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Rhythmic Structure in the Holy Qur'an and Its Impact on Auditory Perception: An Analytical Study in the Light of Modern Phonetics

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Abstract. This research examines the subject of Qur'anic rhythm and its impact on auditory reception, analyzing it in the light of modern phonetics, based on the premise that the Holy Qur'an is an eternal miracle that combines meaning and inner music within a unique phonetic system. The study aims to reveal the rhythmic structure of the Holy Qur'an, to demonstrate its psychological and emotional impact on the listener, and to elucidate the mechanisms by which it is formed across the various phonetic levels of the letter, word, sentence and verse. The research adopts an analytical and descriptive approach, combining textual analysis of selected verses with the application of modern phonetics tools, such as the Pratt software, to measure frequencies and durations. The research is divided into five main sections covering the concept of rhythm in linguistic and technical terms, its relationship with modern phonetics, the levels of rhythmic structure, its impact on auditory reception, and finally the applied analytical study. The study demonstrated that Qur'anic rhythm is an integrated system combining diversity and harmony, and that any change in the order of sounds or words leads to a rhythmic and semantic imbalance, thereby confirming the miraculous nature of its phonetic structure.

1. Introduction

The Holy Qur'an is a divine text that combines linguistic and phonetic beauty in a unique harmony, with its phonetic rhythm emerging as a fundamental element that enhances its impact on listeners' auditory perception. In the present day, with the advancement of modern phonetics and digital technologies, it has become possible to explore these rhythmic structures through precise analytical methods, opening up new horizons for understanding the miraculous nature of the Qur'an.

This study aims to analyze the rhythmic structure of the Holy Qur'an at its various levels, from the letter to the verse, and to explore its impact on auditory and psychological responses, drawing on phonetic tools such as spectral and rhythmic analysis. Interest in this subject has been revived in the light of contemporary linguistic and phonetic studies which demonstrate how sounds are organized to achieve a profound effect that transcends superficial understanding.
The importance of this research is further heightened by the fact that many traditional studies have confined themselves to description and rhetorical analysis without employing precise scientific tools, leading to a knowledge gap in understanding the precise acoustic mechanisms through which Qur'anic rhythm operates. Hence, this study aims to bridge the gap between the traditional heritage of Qur'anic sciences and tajweed, and the modern findings of phonetics.

1.1 Research Problem and Research Questions

The research problem centers on the following main question: How is the rhythmic structure of the Holy Qur'an formed at its various levels; what impact does it have on the listener's auditory reception; and how can this structure be studied using the tools of modern phonetics?

This question gives rise to a series of sub-questions:

1. What is the concept of rhythm in linguistic and technical terms, and what are the distinctive features of Qur'anic rhythm?

2. At what levels is the rhythmic structure of the Holy Qur'an formed?
3. How do the various phonetic elements (letters, syllables, pauses, and parallelism) contribute to the formation of Qur'anic rhythm?
4. What is the nature of the psychological and emotional impact of Qur'anic rhythm on the listener?
5. How does rhythm facilitate understanding, memorization and comprehension?

1.2 Research Objectives

This research seeks to achieve the following objectives:

Firstly – the epistemological objective: to uncover the rhythmic structure in the Holy Qur'an and to study it through rigorous scientific analysis using the tools of modern phonetics.
Secondly – Analytical objective: To analyze the various levels of Qur'anic rhythm (letter, word, sentence, verse) and to elucidate the relationships between them and their impact on the overall effect.
Thirdly – Applied objective: To apply modern phonetic methodology to selected Qur'anic examples such as Surah al-Fatihah, al-Ikhlas and al-Rahman.
Fourth – The Objective of Miraculousness: To highlight the phonetic Miraculousness of the Holy Qur'an through the precision and harmony of its rhythmic structure.
Fifth – The Educational and Da'wah Objective: To clarify how the rhythmic structure can be utilized in the teaching and memorization of the Holy Qur'an and in strengthening da'wah.

