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New Perspective on Musical Literacy: Examination of Singer's Singing Peak in Chinese Folk Songs

Wang Ping*

Institute of Music, UCSI University, Kuala Lumpur, Malaysia

Corresponding author: Wang Ping, E-mail: 1002265851@ucsiuniversity.edu.my

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ABSTRACT

Singing peak denotes an optimal performance by the singer, reflecting their singing effectiveness. Previous research has established the existence of singing peaks within the recording industry; however, this concept has not yet been validated in the context of Chinese folk singing. Ten Chinese folk singers participated in a recording session for one song. During the recording, variables Rhythm (R), intensity, and rework time (RwT) were calculated, while the vocal director provided descriptions of the singing peak performances. It was observed that singing peaks in Chinese folk singing primarily occur in the later parts of the song. Contrary to earlier findings, the Singing Duration (SinD) associated with the singing peak exhibited variations from those reported in previous reviews. Therefore, it can be suggested that singing working time be incorporated into future research on singing peaks. Exploring the dynamics of the singing peak enables singers to gain a clearer understanding of their vocal performance, enhancing the musical literacy.

Key words: Singing Peak, Rework Time, Chinese Folk Song, Musical Literacy, Singing Duration, Rhythm Consistency

INTRODUCTION

Singing peak is the singer's optimal vocal performance during singing, which refers to this best performance which achieve the ideal pitch, rhythm consistency. Pitch and rhythm consistency are the basic musical literacy in music practice (Coleman, 1987). (Sinnamon et al., 2012) discussed the concept of singing peaks through the theory of flow, revealing that 95% of musicians experience noticeable peaks during their performances. In the context of Chinese traditional vocal singing, Jinlong (2023) used terms "best singing voice" (最佳歌唱声音) and Yinyu (2024) used "best condition" (最佳状态) to describe the concept of singing peaks. In their perspectives, singers would sing effectively with a singing peak. Indeed, achieving singing peaks has become the lifelong pursuit of singers. Evidence from the practitioners' vocal singing experience proves the singing peak exists in singing practice. For example, the vocal students were asked to self-report the singing perception, and it was found that there was no significant difference between students' perceptional singing peaks and the parameters (Coleman, 1987). Building on this, Dayme (2009) noted that humans are continually pushing the boundaries of their vocal control abilities, often employing various singing techniques to reach their peak performance. This observation provides strong support for the feasibility of using parameter reports in the empirical study of singing peaks, highlighting the close relationship between subjective perception and measurable vocal configurations.

Previous studies have mainly focused on classical and popular music, lack of observation on singing peaks in Chinese folk songs. Therefore, it is intriguing to consider whether similar experiments could be replicated using Chinese folk songs for singing, and whether the findings would be consistent with prior research. In other words, the past discovery of singing peak signifies the potential for quantifying singing. Therefore, the concept of the singing peak requires validation across different musical styles and populations. This serves as the motivation for our research.

Chinese folk songs constitute a unique genre within world music, standing apart in the realm of vocal pedagogy (Zhang, 2024). Traditional methods of singing are generally not able to achieve the full auditory level required by Chinese folk songs. Singing techniques, such as, Shuai Qiang (甩腔) (Yifei, 2024) and Ku Qiang (哭腔) (Ye et al., 2024), are integral to performing these songs, yet whether there is singing peak would be presented remains unknown. Therefore, this empirical study was conducted to determine the existence of singing peak in singing Chinese folk songs.

RELATED WORK

Davids and LaTour (2012) discussed methods to achieve optimal vocal conditions and peak performance in vocal singing through the basis of vocal techniques, resonance and

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timbre, psychological factors, and the integration of technique and artistry. In Malaysia, Huang and Ang (2024) have identified the existence of singer's singing peak through acoustic analysis. "Singing peak" refers to the moment when a singer reaches the optimal level of vocal intensity, rhythm, pitch accuracy, and dynamic range within a certain period (possibly over a few music bars). It represents an effective singing performance. It was revealed that a singer's vocal peak could be identified by the core factors of Intensity and Rhythm Consistency. The relationship between singing peaks and acoustic parameters suggested that when a singer has better intensity and rhythm consistency, the probability of experiencing a singing peak increased. In addition, scholars emphasized that singing practice should be approached in an organized and goal-oriented manner (Parncutt & McPherson, 2002). Hence, the literature indicated that the practice for voice intensity and rhythm coherence contributed a lot to achieving peak performance.

