A PILOT STUDY OF SEVEN-YEAR-OLD CHILDREN'S SINGING BEHAVIOUR, DEVELOPMENT AND ENGAGEMENT IN CHINA

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ABSTRACT

The article reports the outcomes of a pilot study that is part of a larger investigation into Chinese Primary school children's singing behaviours, development and engagement. The prime aims of the pilot study were both to evaluate the assessment tools and protocol for the main study, which is designed to create a rounded picture of older Chinese children's singing (aged 7-11 years), and also to explore the initial pilot study data for any emergent patterns. During the pilot study, data were collected from N = 15 participant children aged 7 years, drawn from 5 Primary schools in mainland China. Of these, there were 10 boys and 5 girls, with 2 out of 3 children drawn from rural areas. Child participants had no specialised singing training and all were volunteers, each participating with appropriate ethical approval). The pilot study focused on testing different aspects of children's vocal products, as well as their perceptions about singing and one additional, non-musical aspect of identity (social inclusion). Assessments included each child's spoken pitch centre, comfortable singing range, singing behaviours of three songs and attitudes to singing in

different contexts, as well as their sense of being socially included. Vocal pitch behaviours were audio/video recorded and vocal pitching was assessed against a reference piano keyboard. The three target songs embraced one with a simple limited pitch range (*Twinkle, Twinkle*), one that had a more extended pitch range and contour (*Happy Birthday*) and a Chinese language nursery song (*Little Donkey*). Participants' singing behaviours were measured against two established and complementary scales: Vocal Pitch Matching Development (VPMD) (Welch, 1998) and a Singing Voice Development Measure (SVDM) (Rutkowski, 1997). The children's questionnaire contained statements concerning their attitudes to singing in different settings, including school, home, informal settings, their perceived identity as a singer (exploring their emotional connection with singing and self-identity) and their sense of social inclusion. The results confirmed that methods of singing assessment were generally appropriate to test participants' singing behaviours. *Little Donkey* was reported as the hardest song by participants because of its lyrics, whilst *Happy Birthday* was the easiest song for them. Some statements in the questionnaire could not be understood easily by a few participants, and adults provided help. The questionnaire was effective in building a holistic picture of participants' attitudes to singing. The results of the pilot study were as follows: (1) n=13 of 15 participants (87%) had a spoken pitch centre in the range from A_3 to E_4 (220Hz - 329Hz); (2) 75% of their comfortable singing range was encompassed by $A^{\#}_3$ to A_4 (233Hz - 440Hz), being almost 1 octave; (3) girls' VPMD ratings were found to be significantly higher than those of boys in *Twinkle, Twinkle* (p = .001), and *Little Donkey* (p = .044), but similar for *Happy Birthday*. The VPMD ratings for *Happy Birthday* were the lowest of the three target songs for both sexes. No sex differences were found in SVDM ratings, and the SVDM scores across the three songs were similar. After combining the data from the two established rating scales to provide a composite measure

of singing competency, only the song *Twinkle, Twinkle* had significant sex differences, in favour of females. N=10 children (4 boys and 6 girls) completed the questionnaire. The results suggested that these children's attitudes to singing varied by theme. The ranking in order of relative positivity by means were as follows: social inclusion > emotional engagement to singing > values for singing at home > values for self-identity > values for singing in school > singing in informal settings. Overall, the pilot study indicated that the assessment tools and protocol were appropriate and could be applied in the proposed longitudinal main study in China that began in late 2017 and continues over successive years.

Keywords: singing behaviours, 7-year-olds, sex differences, attitudes to singing, China

INTRODUCTION

Singing is one of essential musical forms in Chinese music (Yang, 2011; Yang & Welch, 2016), and singing performance often combines movement of body and percussion playing. Nevertheless, the nature of the Chinese Primary school children's singing behaviour and attitudes towards singing have not received much attention in previous literature, although Liu et al. (2011) tested singing behaviour and development in N =180 Grades 1 to 5 children from north-east China, noting age and sex differences. The current pilot study reported here forms part of a larger longitudinal study that seeks to address this need for more systematic research into children's singing. Although the sample size in this pilot is small, the purpose of the pilot study was to trial core features of the methodology and also to report on the initial data analyses. There were 15 participants in this pilot study, aged 7-years-old.

The main research questions were as follows: (i) Is the pilot research methodology appropriate for the proposed main study? (ii) What is the nature of participants' singing behaviour, including general spoken pitch centre, comfortable singing range, and assessed singing behaviours of three songs by sex? and (iii) What are Chinese participants' attitudes towards singing in different settings? The pilot study was the first step prior to undertaking the larger main study that seeks to create a rounded picture of approximately 1,000 Chinese children's singing behaviours and attitudes towards singing, located in Hunan Province, China. The prime aims of the pilot study were (a) to assess the feasibility of protocols (data collection and synthesis) to be used in a main study; and (b) to help the first author become familiar with the fieldwork process, including teamwork with local colleagues in Chinese schools, building a database, data collection, and the design of the data entry system. Given the complexity of Chinese cultural and economic background

evidenced in the official statistics of China (OECD, 2016), adopting multiple perspectives was seen as being appropriate in order to explain Chinese pupils' singing behaviour.

