Cognitive and cultural dynamics of melodic structure: a study of post-skip reversals in Rast and Nihavent makams

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Abstract

Post skip reversals, where a significant melodic leap is followed by a change, in direction have been recognized in Western Classical music but haven›t been extensively explored in non-Western traditions like Turkish makam music. We investigated the presence of skip reversals in both the Rast and Nihavent makam within SymbTr encompassing 50 and 45 pieces respectively. To compare types of skip reversals in Rast and Nihavent we categorized all melodic intervals based on their median pitch into four types; landing, approaching, departing and crossing. Chi Squared tests were utilized to analyze the significance of direction changes. Our findings reveal that post skip reversals are prevalent in Turkish makam music. In Rast makam 88.62% of crossing leaps resulted in a change of direction. Similarly, for Nihavent makam, 87.38% of crossing leaps exhibited this pattern. These outcomes support the notion that certain cognitive processes associated with reversals may possess traits that align with theories proposing that melodic skips generate a perceptual imbalance necessitating a reversal. Furthermore, cultural practices and stylistic conventions play a role, in influencing the occurrence of skip reversals. For instance, the strong association between crossing leaps and direction changes in Nihavent makam reflects specific stylistic practices within Turkish classical music, such as the emphasis on maintaining a balanced melodic contour. This indicates that while there are aspects to how we perceive music cultural influences play a role in shaping how these processes are expressed. It shows the interplay, between cognitive tendencies and cultural traditions. The findings focus on the complex interplay between universal cognitive processes, cultural practices and physical constraints, which contribute to a wider understanding of melodic organization in different cultures. In future research, the analysis should expand to include a wider range of makams and incorporate qualitative methods for deeper insight into cultural, historical or performance contexts that influence Post-skip reversal.

Keywords

Cognitive ethnomusicology, cognitive music theory, melodic patterns, post-skip reversals, Turkish makam music

Introduction

The concept of post-skip reversals, where a significant melodic leap is often followed by a change, in direction has attracted attention from scholars in music theory and cognitive psychology. This trend, commonly seen in music is believed to be influenced by melodic expectations and patterns of statistical learning. However, its relevance and occurrence in Western musical traditions like Turkish makam music have not been extensively studied.

Post-skip reversals have been identified across musical traditions ranging from Western classical compositions to non-Western genres such as Arab tunes, Native American ballads and North Indian ragas (Watt, 1924; Fox Strangways, 1914). Historically, this phenomenon is often explained by aesthetic theories or perceptual biases. Meyer (1973) and Narmour (1990, 1992) posited that large skips generate the perception of a structural gap, which in turn creates a demand for a reversal in direction to bridge the gap. These expectations fits well the principle of closure, which asserts that individuals strive to complete and regularize perceptual patterns.

Several suggestions have been put forth to account for the high prevalence of postskip reversals. One influential account is the Elastic-Skips Hypothesis (Toch, 1948),

which claims that skips themselves carry a tendency to be followed by a reversal—since perception also calls for balance and closure (Toch, 1948; Meyer, 1973; Narmour, 1990). This explanation depends on the nature of the skips themselves and argues that our perceptual system perceives skip as a tension, which must be resolved by reversal.

On the other hand, the Limited-Range Hypothesis put forward by Watt (1924) and further developed by Von Hippel (1998) proposes that post-skip reverses are consequences of the constraints on melodic range rather than any essence of the skips themselves. It posits that large intervals are more likely to end on extreme pitches of the melody's range, thereby causing a higher probability of reversal simply because the majority of the pitches on hand are in the opposite direction.

Another potential explanation is the principle of Regression to the Mean, which suggests that after a large deviation (i.e., a leap), a return to more central pitches is likely from a statistical standpoint, giving the illusion of a reversal in directions (von Hippel & Huron, 2000). This explanation is consistent with broader statistical principles that are observed in many domains, such as the fact that extreme values are often followed by more central ones.

Dmitri Tymoczko, however, offers a different approach, focusing on music's cultural context. Tymoczko (2016) argues that the tendency for post-skip reversals is not simply a universal cognitive phenomenon but is highly influenced by the style rules of specific musical traditions. His investigation into different musical corpora such as Renaissance, Baroque, and Classical music, strongly suggest that these genres have strong preferences for post-skip reversals. Tymoczko (2016) claims that cultural norms play an important part in shaping melodic expectations and practices, and therefore, what would seem a universal cognitive pattern could be heavily influenced by a cultural context.

Tymoczko's critique rests on his observation that though statistical and cognitive models, such as those proposed by von Hippel and Huron, offer a broad framework, they can oversimplify the importance of cultural and stylistic variables. He argues that these models often fail to capture the nuances of various musical traditions and of how composers and performers within these traditions in fact stick to or diverge from their respective norms. (Tymoczko, 2016)

Apart from Tymoczkos standpoint other researchers have also pointed out shortcomings, in existing theories concerning skip reversals (Butler, 1989; Temperley, 2014). Butler (1989) suggests that cognitive models of expectation those focusing on post skip reversals often overlook the significance of learned musical customs and the listeners cultural background. These critics stress that while cognitive constraints are crucial they should be considered in conjunction, with the influences that shape musical comprehension and anticipation.

