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THE TURKISH BEAUTIFUL VOICE: ACOUSTIC TRAITS OF PREFERRED MUEZZINS’ VOICES IN ISTANBUL, TURKEY

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Abstract:
In Islamic call-to-prayer recitation, a strong preference exists for recitation with a beautiful voice. In primarily Muslim countries, stories circulate that testify to the power of this beautiful voice. A common theme, for instance, extols the ability of the beautiful voice to entice, perhaps even convert, non-Muslims. So, while this preference manifests itself as a pan-Islamic construct, oral and written reports often note that distinct styles of recitation exist that are culturally bound and which reflect local preferences for treatment of melody and timbre in call-to-prayer recitation. Therefore, any study aiming to understand a sound that is perceived as beautiful must situate itself in a particular local context. Thus, my research specifically focuses on the question: What is a beautiful voice and how does it manifest itself locally in Istanbul, Turkey, until the end of the nineteenth-century the cultural and spiritual center of the Islamic world? To answer this question I employ a variety of techniques, including archival research, interviews with recitation practitioners and expert listeners, and acoustic analysis of several preferred recitation practitioners. This paper presents my findings as they concern the timbral attributes of preferred Istanbul muezzins’ voices. My spectrographic analysis indicates the presence of anti-formants (bands of frequencies at very low amplitudes) throughout these recitations, possibly a unique Turkish approach to the production of this sound, one which offers clues to specific vocal production techniques and one that I have yet to detect in non-Turkish call-to-prayer samples. Included with these results is a summary of how listeners and practitioners express their understanding of the beautiful voice through narrative and suggestions for extending the research in this area.

Introduction
In recitation of the Islamic call to prayer, a strong preference for a ‘beautiful voice’ is often expressed; many adherents report that the voice quality of the muezzin, official reciter, outweighs other sonic elements, most notably melodic attributes, since the call to prayer is recited in a rhythmically free manner. This preference for a beautiful voice has a long history, dating back to the time of the Prophet Mohammed and his appointment of Bilâl as the first muezzin, who was considered to have the strongest and most beautiful voice among the Prophet’s followers. The importance of the beautiful voice is underlined by stories that circulate (both orally and in print) concerning its power to evoke an affective response: it is reported that the beautiful voice can draw a listener to Islam, perhaps effecting a conversion, and an undesirable voice can repel both believers and converts. Arguably, vocal timbre is the most salient attribute of the call to prayer and therefore vocal production practices and acoustical traits of preferred voices warrant investigation.

In this article, I present an examination of acoustical timbral aspects of the call when produced by voices identified by cultural insiders as preferred. From this analysis I draw some conclusions about the means of vocal production. To do
so, I rely on Fales’s proposed methodology for the examination of timbre. This methodology requires the researcher to conduct the analysis using three areas of investigation: indigenous listener perception, practitioner mechanics of production, and acoustic analysis (Fales, 2005, p.157). While overlap can occur among these three areas, at the most basic level, production is the way in which the sound is physically created, perception is the way in which the sound is experienced, and the acoustic structure is the sound’s transmission and its spectral composition. Thus, studied separately and comparatively, each domain can reveal unique features of voice quality and offer a means by which to address the slippery percept of timbre. A practitioner, for instance, may be able to guess at how he produces the sound and his description may lead to a clearer interpretation of acoustic data. Listeners, while rarely describing what they hear in acoustic terms, offer reactions that may reveal a pattern in terms of preference. That information, in turn, can be used together with a visual depiction of the sound (in the form of either a spectrograph or a spectrum) in order to work towards an understanding of which particular acoustic features of a voice are indicative of a preferred sound. However, the study of the three domains can be problematic: listeners often have a difficult time uniformly describing sound quality due to a reliance on ambiguous terminology; the vocal apparatus is internal and cannot be observed easily by the practitioner and therefore practitioners often do not have a complete understanding of how the vocal apparatus works to make preferred sounds; and acoustic analysis, while more reliable than the first two avenues of investigation, can be questionable in a comparative study if all the samples being analyzed are not made under similar circumstances. And, in my specific timbral study, understanding the perceived beautiful sound of Islamic call-to-prayer recitation is further complicated by the fact that the style and voice quality of a recitation is bound not to a pan-Islamic aesthetic, but rather to a localized aesthetic in terms of both melodic structure and voice quality. Scholarship from a variety of sources (Baralić, 1983; Hickmann, 1970; Hoerburger, 1975; Anon, 2002; Levin and Matyakubov, 1993; Levin and Petrović, 1993; Marcus, 2002; Monts, 1998; Nelson, 1985; Özcan, 1995; Schaefer, 2000), along with my own fieldwork and observations, support the assertion that distinct culturally bound recitation styles exist and that local listeners’ perceptions of beauty and their affective responses are tied to local style and sound. Therefore, examinations of a preferred recitation timbre need to start with locally based studies. Here I present findings that concern the beautiful voice as it is perceived and produced in Istanbul, Turkey, for many centuries the cultural and artistic capital of the Ottoman Empire. The Istanbul call-to-prayer style remains directly linked to the highly regarded Ottoman Istanbul palace style and is among the most respected in Turkey (McPherson, 2011, 2).

