A STUDY ON SMALL MELODIC MOTIVES IN VOCAL PARTS OF JINGJU

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ABSTRACT

In recent years, there has been increased attention on computational approaches for studying music traditions from an ethnomusicological perspective, being Jingju one significant case of study. Analyses about melodic characteristics of vocal parts in Jingju have been the focus of many research works. In this paper, we use the Jingju Music Scores Collection and music21 to extend the previous interval analyses by considering small melodic motives of three notes in vocal parts of Jingju. The aim is to identify which pairs of consecutive intervals (considering interval class and direction) are more frequent in order to further characterize and understand this important musical tradition. Specifically, for our analysis, we attend to different *shengqiang*, namely *erhuang* and *xipi*, and different role types, namely *dan* and *laosheng*; and confirm the existence of variations between these four categories in regards to small melodic motives of three notes. We present our experiments showing overall conclusions and differences between *shengqiang* and role types, and finally end up with a discussion about the results of this study, as well as its limitations and future work.

1. INTRODUCTION

Jingju, also known as Beijing or Peking Opera, is a traditional Chinese art that combines vocal performance, music, dance, mime and acrobatics. It was originated in the late 18th century and became significantly popular during the Qing Dynasty. In particular, around 1790, outstanding opera artists all over the country came to Beijing and play for the 80th birthday of the Emperor. Various types of local traditional operas were integrated at that time and eventually, Jingju was formed and became the most influential traditional opera in China [1, 2].

The main themes of Jingju are political and military struggles in history. Most stories are taken from historical romance and novel scripts [3]. In order to interpret a story vividly, there is a variety of role types characterized by male or female gender, with *dan* (female character) and *laosheng* (male character above middle age) being the central ones. The structure of Jingju arias is based on couplets, where each couplet consists of two lines: an opening line and a closing line [2]. The term *shengqiang* conveys the specific melodic framework for the music and singing of a Beijing opera. Different *shengqiang* are used to express different emotions, and *xipi* and *erhuang* are the most popular ones. On the one hand, the style of *xipi* is often lively, vigorous, bright, and light. It is often used to express cheerful, resolute, passionate and restrained feeling. On the other hand, *erhuang* is often peaceful, modest and lyrical, often expressing meditation, sadness, sigh and anger [4, 5].

Over the last twenty years, there has been an increasing interest in computational approaches for studying music traditions from an ethnomusicological point of view [6–9]. In regard to Jingju music, since melodic contours of singing parts are key characteristics to understand the tradition, several articles and theses have been devoted to their study. Most of the works use audio datasets to perform pitch and melodic analyses. However, in recent years, the appearance of datasets containing score notation for Jingju music, like the Jingju Music Scores Collection [10], has promoted new studies using symbolic analysis, thus offering new possibilities for computational ethnomusicology. The main melody structure of Jingju is based on an anhemitonic pentatonic scale, and also but less common, a hexachord scale. Therefore, this music can be conceived as modal, and intervals, a key aspect in singing parts, can be analyzed using the "Western" scale [5].

In this paper, we aim at extending the interval analyses of previous Jingju works using symbolic data. In particular, our focus is to consider melodic motives of three consecutive notes, attending to the pair of intervals formed between these three notes, in terms of class and direction (ascending or descending). We attend to different categories, namely *erhuang* and *xipi*, and role types *dan* and *laosheng*. Specifically, in this paper the following research questions are addressed: (1) What are the most frequent melodic motives of three notes in vocal parts? and (2) are they different between *erhuang* and *xipi*, or between *dan* and *laosheng*?

The remaining of this paper is structured as follows. In Section 2 we discuss the related work, specifically we illustrate the main points in [11] regarding its interval study. In Section 3, we present the methodology used in this work and the results are showed in section 4. In the last section, we discuss the main conclusions together with a discussion about the main results of the papers and limitations.

2. RELATED WORK

In [11], the author discusses some of the main differences between *xipi* and *erhuang*, and between *dan* and *laosheng* in regards to the intervallic nature of the voices. Some general agreed characterizations made in the literature are pointed out, such as *xipi* using larger intervals than *erhuang*, *erhuang* having more preference towards conjunct steps than *xipi*, or female singing being more melismatic than male singing. Then, symbolic analyses are performed to verify these general assumptions.

The results in [11] are represented in terms of interval histograms and focused solely on pairs of notes, also considering the direction of the different intervals. Some of the most relevant outcomes of this analysis is that major second is shown to be the most used interval for both *shengqiang* cases, followed by the minor third, which both are the natural intervals of the pentatonic scale used in Jingju. In addition, the distribution of intervals of *erhuang* and *xipi* is shown to be quite similar, with small differences that confirm the previous claimed assumptions. Regarding role types, male and female vocal parts are also shown to be very alike when it comes to intervallic space, with female having more predominance of perfect fourths –an interval which is also shown to be more frequent in descending form than ascending– and minor sixths, when compared to male singing [11].