2. Research Methodology

This study adopts a descriptive-analytical approach, combining, on the one hand, a textual approach based on the study of Qur'anic verses using the tools of Arabic rhetoric and Qur'anic studies, and, on the other hand, an applied approach based on the tools of modern phonetics. The comparative approach is also utilised to highlight the distinctive nature of Qur'anic rhythm in comparison with other linguistic rhythms.

Chapter One: The Concept of Rhythm in Language and Terminology, and the Distinctive Characteristics of Qur'anic Rhythm

Section One: The Concept of Rhythm in Language

The term 'rhythm' in the Arabic language is derived from the root (w-q-'). Ibn Fāris stated in Maqā'is al-Lugha*: "The waw, qāf and 'ayn share a single root to which all its branches trace back; it denotes the falling of something," as well as the occurrence of a sound. (Ibn Fāris, 1, 1979) Ibn Manzūr stated in *Lisan al-'Arab*: "Rhythm: relating to the rhythm of melody and singing; that is, to set the melodies to rhythm and articulate them clearly. Al-Khalīl, may God have mercy on him, named one of his books on this subject *Kitāb al-Iqā'*." It is stated in *Tāj al-'Arūs* by al-Zubaydī: "} 'Iqā' derives from the rhythm of musical melodies; it is the act of {composing melodies and elucidating them clearly, as it is described in *Al-Lisan* and *Al-'Ubab*; in some manuscripts, it is described as 'constructing them from the structure'; and Al-Khalil, may God have mercy on him, named one of his books on this subject Kitab al-Iqa'(Al-Zubaidi, 3, 1985)

The researcher holds the view that: in the Arabic language, 'iqa' means the phonetic organization based on the harmony and balance of sounds over time. The ancients confined themselves to linguistic dictionaries, rather than critical or rhetorical works, when defining the linguistic meaning of 'iqa', because these dictionaries are the primary reference for determining the linguistic meaning of terms.

The Second Point: The Concept of Rhythm in Technical Terminology

In the field of rhetoric and literary criticism, however, scholars of the Arabic language have used the term 'rhythm' in a broader sense, referring to the organized repetition of phonetic elements such as intensity, duration and pitch, in a way that creates a sense of movement and fluidity. Al-Khalil ibn Ahmad al-Farahidi addressed this concept through his codification of the science of prosody and the standardization of Arabic poetic meters according to specific phonetic units. (Al-Khalil, 19, 1967) 'Abd al-Qahir al-Jurjani expanded on this in *Dalail al-I'jaz* by discussing phonetic proportion and its effect on the conveyance of meaning, drawing on the concept of *nazm*, which is based on the choice of a word, its position and its sound within its context (Al-Jurjani, 17, 1984)

Linguists distinguish between external rhythm, which is based on sounds and meters, and internal rhythm, which is based on narrative and syntactic structure. What concerns us in this study is the external phonetic rhythm associated with the characteristics of letters, syllables and pauses in the Qur'anic text.

The Third Topic: The Concept of Rhythm in the Holy Qur'an and Its Characteristics

In the Holy Qur'an, rhythm is defined as the phonetic harmony that enables the text to be recited smoothly

and with natural fluency, as indicated by the words of Allah: ﴿And recite the Qur'an in a measured manner﴾ (Surah Al-Muzzammil: 4), where 'recite in a measured manner' refers to the regular rhythm that combines pauses, connections and assimilation to create a natural flow.

Qur'anic rhythm transcends traditional poetic rhythm in that it is not subject to fixed meters such as those found in poetry; rather, it is a rhythm that constitutes a rhetorical miracle in its own right, as is evident in the words of Allah: ﴿Let them produce a discourse like it, if they are truthful﴾(Surah At-Tur: 34). In his book *Al-Tahdīd fī al-Itqān wa al-Tajwīd*, Abu 'Amr al-Dani highlighted that the Qur'anic rhythm surpasses Arabic poetry in its combination of variety and balance without strict constraints, thereby enhancing its auditory impact on listeners throughout the ages. (Abu 'Amr al-Dani, 4, 1987)

The rhythmic structure of the Holy Qur'an is characterized by a number of features, the most notable of which are: spontaneity and precision in equal measure; diversity within a framework of unity; and a harmony between rhythm and meaning, such that any change in the order of sounds or words would result in a disruption of both rhythm and meaning.

