Artistic Characteristics and Modern Music Value of National Musical Instruments--From the Chimes of Spring and Autumn Tombs Unearthed in Xiasi, Xichuan

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Abstract: The Spring and Autumn chimes are an important component of Chinese national musical instruments, and they play an important role in the development of national musical instruments. However, modern research on the Spring and Autumn Chimes mainly focuses on the theoretical aspect, and lacks practical case analysis. Therefore, this paper takes the No. 1, No. 2 and No. 7 chimes of Xichuan Xia Temple as an example for analysis and uses the Mammoth Lark mini microphone, Capella and RAW software to compare and analyze the rhythm, notes, and rhythm, and study the indicators of timbre, loudness, frequency and rhythm. The results show that the No. 1 and No. 2 chimes unearthed in Xichuan Xiasi, Henan Province have different shapes, and the copper, tin, and lead are different, which are 90:7:2:186:9:4:1, which directly affects the timbre, frequency and loudness of the chimes. Among them, No. 1 has a higher loudness and faster tempo, while No. 2 has a lower loudness and a slower tempo, so the Spring and Autumn Chimes have high archaeological value and can support the study of modern music.
Keywords: Chimes, National Musical Instruments, Modern Music Value, Xichuan Lower Temple, Unearthed

1. INTRODUCTION

During the Spring and Autumn period, the Chinese began making and using chimes to highlight rulers' or nobles' status and glory. In addition, the chimes of this period are often used for cultural interaction and exchange between countries (Bell, Nwobbi, Parrow, Wheeler, & Zelleke, 2021). The bells of the Spring and Autumn Period not only had a certain role of symbolizing the status of the nobility but also played a practical role in some military, diplomatic and sacrificial activities.

The existence of the Spring and Autumn Chimes not only reflects the performance specifications of music (Bhattacharyya, Bharadwaj, Tiwari, & Majumdar, 2023), etiquette, and ceremonial activities in Chinese society during the Spring and Autumn Period but also reflects the musical aesthetic ability of the aristocratic class at that time. In 1977, a severe drought in the western and southern parts of China's Henan province

caused the water level of the Danjiangkou Reservoir in Xichuan County, Henan Province, to drop (Damsgaard & Jensen, 2021). One day, a shepherd boy in the county was grazing next to the reservoir and accidentally tripped over something that had been exposed to the ground, and the shepherd boy later discovered that it turned out to be an ancient bronze (Fillerup, 2022). In this way, the Spring and Autumn Ancient Tomb of Xichuan Xia Temple in Henan Province was discovered, which mainly includes a number of ancient tombs to form a complete tomb group. Later archaeological research by archaeologists found that in this tomb group(Goldman et al., 2023), the bells of tombs No. 1 and No. 2 have higher research value. There is a particular controversy in the research of chimes in China (Goldman, Fried, Lindsey, Pham, & Dettori, 2023), which is mainly reflected in the musical value, music theory and design concept of chimes.

It is believed that the musical value of chimes is small, and the archaeological value is high, which can represent ancient Chinese music's development and play the ultimate traceability role. However, some scholars believe that the design of chimes has high musical value, not only for theoretical archaeological value, but also for the study of the development of Chinese local rhythms, so it has high musical value and can provide support for the development of modern music and the integration of Chinese and Western music. In order to solve this problem, this paper starts from the study of the characteristics of national musical instruments and the value of modern music, takes the Spring and Autumn Tomb Chimes unearthed in Xichuan Xia Temple as an example, and analyzes them with the help of modern music digital simulation equipment such as mini microphones and Capella software, and excavates the artistic characteristics and modern music value of Spring and Autumn chimes. First of all, the relevant data at home and abroad were collected, and the chimes unearthed in Xichuanxia Temple, Henan Province were classified, and then the signal collection of scale mode, palace tune attribution, and rhythm attribution was carried out according to the musical score (Good et al., 2023). Then, the musical characteristics of chimes in the Spring and Autumn period were verified, and finally, the musical fusion effect and musical style of the chimes in the Spring and Autumn period were analyzed to provide reference for related research in China. Figure 1 shows the specific operation process.