These claims made in [11] will be analyzed in this paper extending the interval study to groups of three consecutive notes. In particular, taking the state-of-the-art into account, we expect that melodic motives with conjunct steps of major seconds are the most frequent type, also with minor thirds. We also expect motives with symmetric movement, i.e. an ascending interval followed by the same interval class in descending form, or viceversa; to be quite frequent given the melismatic nature of Jingju voices. These hypotheses will be verified with our computational analysis.

3. METHOD

In order to carry out this study, the Jingju Music Scores Collection (JMSC) presented in [10] and updated in 2019 [12] was used. JMSC is a set of collection accompanied by scores metadata, curated annotations per score and melodic line, and a set of software tools for extracting statistical information from it. JMSC offers a comprehensive and complete resource for the study of Jingju singing in terms of its musical system which can help understand the elements that build the Jingju musical system. [10]

JMSC contains 108 MusicXML scores and covers 1084 melodic lines [12]. For the scores, the metadata contain the title of the work in Chinese, role type, shengqiang, banshi, the reference of the original score. For the lines, each of them is annotated with the role type, shengqiang, banshi, line type, the lyrics for the whole line and for each of its sections, the linguistic tones of the lyrics, and the starting and ending offsets of the line and each of its sections. [10]

The computational analysis in this study was developed using Python. In particular, Jupyter notebook and music21

library [14] was used to perform the symbolic processing. Music21 is an open-source, cross-platform toolkit developed by Massachusetts Institute of Technology. It provides a modular approach, melding object-oriented music representation and analysis with a concise and simple programming interface. Because it is written in Python, music21 can tap into many other libraries and sophisticated database searches with musical analysis [15]. Simplicity of use, ease of expansion, and access to existing data, Music21 can not only be used to study basic music theory and edit musical notation. With the powerful computing capability of computers, it can also be used for generating musical examples, studying large music datasets and composing music both algorithmically and directly. Even more, it can help people study music and our brain. [14, 15]

The general methodology used for addressing the research questions of this paper is as follows. First, the Jingju scores were read and the vocal parts for each of them were obtained. Then, we extracted sequences of three consecutive notes following these criteria:

1. **No rests in the middle**: we only attend to continuous groups of three notes. Therefore, we do not include in the analysis groups of notes with rests in the middle, independently of the duration of the rests.

2. **Grace notes ignored**: as in [11], grace notes are ignored when retrieving groups of contiguous notes. This means that if a grace note is encountered it is omitted and the next note that is not a grace note is extracted instead. Because of our decision to restrict the analysis to the core melodic content of Jingju vocal parts and since grace notes could be subject of variations depending on the performer, we chose not to include them in our analysis.

3. **Unison intervals not considered**: in our analysis we are interested in looking at the melodic movement of voices in order to relate it to the modal scale used in Jingju as well as the melismatic behavior. Since unison intervals do not contribute much to these aspects, we decided not to include them in our analysis.

After extracting all the three-note motives in vocal parts following the previous criteria, the *Shengqiang* type was obtained for each score using the metadata files included in the JMSC. Moreover, for each melodic line, the role type was also extracted using these metadata.

Then, each pair of intervals was saved following this format: $\{itv1\_dir\}\{itv1\_class\}\_\{itv2\_dir\}\{itv2\_class\}$, where $\{itv1\_dir\}$ and $\{itv2\_dir\}$ are A or D depending on whether the first and second interval is ascending or descending, respectively; and $\{itv1\_class\}$ and $\{itv2\_class\}$ stand for the interval classes for the two retrieved intervals, respectively, as given by the nomenclature used in music21. For example, $AM2\_Dm3$ represents a motive consisting of an ascending major second followed by a descending minor third.

Afterwards, we obtained results in three different stages plotting bar graphs with the percentage of each of the possible pair of intervals, and drew conclusions for each of them. The first stage consists in analyzing all the Jingju scores without making any distinction between *shengqiang* or role type. Second, the same bar graphs were extracted separating between *erhuang* and *xipi*. Finally, a further separation by role type was also considered giving rise to four different categories: *erhuang dan*, *erhuang laosheng*, *xipi dan* and *xipi laosheng*.

The Jupyter Notebook used for this analysis is public available in GitHub: `https://github.com/clbetty/Jingju-Melodic-Motives.git`.

4. RESULTS

In this section, we present the results for the three stages of the analysis described previously.

4.1 Overall Jingju scores

Figure 1 shows the interval-pair histogram when analyzing the JMSC as a whole. For visualization purposes, we only included here –and in the next figures too– the twenty most frequent pairs of intervals. The whole histogram with all the existent three-note motives can be seen in the Jupyter Notebook available in Github.