David Temperley contributes another analytic lens centered on the importance of probabilistic models and cognitive constrictions that phenomenologically account for post-skip Reversals. In his recent work, Temperley (2014) employs statistical analysis of musical corpora to discern patterns of expectation and deviation. He contends that post-skip Reversals are often likely outcomes of melodic structures, not some deeply embedded aesthetic or cognitive principles.

In his study, Temperley takes a computational approach, analyzing large datasets of melodies to calculate the probability of post-skip reversals occurring by chance. His results show that while post-skip reversals are found in many musical traditions, they often appear at rates predicted by purely statistical properties of melodic construction rather than specific cognitive biases. This perspective connects with the Limited-Range Hypothesis, suggesting that the phenomenon may be more a matter

of statistical inevitability than perceptual necessity (Temperley, 2014).

Aim and Significance of Study

The study of post-skip reversals is essential for advancing our understanding of the cognitive and perceptual mechanisms underlying musical expectation. By examining how listeners across different cultures perceive and process large melodic intervals, researchers can gain insights into the universality and variability of these mechanisms. This analysis also elucidates the interplay between universal cognitive processes and culturally specific musical practices. Understanding whether post-skip reversals occur in Turkish makam music, for instance, can reveal the extent to which cultural contexts shape or modify fundamental perceptual tendencies.

Thus, in this study the aim is to investigate the occurrence and nature of post-skip reversals in Turkish makam music, specifically within the Rast and Nihavent makams. These makams were specifically chosen for several reasons. First, both Rast and Nihavent are among the most frequently used and well-documented makams, making them ideal for a detailed analysis of melodic structures such as post-skip reversals. These makams also exhibit distinct melodic contours that are particularly well-suited to examining the interplay between cognitive and cultural factors. This focus allows for a concentrated investigation into how these factors influence post-skip reversals, while still providing insights that are generalizable to other makams within Turkish music.

While other makams, such as Rehavi or Kürdilihicazkar, also possess unique melodic features, the decision to concentrate on Rast and Nihavent was made to ensure that the study remains focused and methodologically robust.

The study of post-skip reversals offers valuable insights into the cognitive and perceptual processes underlying musical expectation and composition. By examining both Western and non-Western musical traditions, researchers can better understand the universal principles that govern melodic structure and listener expectations. The current study aims to fill the gap in the literature by investigating the presence of post-skip reversals in Turkish makam music, thereby contributing to a broader understanding of melodic organization across cultures.

Pitch and Interval Structures in Turkish Makam Music

In Turkish makam music, the concept of makam refers to a structured melodic framework where certain pitches are emphasized to create a characteristic melodic progression. These pitches are integral to the identity of the makam and are known as "Kutup" or "Güçlü," serving as focal points around which the melody is organized. For instance, in both the Rast and Nihavent makams, the Neva pitch (D5) holds a prominent position, akin to the Dominant in Western music theory. This emphasis is not arbitrary; it is rooted in the tradition and plays a critical role in defining the makam's melodic contour. Understanding this cultural context is essential for interpreting the significance of post-skip reversals observed in these makams.

In Turkish makam music, as opposed to the Western equal temperament (ET) system, an octave comprises 24 unequally divided pitches. A whole step is divided into nine equal steps with the Holdrian Comma, and a half step is divided into four equal steps. Each of these steps is known as a comma, which is the smallest interval unit in the Turkish makam music system. Unlike the typical solmization approach, every pitch in a 24 unevenly divided temperament system is assigned distinct names, and these names change when repeated in the upper octave (Altun & Egermann, 2021).

In contrast, Western music typically utilizes the 12-tone equal temperament (12-ET) system where the octave is divided into 12

equal parts. This results in each half step being 100 cents apart, creating a uniform pitch structure. In Turkish makam music, however, intervals are not equal, which allows for microtonal variations and more expressive melodic contours. For example, while a major second in the 12 ET system always equals 200 cents its counterpart in Turkish Makam music can vary. The "tanini" interval in Turkish music, which is somewhat analogous to the major second, is approximately 204 cents, but other intervals like "küçük mücenneb" and "büyük mücenneb" provide different sizes of second intervals (Altun & Egermann, 2021).

The distinct intervallic structures in Turkish makam music provide a unique context for studying post-skip reversals. Given that post-skip reversals are a cognitive phenomenon where large melodic leaps are typically followed by a change in direction, examining this in the microtonal context of Turkish makams can reveal whether this phenomenon is universal or culturally specific. The finer gradations of pitch in Turkish makam music might lead to different patterns of melodic expectation and realization compared to Western music, where intervals are more uniform and predictable.

Method

This study employs a structured methodology to analyse the melodic structures and interval behaviours within the Rast and Nihavent makams, key elements of Turkish classical music. The methodological approach is grounded in a careful selection of representative musical scores, ensuring that the analysis covers a wide range of forms to avoid stylistic bias.