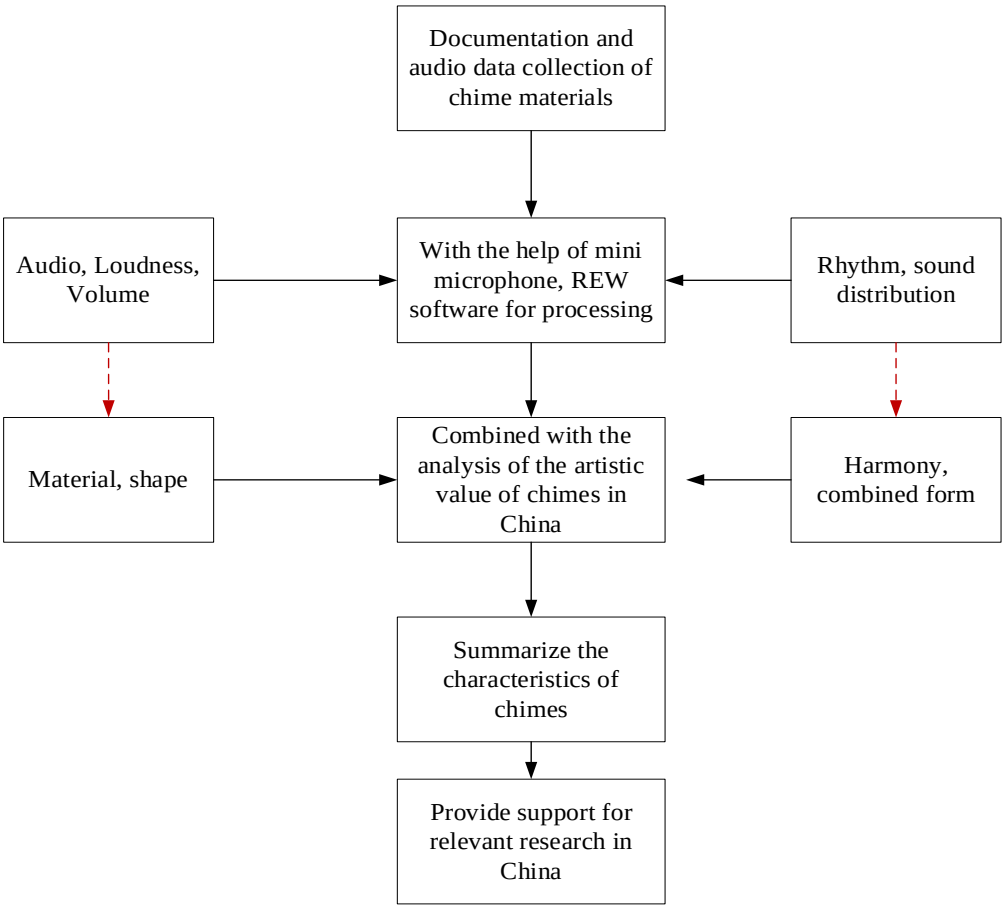


Figure 1: Research Process of Spring and Autumn Chimes

2. CHIMES IN THE SPRING AND AUTUMN PERIOD

2.1 The Origin of Chimes in the Spring and Autumn Period

In ancient China's Spring and Autumn period, chimes became an important court musical instrument. Because the Spring and Autumn Period was a very important period, and at the same time, its politics, society, and economy all had certain changes (Hashimoto et al., 2022), so it also allowed the music art at that time to be better developed, and had a certain degree of innovative performance. In the Spring and Autumn Period, chimes were an important musical instrument, mainly derived from various banquets and celebrations in aristocratic society. As the power struggle between the various nobles intensified, it gained wider application, enhanced rituals and manners and, displayed social status, and became a symbol of the ruling class's power and wealth. From a political point of view, in the Spring and Autumn Period, the existence of chimes can highlight the weight of the vassal states in the political alliances and hostile relations of the parties. For example, each vassal state has its own bell band

(Hurst & Carson, 2021), and they will show their national strength and prestige through the scale of chime performance in political exchanges and even use it to engage in hidden power struggles with other countries. In addition to some symbolic meaning, these performances also played a role in strengthening diplomatic interaction and exchanges between various vassal states. Moreover, in the Spring and Autumn Period, to show their power and status (Hurst et al., 2022), the nobles of various countries often began to increase the number of their chime musicians and the size of their bands. In this way, these bells of the spring and autumn periods began to enrich social and cultural activities, promote social and cultural exchanges between countries, and achieve mutual influence. In addition, economic factors have also had a certain impact on the development of the Spring and Autumn Chimes (James, 2023). For example, when making chimes, people had to use a lot of copper, which in turn had a certain economic impact on society then. Moreover, the production of high-quality bronze bells often requires great manpower and material resources (Krochek & Kovetz, 2022), which will limit the development of chimes in some smaller vassal states, thus causing the development of music in various smaller countries to lag behind. It can be seen that the larger and more numerous the bells, the more powerful the vassal states, the stronger their economic power (Luo, Zhu-Ge, & Zhang, 2023).

2.2 Musical Characteristics of Chimes in the Spring And Autumn Period

Among the bells of the Spring and Autumn Period that have been unearthed in China, there are as many as 70 cases of chimes with different degrees of tuning and filing marks, 32 cases of chimes are shown as sound tunnel-like grooves, and another 32 cases are shown as sound tunnel-like grooves because of tuning. Among all the 70 chimes, 18 chimes not only have obvious traces of tone tunnel tuning, but also show an even number and symmetrical distribution, such as the Qin Gong Bell and the Baoji Xigaoquan Bell, the Yong Bell and the Radial Bell of Dabaozi Mountain in Lixian County, Gansu Province, the Yi Gonghua Bell and the Cangshan Yong Bell. Moreover, the Qin Gong bell belongs to the bells of the earlier period of the Spring and Autumn Period in China, there are 5 pieces in total, and in each Qin Gong bell, people can find that there are obvious 8 tunnels on its inner wall, and there are also obvious tuning traces on the front and back sides of its front and back walls (Magalhães & Limpo, 2022). This shows that in the early Spring and Autumn period, the Chinese already knew how to tune out the tone they wanted, and Chinese national musical instruments already had their own independent tuning methods at that

time. Gong Hua bell is the late Spring and Autumn period of the bell, in the set of bells on the two inner walls of the body, a total of 6 tuning grooves were found by archaeologists, which shows that from the Western Zhou Dynasty to the late Spring and Autumn Period, although the tuning mode of the chime has been developed, but the musicians at that time still because of inertial thinking, and the same tuning mode as the Western Zhou Dynasty- Even or symmetrical sound tunnel patterns (Michilli et al., 2023). It can be seen that until the Spring and Autumn Period, the Western Zhou Dynasty's tuning mode was still retained. According to the research, in the chimes of the Spring and Autumn Period, the sound beam design often appeared, and the more common sound beam forms include semi-cylindrical shape, ridge shape, table shape, etc. Therefore, it is obvious that the number of chimes in the spring and autumn periods increased significantly, confirming that the music of the spring and autumn periods had been well developed. For example, among the bells of the Spring and Autumn Period that have been unearthed, there are as many as 20 bells with sound beams, including a small number of bells of Wang Sun He and the bells of the tomb of Caihou in Shou County. Among the 20 chimes with sound beam design, their sound beams are diverse, and the shape of the sound beams includes: beam-shaped and ridge-shaped, ridge-shaped, ridge-shaped, etc., which can prove that the bells of the Spring and Autumn Period have a variety of tuning methods (Qiang, Li, & Wei, 2022).