As it can be seen, the most frequent motive is a symmetric movement of major seconds (i.e. $DM2\_AM2$), followed by a symmetric movement of minor thirds ($Dm3\_Am3$). The rest of frequent motives contain variations of these two movements, some of them symmetric and others combining major second with minor third. As expected, the most important intervals are major second and minor third, which are natural intervals of the pentatonic scale used in Jingju. In addition, the next important interval coming into play is the descending perfect fourth, which is commonly encountered in conjunction with an ascending minor third. Furthermore, in parallel with the claims in [11], motives with descendent perfect fourths are more frequent, representing the 12.17% when compared with the 7.67% containing ascendent perfect fourths.

4.2 *Shengqiang*

Figure 2 shows the interval-pair histograms when separating the scores by *shengqiang* type, namely *erhuang* and *xipi*.

The results for the twenty most frequent motives show again symmetric movement $DM2\_AM2$ is the most frequent for both *shengqiang*, followed by other symmetric motives, $Dm3\_Am3$ is the second most important three-note motive in *erhuang* while $AM2\_DM2$ is the second most important for *xipi*. Combinations of major seconds and minor thirds are very frequent for both categories, again the natural intervals of the pentatonic scale used in Jingju.

As for the main differences encountered between *erhuang* and *xipi*, it can be shown that in *xipi* there are
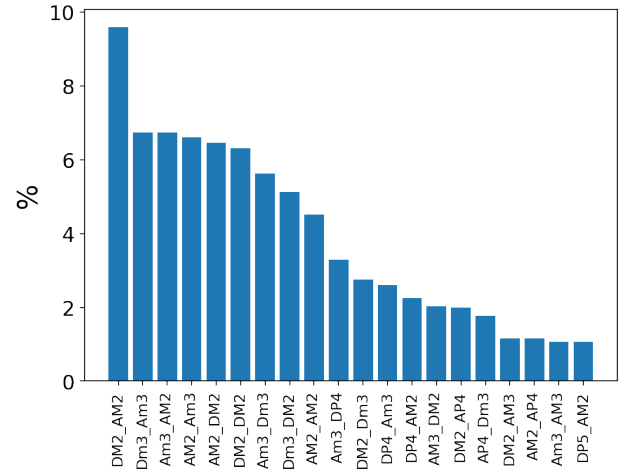

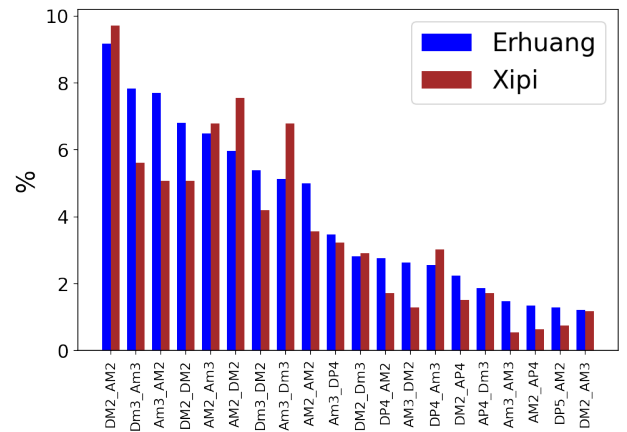**Figure 1**. The 20 most frequent three-note motives of all.

Figure 2. The 20 most frequent three-note motives for *erhuang* and *xipi*.

more types of combinations present between pairs of intervals than in *erhuang*, since there are 42 interval pairs in *xipi* with an occurrence larger than 0.5% as compared with the 30 types of interval pairs in *erhuang*. Moreover, in *xipi* there is a slight greater percentage of symmetric movements than in *erhuang*, representing the 31.71% of three-note motives in *xipi* and the 30.49% in *erhuang*. Finally, in *xipi* there is also a greater percentage of motives with intervals larger than M3 (e.g. P4, P5, m6). These motives containing larger intervals represent the 31.28% in *xipi* and 25.74% in *erhuang*, thus confirming the general claim discussed in [11] about *xipi* using larger intervals than *erhuang*. Regarding conjunct motives (containing only M2 or m2) there is no difference between both *shengqiang*, in *erhuang* conjunct motives represents the 28.56% while in *xipi* they represent a very slightly greater percentage of 28.59%. Therefore, the claim about *erhuang* having more preference towards conjunct steps is not representative when considering three-note motives.
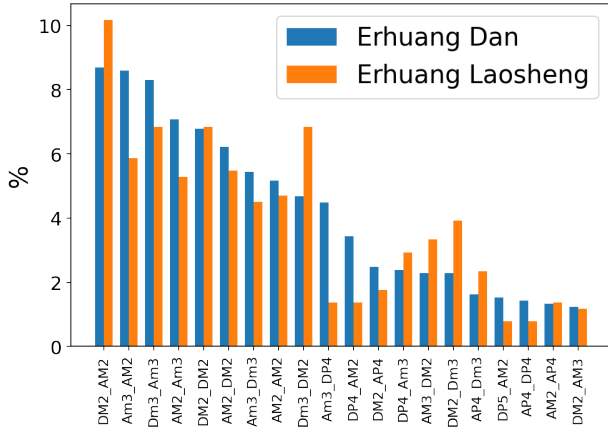
Figure 3. The 20 most frequent three-note motives for *erhuang dan* and *erhuang laosheng*.