Chapter Two: Modern Phonetics and its Relationship to Qur'anic Rhythm

Section One: The Origins of Modern Phonetics and its Fields

Modern phonetics emerged as a scientific discipline in the nineteenth century, alongside the development of acoustics, and in particular following Hermann von Helmholtz's discoveries regarding the analysis of sound waves, published in 1863. (Helmholtz, 1954, 33) This discipline expanded in the twentieth century thanks to digital technologies such as spectrograph, the applications of which were introduced in the 1930s.

The fields of modern phonetics include: the study of the characteristics of human speech in terms of production, transmission and reception; the quantitative analysis of intensity, frequency and duration; applications of artificial intelligence in speech analysis; and speech therapy for speech disorders. One of the most prominent pieces of software used in this field is Praat, developed by Paul Borsma and David Winnenk, which enables precise analysis of vocal frequencies and rhythmic patterns. (Ladefoged, 54, 2015)

In the Arab context, Kamal Bashir, Ibrahim Anis and Tamam Hassan are regarded as pioneers who contributed to the introduction of modern phonetic methodologies into Arabic linguistic studies, having presented a phonetic analysis of the Arabic language in the light of modern linguistic data. (Bashir, 22, 2000)

Section Two: The Relationship between Qur'anic Rhythm and Modern Phonetics

The study of Qur'anic rhythm is linked to modern phonetics through the possibility of measuring its phonetic structure using objective tools; spectral analysis reveals a unique harmony in frequencies that surpasses that found in ordinary linguistic rhythms. In his book *Al-Naba' al-'Azim* (The Great News), Muhammad 'Abdullah Daraz referred to the phonetic dimensions of the Qur'an, cautioning against confusing what science can prove with that which remains within the realm of spiritual Miraculousness, which cannot be measured by material standards. (Bashir, 22, 2000)

Software such as Praat and other acoustic analysis tools have enabled applied studies to be carried out on documented recitations of the Qur'an, revealing rhythmic patterns and temporal durations that cannot be perceived by the unaided ear, thereby adding to the aspects of the Qur'an's acoustic Miraculousness (Ghanem, 15, 1986)

It is worth noting that modern acoustic analysis complements, rather than replaces, our understanding of the Qur'anic rhythm, as the Holy Qur'an possesses a spiritual and devotional dimension that cannot be captured by measuring instruments. However, this does not preclude the use of modern scientific tools to provide a precise scientific description of the acoustic phenomena of the Qur'an.

The Third Requirement: Rhythm at the Level of the Sentence and the Verse

At the level of the sentence, rhythm is achieved through variation in the length of the verses and the repetition of syntactic structures, creating a wave-like flow of sound. Ibn Kathir noted in Tafsir al-Qur'an al-'Azim that the length of the verses corresponds to the subject matter; the short verses in the Meccan surahs create a rapid rhythm for warning and alerting, whilst the long verses in the Medinan surahs slow the rhythm down to encourage reflection and the laying down of laws. (Ismail, 5, 1999)

At the verse level, the Qur'anic pause is considered a central rhythmic pillar, as it serves a dual function: on the one hand, it defines the boundaries of semantic units; on the other, it unifies the text into a harmonious auditory rhythm. Scholars of tajweed, such as Makki ibn Abi Talib al-Qaisi, have paid great attention to regulating rhythmic pauses that correspond to the Qur'anic pauses. (Makki, 13, 1996)

In the Ayat al-Kursi Allah, there is no god but Him, the Ever-Living, the Self-Subsisting. ﴿(Al-Baqarah: 255), the rhythm extends over 128 words with a balance that combines repetition and variation, evoking a sense of spiritual security and the grandeur of the meaning.

Section Four: Patterns of Qur'anic Rhythm and Their Manifestations

The patterns of Qur'anic rhythm encompass three main aspects: firstly, assonance, which is the similarity in sound between the endings of verses whilst their meanings and structures differ. Secondly, parallelism, which is the repetition of grammatical structure whilst varying the vocabulary. Thirdly, the rhythmic repetition of a sentence or question, as in Which of your Lord's blessings will you deny? (Surah Ar-Rahman: 13), which is repeated thirty-one times in the surah.