The focus on post-skip reversals in these makams necessitated a detailed classification of melodic intervals in relation to the median pitch, which was identified for each makam. The subsequent statistical analysis was designed to rigorously test the relationships between different types of melodic leaps and changes in direction, with results presented clearly through visualisations.

The following sections provide a detailed account of the data collection, interval classification, statistical methods, and tools employed. These steps were taken to ensure that the analysis is thorough, transparent, and reproducible.

Data Collection

The study focuses on the analysis of two Turkish makam types: Rast and Nihavent. Music scores for these makams were collected from the SymbTr database (version 2.4.3), a well-documented resource for Turkish classical music (Karaosmanoğlu, 2012). The selection criteria included scores that were representative of each makam and sufficiently detailed for interval analysis. In total, 50 pieces of Rast and 45 pieces of Nihavent were analyzed. These pieces included various forms such as peşrev, saz semai, kar, beste, and şarkı, providing a comprehensive representation of each makam's melodic structure. Another reason to include various forms was to prevent any stylistic tendency when analyzing post skip reversals in selected makams.

Analysis of Leaps

Classification of leaps

Melodic intervals were categorized based on their relationship, to the median pitch of each respective makam. The median pitch was found by calculating the range of each makam and identifying the pitch in that range. Figures 1 and 2 show the range and frequency of pitches, for each makam.
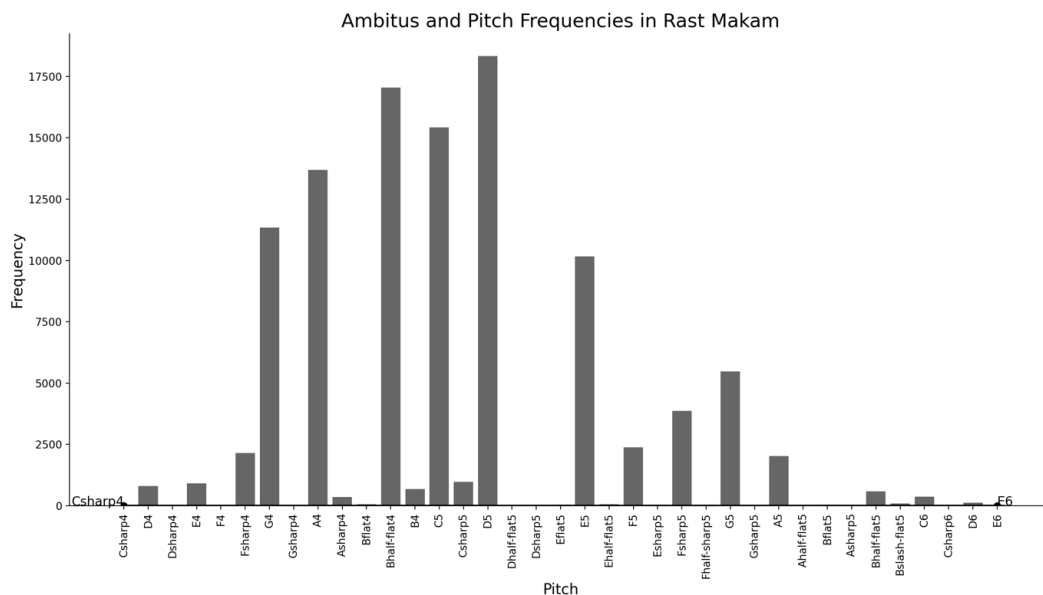
Ambitus and Pitch Frequencies in Rast Makam

Figure 1. Ambitus and Pitch Frequencies in Rast Makam (Median Pitch:D5)

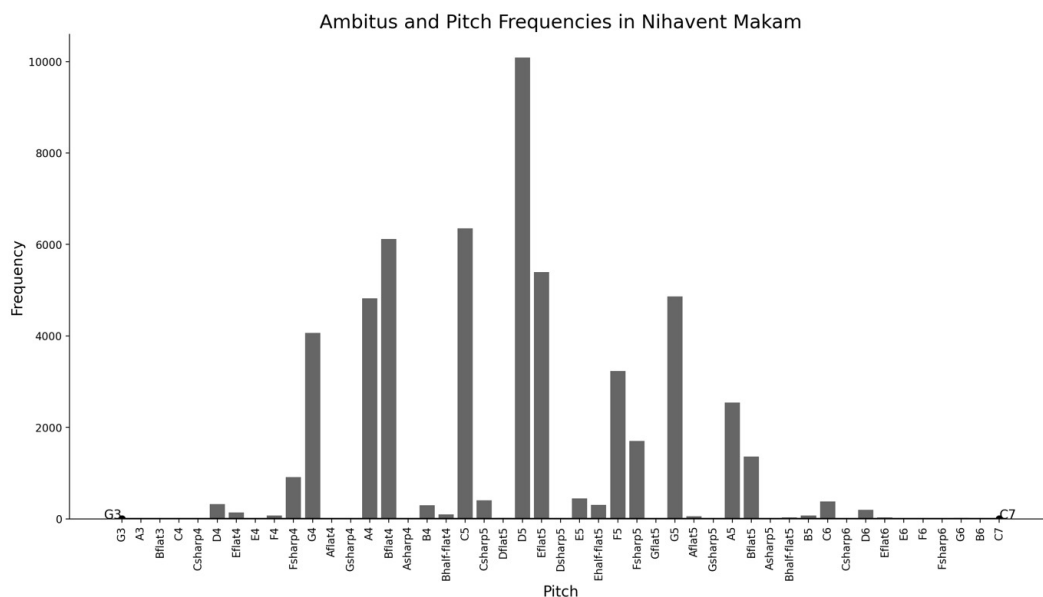Ambitus and Pitch Frequencies in Nihavent Makam