The OECD (2016) reports that China has the world's largest population at nearly 1.4 billion, with 'vast' income inequality, a state-run education system of over 500,000 schools that is increasingly decentralized and with four levels of organization: national (central), provincial, county and local township. Students must complete nine years of compulsory education. There are 56 recognised ethnic groups nationally.

Luria, Vygotsky and Leont'ev were three of the first psychologists in the early decades of the twentieth century to explore how individual learning might be influenced by cultural artefacts and the local community within a wider community (*cf*. Bannon, 1997; Cole, 1999). These psychologists' work on the social psychology of learning was crucial in the creation of what came to be known as Culture Historical Activity Theory (CHAT) – often called Activity Theory for short – to analyse the systematic shaping of human activity. Key CHAT elements embrace concepts of the 'subject [individual/topic], rules, community, division of labour, mediating artefacts, object, and outcome' in an integrated way (Engestrom, 2001, p. 136). Drawing on Activity Theory, Welch (2007) analysed aspects of children's singing behaviour from three prime generative elements: (i) neuropsychobiological development, (ii) socio-cultural context and (iii) musical task, suggesting that each component—individually and collectively—has a role in shaping behaviour.

(i) Neuropsychobiological development

Looking at the three perspectives more closely, the physical vocal apparatus for singing is composed of the respiratory system (energy source), larynx (sound generator), articulatory apparatus, nasal cavity and side cavities (part of the sound resonators) (Kayes,

2015; Davidova et al., 2015), and all of these components are interrelated in function and subject to neurological activity (Kleber & Zarate, 2014). The position of the larynx is an important feature of vocal practice (Davidova et al., 2015), being related to the stylistics of singing (Kayes, 2015), and the vibrating vocal folds are the most important part of the larynx as the voice source. Furthermore, singing is a psycho-physiological process, which means that children's emotional state could change the organism's action, such as related to respiration and gas exchange (Davidova et al., 2015), as well as tone quality. The output characteristics of the vocal apparatus in action are indicated by a range of psychoacoustic parameters, such as frequency and harmonics, range, dynamics and vocal registers.

In terms of socio-cultural context, children's attitudes towards singing are shaped by context and biography, such that they can have different attitudes towards singing depending on the environment (Welch et al., 2009).

The structural functioning of a 7-year-old child's vocal mechanism is relatively simple. It is reported that they only use marginal tension of the vocal ligaments to sing, and their vocal folds are relatively thin (compared to older children) and short compared to those of adults (Davidova et al., 2015), characteristics which can make vocal control uneven for some children. During phonation, the vocal folds mainly use their inner edges to vibrate in the upper register. A small respiratory system and higher pressure in their trachea can produce relatively short breathing cycles. According to Davidova et al. (2015), the quality of the voices of children aged 6 - 8 is characterised by a relatively high pitch, although they can achieve similar loudness levels to adults by using relatively more breath (Stathopoulos, 2000), but with little difference between the sexes. As the vocal mechanism develops with age, older children tend to show a greater ability to sing in-tune and with a wider singing range (Welch et al, 2012).

Our perception of pitch is determined essentially by the frequency of vibration of the vocal folds (Welch & Sundberg, 2002; Davidova et al., 2015). In terms of spoken pitch or speaking fundamental frequency (SFF), Gelfer and Denor (2014) report a mean range between 253Hz and 256Hz for 7-year-old participants which, in musical terms is somewhere between B_3 and middle C_4. Relatedly, Welch et al. (2009) report a slightly wider range of B_3 - $C^{\#}_4$ for a large number (n=1,823) participants of the same age (i.e., children in English Primary school Year 3). Nicollas et al. (2008) reported a centre spoken frequency of 252.7Hz for 7-year-old boys and 255.98Hz for girls (approximately B_3). Sorenson (1989) reported the pitch D_4 (approximately 294Hz) as the mean of 7-year-old children's speaking fundamental frequency. Speaking fundamental frequency can be variable, depending on context, but is usually considered to be within 3 semitones of their commonplace speaking fundamental frequency, at least for 90% of the time (Coleman & Markham, 1991). Overall, given that children's physical size differs for a given age, it is likely that spoken pitch will similarly vary – in this case for 7-year-olds, just above or below middle C (C_4, approximately 260Hz).

Vocal range is an individual thing in terms of the extremes of the range, although common pitches are evidenced for the majority. Vocal range depends on both the natural anatomical and physiological features of the singers' vocal mechanism (Davidova et al., 2015), as well as age and experience (Welch et al., 2009). In terms of 'comfortable' singing range, the definition of 'comfort' is used to signify 'sung with no evident vocal strain or perceptible change in vocal quality across the range' (Welch et al., 2009, p. 32) and is usually less than the total possible vocal pitch range. Joyner (1971) reported B^{b}_3 - B^{b}_4 as the comfortable singing range for 7-year-old participants. Similarly, Hall (1972) reported A_3 - B_4 and Hattwick (1933) earlier reported B_3 - A_4. Plumridge (1972) reported a slightly narrower range of C_4 - A_4. In contrast, within the assessments of an overall N = 8,799 children

involved in a mid-point evaluation of a four-year-longitudinal evaluation of the national *Sing Up* programme in England, Welch et al. (2009) reported that Year 3 children's comfortable singing range was G_3 - C_5, which is wider than the ranges reported in the other literature sources above, but based on a much larger population. However, it should be noted that children in all of these studies have a Western cultural background, rather than Chinese.