Figure 4. The 20 most frequent three-note motives for *xipi dan* and *xipi laosheng*.

4.3 *Shengqiang* and role type

Figure 3 shows the interval-pair histograms for the twenty most frequent motives when separating the scores by *erhuang dan* and *erhuang laosheng*. As it can be seen, there are no significant differences at first sight. However, some subtle nuances can be shown, namely, in *erhuang laosheng* there are more types of combinations present between pairs of intervals than in *erhuang dan*, since there are 32 interval pairs in *erhuang laosheng* with an occurrence larger than 0.5% as compared with the 28 types of interval pairs in *erhuang dan*. Furthermore, in *erhuang laosheng* motives with M3 (e.g. Am3_AM3, DM3_AM2) have more presence, representing the 13.89% compared to the 6.68% in *erhuang dan*. In addition, in parallel with the claims in [11], motives containing perfect fourths are more frequent for the female *erhuang* singing, representing the 22.45% compared to the 17.61% in male *erhuang* singing. Regarding minor sixth, motives containing this interval are also more frequent in female *erhuang* singing, representing the 0.95% compared to the 0.20% in male *erhuang* singing.

Figure 4 shows the interval-pair histograms for the twenty most frequent motives when separating the scores by *xipi dan* and *xipi laosheng*. Some subtle differences between both categories can be shown, namely, in *xipi dan* there are more types of combinations present between pairs of intervals than in *xipi laosheng*, since there are 36 interval pairs in *erhuang laosheng* with an occurrence larger than 0.5% as compared with the 30 types of interval pairs in *erhuang dan*. This shows an interesting difference in the number of intervals present specially between the *dan* role type in *erhuang* or *xipi*, in the former there are 28 types with an occurence larger than 0.5% compared to the 36 types of the latter. Going back to the *xipi* results, in *xipi laosheng* there are more motives combining M2 and M3, representing the 13.52% compared to a minimal 0.29% in *xipi dan*. In addition, in parallel with the claims in [11], motives containing perfect fourths are more frequent for the female *xipi* singing, representing the 23.87% compared to the 20.49% in male *xipi* singing. Regarding minor sixth, motives containing this interval are way more frequent in
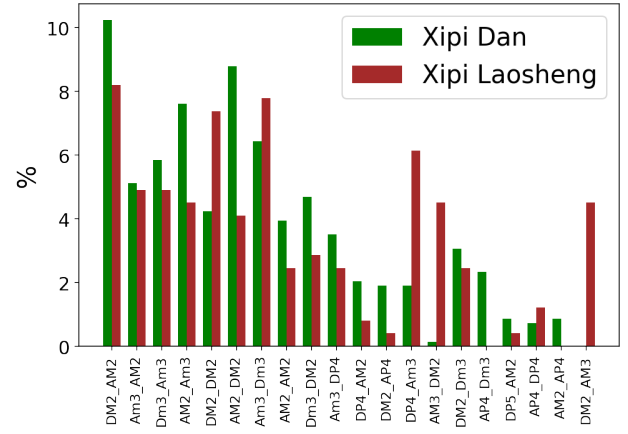
female *xipi* singing, representing the 4.39% while in male *xipi* male there are not three-note motives containing minor sixth. Interestingly, the percentage of minor sixths in motives in female *xipi* is significantly greater than in *erhuang*.

5. CONCLUSION

In this paper, we studied melodic motives of three notes in vocal parts in Jingju. We selected and compared the most 20 frequent three-note motives on all scores, different *shengqiang* and different role-types respectively. We also extracted some meaningful percentages of motives containing certain intervals for each category. In particular, the following claims made for separate intervals (pairs of notes) in [11] were extended and verified for melodic motives of three notes in our study:

1. The most frequent motives contain major second and minor third, natural intervals of the pentatonic scale used in Jingju.

2. Motives containing descending perfect fourths are more frequent than motives containing ascending perfect fourths.

3. In *xipi* there is a major percentage of motives containing large intervals (larger than M3) than in *erhuang*.

4. Female singing has more preference towards perfect fourths and minor sixths than male singing.

Due to time constraints, this study was only focused on three-note motives. Larger motives might include more features and information. And we ignored grace notes which might affected the final results to a certain degree. These ornaments might be used to notate melodic inflection that convey tonal information.

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