Figure 2. Ambitus and Pitch Frequencies in Nihavent Makam (Median Pitch:D5)

To classify the melodic behaviour of post-skip reversals in Turkish makam music, leaps were classified according to its motion against to median pitch. Accordingly, four types of leaps were identified:

➤ **Departing leaps:** The first note of the interval is the median pitch.

➤ **Landing leaps:** The second note of the interval is the median pitch.

➤ **Crossing leaps:** The interval crosses the median pitch.

➤ **Approaching leaps:** The interval moves towards the median pitch without crossing it.

This figure depicts different types of melodic movements relative to the median pitch in a musical context. The movements include Departing (notes moving away from the median pitch), Crossing (notes crossing the median pitch), Landing (notes landing on the median pitch), and Approaching (notes approaching the median pitch). Each movement type is illustrated with musical notation.

Figure 3. Types of Leaps Relative to the Median Pitch

Statistical Analysis

A 4x2 contingency table was constructed to examine the relationship between leap types (landing, approaching, departing, and crossing) and direction changes (change vs. no change). The Chi-Squared test for independence was applied to determine if the observed frequencies differed significantly from the expected frequencies based on chance.

Post hoc analysis involved calculating adjusted residuals for each cell in the contingency table. Adjusted residuals greater than ±1.96 were considered significant at the 0.05 level. The Bonferroni correction was applied to adjust the significance levels for multiple comparisons. Additionally, odds ratios were calculated to measure the strength of the association between each leap type and direction changes.

Visualization

The findings were presented using Pythons Seaborn and Matplotlib libraries. Point plots and bar graphs were created to showcase the distribution of leap types and direction change frequencies. Noteworthy results, as indicated by adjusted residuals and odds ratios were highlighted in the visualizations (Waskom, 2021; Hunter, 2007).

Software and Tools

Due to the lack of a Turkish Makam music accidental parser, the Music21 analysis employed only overlapping intervals with Western music. The leaps specific to Turkish makam music were manually analysed and added to the CSV table and combined with the Music21 analysis (Cuthbert & Ariza, 2010). The data and scripts are available upon request for reproducibility and further research.

Ethical Considerations

The research was conducted using publicly available data, ensuring no ethical concerns regarding data privacy or participant consent. The analysis focused on musical structures, adhering to ethical guidelines for research in musicology and cognitive science

Results

Statistical Method

This research delves into skip reversals, within Turkish makam music specifically focusing on Rast and Nihavent Makams. The goal is to investigate how different kinds of leaps (such, as landing, approaching, departing and crossing) relate to the chances of changing direction in music.

We utilized the Chi Squared test to explore the connections within a 4x2 contingency table. This helped us determine if the actual occurrences of direction changes versus no changes significantly differ from what would be expected by chance. The Chi Squared test is a method used to assess the independence of variables. In this research we computed expected frequencies, square contributions, adjusted residuals and odds ratios for each type of leap.

Adjusted residuals were employed for analysis to pinpoint cells in the contingency table that notably impact the overall chi square statistic. Adjusted residuals exceeding ±1.96 signal deviations from frequencies at a significance level of 0.05. To ensure an interpretation of the data we applied Bonferroni correction to adjust significance levels accordingly.

Rast Makam

The chi-square test for independence showed a significant association between leap type and direction change in Rast Makam, $X^2(3)$ = 77.9990, p < .001), exceeding the critical value of 7.815 for 3 degrees of freedom at the 0.05 significance level. Post hoc analysis using adjusted residuals provided further insights.