Intonation problems in young children's singing can be one of the biggest challenges for music teachers of singing. Thurman and Welch (2000) reported that, within Western cultures, it is common for approximately 30-40% of 7-year-old children to find difficulty in singing with precise intonation, although this proportion reduces significantly as children get older. Goetze (1985) reported a higher number of 70% for ages 6-8 years in her USA study. In order to explain why children sing out-of-tune when asked to reproduce a song from their immediate culture, Shaw (2013) suggested four perspectives: physiological reasons (e.g. respiration), psychological reasons (e.g. emotion), organic (e.g. disease) and environmental influences (e.g. musical exposure). To these should be added developmental aspects of motor control (Welch, 1985; 2016). A large-scale longitudinal study of N = 184 children aged 5 to 7 years in London found that young children were much more accurate in their vocal pitching when reproducing the constituent pitches of songs without the addition of lyrics (Welch et al., 1997). This finding implies that it is the combination of language and music in song singing that presents challenges for some children; they over-focus on the lyrics (which are likely to have the greatest cognitive loading) rather than the melodic (musical) features of the songs.

In terms of sex differences, previous literature has commonly reported that a larger proportion of girls sing in-tune than boys of the same age (e.g. Ellis, 1993; Goetze, 1985; Howard et al., 1994; Norioka, 1994; Trollinger, 1994; Welch & Murao, 1994), although

Mizener (1990) found no significant sex differences in Primary school students' pitch matching accuracy. In the three-year longitudinal study of N = 184 children reported above (Welch et al., 1997), sex differences were evident in vocal pitch accuracy in song singing at each successive age, but there were no sex differences when children sang examples of the songs' constituent pitches without words. Furthermore, analyses of N = 11,388 individual assessments of children's singing that were undertaken across England as part of the *Sing Up* evaluation found sex differences in each year group (Welch et al., 2012). However, these sex differences were open to modification and reduction through appropriate educational experiences. Although boys tend to be less skilled in singing than their female peers at each age, boys are able to improve and develop, especially when they experienced a nurturing musical environment (Zdzinski, 1992; Welch et al, 2012).

Given the importance of talk and communication in young children's development, it is likely that – for some – their speech behaviours dominate when they are asked to sing. Such children can be relatively more accurate when asked to sing in their spoken pitch range, but become much more inaccurate when the target pitch moves above this. The implication is that out-of-tune singing of higher pitches is a product of children trying to take their 'chest' (speaking) voice upward (Patricia, 2006). Wurgler (1990) reported earlier that most children often chose to sing in a chest (speech) register, and that children tend to sing more accurately in the lower than in higher keys.

(ii) *The impact of socio-cultural context*

Young children's singing behaviours are shaped by the community around them as part of a normal process of enculturation (Welch, 2000). However, the term community implies a multi-faceted reality. For Primary school children, this will include school, home, informal

settings, and a wider community. Individual identity is shaped by experience of the roles in the community, with different elements of the community having different levels of influence on the individual. Hale (2006) reports that Primary students' attitudes towards singing may influence later singing and music participation, a position that is supported by empirical evidence of adults who do not sing (e.g., Knight, 2016).

Two years into the research evaluation of the National Singing Programme *Sing Up* in England, data had been collected at that moment from N = 8,124 7- to 10-year-olds concerning their attitudes towards singing in different contexts (home, school, wider environment) and also concerning their emotional engagement with singing (Welch et al., 2009). The researchers concluded that children's attitudes towards singing demonstrate significant differences by school age and sex in all selected contexts, as well as variations in exposure to singing education between *Sing Up* participatory schools and non-*Sing Up* schools. The mean ratings for 7-year-old females and males (based on a seven-point Likert-type scale) demonstrates effects of group membership (see Table 1) (Welch, private correspondence). In particular, three things are striking about the data: (1) girls tend to be more positive than boys, in general, on all five questionnaire themes that relate to singing identity, including location and emotional engagement with singing; (2) within each sex group, girls with experience of *Sing Up* are even more positive on three of the five themes, whereas the comparative outcomes for boys are more mixed; and (3) despite the variations, all mean scores for both sexes are above the mid-point (3.5) on the 7-point scale for each theme (see Table 1).

Table 1: Children's attitudes and emotional engagement with singing, questionnaire data from *Sing Up* evaluation, children aged 7-8 years (Welch, private correspondence)

Sing Up Questionnaire responses by theme for n=8,124 pupils in School Year 3 (ages 7-8 years)	Female non Sing Up	Female Sing Up	Male non Sing Up	Male Sing Up
Emotional engagement with singing	5.9	5.9	5.1	5
Identity as a singer (self)	5.1	5.2	4.8	4.7
Singing at home	5.1	5.3	4.1	4.2
Singing at school	5.3	5.3	5.1	5.1
Singing in informal settings	4.8	5	3.7	3.9

	FEMALE OVERALL	MALE OVERALL
Emotional engagement with singing	5.9	5.1
Identity as a singer (self)	5.2	4.7
Singing at home	5.2	4.2
Singing at school	5.3	5.1
Singing in informal settings	4.9	3.8

Primary school children's attitudes towards singing and music in school may be influenced by various elements, including teachers (Boswell, 1991) and peers, as well as teaching methods (Siebenaler, 2008). However, Welch et al., (2009) reports that school education has less influence on children's attitudes toward singing at home, with the latter tending to be reported as more negative for boys, but equally positively by girls. Other previous literature suggests that children's attitudes to singing are influenced by their friends (e.g. Meilink, 1999; Richard, 1999; Roewer, 2000; Wapnick, 1976). For singing at home, Adachi and Trehub (1998) reported that children aged 4-12-years-old can contrastively note happy and sad emotions in familiar songs. Joyce (2005) notes that over 70% of her child participants agreed that they learnt songs at home, although there are sex differences in favour of girls. However, only 57% of all participants had been told that they are 'good' singers by family members. In this study, participants from Muslim families and those receiving free school meals (a measure of family poverty in England) are even less

likely to have received praise from their families.