These patterns are clearly evident in the short Meccan surahs, where the rhythm is rapid and sharp, suited to the tone of warning and admonition, as in Surah al-Ikhlas: ﴾Say: 'He is Allah, the One * Allah, the Self-Sufficient Master' ﴿(Al-Ikhlas: 1–2), where the syntactic structure is repeated with a rhythm resembling a hymn in its power and clarity. In the Medinan surahs, however, the rhythm is slower and more contemplative, suited to legislation and exposition.

Chapter Four: The Impact of Rhythmic Structure on Auditory Reception

Section One: Phonetic Elements Influencing Reception

According to modern phonetics, the phonetic elements influencing auditory reception comprise three main components: intensity, pitch and duration. These elements work together in the recitation of the Qur'an to achieve a cumulative effect on the listener; intensity increases in verses of warning and glorification, and diminishes in verses of mercy and hope, thereby making auditory reception a holistic sensory experience. (Labib, 12, 1985)

Scholars of tajweed have highlighted the rules governing elongation, shortening, and vocalization, amongst others, as precise phonetic controls that regulate the rhythm of recitation; in essence, these correspond to what is known in modern phonetics as the regulation of duration and pitch. An example of this is that natural elongation by the equivalent of two movements helps to create a temporal balance between the syllables of the verse, thereby preserving its phonetic beauty. (Ghanim, 15, 1986)

Added to this are timbre and rhythmic pattern, where assimilation, emphasis, elision and inversion are employed in the rules of tajweed to vary the timbre and enrich the auditory experience. Of particular note here is what Ghanim Qaduri al-Hamad pointed out in his book *Phonetic Studies Among Scholars of Tajweed*, namely that early scholars arrived at many phonetic facts through careful auditory experimentation before modern phonetics codified them using technical instruments. (Labib, 12, 1985)

Second Point: The listener's psychological and emotional response

The rhythm of the Qur'an evokes a psychological response that promotes relaxation and contemplation. Recent scientific studies in the field of psychoacoustics have shown that regular frequencies help to reduce levels of the stress hormone (cortisol) whilst listening to recitation (Benson, 2000, 40). It is reported in a noble Prophetic hadith that the Prophet, peace and blessings be upon him and his family, said: 'Adorn the Qur'an with your voices.' This was narrated by Abu Dawood and Ibn Majah and authenticated by Ibn Hibban, ( ), which points to the profound emotional and psychological impact of beautiful recitation.
In *The Qur'anic Phenomenon*, Malik bin Nabi highlighted that this emotional response is linked to the rhythmic cadence, which resembles a heartbeat, thereby creating a sense of spiritual belonging, particularly during collective recitation in mosques and study circles. ( )The rhythm of Which of your Lord's blessings will you deny? (Surah al-Rahman: 13 and following) evokes in the listener a cumulative sense of reverence and gratitude that is difficult to achieve by any other human means.

Comparative studies show that non-Arabic-speaking listeners are also moved by the Qur'anic rhythm even without understanding the meaning, which proves that the Qur'an's auditory impact transcends linguistic and cultural boundaries. (Malik, 30, 2000)

The Third Point: The Aesthetic and Miraculous Role of Rhythm

Rhythm is an integral part of the miraculous nature of the Qur'an, as it surpasses human poetic rhythm in a beauty that is not bound by meters nor subject to fixed forms. This miraculous nature is confirmed by the words of Allah, the Exalted: 'Say: "Even if all humankind and the jinn were to gather together to produce the like of this Qur'an, they could not produce the like of it, even if they were to support one another."' (Al-Isra': 88). Al-Jurjani, in *Dala'il al-I'jaz*, paid particular attention to this phonetic beauty, explaining that the rhythm imparts a beauty that transcends the literal wording to reach the meaning, such that sound and meaning are inseparable in the Holy Qur'an. (Al-Suyuti, 8, 1974). Sheikh Mahmoud Muhammad Shaker notes in *Madakhil I'jaz al-Qur'an* that the Qur'anic rhythm has a more profound effect on the soul than any other rhythm because it springs from the source of divine revelation. (Mahmoud, 25, 1976)