My work has examined interactions among Fales’s three domains of timbral analysis with a specific focus on the recitation art of Istanbul. The analysis presented in this article focuses on the acoustic domain; however, I relied on the perceptual domain to help guide my analysis of acoustic profiles toward salient features of the sound and the productive domain to explain the manifestation of the features in the acoustic profile. This work has led to some interesting possibilities concerning the acoustic structure and productive tendencies of Istanbul muezzins with preferred voices.1

The Acoustic Structure of the Beautiful Voice in Istanbul Call-to-Prayer Recitation

Explanation of Samples for Analysis

The recitation samples I analyzed were the recitations of nine competitors at the 2006 Istanbul Beautiful Call-to-Prayer Recitation Competition, which took place in the Sultan Ahmet Mosque of Istanbul. I recorded these recitations using the same M-Audio device, placed in one location, and on which the settings remained the same throughout the competition. I eliminated many variables by using the same recording device and therefore these recordings were ideal for a comparative analysis. Also, these competitors had already undergone preliminary competitions prior to arriving at the 2006 Istanbul citywide competition, so I feel somewhat secure in my assertion that these competitors represent a preferred Istanbul sound. Nonetheless, I confirmed this assertion by sitting with indigenous listeners, all musicians with professional standing or working towards graduate degrees, and asking them to comment on the recordings of the nine recitation practitioners. The general feedback I received was that all nine practitioners had pleasing voices.

Determining Avenues of Investigation

Interviews with listeners and recitation practitioners, who were also consulted, pointed to two common perceptions of the source of a beautiful Istanbul voice: the register and the accent. In addition to the information gathered at interviews, I examined spectrograms to discern any interesting patterns that might warrant further investigation of voice quality.1 These spectrograms led me to an examination of anti-formants (areas of relatively low amplification), which is discussed below.

Clues about the Beautiful Voice from Listeners and Practitioners

When discussing vocal production and timbre with practitioners and expert listeners, one common theme was that the Istanbul call to prayer employed a higher register when compared to other recitation styles, particularly those of Arab cultures (Egypt being the most frequently cited country of comparison). Register can be considered a timbral component in vocal production. Most voice scientists and teachers agree that register is defined not only by range, but also by a quality of

1 This study is a continuation of work I began in 2003, in which I examined the call to prayer’s pan-Islamic timbral features and then moved on to the acoustic structure of the Turkish sound specifically. (McPherson, 2005; McPherson, 2008). In my second study, I found that a salient component of Turkish call-to-prayer voice quality might be an amplification of the frequencies between 3000 and 4000 Hz. At the time, I was not convinced that this frequency range was, in fact, a particularly important one; however, with the continuation of this work and the results presented in this article, I have a fuller understanding of the significance of that frequency range and the role it is playing.

