Mojannab Interval-class and the Question of Precision in Creating and Recognizing modes in Persian *Dastgah* Music: A Pilot Study on Perception of *Mojannab* in the Mode *Afshari*

NEGAR BOUBAN [1]
Independent Scholar, Musicologist (PhD) and Musician

Mojannab in Persian *Dastgah* music is the characteristic interval-class that appears in every Dastgah,[2] creating the authentic sound of Persian modes. Although whole-tones and semi-tones in the Dastgah system are largely accepted as identical to their Pythagorean versions, the size of the Mojannab interval-class is still in dispute. The interval-label of Mojannab, often referred to as a 3/4-tone, covers intervals bigger than a semi-tone and smaller than a whole-tone, and is therefore considered as a separate class of intervals here. There have been various studies and theoretical frameworks aiming to specify Mojannab interval-sizes. However, their disparate results have caused more confusion than clarity for further theoretical studies or application to practical music making.

In this paper I present a pilot study on the Mojannab interval-class, using a new approach: an audio survey that addresses the perception of the interval in its modal melodic context. 41 professional musicians of Dastgah tradition took part in an online quantitative survey to choose from five melody-excerpts of well-known pieces in the mode *Afshari*. For each excerpt, participants were given four prepared audio samples, each of which presented the same melody with different interval sizes for Mojannab they contained. Samples were produced with controlled interval-sizes based on previous literature summarised in Figure 2. The results show clear preferences for two Mojannab sizes.

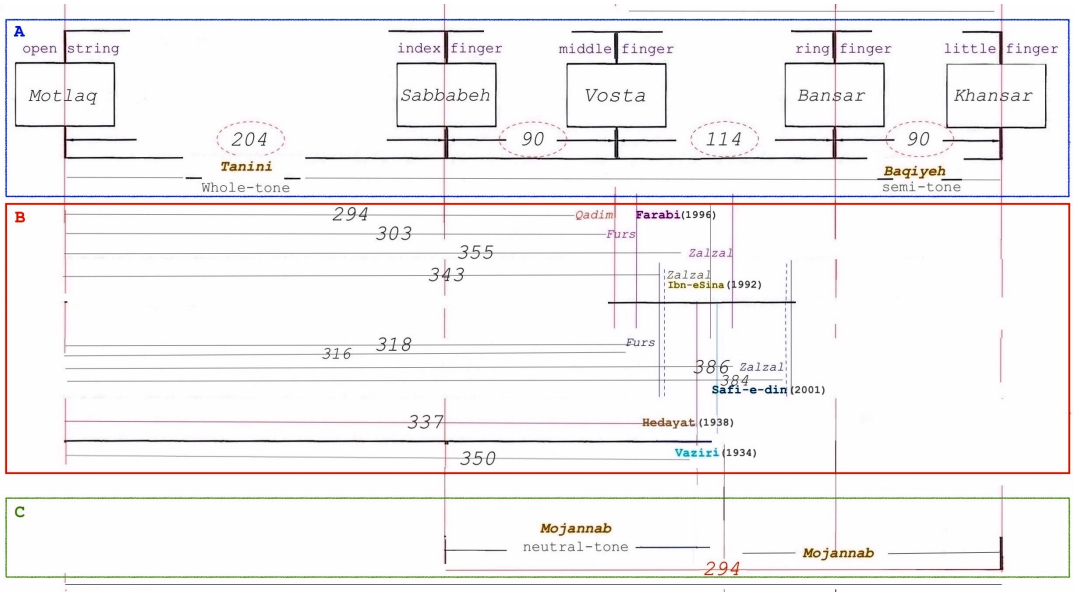


Fig. 1. An illustration of the range of Vosta (middle-finger positions) and the resulting musical intervals, found in literature from the 9th to 20th centuries. Intervals are presented in musical cents, within the frame of a tetrachord (ratio of 4/3, 498 cents). Box *A* shows (from left to right) the main four tones named after fingers' positions, with the intervals created between them. Box *B* presents intervals produced between the open string and Vosta tones, according to Farabi (1996), Ibn-e Sina (1992), Safi-e-din (2001), Hedayat (1938), and Vaziri (1934). The first three of these sources, each introduce two versions of Vosta; for example, according to Farabi (1996), a *Furs* Vosta of 303 cents, and a Zalzal Vosta of 355 cents are documented,

whereas for Ibn-e Sina (1992), the Zalzal Vosta equals 343 cents, while the Furs Vosta is 318 cents. Box *C* at the bottom, demonstrates how two consecutive Mojannabs make a minor third of 294 cents.