The Figure 4 presents the count of different leap types in the Rast makam with a median pitch of D5. The leap types analyzed are landing, approaching, departing, and crossing. The data is categorized by whether there is a change or no change in direction. The solid line with circles represents leaps with a direction change, while the dashed line with squares indicates no change in direction. Accordingly, for landing leaps, out of 1174 instances, 83.30% resulted in direction changes, while 16.70% did not. The expected frequencies for changes and no changes were 963.83 and 210.17, respectively. The chi-square contributions were 0.21 for changes and 0.96 for no changes. The adjusted residuals were 1.27 for changes and -1.27 for no changes, indicating no significant deviations from the expected frequencies (as they are within ±1.96). The odds ratio for landing leaps was 24.90, suggesting a strong association between landing leaps and direction changes.
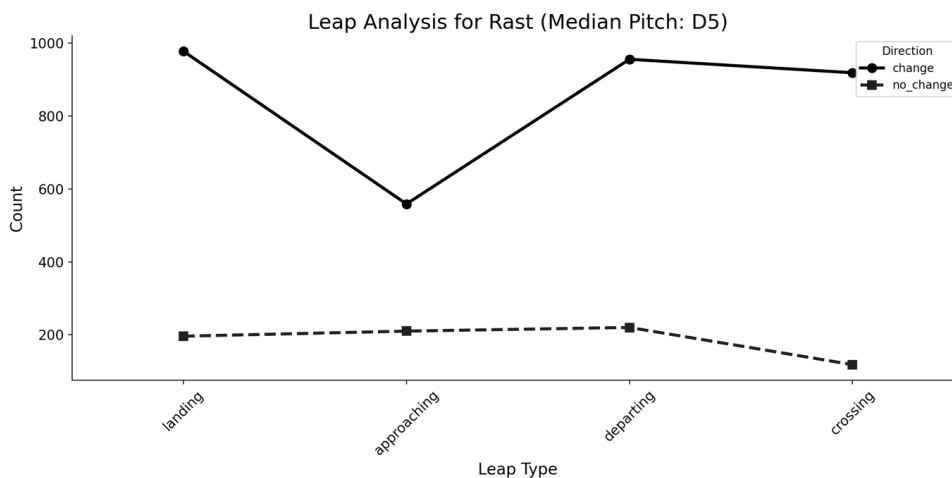

Figure 4. Leap Analysis for Rast (Median Pitch: D5)

In approaching leaps, of the 769 instances, 72.69% led to changes and 27.31% did not. The expected frequencies were 631.33 for changes and 137.67 for no changes. The chi-square contributions were 8.29 for changes and 38.01 for no changes. The adjusted residuals were -7.54 for changes and 7.54 for no changes, indicating significant deviations from the expected frequencies. This suggests that the number of changes is significantly lower than expected, and the number of no changes is significantly higher than expected. The odds ratio was 7.09, indicating a moderate association between approaching leaps and direction changes.

For departing leaps, out of 1176 instances, 81.29% resulted in changes and 18.71% did not. The expected frequencies were 965.47 for changes and 210.53 for no changes. The chi-square contributions were 0.09 for changes and 0.43 for no changes. The

adjusted residuals were -0.85 for changes and 0.85 for no changes, indicating no significant deviations from the expected frequencies. The odds ratio for departing leaps was 18.88, suggesting a strong association between departing leaps and direction changes.

In crossing leaps, out of 1037 instances, 88.62% resulted in changes and 11.38% did not. The expected frequencies were 851.36 for changes and 185.64 for no changes. The chi-square contributions were 5.37 for changes and 24.65 for no changes. The adjusted residuals were 6.32 for changes and -6.32 for no changes, indicating significant deviations from the expected frequencies. This suggests that the number of changes is significantly higher than expected, and the number of no changes is significantly lower than expected. The odds ratio for crossing leaps was 60.66, indicating a very strong association between crossing leaps and direction changes.

Nihavent Makam

The chi-square test for independence also showed a significant association between leap type and direction change in Nihavent Makam, x^2 (3) = 694.9168, p < .001), exceeding the critical value of 7.815 for 3 degrees of freedom at the 0.05 significance level. Post hoc analysis provided the following insights:

The Figure 5 presents the count of different leap types in the Nihavent makam with a median pitch of D5. The leap types analysed include crossing, departing, approaching, and landing. The data is categorized by whether there is a change or no change in direction. The solid line with circles represents leaps with a direction change, while the dashed line with squares indicates no change in direction.
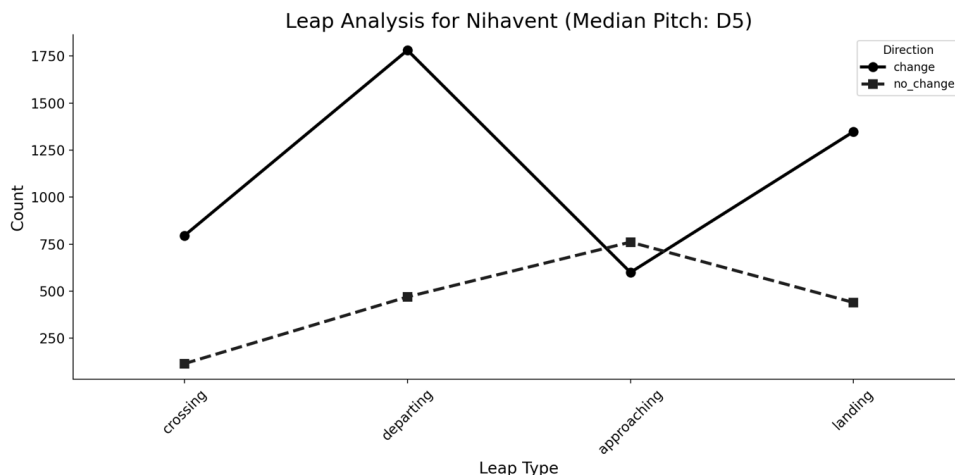

Figure 5. Leap Analysis for Nihavent (Median Pitch: D5)

For crossing leaps, out of 911 instances, 87.38% resulted in direction changes, while 12.62% did not. The expected frequencies for changes and no changes were 653.19 and 257.81, respectively. The chi-square contributions were 31.22 for changes and 79.11 for no changes. The adjusted residuals were 11.36 for changes and -11.36 for no changes, indicating significant deviations from the expected frequencies. This suggests

that the number of changes is significantly higher than expected, and the number of no changes is significantly lower than expected. The odds ratio for crossing leaps was 47.91, indicating a very strong association between crossing leaps and direction changes.