2.3 The Role of Spring and Autumn Chimes on National Musical Instruments

The study of chimes in the spring and autumn periods will raise people's awareness of the artistic characteristics of Chinese national musical instruments and have an important impact. First, chimes are a kind of percussion instrument in ancient China, which is a treasure of ancient Chinese music culture, which can show the unique performing arts and manufacturing techniques of ancient Chinese music. Through the study of the chimes of the Spring and Autumn Period, people will know and understand the characteristics of musical instruments and timbre of ancient Chinese music, as well as related music production techniques. This has a good role in promoting the inheritance and development of Chinese culture and art. Second, the unique timbre and performance skills of chimes and the concerto characteristics of other musical instruments can also provide valuable materials and performance experience for modern people's research on national musical instruments. In addition, the unique timbre, tone, and performance method of chimes in the Spring and

Autumn Period can improve people's understanding of ancient Chinese music culture. Therefore, the study of chimes in the Spring and Autumn Period will play a certain role in the study of Chinese music culture in later generations. At the same time, it can promote further development, research and inheritance of traditional Chinese musical instruments. It can be seen that people should carry out specific research on the bells of the Spring and Autumn Period, and effectively protect the unearthed bells of the Spring and Autumn Period, so as to better protect the Chinese national musical instruments. Finally, as a precious musical cultural property, the chimes of the Spring and Autumn Period can also provide a certain reference for the creation and performance of modern music (Rafiei-Ravandi & Smith, 2023).

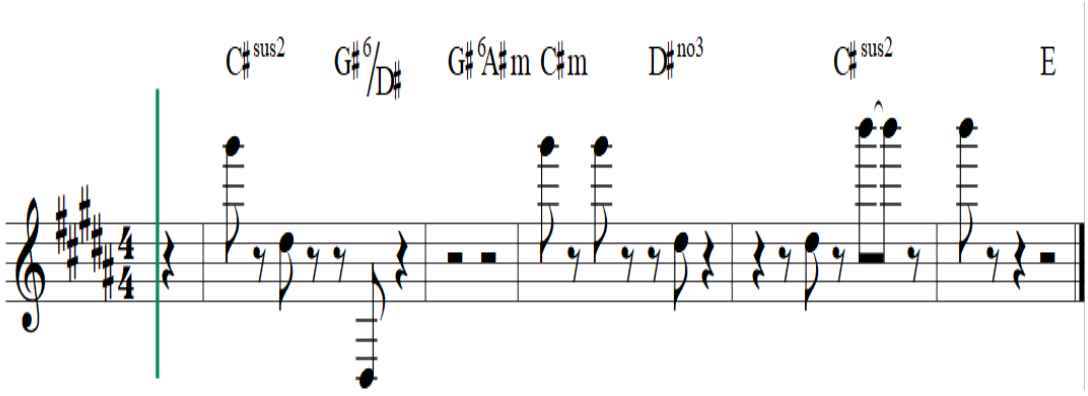
3. RESEARCH METHODS AND RESULTS

3.1 Research Methodology

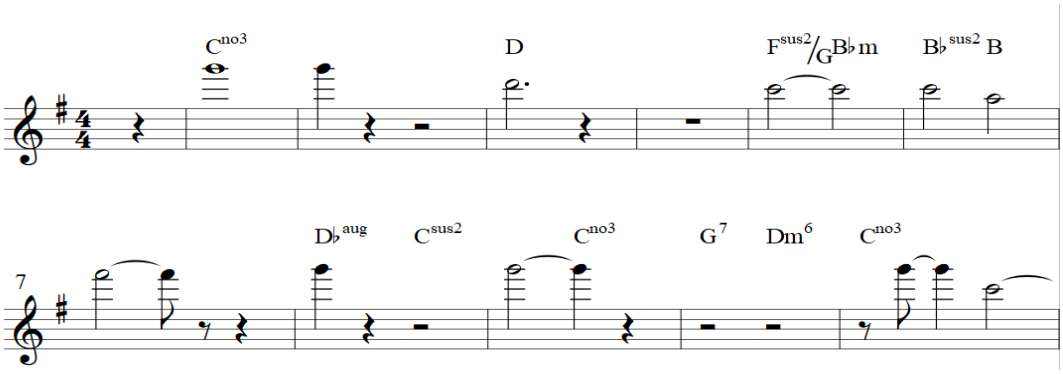
In this paper, the musical value of the representative chimes such as No. 1, No. 2 and No. 7 in the ancient tombs of Xichuan Xia Temple was analyzed, and the digital information of the chimes was obtained with the help of the modern digital signal collection method of Mammoth Lark mini microphone (China: Shenzhen), and the rhythm, notes and rhythm were compared and analyzed by Capella and REW software. The test data comes from published Internet resources, and the chime composition data comes from the reference literature and spectral element analysis (provided by a third-party metal testing agency). Test metrics, chime composition, notes, melody and other musical value signals.