MOJANNAB INTERVAL-CLASS AND ITS BACKGROUND

The word Mojannab comes from Arabic, literally referring to something on the side of another. In musical-intervals terminology, it was coined as a result of fingering-positions on the strings of the Oud (a fretless short-necked lute), creating intervals for different modes. As the four fingers are used to generate whole- and semi-tone intervals, in order to produce a tone in between these, one of the fingers has to sit on a side position, and is therefore called Mojannab.[3]

On the Oud, the oldest and clearest of such side positions is played by the middle finger, dividing the distance between first and fourth fingers in half. This fingering position of *Vosta* (the name for the middle finger), in relation to the first finger, creates an interval size of 151 musical-cents, versus a whole-tone of 204 cents. This particular Vosta is named Zalzal.[4] However, Vosta as the middle finger was used for other tones as well. Therefore, there exist varieties of Vosta positions, and as a result, varieties of Mojannab. In Figure 1, different varieties of Vosta finger positions are summarized, based on literature from the 9th to 20th centuries.[5] The range of Vosta intervals are wide: from 294 to 386 cents, and include the minor-third of the system.[6]

RECENT THEORIES AND MEASUREMENTS

In recent decades, many scholars and musicologists have studied and written on the subject of intonation in Dastgah music. In their work, they mention the unclear state of Mojannab and its varieties. Some scholars suggest flexibility,[7] interpreting different Mojannab-sizes, as individual choices of the musician (Farhat, 1990). Some imply there are different Mojannabs for different Dastgahs (During, 2006), while others use an average pitch (Tala"i, 1993) around which lies a cluster of tones. While this is already chaotic enough, suggesting specific temperaments to establish order (e.g. Vaziri, 1934) tends to be strongly criticized.

There have been a couple of recent studies, measuring intervals within the context of modes, using computational methods (Sanati, 2020; Shafiei, 2021). Yet, the question of Mojannab size is still open, which some musicologists and musicians have taken as confirmation of the idea that intervals are flexible: as though different varieties are equally acceptable. In Figure 2, the results of the various studies and measurements are summarized. It shows that the Mojannab interval-class can be put in three categories: around 120-cents, around 145-cents, and above 160-cents. A similar categorisation can be traced in older treatises with Mojannab *Kabir*, Mojannab *Zalzal*, and Mojannab *Saqir*. [8]