The miraculous nature of this rhythm is evident in the inability of Arab poets and writers to imitate it. As al-Suyuti documented in *Al-Itqan fi 'Ulum al-Qur'an*, the Arabs would recite the Qur'an in their gatherings, and it would astonish them even before they embraced Islam; this is proof that the Qur'anic rhythm surpasses human capacity. (Al-Suyuti, vol. 8, 1974)

Section Four: Comprehension and Understanding through Phonetic Rhythm

Rhythm contributes to enhancing memory and understanding; studies in cognitive psychology have demonstrated that a regular rhythm increases the memory's capacity to retain and consolidate information. This partly explains the phenomenon of memorizing the entire Holy Qur'an, which is unparalleled in other holy books, as rhythm acts as an aid to memorization as well as a means of contemplation and reflection. (Al-Jurjani, 17, 1984)

Al-Khalil ibn Ahmad al-Farahidi noted that a regular rhythm links sound to meaning and facilitates the retrieval of memorized material; this is also confirmed by Ladefoged's research in phonetics, which shows that repetitive rhythmic patterns activate long-term auditory memory (Ladefoged, 35, 1996)

From an educational perspective, an understanding of rhythmic structure is beneficial in the development of curricula for the teaching of the Holy Qur'an and tajweed, as phonetic analysis can be utilized in the design of systematic exercises for correct pronunciation, using rhythm as a measurable and assessable criterion.

Section Five: A Phonetic Analysis of Selected Qur'anic Samples

Subsection One: Methodology of Phonetic Analysis

This applied analytical study relies on audio recordings of authorized recitations in the Hafs narration from 'Asim, followed by spectral analysis using the Praat software to measure sound frequencies, intensity and the duration of segments. The methodological procedure involves selecting a sample of Qur'anic verses from various surahs representing different rhythmic levels, whilst applying the Fast Fourier Transform (FFT) to extract periodic rhythms, thereby enabling a comparison of Qur'anic rhythm with other linguistic texts.

This approach combines qualitative descriptive methodology with quantitative methodology, analyzing the phonetic spectrum at each level (letter, word, verse) whilst remaining fully aware that phonetic analysis is a means of discovery, not of judging divine Miraculousness. Among the methodological limitations acknowledged in this study are: differences in pronunciation styles amongst recites, and the fact that the analysis is limited to selected samples and does not claim to be exhaustive.

Section Two: Analysis of Selected Qur'anic Samples

First – Surah al-Fatihah: This surah exhibits a balance in acoustic frequencies ranging between 180 and 280 hertz, with the rhythm beginning at a low intensity in ﴿In the name of Allah, the Most Gracious, the Most Merciful﴾ (Al-Fatiha: 1) and gradually builds to a peak in ﴿Master of the Day of Judgement﴾ (Al-Fatiha: 4), reflecting a transition from praise to awe. Spectral analysis reveals balanced harmonics, which contributes to making this surah an ideal choice for daily recitation and easy memorization.

Secondly – Surah al-Ikhlas: The rhythm here is characterized by a powerful simplicity in ﴿Say: He is Allah, the One﴾ (al-Ikhlas: 1), with stable frequencies and short, balanced word durations, creating a rhythm akin to a definitive divine proclamation. Spectral analysis reveals highly concentrated, pure harmonics, which enhances the auditory reception of this surah as a short yet profoundly effective surah for memorization and contemplation.

Thirdly – Surah Ar-Rahman: The question Which of your Lord's blessings will you deny? (Surah Ar-

Rahman: 13 and following) is repeated thirty-one times with a steady, cyclical rhythm, creating a cumulative effect that reinforces a sense of gratitude and acknowledgement of divine blessings. Phonetic analysis reveals a consistency in intensity whose psychological effect is reminiscent of that produced by classical music with its repetitive rhythms, although the Qur'anic rhythm surpasses this in its spiritual and semantic impact.