The previous research established a criterion of including the singing peaks. However, the applicability of this finding to Chinese folk songs remains unexplored. Thus, it is proposed to investigate the definition of singing peak within the context of Chinese folk singing performance. Consequently, the central research question of this study is:

- Is there a singing peak in Chinese folk song performances?

Music Information Retrieval (MIR) is a scientific field of study dedicated to developing and utilizing computer technologies for storage, retrieval, and analysis of music information. Many researchers drove the field further (Downie et al., 2004; Holzapfel et al., 2018; Lui & Widmer, 2005; Magnusson, 2017; Orio, 2006). MIR emerged as an interdisciplinary field and draws from computer science, audio signal processing, music theory, and psychology, among others. Based on the theory of MIR, singing voice is a diverse field, encompassing various dimensions such as its analysis, synthesis, and practical applications (Umbert et al., 2015).

Downie et al. (2004) surveyed the underlying concepts and emerging trends of the field of music information retrieval with the emphasis put on the topic of storing and recalling information from databases of music. Holzapfel et al. (2018) focused on sound feature extraction and music analysis and proposed a better method towards increasing the effectiveness of music information retrieval. Their methodology emphasized the significance of music data visualization and music analysis in signal processing and machine learning. González-Álvarez et al. (2017) explored users' needs and preferences for music retrieval and proposed algorithms for providing personalized music recommendation systems to users. This provided insightful information for practical applications of MIR. Lui and Widmer (2005) highlighted music information search and retrieval and described how the music search engines could be optimized by taking user interaction patterns into account. Authors proposed a dynamic adjustment model involving machine learning and user feedback. Magnusson (2017) opened up new areas of voice analysis in MIR, exploring the characteristics and behavior of singing voices and providing a multi-dimensional evaluation method based on audio analysis. Orio (2006) explained audio content analysis techniques in MIR, extensively critiquing current signal processing methods to enable a deeper understanding of audio data traits. Umbert et al. (2015) explained the various features of singing voices, suggesting an algorithm for analyzing and synthesizing singing performances. This research provided indications of new means for detecting and classifying vocal performances.

However, most of these studies extracted vocal data through MIR using vowels, without genuinely capturing the spontaneous performances of singers. This contradicts the real-time dynamic characteristics of singing. Therefore, our research addressed these gaps by using the real performances of singers in recording studios and live settings as the material.

METHOD

Ten singers specializing in the Chinese folk singing style participated in the recording of singing waves, each possessing at least three years of experience in recording studio settings. This criterion facilitated effective communication and feedback among the singers, sound engineers, and vocal directors, which was essential for the research. The song "*Little Running River*" (小河淌水), a representative piece of Yunnan folk melody from China, was selected for the recording. For soprano and tenor, d minor and g minor were utilized, with the soprano's pitch ranging from f to f2 and the tenor's pitch spanning from g to g2. The dry and uncompressed voices were recorded and analyzed for each singer.

The researcher employed a recording set that included a Mac computer running macOS Monterey and appropriate microphone equipment in the form of preamps, studio monitors, and closed-back headphones. For recording audio, Logic Pro X was the digital audio workstation. Audio signals were captured with a Shure SM7B dynamic microphone, which was positioned approximately 10 cm from the singers' mouths. The amplification preamp used was a Focusrite Scarlett 2i2 (Gen 3) interface. Yamaha HS8 studio monitors were utilized for playback, and for monitoring the sound, Sony MDR-7506 headphones were used.