3.2 Timbre and Frequency Research

Taking the No. 1 and No. 2 chimes as examples, the score was constructed by software, and the specific results are shown in Figure 2.



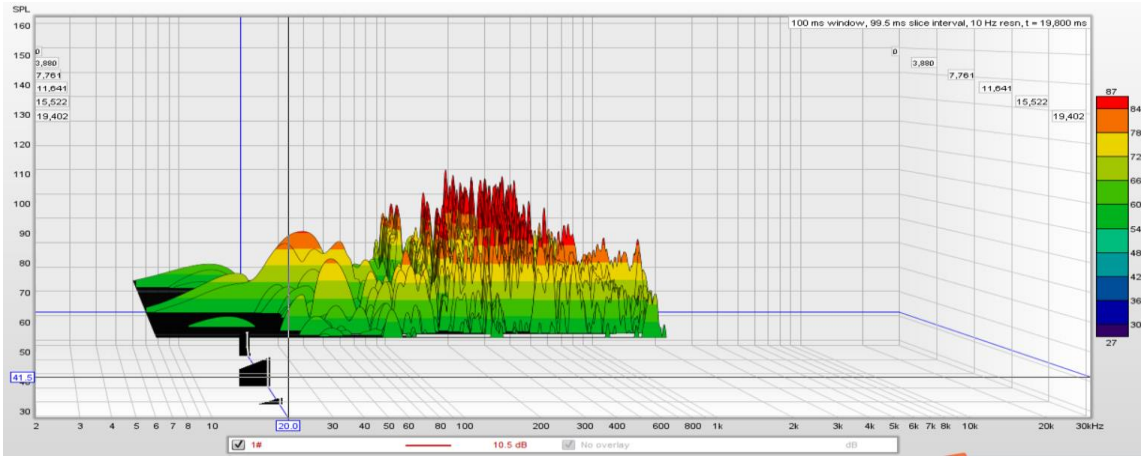
Tomb No. 1 chime



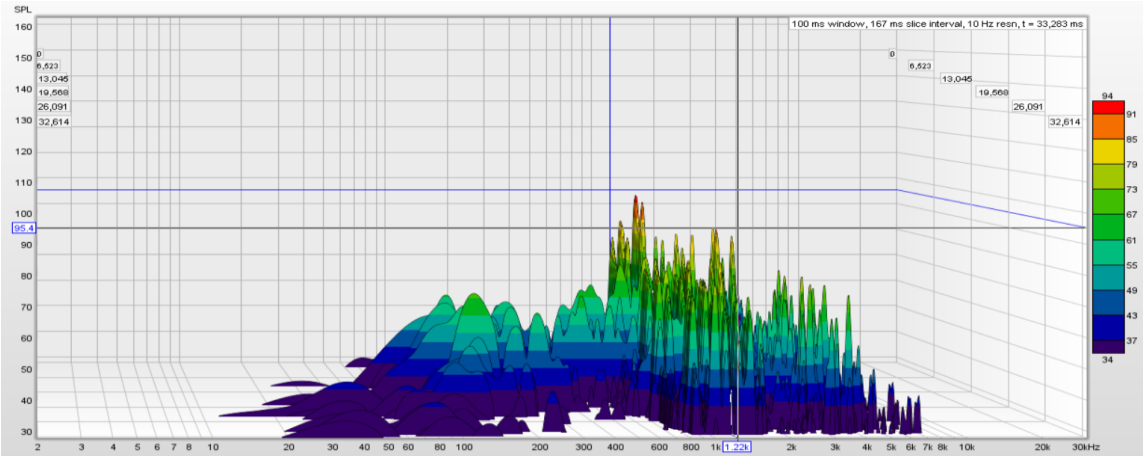
Chime No. 2

Figure 2: Staffs of Different Chimes

The Capella software restored the sound of the chimes, and the stave was drawn, and it was found that the sound of the chimes was rich and the rhythm was stable, mainly due to the material of the chimes themselves. The bells unearthed in Xichuan Xia Temple in Henan Province are mainly bells in the Spring and Autumn Period, mainly bronzes, so the frequency of bells is low. The frequency and timbre analysis of the No. 1 and No. 2 chimes are shown in Figure 3.



Tomb No. 1 chime



Tomb No. 2 chime

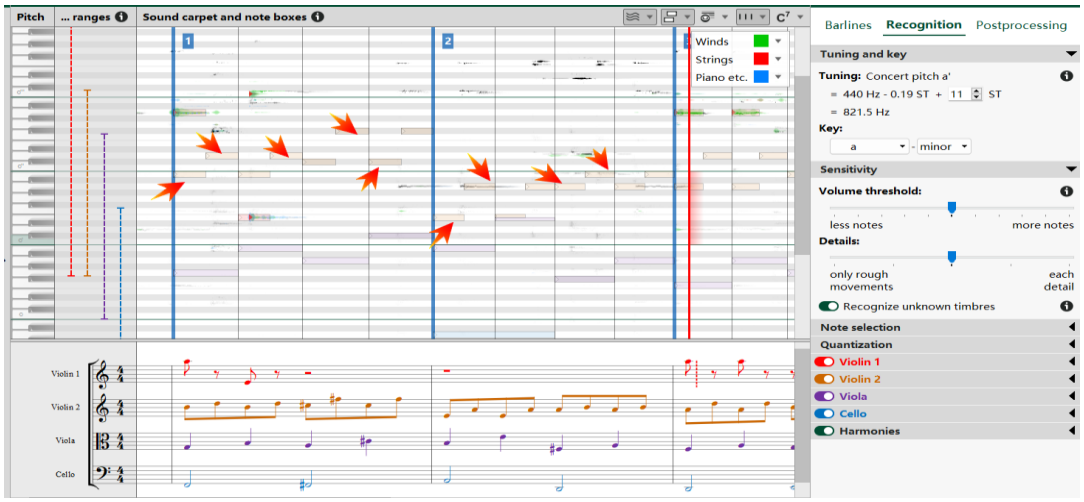
Figure 3: Frequency and Timbre of Chimes