As mentioned above, socio-economic status can influence children's attitudes towards singing in the home. In a non-musical study, Dai and Chu (2016) assessed N = 448 'left-behind' children aged 7-16 from Western China. 'Left-behind' children are defined as those whose parents need to work in other parts of the country and, consequently, such parents usually have very few opportunities to return home across the year. Child participants were asked to complete a questionnaire and also four teachers were interviewed. The authors reported that Grade 3 and 4 children (8-9 year-olds) had lower self-esteem than their Grade 5 and 6 peers, primarily because they were perceived to be suffering more from the deprivation of parental care. It is also suggested that the home environment is an essential element in our understanding of children's sense of social inclusion. Welch et al. (2009) explored the relationship between singing behaviour and children's social inclusion (children's sense of being socially involved) in 4,495 children aged 7-11 years in England by 15 statements. They report that girls' sense of social inclusion was stronger than that of boys. As children get older, the situation can change. Subsequent research analyses with a larger group of participants (n=6,087) compared perceptions of social inclusion and singing competency in the same children (Welch et al, 2014), and revealed a clear relationship between the two: the more competent singers are likely to report themselves as more socially included, and vice versa. In contrast, in a non-music study, Watkins et al., (1997) tested general self-esteem in N = 599 Chinese children from urban Beijing aged 10 to 13 years. They reported that girls had lower self-esteem than boys.

Overall, notwithstanding the relatively extensive study of children's singing behaviour and development in the West, there have been relatively few studies of Chinese children's singing, especially in mainland China, although some studies exist from Hong Kong – see

Chen-Haftek, 1998 and Mang 2002, 2006 as examples. Consequently, the current study sought to initiate a pilot study exploration of the nature of children's singing competency in schools in mainland China, in the context of an application and extension of the musical tasks used in the English *Sing Up* study (see below) – being an example of the third generative element in understanding of singing behaviour and development, as proposed by Welch (2007).

METHODOLOGY

The prime aims of the pilot study were (i) to evaluate the assessment tools and protocol for the subsequent main study – which is designed to create a rounded picture of older Chinese children's singing (aged 7-11 years) – and also (ii) to explore the initial pilot study data collection for any emergent patterns in the data.

Participants: During the singing assessment, five adults who are known by the first author (three relatives and two music teachers) helped to collect data from 15 participant children, drawn from five Primary schools in the north-east of Hunan Province, China. The pilot study was undertaken from August to September 2016 in two phases. All the pilot participants were 7-years-old and in their 2nd grade in school. This age group is the youngest age group proposed for the main fieldwork, and were chosen on the hypothesis that if the procedure worked with them, it would probably also be appropriate for a broader age range, including older participants, in the main study. These children were both sexes (10 boys and 5 girls) in order to explore any possible sex differences in children's understanding of the pilot study tasks. Participants from two of the primary schools were selected by their music teachers, with equal numbers of boys and girls. All participants had Han ethnicity, which makes up

91.6% of the population of China (State Council Census Office & NBSC, 2011) and with a ratio of 2:3 participants drawn from rural areas. These schools were chosen as a convenience sample through personal contacts. None of the child participants had received any specialised singing training and all were volunteers (with appropriate informed consent and ethical approval at university and local level). All participants undertook an individual singing assessment (see below), and 10 children (six girls and four boys) completed the attitudinal questionnaire. Five participants did not complete the questionnaire for logistical reasons at the time of assessment, rather than having a reluctance to participate.

Under the ethical approval, all children and adults were given permission to withdraw from the study at any time for any or no reason, in line with British Educational Research Association guidelines. Personal information, school and family details have been anonymised in the reporting.

Subsequently, a larger group of children (n=102), aged 7-9 years were asked to count backwards from 1-20 to to explore the validity of using an IT-based process to assess the pilot children's sung pitches (see below), rather than relying on the listener perception alone.

Singing Assessment Protocol: The singing assessment included: (i) spoken pitch centre, by asking each participant to count backwards from 20 to 1 and noting the dominant pitch. One reason for assessing the spoken pitch centre was to infer information about the relative size of the vocal mechanism (Welch et al., 2009) and whether the child had a naturally high or low speaking voice; another reason was that it provides a guide to the likely sung range, which has been reported to be approximately two octaves above one

whole tone below the spoken pitch centre; (ii) comfortable singing range by upward and downward simple glides, as Welch (1979) had reported that comfortable singing range was a more valid measurement than total singing range in the assessment of children's customary singing behaviour; and finally (iii) singing behaviours of three songs. The three songs embraced one with a simple pitch range (a major sixth) (*Twinkle, Twinkle*), two that had a more complex pitch range (a perfect octave) (*Happy Birthday*) and a Chinese nursery song (*Little Donkey*). One of differences between the songs is that the maximum musical interval of *Happy Birthday* is a perfect octave, and that of *Little Donkey* is a perfect fifth. This difference may have an influence on accuracy of melodic contour. Mang (2006) suggested that singing a whole song is the most frequent activity in a Chinese music class. In addition, children' attitudes to singing in different contexts were assessed by a 61-question survey in Mandarin, based on the UK *Sing Up* original where the youngest participants were 5-year-old (see Welch et al., 2008). The research protocols for the singing assessment and attitudes towards singing were based on that used in the evaluation of UK *Sing Up* programme (see Welch et al., 2009; 2011) (see Figure 1), permitting data from the subsequent main study to be compared with data from the UK *Sing Up* programme.

