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A New Measurement for Pitch-Matching Accuracy of Song Singing Based on Absolute Semitone Differences

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Abstract

Pitch-matching accuracy in song singing has been widely tested using ratings scales. The main drawback of these scales is that they are relatively subjective and summative, relying on the perception of the assessor(s). Young children's singing is often quite inaccurate against a song model. Consequently, this study sought to design a more objective measure which could also be used to reveal the missing detail and validity of subjective ratings. $N = 1,608$ song singing products, including $n = 696$ one-year longitudinal singing performances, were collected from Grades 1 to 6 in seven schools across rural and urban areas in Hunan and Guangdong provinces in mainland China from 2017 to 2018. All participants sang three familiar children's songs: *Twinkle, twinkle*; *Little donkey* (a Chinese nursery song); and *Happy birthday*, with no starting pitch given. Performances were audio recorded. $n = 134$ (8.3%) sung performances were randomly selected and analysed using the two separate measures: the Vocal Pitch-Matching Development scale (VPMD) and a new software-based measure, based on absolute semitone errors. In the new measure, each sung pitch was compared with a related standard pitch, based on the sung key as defined by the first sung pitch. Each sung product was entered into *Praat* for frequency analysis and simultaneously played as pitch using *Sing & See* software. The sung products – based on *Praat* frequency and *Sing & See* pitch – were inputted into an Excel file for each target note. Secondly, analysis was undertaken to calculate sharp and flat semitone errors, noted from -8 to 8 (0 means no semitone error), based on the sung key. Thirdly, a different colour was applied to characterize each semitone error to illustrate visually the most common sung key. Fourthly, semitone error was recalculated by the most dominant key centre, taking its absolute value noted from 1 to 9 (9 means no semitone error). Finally, the percentage of pitch accuracy of each song singing (100% means no pitch error) was calculated and analysed by *SPSS*. The ratings using the VPMD scale and the new scale for three songs were positively correlated ($r(134) = 0.713$, $p < .001$, $r^2 = 0.508$). These results suggest that the new scale is a reliable measure to test the pitch accuracy of song singing, and is appropriate to use in further studies to provide a more objective judgement.