In departing leaps, of the 2251 instances, 79.12% led to changes and 20.88% did not. The expected frequencies were 1613.97 for

changes and 637.03 for no changes. The chi-square contributions were 17.29 for changes and 43.79 for no changes. The adjusted residuals were 9.74 for changes and -9.74 for no changes, indicating significant deviations from the expected frequencies. This suggests that the number of changes is significantly higher than expected, and the number of no changes is significantly lower than expected. The odds ratio was 14.36, indicating a strong association between departing leaps and direction changes.

Out of 1,361 instances of an approaching leap, 44.09% resulted in changes, while 55.91% did not. The expected frequencies were 975.84 for changes and 385.16 for no changes. The chi-square contributions were 144.75 for changes and 366.74 for no changes. The adjusted residuals were -25.54 for changes and 25.54 for no changes, indicating considerable deviations from the expected frequencies. Thus, the number of changes is significantly less than expected, and the number of no changes is significantly greater than expected. The odds ratio for approaches was 0.62. differently put, approaches were associated weakly with changes.

In landing leaps, out of 1788 instances, 75.39% resulted in changes and 24.61% did not. The expected frequencies were 1282.00 for changes and 506.00 for no changes. The chi-square contributions were 3.40 for changes and 8.61 for no changes. The adjusted residuals were 4.09 for changes and -4.09 for no changes, indicating significant deviations from the expected frequencies. This suggests that the number of changes is significantly higher than expected, and the number of no changes is significantly lower than expected. The odds ratio for landing leaps was 9.39, indicating a strong association between landing leaps and direction changes.

Discusssion and Conclusion

The purpose of this study was to examine the presence and types of the post-skip reversals in Turkish makam music, with a specific focus on Rast and Nihavent makams. Using the methodologies of cognition approach to music theory and statistical analysis, the intervals were categorized in relation to the median pitch, and the chi-squared tests with Yates's correction were conducted for the purpose of determining the significance of the direction changes.

The patterns of melodic directionality were discovered from the analysis which proved that post-skip reversals were found to be common in Turkish makam music. These large skips mostly happened around pitch extremes where that caused the reversals in order to stay in a comfortable vocal or instrumental range. These findings coincide with cognitive theory of regression to the mean that provides that extreme values are typically followed by those more central due to probabilistic tendencies.

The results provide evidence for the prevalence of skip reversals in Turkish makam music. To understand the implications of these findings, it is crucial to ask whether post skip reversals are a phenomenon constrained by cognitive factors or heavily influenced by cultural and stylistic norms.

Universal Cognitive Phenomenon

The high prevalence of post-skip reversals in Turkish makam music suggests a possibility that some of the perceptual mechanisms behind this phenomenon may indeed be universal. Meyer (1973) and Narmour's (1990) cognitive tonal schema theories propose that listeners hear skips as creating a structural gap that produces an expectation for a reversal in direction to generate perceptual balance and closure. The present study's findings are consistent with these theories, especially in the strong relationships that the crossing leaps exhibit in both makams.

For example, in the Rast makam, the results showed a tendency for direction changes after crossing leaps in 88.62% of the cases (918 cases out of 1037). In the case of Nihavent makam, we observed crossing leaps with a tendency for direction changes in 87.38%

of the cases (796 out of 911 cases). These results are similar to findings in Western classical music, where von Hippel and Huron (2000) found that approximately 72% of large leaps were followed by a reversal. The higher percentages in Turkish makam music might indicate a robust cognitive mechanism that produces post-skip reversals across musical traditions.

In the context of this study, the probabilistic models operate on the principle that after a large melodic leap, a reversal is statistically more probable. This is due to the regression to the mean, where extreme values, such as significant leaps, are likely followed by more central pitches. Additionally, the tessitura—the range in which most pitches of a melody occur—plays a crucial role, as pitches near the extremes of this range are more likely to reverse direction. By considering these factors, the probabilistic models provide a robust framework for understanding the high incidence of post-skip reversals observed in the Rast and Nihavent makams, consistent with patterns found in other musical traditions.

These results might be explicable with Von Hippel and Huron's (2000) principle of regression to the mean. Statistical properties inherent in melodic structures imply that extreme values (large leaps) should tend to be followed by more central ones (direction changes); and this is what we observed. This probabilistic tendency was evident in the high prevalence of post-skip reversals in our data, which suggests that these reversals might be a natural consequence of statistical learning in music perception.