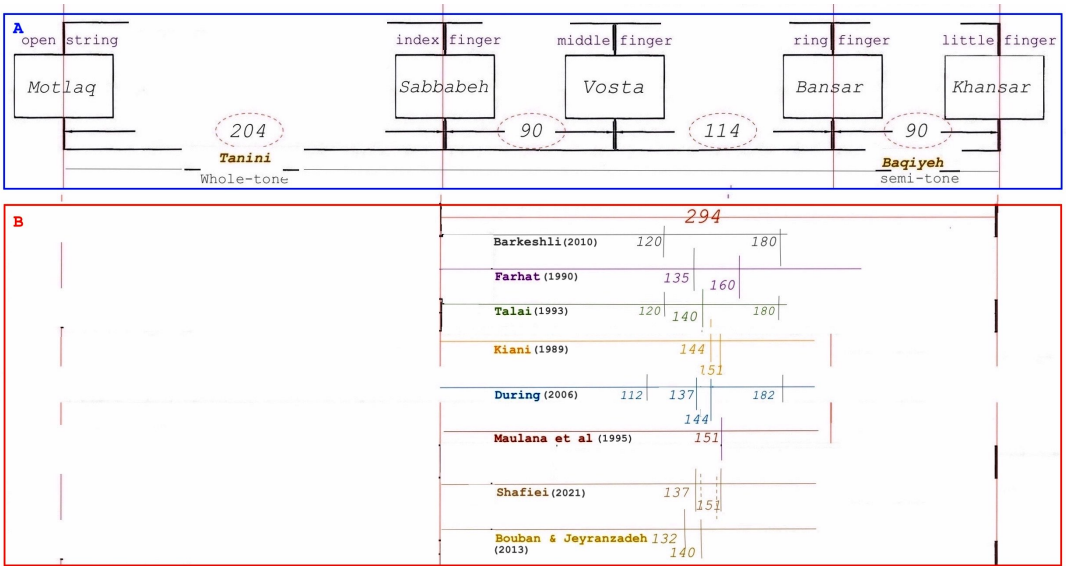


Fig. 2. An illustration of the range of *Mojannab* sizes reported by different studies in recent decades. Similar to Figure 1, box *A* shows the main four finger positions and their intervals. Box *B* demonstrates Mojannab-

intervals between the index and middle fingers in cents, as reported by Barkeshli (2010), Farhat (1990), Talai (1993), Kiani (1989), During (2006), Maulana & Osqueezadeh (1995), Shafiei (2021) and Bouban & Jeyranzadeh (2013). Five out of the eight, report two different Mojannabs, while Talai has three different sizes, During presents four, and Maulana & Osqueezadeh report only one.

Having observed the Mojannab varieties, the question of how many Mojannabs actually exist and why there are different measurements, leads to four different hypotheses:

a. Flexibility, leading to a considerable range of acceptable intervals.
b. Tolerance, resulting from imprecision in perception.
c. Ambiguity, resulting from oral traditions.
d. Diversity, necessary for creating various modes, though not precisely documented.[9]

AN AUDIO SURVEY ON PERCEPTION OF MOJANNAB

In all previous studies, measurements and theoretical frameworks were either formed or presented without reproducing them for testing afterwards. The present pilot study is an attempt to produce melody-samples with controlled pitch creating the various Mojannab intervals. Well-known melody excerpts are played and presented to professional musicians of Persian Dastgah background, where they are asked to choose from amongst four versions in a multiple-choice survey. An online survey was sent to participants containing five questions for each melody-excerpt,[10] which was in the mode of *Afshari*.[11] The hypotheses explored are Diversity and Flexibility (a and d in the list above), to see if there is noticeable preference for any of Mojannab-sizes in the Afshari modal context. The interval-sizes between tones were taken from the existing literature, summarised in Figure 2.

I first recorded single tones played on the Oud and re-tuned them to the desired calculated pitch and then checked the pitch on Praat (Boersma & Weenink, 2019). The tones were then put into Soundplant software[12], where a key of the keyboard was assigned to each tone. Melody-excerpts were performed on the computer keyboard and recorded, and then uploaded as choices in the online survey.

Mojannab sizes tested were as follows: 139 cents (ratio: 13/12), 151 cents (ratio: 12/11), 165 cents (ratio: 11/10) and 182 cents (ratio: 10/9).

RESULTS

The survey was sent to 41 musicians with years of professional experience in Dastgah music. Participants were asked to listen to the original melody excerpt in each question, then check the four produced samples. They were then asked to choose the one they found to be closest to how that melody in Afshari should sound. Choices of “all” and “none” were presented as well, in case the participant had no preference for any of the four.

In Figures 3 and 4, the first results are visualized, showing that choices of “all” were relatively low in four out of five melodies. In Figure 4, the ratios of Mojannabs, used in each sample, are given on the chart bars and the visualization shows that intervals of 139 cents (13/12) and 151 cents (12/11) were generally preferred. It is only in the 2nd melody that a considerable choice of “all” is observed.