As illustrated in Figure 1, the researcher divided a unit singing duration into four bars, resulting in the recording waves being segmented into 18 distinct singing durations. Each singer had unlimited recording time, with the condition that they continued until the take achieved the optimal quality as determined by the sound engineer and vocal director. Repeated durations were automatically tracked by Protools, which facilitated the calculation of the rework time. The Music Information Retrieval (MIR) approach was utilized for abstracting the R and Intensity. For assessing rhythm consistency, the researcher employed Melodyne (Editor version, UK) to identify deviations. The rhythm consistency was assessed on a six-point scale (1 = messy, 2 = difficult to follow, 3 = can follow but feels forced, 4 = adequate, 5 = precise, and 6 = strong sense of rhythm). Mean intensity for each musical phrase was calculated using Praat. Statistical analyses were conducted using SPSS (version 27). The researcher extracted the singing segments that exhibited the

lowest rework time (RwT) for a continuous singing duration, defined as the singing peak.

According to the exploration by Huang and Ang (2024), it was discovered that the characteristics of singing peaks are associated with the lowest rework time (RwT) during a continuous singing duration. Regarding the performance characteristics of the singing peak, it should be associated with a minimum number of reworks, while its sound characteristics should maintain the rhythm consistency above the level of precise. Thus, in this research, the criteria for selecting the singing peak must satisfy two conditions: 1. RwT = 0 or 1, continuously for 3 bars or more. 2. the R is greater than or equal to level 5. Finally, the temporal variation of RwT by SinD was illustrated through a histogram. The researcher validated and discussed the concept of the singing peak by describing the performances of the singers.

RESULTS

The singers consisted of five tenors and five sopranos, all of whom were very familiar with this song and had experience performing it. They were not restricted in their singing techniques, so each singer completed the recording based on their own understanding of the song and their individual singing style. All takes were judged by both the vocal director and the sound engineer (Table 1).

Among participants, the singers' maximum service experience was 15 years, and the minimum was 3 years. Singers with 0 or 1 rework occurrence in order over 3 durations were marked as their "singing peak." From descriptive statistics, the researcher observed that the lowest rework remained at 0, only two singers (S6 and S10) had a minimum rework of 1. To assess the interval with the minimum reworks, a histogram (see Figure 2) displayed the average rework count in these periods.

In this study, the singing peak could last for a maximum of 6 durations. Furthermore, in this song, the tenors (S7 and S8, both with 6 durations) demonstrated a better ability to maintain this peak. Singing durations from 8 to 16 (third verse session) received the least rework time, and the singers were observed to be fully immersed in their singing and could communicate easily with the director and sound engineer. The exception was that S6 did not achieve her singing peak.

In the validation of singing peak using Chinese folk songs, it was found that this aligned with the observation of the singing peak, which normally appeared after the first session of a song. This positive singing state lasted for at least 3 periods, indicating very effective singing. The singer's performance during the singing peak was described:

> She started to make some moves, the confidence grew, and the singing condition was great, and she became actively chat with the sound engineer; she started to feel herself really charismatic. [The description of S4 in reaching singing peak by vocal director Dr. Yang].

In the observations, the researcher noticed that when the singers (S1, S2, S3, S4, S8, S9) entered the studio, the anxiety was exhibited (for instance, they felt uncertain about the microphone distance, sound feedback, and stiffness in their bodies). As the singers reached their singing peak, they