According to Temperley (2014), probabilistic models play a crucial role in explaining post-skip reversals. He argued that these reversals can be predicted frequently on the basis of the statistical depth of melodic structures. Our study provided similar support for Temperley's argument: it was demonstrated that the great incidence of direction changes after large leap in Rast and Nihavent makams can be readily rattled off

by the statistical tendencies. In other words, focusing on Rast makam, departing leaps with direction change was shown to have an 81.29% tendency (957 out of 1176 instances) in Rast makam, and departing leaps with direction change had a 79.12% tendency (1782 out of 2251 instances) in Nihavent makam. These results support the relevance of probabilistic models, which suggest that post-skip reversals are statistically likely due to tendencies such as regression to the mean. Specifically, these models predict that large melodic leaps are often followed by a reversal in direction as a result of the statistical distribution of intervals and the influence of tessitura. This pattern is not unique to Turkish makam music but is observed across various musical cultures, highlighting the broader applicability of these probabilistic principles.

Cultural and Stylistic Influences

While there is evidence indicating universal cognitive mechanisms playing a part in our musical processing, cultural conventions also appear to have a major impact on the manifestations of these mechanisms specifically. Tymoczko (2016) highlighted the cultural context of music, arguing that it is the stylistic norms that shape our melodic expectations. The connection between crossings leaps and direction changes for the Nihâvent makam might be due to specific stylistic practices in Turkish classical music that emphasize the maintenance of a balanced melodic contour within the framework of the makam.

Moreover, the lower percentages found in makam music, in comparison to Western classical music indicate that cultural and stylistic elements may also have a significant influence. According to Butler (1989) learned customs and the listeners cultural background play a role in shaping melodic expectations. The unique melodic structures of Rast and Nihavent makams distinguished by their progressions and microtonal scales illustrate how cultural norms impact the application of universal cognitive principles.

This interaction between cultural factors suggests that while the fundamental mechanisms may be universal their manifestation is influenced by context.

Huron's (1996) examination of the melodic arch in Western folksongs emphasizes the importance of cultural factors in shaping melodic patterns. Huron reports that folksongs often exhibit a melody that rises and falls in a predictable, arch-shaped pattern, where an initial low pitch is followed by rising phrases, eventually leading to a decline. This rise-and-fall structure could be attributed to both cognitive expectancy and cultural conventions specific to Western music. Our observations in Turkish makam music, where post-skip reversals frequently occur, similarly suggest that while cognitive mechanisms, such as the tendency to expect reversals after large skips, may be universal, the specific patterns—such as the prominence of certain pitches or the exact contour of the melody—are influenced by cultural context. The results of this study, particularly the consistent occurrence of post-skip reversals around key pitches in Rast and Nihavent makams, support the idea that while the cognitive basis for these patterns is shared, their expression is uniquely shaped by the traditions and norms of Turkish makam music.

Intervallic Perspective on Results

Our analysis of post-skip reversals in the Rast and Nihavent makams revealed distinct patterns influenced by their unique intervallic structures. However, the high frequency of post-skip reversals in these makams suggests that cognitive principles governing melodic expectation may operate similarly across different musical traditions, despite the microtonal context of Turkish makam music.

For instance, in the case of Rast makam, the high frequency of direction changes following leaps (88.62%) aligns with cognitive theories that predict a reversal in direction after large melodic leaps, as commonly observed in Western music. However, the microtonal variations characteristic of Rast makam introduce additional complexity, suggesting that these reversals may not always follow a strictly predictable pattern but rather reflect a more nuanced and flexible approach to melodic development within the makam. Similarly, in Nihavent makam, the high frequency of direction changes (87.38%) supports the cognitive expectation of post-skip reversals. However, it also highlights how stylistic conventions unique to Turkish music, such as the emphasis on maintaining a balanced melodic contour, shape the manifestation of these cognitive tendencies. This suggests that while the cognitive basis for post-skip reversals is universal, its expression is intricately linked to the specific musical and cultural context

The results imply that even though basic cognitive mechanisms are universal when it comes to post-skip reversals, the specific intervallic structures and stylistic norms of Turkish makam music shape how this is manifested. The dual influence underscores the importance of considering both cognitive and cultural factors in our understanding of musical perception and analysis.

Motor Constraints

Another explanation for post-skip reversals comes from theories that highlight the influence of motor constraints. Huron (2001) suggests that the practical constraints of performers, especially singers and instrumentalists, might force composers to reversals when they leap a large distance in order to stay in control and well-targeted as a change. Such a motor explanation would imply that post-skip reversals are not exclusively perceptual or cognitive phenomena, but instead perceptual and cognitive phenomena shaped by the physicality of music making. The large number of leaps to and from pitch extremes that seem to require reversals could be explained by such motor constraints as performers adjust their skill to handle such leaps.

This idea is backed by a study from Tierney, Russo, and Patel (2011), which explains that motor constraints could cause a pattern, such as the post-skip reversal, to exist across different domains, such as music, language, or birdsong. They found very similar pitch patterns across these domains, implying that motor constraints could be a crucial aspect in the formation of these kinds of patterns. The high prevalence of post-skip reversals in Turkish makam music, therefore, could also be explained by motor constraints that affect vocal and instrumental performance.

