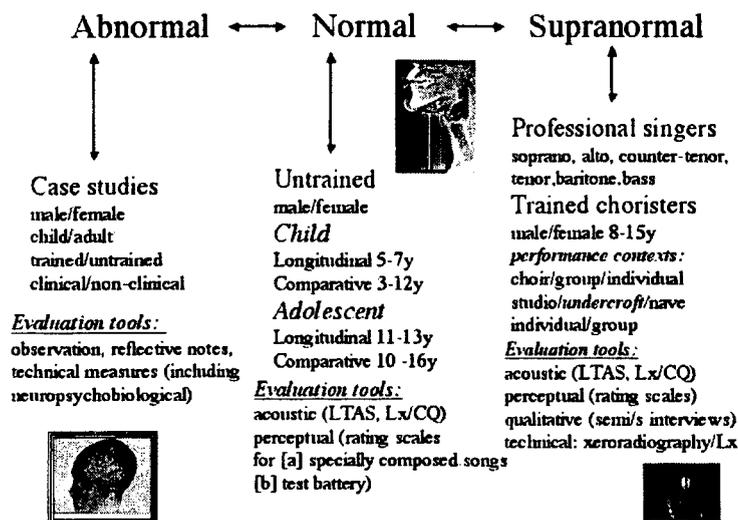


Figure 6: Example researches across the ability continuum

One aspect of the recent (ongoing) study of female cathedral choristers (cf. Welch & Howard, 2002) is exploring how their singing behaviours are modified by a particular socio-cultural context, such as the location for the singing performance (whether a practice room, the Cathedral Nave or Undercroft), the size of the group and the nature of the musical genre being performed (Figure 7). A related focus is on gender, with a series of perceptual studies aimed at identifying particular acoustic features that have an identifiable impact on gender perception (Howard, Barlow, Szymanski, & Welch, 2001; Howard, Welch, & Szymanski, 2002). Another focus is on identifying acoustic changes in individual female chorister vocal products over time (Howard & Welch, 2002).

Q: What is the nature of the vocal output? In what context?

Performer & context	Medium	Participant Tasks	Quantitative Data tools	Qualitative Data tools
Individual chorister Small group (after vocal warm up) 	Speech	• Conversational speech • Text reading 'Arthur the Rat' • Single words/vowels	Spectrum (LTAS) Voice source (LX/CQ)	Semi-Structured Interviews (data analysis using Hyper Research)
	Singing	• Scale (2 x 8ve g3-g5) • Vowels (x 4 pitches: c4, e4, c5, e5) • Familiar carol (v1) • Other vocal genre	Perceptual analyses (panels + rating scale)	
Choir	Singing	Selected repertoire	[as above]	[as above]

Figure 7: Tracking contextual variables in a supranormal study of female cathedral choristers

The 'quantitative data tools' column of the figure includes acoustical measures applied from speech science to singing. LTAS refers to a measure of long term average spectra, an assessment of the spectral peaks over time within the acoustic output that contribute to the perception of the singer's individual vocal timbre. Lx and CQ are measures derived from an electrolaryngograph in relation to the pattern of vocal fold contact. These measures provide an indication of the effects of training on the voice source and underpin notions of perceived vocal efficiency for the voice scientist.

Coda

The personal examples given above are just some of the possible ways in which singing can be researched. There are many others, including:

- Policy development (such as the policy on singing in a particular location)
- Curriculum design for singing
- Learning and teaching processes
- Access (opportunities for inclusion/exclusion)
- The professional development of singers and their teachers
- Change over time (with a definable 'baseline' for longitudinal study)
- The study of previous singing (and/or singing pedagogy) cultures
- Systems, procedures, criteria for singing assessment and evaluation
- Student and teacher identities as singers
- Educational cultures where singing is taught
- The influence of contexts and cultures (such as people, places, practices, policies)
- Neuropsychobiological aspects
- Singing as psychological or physiological 'therapy'
- Singing and health

Some of these topics are rarely found in the research literature, perhaps because they suggest a wider social science perspective that is beyond the traditional viewpoints offered

by musicology, psychoacoustics, developmental psychology and medicine. Nevertheless, they are worthwhile, not least because such research would expand our range of ontological and epistemological perspectives and so increase our understanding of the phenomenon of singing.

As for the users of research, four recent studies initiated by the Australian Department of Education, Training & Youth Affairs (DEVTA) and the Australian Research Council (ARC), as well as a separate study by Selby Smith (1999), have revealed (or confirmed, depending on your point of view) that the relationship between educational research and practice is not linear. The impact is multi-layered and unpredictable, being an interactive process between the researcher (and their data) and the educator. This is yet another reason for us to ensure that our research frameworks continue to be interrogated and made explicit when we report our data. Like singing, research is socially and culturally located.

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Endnotes

1. An earlier and shorter version of this paper formed the basis for a keynote address given at the CIPEM/ISME Research Commission Pre-Seminar Workshop, Porto, July 2002. The current text has been expanded and includes new material.
2. European Science Foundation Standing Committee for the Social Sciences (ESF/SCSS) Exploratory Workshop on 'Voice Development, Assessment, Education and Care in Childhood and Adolescence' May 1-2, University of London Institute of Education. Workshop Coordinator - Professor Graham F Welch. See the ESF website www.esf.org/workshops for details.
3. See Thurman & Welch, (2000, pp. 657-744) on 'Lifespan voice development' for more detail on how anatomy and physiology develop across the lifespan and the effects of these on vocal production.
4. See Welch & Howard (2002, pp.104-107) for an overview of key physical changes and sex differences in the transition from later childhood to early adulthood. See also Titze (1994, pp. 178-185).
5. However, these apparently dichotomous positions between natural and social sciences – known as 'science wars' in some circles – have led others to suggest that a new 'consilience' (coming together) is both possible and emergent. See Damasio *et al* (2001) for one recent debate, particularly pages 233-257 on 'Science, Culture, Meaning, Values: A Dialogue'.
6. Such social construction is commonly evidenced in curriculum design, where the knowledge content is a selection from all that is potentially available. Choice is based on a particular group having specific priorities and definitions of what they consider to be significant and appropriate. There are many different curricula evidenced in the world's education systems because education and research are contested concepts, as well as being culturally bound (Welch, 2000b).
7. 'Inverse filtering' (Rothenburg, 1973) is a technique designed to remove the filtering effect of the vocal tract on the sound source at the level of the vocal folds.
8. A more recent example is found in the work of one of my co-researchers, Susan Young (1999). Her doctoral studies contrasted the epistemological positions of early childhood researchers with music education researchers. The former tended to build a 'bottom-up' model that celebrated an idiosyncratic developing mastery, whilst the later often took a 'top-down' view of childhood as somehow 'deficient' compared to the model of a competent adult.
9. This is an insightful comment from a Swedish co-researcher, Göran Folkestad.