Among them, the ordinate is the SPL signal, which is mainly the timbre signal representing the chime. Comparing the timbre of the two chimes combined, it is found that the chimes of number 7 have a more rich timbre, but the highest frequency is similar to that of number 1. This proves that the overall timbre of Xichuan Xia Temple in Henan Province is the same, but there are certain differences in frequency. The chime material mainly determines the timbre, and the frequency is related to the shape of the chime. The bells of the No. 1 ancient tomb of Xichuan Xia Temple mainly include button bells, stone chimes and stone flutes. Among them, the burial position of the bell is southerly in the middle of the burial chamber, and the six largest pieces are numbered M1:20 to M1:25 and arranged from south to north (from small to large). While the smallest 3 pieces are located in the east. The frames of these chimes are generally in the shape of a curved ruler and are 1.5 m long and 0.4 m wide, respectively (Schwarz et al., 2023). According to the analysis and research of experts, the date of these buttons should be 552 BC. Despite their age, nine of the bells are still very well preserved and have a golden yellow color. They have the same shape and are free of patina. The bell body of these chimes is in the shape of a tile, on the bell body, there is a decoration of the cocktail pattern, and the cockroach pattern on the dance department is basically symmetrically arranged, and the seal part of the cockroach pattern decoration has a spiral design. In addition to this, the drums and cymbals of these chimes are also engraved with different inscriptions. On larger chimes, this inscription is engraved only on the front of them, and only on the lower chimes is engraved on both the front and back. On the inner wall of the drum part of some button bells, there will be a distinct rectangular sound beam, and it is in a convex state (Schwarz et al., 2023). The inner lip of their bell mouth is conspicuously outwardly protruding. According to the research, there are obvious grooves on the inner lip of their sound beams and bell mouths, which can basically be determined to be caused by tuning (Sen et al., 2022). So in reality, these grooves are not intentional but are the result of natural tuning behavior. After testing, the timbre of these chimes is gorgeous, and the sound quality is relatively pure. The bell of Tomb 2 has a total of 8 phonemes - #C-#D-E-F-#F-#G-#A-B, which is 1 phoneme more than the 7-phoneme that was first studied, and this extra phoneme is the "E" . Based on their combination, it can be seen that the seven most commonly used phonemes of the chimes of the No. 2 ancient tomb of Xichuan Xiasi in Henan are #C, #D, F, #F, #G, #A, and B. At the same time, among these 7 phonemes, the #F sound has an extremely wide range, reaching 3 8 degrees between upper and lower. The No. 2 tomb bell is similar in shape

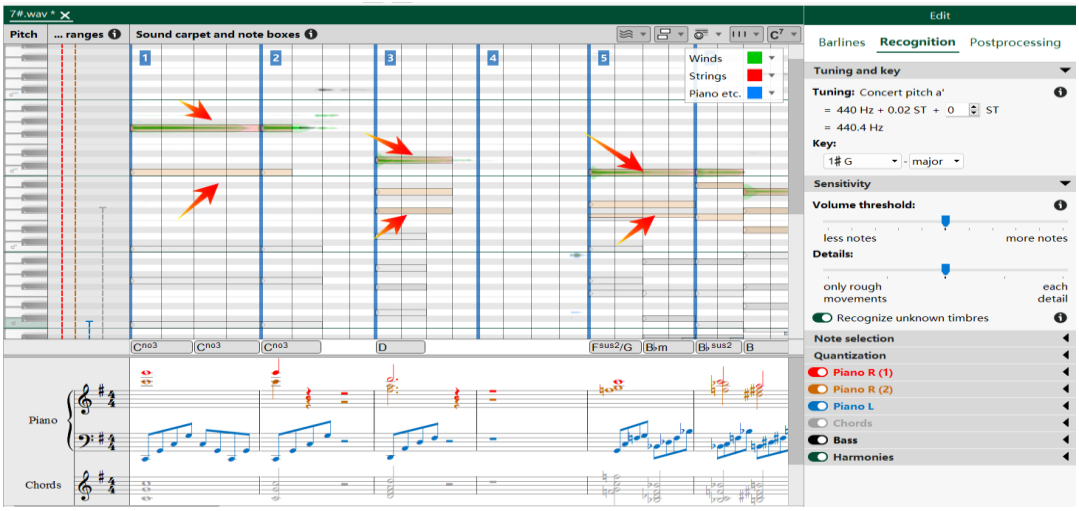
to the famous Zeng Hou Yi chime, with a 5-tone pattern of the drum sound. In the chimes of Tomb No. 2, there are 6 two-tone chimes, and their front and side drum sounds occupy only 8 phonemes, and the remaining 4 phonemes are not included, indicating that the range of the No. 2 chimes is narrow (Tang, Lin, & Li, 2023).

3.3 Comparison of the Loudness and Rhythm Of Chimes

In order to better compare the loudness and rhythm of chimes, rhythms from modern music analysis methods are applied, and the specific analysis results are shown in Figure 4.