Fourthly – Ayat al-Kursi (Al-Baqarah: 255) The verse spans one hundred and twenty-eight words with a structural repetition that creates a balanced phonetic cycle, which lowers in tone when mentioning the Names of Allah and rises when describing His attributes of power, thereby instilling in the listener a sense of tranquility in the face of divine majesty. Scholars of tajweed have devoted particular attention to this verse due to its subtle phonetic diversity, which encompasses many of the rules of recitation (Fadl, 27, 2006).

Section Three: Applications of Modern Phonetics in Understanding Qur'anic Rhythm

There are numerous contemporary technical applications for understanding and teaching Qur'anic rhythm; amongst the most prominent are Smartphone applications designed to teach tajweed, which rely on speech recognition technology to correct pronunciation and adjust rhythm in real time. (Fadl, 27, 2006) Spectral analysis has also been utilised in academic studies to compare different recitation styles, such as the Warsh recitation based on Nafi' and the Hafs recitation based on Asim, and to observe how each preserves the rhythmic essence of the Qur'an despite differences in certain performance details.

These applications extend to the fields of psychological and medical research, where the effect of listening to Qur'anic recitation on the autonomic nervous system is being studied; several studies have concluded that regular listening to recitation helps to reduce stress levels, making the Qur'anic rhythm a scientific entry point for Islamic mental health programmers.

However, these applications face a number of challenges, the most notable of which are preserving the spiritual and devotional nature of the Qur'an in the digital age, and the need to train users in traditional tajweed alongside the use of modern tools.

Fourth requirement: Findings derived from the acoustic analysis

The acoustic analysis revealed a number of findings which can be summarized as follows:

Firstly: The Qur'anic rhythm is characterized by a unique acoustic harmony that combines consistency and variation within a framework of overall harmony, making it difficult to generate or replicate in other human texts.
Secondly: the analysis revealed a close correlation between the level of acoustic frequencies and the meanings of the verses, confirming that the choice of Qur'anic vocabulary takes into account both the acoustic and semantic dimensions.

Thirdly: The cyclical rhythm and structural repetition help to strengthen auditory memory and facilitate memorization, which explains the widespread practice of memorizing the entire Qur'an throughout history.

Fourthly: certain aspects of the spiritual and emotional impact of the Qur'anic rhythm remain beyond what scientific tools can measure or describe, reminding us that phonetic analysis is a means of approaching the miraculous nature of the Qur'an, not of fully encompassing it.

Conclusion, Key Findings and Recommendations

Firstly: Key Findings

1. The concept of rhythm in the Arabic language is derived from the root (waqa'a) and denotes a regular and balanced sound; this has been confirmed by linguistic dictionaries such as *Lisan al-'Arab* and *Maqayis al-Lugha*, and is contrary to what might be suggested by the confusion between the linguistic and technical meanings.
2. The rhythmic structure of the Holy Qur'an is an integrated system operating on multiple levels, from the individual letter to the verse, with each level contributing in turn to the overall construction of the auditory effect.
3. Qur'anic rhythm is characterized by both spontaneity and precision; any alteration in the order of sounds or words results in a dual disruption—both rhythmic and semantic.
4. Qur'anic rhythm produces a profound psychological effect, including relaxation, the fostering of reverence and the facilitation of memorization; this was demonstrated by historical Islamic experience long before it was confirmed by modern phonetics.
5. The integration of the scholarly heritage of the science of tajweed with modern findings in phonetics represents a rich methodological model that should be utilized in future Qur'anic studies.

Secondly: Recommendations

1. To develop tajweed teaching curricula that draw on modern phonetic analysis to provide precise training in Qur'anic rhythm.
2. To establish documented academic audio databases of recitations by certified recites, which are accessible to researchers.
3. Open up avenues for research collaboration between Islamic universities and specialist phonetic centers in this field.
4. Ensure that researchers in the field of Qur'anic rhythm are committed to referring to original sources, whether linguistic dictionaries, books on exegesis and tajweed, or documented modern phonetic studies.
5. Adopting a rigorous scientific methodology in dividing research into topics and sub-topics, and standardizing footnotes by distinguishing between verbatim quotations and quotations by meaning.

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