The three criterion songs were modelled on a recording by an adult female, and were sent to relatives and music teachers by email or social media. The adults were told that the purpose of the pilot study was to test the protocol of main study. The adults were asked to play the model recordings to the child several times over a 1- to 2-week period prior to assessment, and to note how many times that these had been played before the children became familiar with the songs. Two weeks later, the relatives used video to record the child's private singing of the target songs at home. The music teachers followed a similar protocol, with the same preparation and audio recording of children's singing individually

within a small group in a quiet, familiar place within schools. Attending in a group allowed individual participants to watch and become familiar with the individual recording process. No starting pitch was given in any tasks, so that children could start at their comfortable singing pitch. These recordings were collected by adults' mobile telephones and the files were then sent to the first author using social software 'Wechat'.

Spoken pitch centre and comfortable singing range were measured by reference to a virtual piano keyboard (Sing & See https://www.singandsee.com), whilst the singing development of the three songs was measured against the criteria listed in the Vocal Pitch Matching Development (VPMD) and Singing Voice Development Measure (SVDM) rating scales (as in Figure 1).

Three pitch and frequency (Fo) systems, Praat (www.praat.org), Sing & See (https://www.singandsee.com) and Sonneta (https://itunes.apple.com/us/app/sonneta-voice-monitor/id670854671?mt=8) were used to measure and compare Chinese children's speaking fundamental frequency. Sing & See (http://www.singandsee.com) is a program that is designed to provide real-time visual feedback of vocal pitch in singing. It does this by using a standard musical correlate of perceived fundamental frequency with conventional octave pitch labels (such as C_4 for Middle C), displayed on a Western classical musical staff system. In contrast, Praat (http://www.fon.hum.uva.nl/praat/) and Sonneta (http://mintleafsoftware.com/voice-monitor.html) are speech analysis systems that display fine-grained moment-by-moment and mean measures of fundamental frequency (Fo, such as C_4 reported as 260Hz).

The prime purpose of the pilot study comparison between these three IT-based systems was to ensure that any tracking and analyses of participant children's voices over

time would be based on the choice of a reliable and robust measure. Firstly, an online table (https://pages.mtu.edu/~suits/notefreqs.html) that illustrated pitch to frequency and vice versa was applied, and agreed, with output from an Online Tone Generator (http://www.szynalski.com/tone-generator/). This table was then used to create an Excel spreadsheet of the mean fundamental frequencies of field recordings of children's vocal products for a group of N = 102 children, aged 7-9 years, who had been asked to count backwards from 20 to 1 (an established technique for capturing customary vocal pitch, Welch et al, 2009). The tablulation of the mean vocal pitches, translated to Hz, from Sing & See was compared to Fo ratings for the same children using Praat and Sonneta. Statistically, there was a relatively strong correlation between the Sing & See and Praat analyses of the same spoken sound files (r = .75, N = 102, p < .001). Correlations between Sing & See and Sonneta (r = .60, N = 41, p < .001) and between Praat and Sonneta (r = .52, N = 40, p = .001) were also significant, but somewhat less strong (see Table 2). This may be because some background noise from other children in the vicinity was being picked up in the field recordings by the Sonneta software, given that Sonneta is designed to be very sensitive to the human voice.

Table 2: Pearson correlation within three software packages for speaking fundamental frequency

Measurement	Sing and See & Praat	Sing and See & Sonneta	Praat & Sonneta
Pearson Correlation	.755**	.601**	.524**
p	.001	.001	.001
N	102	41	40

Note: **. Correlation is significant at the 0.01 level (2-tailed)

Overall, it was noted that all three systems create means from the real-time frequency variation of each vocal utterance and the pair-wise analyses suggested that the outcome measures of the three software packages were in general agreement (see Table 2), but that Sing & See and Praat were probable more useful in the context of live recordings in a school environment.