Tomb No. 1 chime

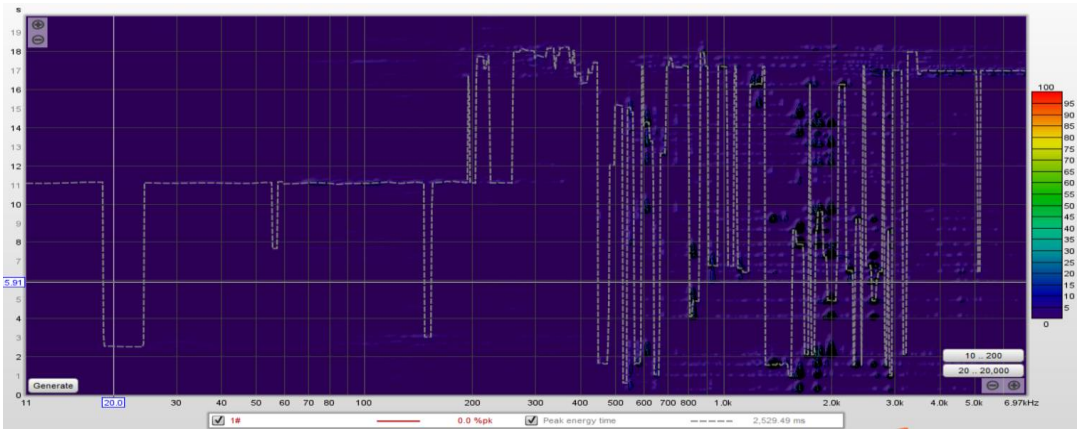


Tomb No. 7 chime

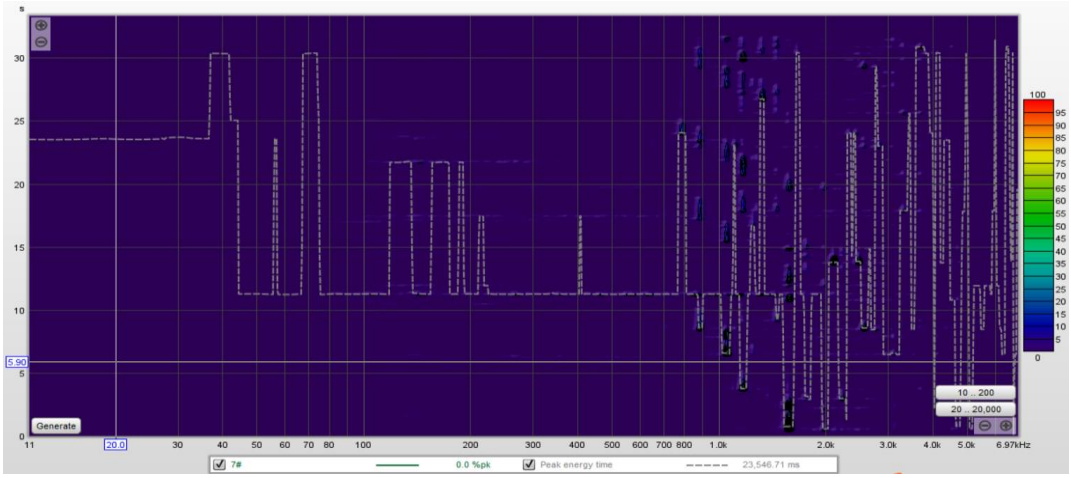
Figure 4: Comparing the Loudness and Rhythm of Different Chimes

As can be seen from the contents of Figure 4, the rhythm of the No. 1 chimes is slower and the loudness is lower, while the rhythm of the No. 7 chimes is faster and the loudness is higher, mainly due to the number of combinations in the chimes, and the number of combinations of the No.

7 chimes is more. The results of searching for relevant data show that the intervals of the main drum and side drum of the chimes in Tomb No. 1 are higher, mainly 20-major, 21-minor, 22-major, 23-major, 24-minor, 25-minor, 26-major, 27-major, and 28-major. Therefore, the chimes No. 1 and No. 2 have a two-tone structure, mainly in the third relationship. Among them, the No. 1 chimes belong to the two-tone arrangement of large and small thirds. Therefore, in the Spring and Autumn Period, the chimes of Xichuan Xiaji Temple finally moved towards a mature development stage after the initial and middle stage of development of double tones. Moreover, the two-tone chimes have formed a fixed mixed combination pattern of large and small thirds in the late Spring and Autumn period. However, of these 9 chimes, there is still 1 chime of the major second. There has been no clear discussion or research on this, so it is not clear whether this is an accidental exception or a deliberate act of musicians during the Spring and Autumn Period. Comparing the loudness and rhythm distributions of the No. 1 and No. 2 chimes, the results are shown in Figure 5.