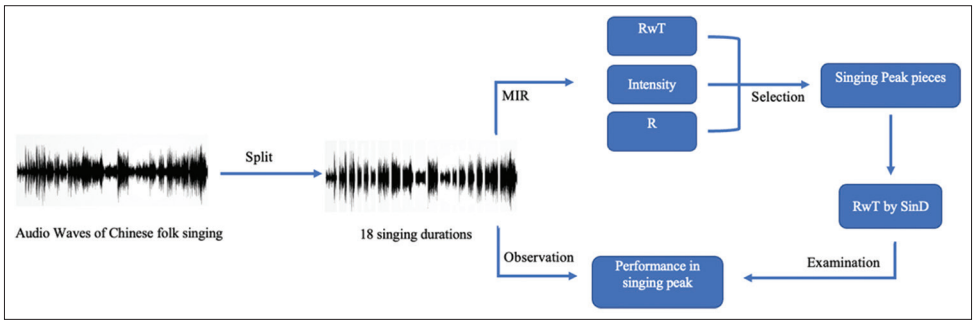

Figure 1. Conceptual framework

Table 1. Singing duration in peak

	Sessions	Experience	Minimum RwT	Range of R	Range of Intensity	Singing Peak Duration
S1	Soprano	3	0	5-6	4	13-15
S2	Tenor	5	0	6	5-6	1-3, 14-17
S3	Tenor	3	0	5-6	5-6	9-13
S4	Soprano	6	0	5-6	3-5	10-13
S5	Soprano	7.5	0	5	5-6	8-11
S6	Soprano	3	1	/	/	/
S7	Tenor	14	0	5	5-6	6-12
S8	Tenor	9	0	5	4-5	8-14
S9	Soprano	4	0	5-6	3-6	4-7
S10	Tenor	15	1	6	4-5	8-11

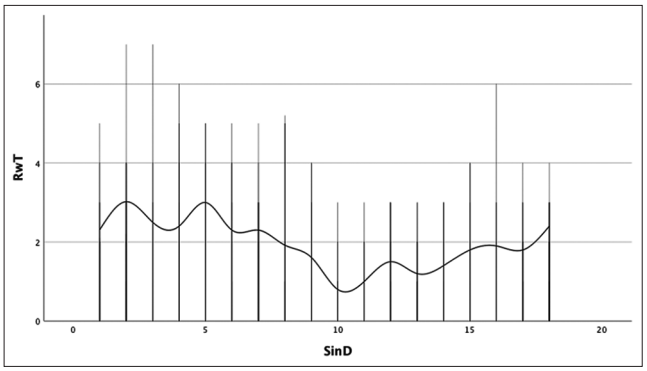

Figure 2. RwT by SinD

accompanied it with an active physical state and increased verbal communication. This gradually reduced the pressure in the recording environment, allowing the singers to become more immersed in their vocal expression.

DISCUSSION AND IMPLICATION

In contrast to previous research findings, the singing peak for this song occurs in the third verse, while earlier studies identified it in the chorus section. Additionally, each song features distinct structures and SinD, making it inappropriate to generalize the relationship between SinD and the singing peak. Therefore, it is proposed that the singing peak is not directly linked to the song's SinD but rather associated with the singers' working time in the studio. This suggests that future research could utilize singing time rather than SinD to investigate the relationship between time and the singing peak.

While intensity has been recognized as an important factor in achieving efficient singing, it cannot serve as a reliable criterion for selecting singing peaks in this study. This is due to the significant variability in intensity among different folk singers. According to the intensity data gathered, very few singers, such as S9, are able to reach singing peaks within a dramatical intensity range. Therefore, further exploration is required to determine the extent of intensity's influence on singing efficiency in folk songs. Additionally, the diverse vocal techniques present in folk singing may not lend themselves well to observing intensity. The limitations of this study include the sample size and the number of singing sessions conducted. Future research should aim to increase both the number of songs and the singers' sessions.

The exploration of the singing peak opens up opportunities for quantitative sound research within the singing community, allowing singers to gain a clearer understanding of the dynamics of voice during performance. As practitioners who frequently engage with voice, singers are encouraged to examine the personal singing peak, thereby enhancing the singing efficiency in voice production.

CONCLUSION

Validation on the Chinese folksongs confirmed the fact that generally the singing peak came after the first session of the song, maintained by at least 3 periods of effective singing. The singing peak is identified by meeting two criteria: a rework count of 0 or 1, and a rating (R) level of 5 or higher. This confirms that a singer's singing peak occurs during efficient singing durations. However, the singing peak is not a universal phenomenon; even among professional singers, such as S6, there are instances where a low rework count is not achieved. Observations revealed early anxiety in singers reduced as they became increasingly actively engaged in their singing, which contributed to a good recording environment and facilitated ideal musical literacy.

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