1 In consulting spectrograms, I was examining the relative amplifications of frequencies. By way of explanation, sound quality is determined by the relative way in which frequencies above the fundamental frequency are amplified. Higher intensity frequency areas of a spectrum are called formants. These higher intensity frequencies may appear as bands of frequencies of relatively higher amplification. When studying most instruments, the frequencies above the fundamental pitch are determined by a consistent mathematical pattern: the first upper frequency will be twice the fundamental, the second will be three times the fundamental, and so on. The relative amplification of these upper frequencies determines the instrument’s quality of sound. In the case of the human voice, the vowel being produced plays a role in the sound quality as well. Vocal formants (intensely amplified frequency areas) can bear little mathematical relationship to the overtones of a fundamental frequency and are often influenced by a particular vowel; thus, the vowel being produced must be taken into consideration, as well.
voice, produced by activating particular muscles and making certain placements in the resonator, which in turn change the percept of the listener and the production of the sound. Thus, a particular range may be stronger or more pleasing in a given voice and can partially define the voice's character; so, while a person could theoretically sing or recite in many different pitch ranges, certain pitch areas are better suited to a particular voice. İstanbul residents note that higher registers are preferred in call-to-prayer recitation and this may very well indicate a timbral preference for voices capable of producing a pleasant or stronger sound in a higher range. Therefore, I examined the ranges employed by the competitors. The ranges employed by the nine competitors' were:

Competitor 1: A3 to B4
Competitor 2: A3 to A4
Competitor 3: D#3 to G#4
Competitor 4: B3 to A4
Competitor 5: B3 to E5
Competitor 6: B3 to B4
Competitor 7: Bb3 to C#5
Competitor 8: A3 to Ab4
Competitor 9: D4 to C4

The data indicates that competitors generally recite in what is considered a tenor range (generally a male voice that comfortably and warmly produces sung sound between the C below Middle C and the C above it), thus supporting the notion that the Turkish style generally prefers a high male register and, possibly, timbral attributes associated with the ability to comfortably recite in those pitch areas. Competitors tended to exploit a limited range of an octave to an octave and a half (in the extreme). The winning competitor, number five, demonstrated the highest range, which also may support the assertion that these qualities are preferred ones in the Istanbul-based tradition.

As to the second common description of a beautiful voice, listeners and practitioners note that there is an Istanbul 'accent.' It is outside the scope of this article to examine what that accent might be and would require some collaboration with scholars of linguistics, speech pathologists, and voice scientists; so for the time being I simply mention that there was some consistency in response using this form of description when describing a Turkish beautiful voice.

Spectrographic Analysis of the Competitors' Voices

The interviews with listeners and practitioners provided me with some insight as to the nature of the beautiful voice in Istanbul, but I also conducted spectrographic analyses in order to determine if there were any obvious common features to the acoustic manifestation of the competitors' voices. My most promising investigation concerned the exploration of anti-formants. All of the spectrographic images have consistent bands of 'missing' frequencies throughout the recitations of each competitor; that is, bands of frequencies that have very low levels of intensity (known as anti-formants or anti-resonances), so that the spectrographic image created shows the frequencies to be of very low amplitude. Such consistent bands of low-amplitude frequencies are fairly unusual, and, for that reason, initially I was concerned that my recording equipment had experienced some sort of malfunction. However, when the samples from each competitor were placed side-by-side, it was apparent that the anti-formants were appearing in different bands of frequencies in each sample. Had it been an equipment malfunction, the anti-formants would have appeared in the same band of frequencies in each sample; therefore, equipment malfunction was ruled out as a possibility, and, instead, I became interested in the unusual appearance of anti-formants and what their role might be in the manifestation of the beautiful voice. Figure 1 below illustrates the appearance of these anti-formants. In it, competitors one-through nine are represented; Phrase 1A (the second rendition of the tekbir, 'Allahu akbar, Allahu akbar') of each competitor's recitation has been copied and placed side-by-side in order to visually display the universal appearance yet varied placement of the anti-formant (in some cases more than one anti-formant is present). The anti-formant appears as a relatively dark frequency area, usually black, when compared to the more intense red and orange areas. The presence of the anti-formant is more clearly viewed in figure 2. Figure 2 demonstrates Competitor Three's full recitation, and here the consistent placement of his anti-formant is seen throughout the spectrograph. Other competitors' spectrographs exhibited stable anti-formant placement in individual areas. I used Adobe Audition 1.5 to create these visual samples; however, my analysis was done using Praat. Thus, excepting these figures, all other visual samples were generated by the Praat analysis program.