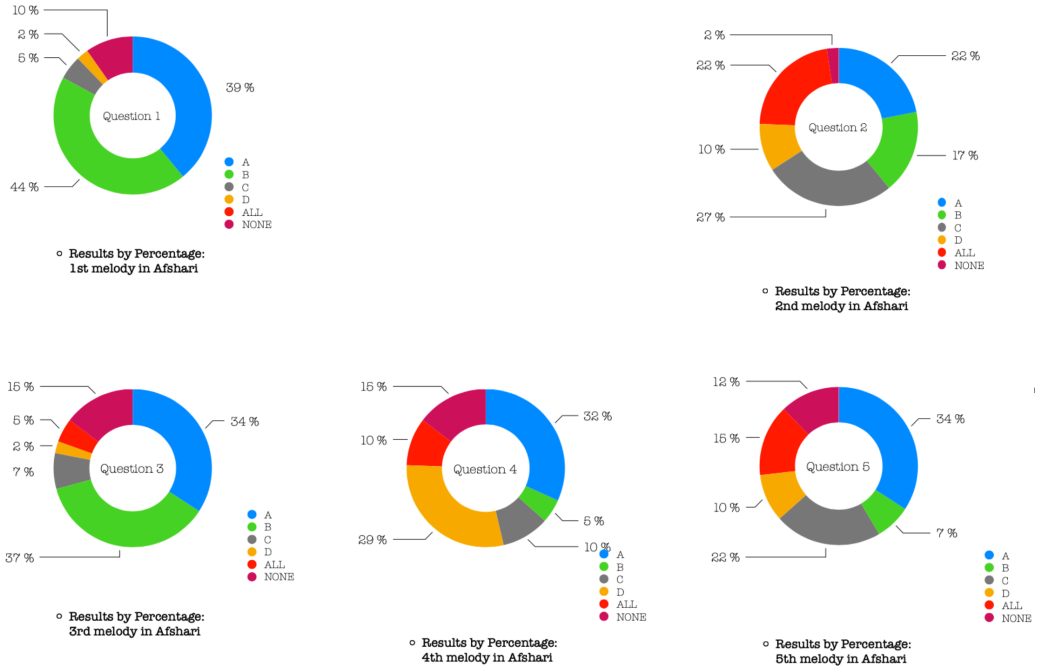


Fig. 3. Survey results showing the percentage of the different answers for each melody-excerpt. The different colors relate to different combinations of Mojannab interval-sizes, details of which can be found in Figure 4. This figure illustrates that the choices "none" (color: magenta) and "all" (color: red) were considerably lower than A, B, C and D combined.