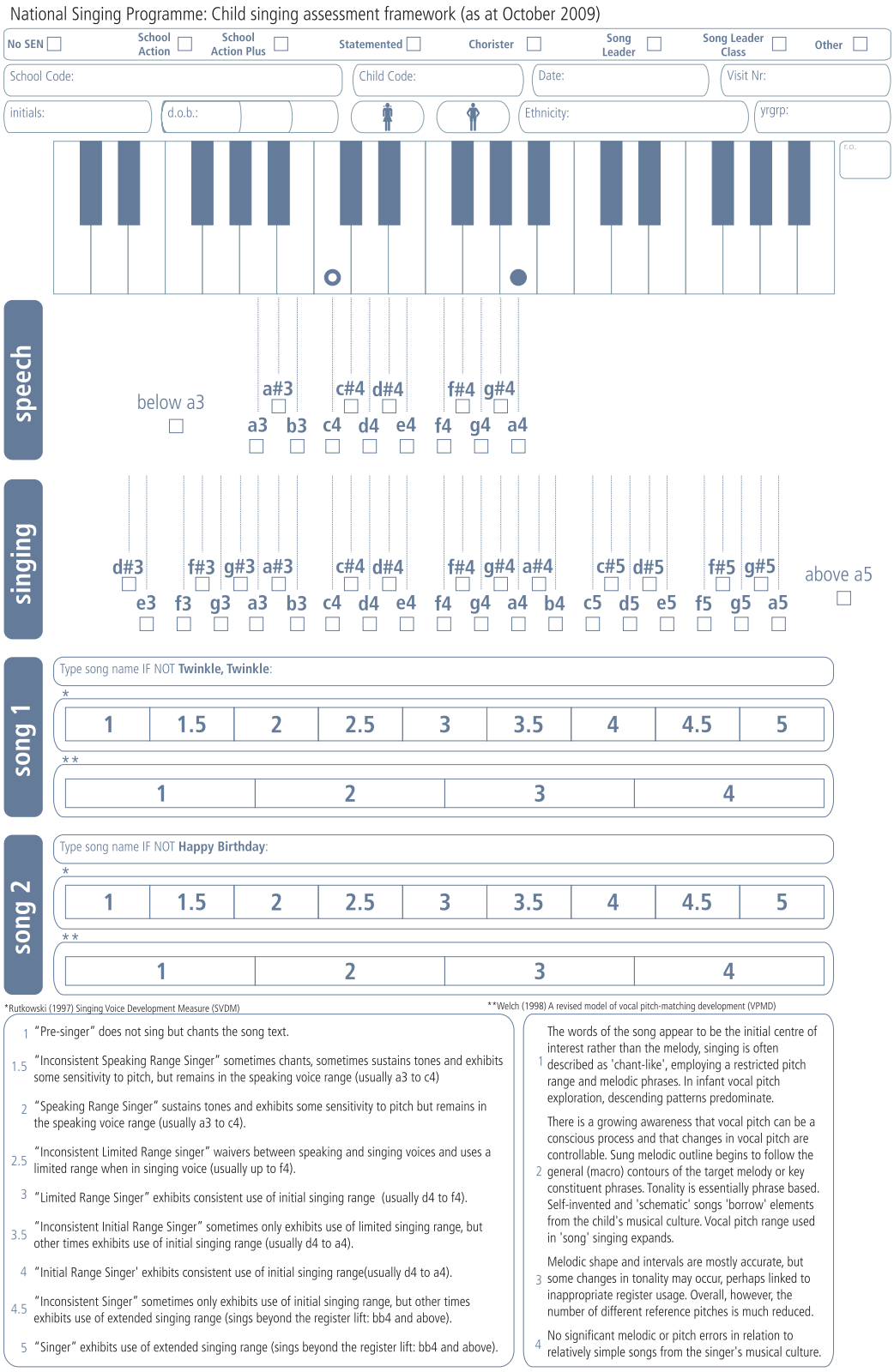

Figure 1: Individual singing assessment protocol and record sheet (Welch et al, 2009)

The VPMD and SVDM ratings (Figure 1) have been used together to assess Primary pupils' singing behaviour. VPMD rating, Welch (1998), is focused on measuring participants' singing accuracy. SVDM (Rutkowski, 1997) is used to measure children's singing voice register. Register boundaries in SVDM elements were reported to be C_4, F_4 and B^b_4, and these created 5 basic rating categories, some of which were then subdivided.

Mang (2006) was the first to use these two rating systems (VPMD and SVDM) together to evaluate singing competency in a study of 60 Cantonese-speaking children and 60 English-speaking children. A high correlation between the two scales was reported (r = .821, N = 120, p = .05), based on the ratings between two judges. Subsequently, the evaluation of the UK Government's National Singing Programme *Sing Up* in England (as reported after two years in Welch et al., 2009) also used the two sets of ratings to measure singing behaviour of 8,799 children aged from 67 months to 144 months, where ratings from the two measures were combined to build a single assessment of a child's singing ability.

Child Questionnaire: The participants' questionnaire was originally designed by Joyce (2005), supported by Welch, and was developed subsequently by Welch and colleagues to test Primary school children's attitudes towards singing in three settings (school, home, informal settings) and in two aspects of their personal engagement with singing (self-identity as a singer and emotional engagement as a singer). One, more general/non-musical theme was added concerning social inclusion, originally because the English Government were interested in the research team exploring a specific aspect of the possible wider benefits of singing This variable was also included in the Chinese pilot study reported here. The original survey has been designed with simple language statements, and sensitive questions were avoided. The Chinese language version of the questionnaire was used in the pilot study with permission from the team at UCL's Institute of Education.

The language was translated carefully from English to Mandarin by the author, and proofed by two senior PhD colleagues who were native Chinese and studying in the UK.