Tomb No. 1 chime



Tomb No. 7 chime

Figure 5: Loudness and Rhythm of Chimes

As can be seen from the results in Figure 5, the chimes are less loud and fluctuate more dispersively. However, the rhythm of the two is auspicious and inversely correlated, mainly because the two chimes are used differently, with No. 2 focusing more on important celebrations and No. 1 focusing more on ordinary inspiration. Comparing the data in Figure 5, four problems are found: 1) the major third interval of bell No. 1 is higher than that of the perfect law, but lower than the third profit and loss law, and the difference between it and the third profit and loss law is significantly smaller, the minor third interval of the No. 2 chime is higher than that of the pure law and the third profit and loss law, and the difference between it and the perfect law is significantly smaller, 2) the major third interval of the No. 1 chime is higher than the pure law, However, it is lower than the third-in-law ratio, but the difference between it and the pure law is significantly smaller;The major third interval of the No. 2 chime is not only lower than the pure law, but also lower than the third-of-profit and loss law, but the gap with the pure law is significantly smaller;3) The minor third interval of the No. 1 chime is higher than the pure law and the third-in-profit and loss law, but the difference from the pure law is significantly smaller;4) The major third interval of No. 1 chimes is lower than that of the perfect law and the third profit and loss law, but the difference from the perfect rhythm is significantly smaller, and the major third interval of the No. 2 chime is lower than that of the perfect law and the third profit and loss law, but the difference from the perfect law is significantly smaller. The difference between No. 1 and No. 2 chimes in terms of loudness and rhythm is not accidental, but a kind of pursuit of interval rhythm by musicians in the Spring and Autumn Period. This is because the structure of the major and minor thirds in the pure rhythm allows the two-tone bell to have a more melodious, durable timbre and play harmoniously and fully (Valentini et al., 2023). The main and side drum sounds of chimes 1 and 2 are basically concentrated in 8 notes, which are #C, D, #D, E, #F, G, A, B. Among them, except for the #D sound, which rarely appears in the 4 groups of small characters, the other sounds basically appear 2-3 times. When studying this set of chimes, some researchers have analyzed their palace tunes, but no clear conclusions have been given. Based on the existing information, this paper argues that in this set of chimes, the two phonemes #C and #F both appear twice, while #D only appears once, so compared to the #D phoneme#C and #F are more likely to be scales within a certain house key, so this is reminiscent of the D house 7 scale. That is to say, the scale logic of each tone emitted by this set of chimes should be Gong, Shang, Jiao, Qingjiao, Hui, Yu, and

Changgong. If this is true of their scale logic, then looking at the individual pronunciations of this set of chimes, one can see that there is only the side drum of the 27th chime#The D note is not included in this house scale, and every other front and side drum note can belong to the D house 7 scale. In addition, the sound of the drum of the No. 20 chime is just the D palace, which is actually the lowest note, which shows that the No. 20 chime is exactly in line with the music system standard of "Da Bu Yu Gong" mentioned in the history of Chinese music. It would make perfect sense if you started with the lowest note of the D house and then ascended to form a complete scale arrangement. Based on the above reasons, this article believes that this set of chimes unearthed in the ancient tomb of Kawashita Temple No. 1 belongs to the D-gong seven-tone scale. In this way, the #D sound of the No. 27 chime is probably the result of a tuning error by the musicians of the time, so the modern people should adjust the No. 27 chime to the D tone.

3.4 Material Differences and Artistic Value of Chimes

Through third-party metal composition monitoring, it was found that there were differences in the composition of No. 1 and No. 2 chimes, and the main results are shown in Table 1.

Table 1: Mparison of Metal Composition of Chimes

Bells	Ingredient	Proportion
Number 1	Copper, tin, lead, and other metals	90:7:2:1
No. 2	Copper, tin, lead, and other metals	86:9:4:1

As can be seen from the results in Table 1, there are differences in the metal composition of the bells No. 1 and No. 2, mainly in the content of lead and tin. The texture of the two is denser, so the sound is crisper during playing. Lead has a lower frequency, so it can make a deep sound. There are many artistic characteristics of Chinese national musical instruments, which are mainly reflected in timbre, phoneme, scale, rhythm, and other aspects. Taking the No. 1 Tomb Bell and No. 2 Tomb Bell unearthed from Xichuan Xia Temple in Henan Province as an example, the bell, as a percussion instrument in the Spring and Autumn Period of China, is generally cast in bronze and composed of a number of bells of different sizes. Their timbre is relatively crisp and melodious, and they have a wide range, and the phoneme is generally 7-8 bits. In the No. 1 chime group, each bell has a distinctive, well-defined pitch, and basically follows a phonemic arrangement with a mixture of large and small thirds. If you play

these bells of different sizes, shapes, scales, and timbres, you can play complete court music. For the No. 2 tomb bell, this paper concludes that the bell of Tomb No. 2 has a total of 8 phonemes, and the most commonly used 7 phonemes are #C, #D, F, #F, #G, #A, B. In addition, among the 7 phonemes, the #F sound has an extremely wide range, with 3 8 degrees between upper and lower, and appears many times in each bell and each striking point of the No. 2 tomb chime, with the highest number of occurrences. It can be seen that the basic scale of this set of chimes is the 7th scale with #F tone as the palace key. First, according to the analysis of this paper, if the No. 2 tomb chime of Xichuan Xiaji Temple is combined, it will be able to play modern symphony, piano sonata, and pop music with a relatively narrow vocal range. If one can use the No. 2 Tomb Chime to pair it with some modern instruments, then their tones will blend effectively and present a graceful, crisp and aura harmonies. At the same time, taking into account the timbre, interval, pitch, scale and musical expressiveness of this group of chimes, people can also make appropriate tuning of them, so that this set of chimes can better show its wide range of sound, and reasonably match with other instruments or vocals such as piano, saxophone, flute, etc., so as to better play some modern music works. Second, because the chimes of the No. 2 ancient tomb of Xichuan Xia Temple are mainly in the 7-tone scale of #F palace tune, its music is relatively broad, and it can meet the sound effects of various styles of music works. In addition, their playing sounds will show different pitches, and the pitch span between the bells is relatively large, so it is more suitable for playing some long music with classical charm and full of different vocal expressions (Y.-F. Wang & Nitz, 2022).