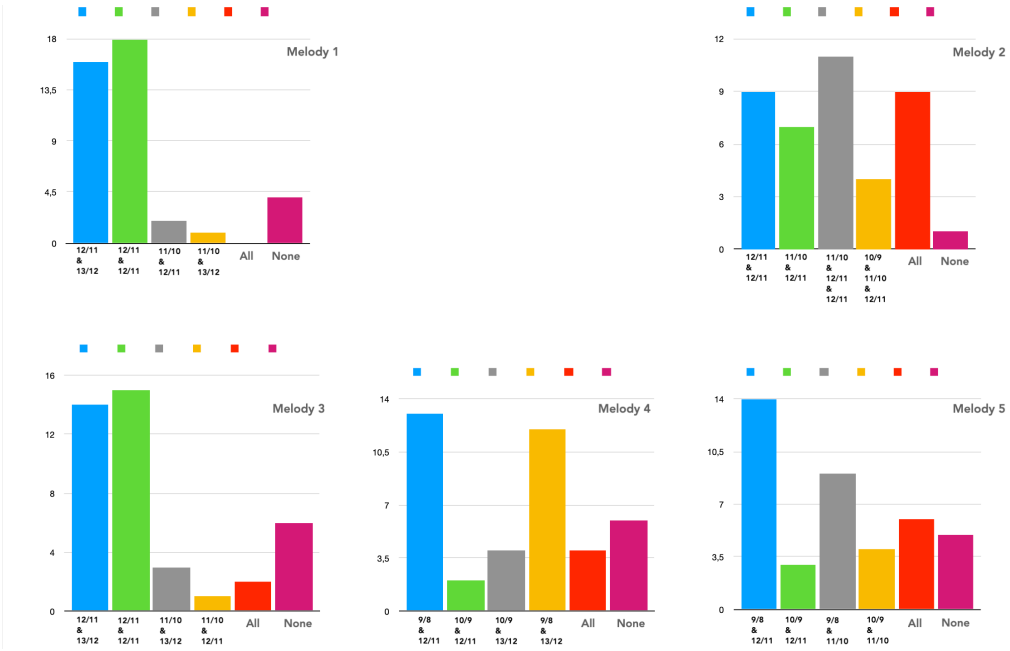


Fig. 4. Survey results for each melody-excerpt, specifying ratios for the two Mojannab intervals used in each of the samples (see the numbers below each bar). Colors used for the bars are the same as in Figure 3. The

y-axis shows number of participant choices. The results show that in melodies 1 and 3, samples with intervals of 12/11 (choices A and B) and 13/12 (choice A) were significantly preferred to those with (11/10). Overall, the most preferred choices are those containing Mojannab intervals of 139 cents (13/12) and 151 cents (12/11), whereas those containing 10/9 and 11/10 were the least preferred.

CONCLUSIONS

Results show relatively low percentage for "all" and "none" choices, which does not support the flexibility hypothesis. The larger number of participant choices for intervals of 139 cents and 151 cents supports the interpretation that musicians have a preference, and does not support the interpretations of flexibility, tolerance or ambiguity. Only in melody-excerpt 2 is there a higher choice of "all." It is possible that this particular melody is perceived differently from the others, as it contains a series of successive pitch changes, parallel to the direction of the descending melody. In this case, the direction of the melody might take precedence over the perception of exact interval-sizes. Further work with audio surveys is recommended to explore these subtleties further.

Some important feedback came from discussions with participants, the most significant of which concerned the importance of ornamentations in creating the "right" sound for Afshari, the possibility of different preferred interval-sizes for ascending versus descending melodies, and the importance of timbre in recognizing modes, as the combination of harmonics may influence interval perception.

NOTES

[1] Correspondence addressed to: Dr. Negar Bouban, Waldstraße 19, 78194 Immendingen, Germany. Email: negarbooban@yahoo.com.

[2] Dastgah is best described as a pre-designed cycle of modes, performed, recorded and taught in the last 200 years as a modal framework for Persian traditional music.

[3] Note that the tones were first named after the fingers, and later the same names were given to the intervals created by the fingers.

[4] Named after the influential musician, theoretician, Oud player and composer of 9th century of Abbasid court: Mansour Zalzal (d. 842 AD).

[5] Note that the size of Vosta-created intervals are given in reference to the open string, and are therefore a minor or neutral third. For the Mojannab size, deduct 204 cents (a whole-tone, ratio of 9/8), as shown in Figure. 2.

[6] The minor-third is 294 cents, a combination of a semi-tone and whole-tone. Documented in sources of 9th to 20th century, a semi-tone interval is 90 cents, and is called *Baqiyeh.*

[7] The suggested flexibility implies that there are different sizes for Mojannab interval, with no clear preference for which to use, as if it is only a matter of personal choice.

[8] *Kabir*, literally meaning "large" (in Turkish music theory: *Buyuk*) is a type of Mojannab that is a comma smaller than a whole-tone (180 or 182 cents). *Saqir*, literally meaning "small" (in Turkish music theory: *Kuchuk*) is a comma bigger than a Baqiyeh or semi-tone: 112 or 114 cents. The *Zalzal* Mojannab of 151 cents lies in between.

[9] Alongside the question of the Mojannab itself, arise questions of mode recognition: can varieties in the Mojannab interval-class work as auditory signals to make modal distinction possible for listeners? If so, the diversity of intervals might be the key to decipher mode perception.

[10] The survey is available: https://negarbouban.com/survey/

[11] Afshari was chosen as a mode in Dastgah system, as it can sound quite wrong or difficult to perceive when Mojannab intervals are far off. There are two tones in Afshari that create Mojannab with their adjacent tones.

[12] Soundplant available to download: https://soundplant.org/

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