Integrating Cognitive, Cultural, and Motor Perspectives

The data presented in this study underscores the complexity of post-skip reversals, revealing that cognitive, cultural, and motor theories each contribute valuable insights into this phenomenon. Rather than viewing these perspectives in isolation, an integrative approach is necessary to fully understand how post-skip reversals manifest in Turkish makam music.

Cognitive mechanisms likely serve as the underlying infrastructure for musical perception, guiding how listeners anticipate and process melodic intervals. These mechanisms are rooted in the brain's innate tendencies, such as the drive for perceptual balance and closure following large melodic skips. However, the expression of these cognitive tendencies is not uniform across different musical traditions. Cultural and stylistic norms play a crucial role in modulating these cognitive processes, adapting them to fit the specific aesthetic and structural requirements of a given musical tradition. For instance, the unique intervallic structures and microtonal nuances of Turkish makam music shape the way post-skip reversals are perceived and realized, differing from how they might occur in Western classical music.

Moreover, the physical constraints imposed by the act of music-making—whether vocal or instrumental—further influence these cognitive and cultural patterns. Performers must navigate the practical limitations of their instruments or voices, which can necessitate changes in melodic direction following large leaps. This motor perspective suggests that the physical demands of performance are integral to understanding how cognitive and cultural factors are expressed in practice.

In this integrative model, cognitive foundations provide the basic framework for musical perception, but it is through the interplay with cultural customs and motor constraints that these foundations are shaped into the distinct melodic forms observed in different musical traditions. This approach highlights the need to consider not only the universal cognitive processes at play but also the ways in which these processes are uniquely adapted and expressed within specific cultural and performative contexts.

In summary the findings of this research, on transitions in makam music lay the groundwork, for further investigations that can enhance our comprehension of how cognitive processes, cultural factors and physical limitations shape musical compositions and interpretations.

Recommendations

Recommendations for Further Research

Several promising directions for future research on post-skip reversals in Turkish makam music and beyond emerge from the findings of these studies. One obvious next step is to broaden the scope of analysis to include a larger variety of makams and musical forms. This expanded view would help determine if the patterns observed in the rast and nihavent makams are consistent across other makam melodic structures in Turkish music.

In future research, it would be useful to investigate how these cognitive mechanisms interact with cultural influences and motor constraints over time. Longitudinal studies that trace the development of musical

perception in different cultural contexts could provide insight into how cultural norms and motor constraints both shape and reinforce cognitive tendencies. In addition, experimental studies that systematically manipulate cultural, stylistic, and motor variables would help to disentangle the relative contributions of these factors to observed post-skip reversal.

Further research should also work toward integrating more qualitative methodologies with quantitative analyses. Interviews with musicians, ethnographic studies, and detailed musicological analyses would all supply more comprehensive insights into the cultural, historical, and performative contexts that impinge on post-skip reversals. Such an integrative approach would also intensify our understanding of how cognitive principles forge internal bonds with executant-specific techniques and cultural traditions.

Recommendations for Applicants

Practitioners and scholars interested in Turkish makam music should consider incorporating an analysis of post-skip reversals into their research and performance practices. Given the significant cognitive and cultural factors influencing these melodic patterns, a deeper understanding of post-skip reversals could enhance interpretative and compositional strategies. Additionally, educators and musicologists may find value in integrating this analytical framework into their curriculum, offering students insights into the interplay between cognitive processes and cultural conventions in Turkish makam music.

Limitations of Study

Although this research does provide important insights into post-skip reversals in Turkish Makam music, it does have some limitations. First, its sample size, while quite diverse in terms of form, is still limited to a specific selection of pieces from the Rast and Nihavent Makams. This selection may not be fully representative of the Turkish

Makam repertoire, potentially limiting how generalizable these findings may be.

Also, the study only examines two specific makams, which limits its scope. Although Rast and Nihavent are major and frequently used makams, there are other makams with different modal and structural features that might demonstrate different patterns of post-skip reversal. Future studies should include a more diverse group of makams to provide a better overall understanding of this occurrence throughout Turkish makam music.

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Biodata of Author

Asst.Prof.Dr., **Fırat Altun,** was born in Diyarbakır, Turkiye, and began his formal musical education at the Diyarbakır Anatolian Fine Arts High School, where he cultivated his foundational skills in music. His academic journey continued with a Bachelor's degree in Music Education, during which he engaged deeply with the polyphonic traditions of Turkish music, advanced his technical and performance skills on the cello, and developed a rigorous understanding of choral conducting and aural skills. After completing his undergraduate studies, Fırat Altun furthered his academic pursuits with a Master's degree in Music Education. His scholarly path then led him to the United Kingdom, where he was awarded a competitive scholarship to undertake doctoral research at a leading institution in Music. His doctoral studies encompassed interdisciplinary research in music cognition and affective response, advanced compositional techniques, and orchestral conducting. In addition to his academic endeavors, he actively contributed as a cellist to various performances with symphony and chamber orchestras. Fırat Altun's research interests lie at the intersection of music perception and cognition, composition, and performance, with a particular focus on the cognitive and cultural dynamics of musical structure. His work contributes to a deeper understanding of how music is perceived, composed, and performed across different cultural contexts.

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