4. THE MODERN MUSICAL VALUE OF THE SPRING AND AUTUMN TOMB CHIMES

4.1 Accurately Restore Ancient Court Music

From the perspective of the two-tone interval structure, their main two-tone interval structure is a mixed structure of major and minor thirds, and only one chime is a major second, indicating that the chimes of the Spring and Autumn Period are basically based on the interval structure of mixed major and minor thirds, rather than all of them adopt major thirds or minor thirds and major seconds;The gap with the pure law is significantly smaller, so this indicates that the tuning method of the Spring and Autumn period tended to be more rational. Playing with a two-tone bell that is a mixture

of major and minor thirds in a pure rhythmic system produces a more melodious and durable sound, and produces a harmonious and full timbre. Thirdly, from the perspective of the palace tune, the palace tune of the tomb chimes should be the 7-tone scale of the D palace (Qingle), and in order for this set of chimes to meet the normal performance needs, people should adjust the side drum note #D of the 27th chime to D. If the tuning is completed, people can use this set of chimes to play a lot of modern music with ancient characteristics, or play some ancient pure music, such as "Yuqing Music" and "Taiqing Music" in the Song Dynasty. The modern musical value of the tomb chimes. First of all, in terms of performance, one can use this set of chimes to play basically the same effect as a modern piano or harp. For example, when playing, the sound, timbre, pitch, and pitch produced by each bell are all accurate. In this way, people can use it to play many musical compositions and show rich harmonic effects. For example, when playing, each of its bells can achieve good harmony and blend with other instruments or vocals, so as to make the harmony more beautiful and moving, and gradually lead people to the unique artistic conception of the music, so that people can be happy and realize its musical value; secondly, in terms of vocal music, their sound conditions are extremely superior. For example, this set of chimes simulates the individual intervals of the human voice, creating a harmonious sonic beauty with the chords, and expressing emotions and rhythmic changes in the music (Z.-H. Wang, Sang, & Zhang, 2023).

4.2 Enhance the Performance of Modern Music

The modern musical value of the tomb chimes. First of all, in terms of performance, one can use this set of chimes to play basically the same effect as a modern piano or harp. For example, when playing, the sound, timbre, pitch, and pitch produced by each bell are all accurate. In this way, people can use it to play many musical compositions and show rich harmonic effects. For example, when playing, each of its bells can achieve good harmony and blend with other instruments or vocals, so as to make the harmony more beautiful and moving, and gradually lead people to the unique artistic conception of the music, so that people can be happy and realize its musical value; secondly, in terms of vocal music, their sound conditions are extremely superior. For example, this set of chimes simulates the individual intervals of the human voice, creating a harmonious sonic beauty with the chords, and expressing emotions and rhythmic changes in the music. The modern musical value of the tomb chimes. From the research in this paper, it can be seen that the No. 2 tomb

chime can be used with different vocals or other instruments to play a complete piece of music (R. C. Zhang & Zhang, 2022). At the same time, if scientific tuning and reasonable instrument matching, people can also use this set of chimes to present the audience with diverse and expressive music performance effects. In addition, the interval of the tomb bell and the attribution of the palace tune have made it realize a certain application. For example, when playing with this set of chimes, they are able to jump between larger tones in a relatively short interval, resulting in a more layered melody and faster interval changes, as well as beautiful harmonies. Therefore, this plays a relatively good role in improving the harmonic effect of modern music performance. It is worth mentioning that the #F is Palace-based 7-tone chimes have rich intervals, therefore, using it to play will present a more beautiful sound effect for the melody, harmony, style, and emotion of the whole piece (C. Zhang et al., 2023).

4.3 Enriching the Forms of Modern Music Teaching

In the process of playing, chimes can interpret a modern light music work with emotion, resonance, and applause from the audience, and finally, in terms of timbre and acoustics. The timbre of this set of chimes varies, some of which are crisp and pleasant, while others are full of tension and movement. As a result, this set of chimes can bring a multi-faceted mood to the interpretation of classical and modern music. If the tuning is done well, the chimes can be combined with appropriate playing techniques and resonances to create a layered, grandiose, powerful sound for the listener, thus showing excellent performance skills and artistic charm. The modern musical value of the tomb chimes is reflected in the improvement of timbre, acoustic effects, artistic conception of the music, and the ensemble with modern music to enrich the form of expression. Chimes can also be used to interpret various styles of modern music, such as some graceful, atmospheric and majestic modern music works. It can be seen that the melody of the tomb chime is changeable, and it can be combined with the harmony of different musical instruments or people to show a more melodic sense or full of artistic conception and highly infectious performance effect (Zhu-Ge, Luo, & Zhang, 2023).

5. CONCLUSION

Through the research in this paper, it can be seen that the artistic characteristics of Chinese folk musical instruments are mainly manifested

in timbre, interval, scale, etc., while their modern musical value is mainly manifested in the integrity and musical expressiveness of the music during performance. The results show that the No. 1 and No. 2 chimes unearthed in Xichuan Xiasi, Henan Province have more spring and autumn characteristics in terms of modeling, and the proportion of shape, copper, tin, lead and other materials will also affect the timbre, frequency and loudness of the chimes. Among them, No. 1 has a higher loudness and faster rhythm, mainly because it is mostly used for court music performances, and No. 2 has a low loudness and slow tempo, which is mainly used for large-scale activities, reflecting a certain solemnity. Comparative analysis shows that the Spring and Autumn Period chimes were mainly thick and slow-paced, and their performance effects were enhanced through combination, material and modeling. Therefore, the Spring and Autumn Chimes are of great value for modern music education, music creation, and cultural deepening. This study also has some shortcomings, mainly because it is difficult to collect chime data and obtain chime test data. In the future, we will focus on data collection to make up for our own imperfections.

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