The translated questionnaire was sent by email or social software with the same detailed guidance to all adult participants who were asked to print the questionnaire out for the participant children. The adults were asked to note the amount of time that each child spent completing the questionnaire, as this could provide a guide about the time that needed to be scheduled for this in the main study. Child participants were asked to show their degree of agreement with 60 statements on a seven-point Likert-type scale from 'I don't agree' to 'I agree'. Smiley faces were used to indicate level distinctions in agreement/disagreement and were included at the top of each questionnaire page. Welch et al. (2008) had suggested that the use of smiley faces helped younger children in their choice of answer. Participants needed to tick the related box underneath the particular smiley face. Children were asked to complete the questionnaire at their own speed, independently, but with adult help if needed. All adults were told that they should not provide answers to the questions for the children, nor suggest nor change any answers to children. In order to note any statement that elicited confusion, an extra column 'I don't understand' was added to the original English language version. The whole process in the participant Primary schools was overseen by music teachers or the volunteer adults and all assessments were made in familiar locations. After being completed, the adults sent the questionnaires back to the first author by photograph through social media (Wechat). The results were collated into SPSS for statistical analyses.

Data analyses: For the pilot study, the independent variables were children's age (7-years-old), sex and location (rural/city). Dependent variables were speech centre by pitch (translated to Hz and based on A_4=440Hz to calculate the mean), comfortable singing

range, the VPMD and SVDM ratings of the three criterion songs, and children's attitudes towards singing on each of the six themes. For the data synthesis of singing assessment, 10% of the video or audio recordings of the three criterion songs were sent to two senior judges to make their own ratings and to check the reliability of the lead author's assessments. Scores of VPMD and SVDM were combined to create one final score. Sex differences in the singing of the three songs were calculated by an Independent – Samples T test. Furthermore, effect size of sex differences of the three songs were calculated used Hedges' g due to the small sample size. In terms of the questionnaire, answers to any negative statements had their polarity changed for the subsequent analysis (e.g., if an original answer was 7, it was translated to 1 during the process of data analysis). Statements from the same themes were combined by 'compute variable', and six variables were created by theme (for example, there were 11 statements related to attitudes towards singing in school and a variable 'school' was the sum of the 11 statements for each participant).

Means were calculated for all dependent variables for each participant, except for comfortable singing range which was assessed as embracing at least 75% of common sung pitches area participants. For questionnaire data, means of the six variables (school, home, informal settings, self-identity as a singer, emotional engagement with singing, and social inclusion) were analysed. These means were then divided by the number of statements under each theme (e.g. the mean of 'singing in school'/11= the final mean of the school-focused variable). Independent-samples T-Tests with a 95% confidence interval for all independent variables were computed.

RESULTS

(1) Speech and Singing data

Firstly, in terms of speech pitch centre, participants did not use a fixed pitch centre to backward count from 20 to 1, and this commonly usually within four tones. The results confirmed that 86.7% of participants (n = 13) had a spoken pitch centre in the range from A_3 to E_4 (220Hz – 329.63Hz), while the median and mean were $C^{\#}_4$ (*M* = 271.11Hz, *SD* = 26.83).

Secondly, it would seem that the singing of upward and downward glides, as applied from the earlier English study, were not easy tasks for the Chinese pilot study participants, implying that examples or modelling might need to be provided in the main study, although modelling could have the drawback of limiting the range of the children's vocalisation to that provided by the model. However, with this caveat, 75% of the sung pitches from the glides of these 7-year-olds, theorised as the likely comfortable singing range, were in the octave from A_3 (*M* = 223.76Hz, *SD* = 19.62) to A_4 (*M* = 439.37Hz, *SD* = 82.02). The *SD* of the low pitch was much smaller than *SD* of the high pitch. The full singing range across all participants was from G_3 (196Hz) to D_5 (587Hz).

Thirdly, fifteen participants (five girls, ten boys) sang the three criterion songs, with the exception of one participant who did not sing *Little Donkey* as the adult forgot to ask her. *Little Donkey* was reported by the adults involved in the data collection to be the most difficult song task within the three, mainly because its lyrics were the most extensive, and some of the song's vocabulary had not been learnt by the young participants. On the other hand, *Happy Birthday* was reported to be the easiest song, as the lyrics repeat regularly. The VPMD ratings were found to be useful in judging the melody accuracy shape of most of song performances. However, repeated listenings were required, especially in

machining decisions on ratings "2" and "3" (see Figure 1). Similarly, the SVDM ratings were able to be used as measuring most sung register products in the pilot study, but the boundaries between categories "2", "3" and "4" were sometimes difficult to ascertain on a single listening.

The data analyses suggest that when the VPMD and SVDM ratings were combined and normalised by songs, the means for *Twinkle, Twinkle* and *Happy Birthday* were close (see Table 3), whereas the mean for *Little Donkey* were slightly higher than for the other two songs. However, the combined scores (VPMD + SVDM) of the three criterion songs were significantly correlated, implying that current level of participants' singing development was relatively constant across the three song tasks. Nevertheless, girls' singing (M = 4.78, SD = 0.33) was statistically significantly better than that of the boys (M = 3.83, SD = 0.73) (t (13) = 2.70, p = .018). When examining the data for each individual song, only *Twinkle, Twinkle* has statistically significant sex differences (t (13) = 3.69, p = .003), with girls (M = 1.66, SD = 0.17) singing *Twinkle, Twinkle* better than boys (M = 1.19, SD = 0.26). The effect size by Hedges' g effect size value of *Twinkle, Twinkle* (g = 1.34) suggested a large positive sex difference in the combined ratings of the three songs, and also for *Little Donkey* (g = 0.93). The Hedges' g effect size value of *Happy Birthday* (g = 0.77) suggested a moderately positive sex difference. However, the power of the sex differences for *Happy Birthday* (24%) and *Little Donkey* (33%) were weak, and it was only the power for *Twinkle, Twinkle* (61%) that was relatively strong.

Table 3: Mean values, standard deviations, and intercorrelations of VPMD + SVDM ratings of the three criterion songs

Song	*M*	*SD*	1	2	3
1. *Twinkle, Twinkle*	1.35	0.32	-		
2. *Happy Birthday*	1.39	0.23	.719**	-	
3. *Little Donkey*	1.42	0.3	.818**	.66**	-

Note: **. Correlation is significant at the 0.01 level (2-tailed)

(2) Questionnaire data

Ten pilot study participants completed the questionnaire. In terms of the responses, the results suggested that these children's attitudes to singing varied by theme. The rankings by means were as follows (highest to lowest): social inclusion > emotional engagement to singing > values for singing at home > values for self-identity > values for singing in school > singing in informal settings (Table 4). All mean responses were above the mid-point on the seven-point scale and biased towards the positive.

Table 4: Mean attitudes and engagement with singing by theme

	Environment for singing			Self-idenity as a singer		Social inclusion
	School	Home	Informal setting	Self	Emotional engagement	
M	4.45	4.63	4.06	4.62	4.76	4.78
SD	1.3	1.69	1.01	1.14	0.98	1.1

Overall, participants appeared to understand most of the sixty statements, but some issues related to comprehension emerged from the data analyses. Firstly, as showed in Table 4, attitudes to singing in the home had the largest standard deviation, with singing in

school the second largest. Secondly, some vocabulary and phrases were not understood by these child participants in translation from English into Chinese, including "boring", "solo", "equal", "plan", "talent", "making music", "singing out of tune", "read music", "how my voice works", "most of" and "the notes". Similarly, four statements of social inclusion were not understood by participants, including "I have control over my future"; "I think that hard work is more important than good luck"; "On the whole, I am satisfied with myself"; and "I feel useless at times". Thirdly, it would seem that a definition of "my teacher" was not clear. Two participants asked whether "my teacher" was the in-school teacher or an out-of-school teacher. Furthermore, participants gave different answer from their teachers. For instance, most participants did not agree with the statement "I sing at school", although those who had the teacher as the participant adult thought that they did. The 7-year-old participants spent about 20-30 minutes completing the questionnaire.

DISCUSSION

The first vocal assessment was of the speech pitch centre. The pilot study used counting backwards from 20 to 1 to test the 7-year-old participants' speech centre, with the findings in line with those reported by Welch et al. (2008). However, this counting assessment in Mandarin involved four tones. As a tonal language, Mandarin speech involves varied tones, instead of a single pitch centre. Story telling also involves varied tones, but it includes more emotion than counting. Compared with forward counting (1-20), backword counting (20-1) requires more concentration as it is relatively unfamiliar. This means that the speaker is focused on the task and not on their voice production. Overall, the backward counting seems as an appropriate method to test spoken pitch in Mandarin, noting that data emerge

on a common spoken vocal pitch range as well as a mean pitch centre.

Participants appeared to need a model to sing pitch glides, but this raises the question of which elements of the sung registers should be provided in the model. In England, the children's glides moved relatively easily across vocal registers (low to high and high to low), but this task seemed to be unusual for the pilot study participants. Given the results of the mean spoken pitch as $C^{\#}_{4}$, alongside their predominantly comfortable pitch range of an octave from A_3 to A_4, it appears that these pilot study 7-year-old participants predominantly used a chest voice register for both the speaking task and the glides. This phenomenon needs to be explored further in the main study as to whether or not this is an artefact of the assessment protocol. It has been reported elsewhere that adult comfortable singing range may depend on their voice quality (Popeil & Means Weekly, 2011), and so perhaps this is also a factor.

In terms of singing the three criterion songs, teachers and parents reported that they did not need to spend much time teaching these as they considered that the songs were already familiar to the children. Perhaps because of this, a small number of participants did not know the songs, and this implies that sufficient rehearsal time by teachers needs to be promoted strongly in the main study.

There is also a need to ensure that a sample of the sung products are moderated by independent judges in order to ensure that the rating scales (SVDM and VPDM) are both valid and reliable in their application to Chinese children's singing in the main study. Some children may be very well in-tune, but within a lower pitch range, and this variable needs to be taken account of when applying the Rutkowski scales which are delineated by particular register pitch ranges (see Figure 1).

In terms of the questionnaire wording, some further pilot activity is necessary to ensure that children understand all the statements or that ambiguous statements be omitted. Statistical analyses (Cronbach's Alpha) will be used to ensure that the internal coherence of each set of statements by theme are sufficiently robust. Overall, the questionnaire is likely to be appropriate for use in the main study, subject to the modifications suggested above.

In conclusion, there is very little data on children's singing in mainland China, although slightly more exists from Hong Kong. The current pilot study borrowed and applied the research protocol from the largest study available of children's singing, based in England. The data collection and analyses will need to be sensitive to the realities of assessing children's singing, attitudes and engagement in a different cultural and linguistic context that will embrace urban, sub-urban and rural settings in one Chinese province (Hunan). Nevertheless, the pilot study analyses indicate that useful data should emerge that will begin to fill in the gap in our knowledge about Chinese children's singing behaviours and development.

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