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3 C4 is middle C. In the case of this paper, I use these scientific note names to indicate the general pitch area. Since this is sound based on Turkish makam (modal entity), however, the frequencies would not exactly correspond to these pitches.

4 I am indebted specifically to my dissertation committee member, Dr. Cornelia Fales, who first noticed the appearance of these anti-formants and advised me to begin examining their contribution to the voice quality of the competitors.

5 During the course of my research, I had made several hundred field recordings using this same equipment, so I also examined these recordings using spectrographic analysis to see if there was any evidence of equipment malfunction (that is, anti-formants appearing in the same location in other recordings), and this examination resulted in the conclusion that the equipment was not responsible for creating these 'missing' frequency bands.

6 The tekbir is the first line of text in the call to prayer.
of vocal production and has a specific effect on the vocal formant. First, the presence of an anti-formant creates a ‘dip’ in the spectrum at the level of the anti-formant frequency. In turn, this ‘dip’ changes the frequencies of the vocal formants, that is, the balance of the spectrum. Where the anti-formant occurs, the first vocal formant is lowered and higher ones are raised. Further, the location of the anti-formant and the change in spectral balance perceptually correlate with nasalization of the sound (Harrington and Cassidy, 1999, 205-206). In ‘Acoustic Phonetics,’ Harrington more specifically describes the production of nasal and nasalyzed sound and its relationship to the anti-formant. An anti-formant is produced physically with a lowered velum and (usually) periodic vocal fold vibration. This means that while the nasal-pharyngeal tract creates the formants, simultaneously the side-branching oral cavity is activated in the process and, along with the lowered velum, produces anti-formants in the acoustic profile (Harrington, 2010, 113-118). Thus, the anti-formants that appear in all the recitations suggest the following about shared features of the beautiful voice in Istanbul recitation:

1. Competitors produce the recitation by placing their voices in both the nasal and pharyngeal tracts, lowering the velum, and engaging the side-branching oral cavity. What seems unusual here is that this manner of production occurs throughout the recitation, not just when explicitly nasalized consonants or vowels are produced; this production of the sound suggests that a certain amount of nasality is preferred in call-to-prayer recitation throughout the entire recitation. This is very interesting in that the production of an anti-formant should occur only when a nasalized consonant or vowel is actually being produced; therefore, the anti-formant should appear in a different location each time it is produced depending on the vowel or consonant and pitch. These competitors do not exhibit this pattern: their anti-formants remain in a more or less consistent place throughout the recitation. So, perhaps there is some sort of consistent placement and productive nasalization of the voice that is resulting in this consistent anti-formant.

2. The manifestation of these anti-formants changes the spectral balance by compressing the distance between more intense frequencies so that they blend into one another, creating one or two formants where four should be discerned. Thus, typically occurring vocal formants are less distinct overall. Again, this alteration of the spectral balance should only manifest itself for ‘true’ nasalization, but a similar effect does seem to occur in these competitors’ samples as well. What is so interesting is that there are so few ‘true’ nasals in the text of the call to prayer (most phrases tend to exploit open vowel sounds), making the consistent appearance of these anti-formants all the more curious.

To demonstrate the effects of these anti-formants across the competitors, I examined the placement of the formants relative to the anti-formants and the anti-formants’ effect on sound quality, and compared competitors’ formants to average representations of formants for specific vowels. The purpose of this investigation was to examine the overall role of the anti-formants in contributing to voice quality.

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**Evaluation of The Anti-formants**

Examinations of spectrograms illustrated that each competitor has a band or bands of frequencies of very low amplitude (anti-formants) and it is apparent that these low intensity bands of frequencies, while consistent in each competitor’s individual recitation, appear in different frequency areas among the competitors. Therefore, I turned to examining what these anti-formants are and what they might indicate about voice quality and vocal production.

Generally speaking, an anti-formant is directly correlated to a particular means...
Determining the Effects of the Anti-formants

Using Praat, I examined the anti-formants in each sample by identifying the formants and the anti-formants' relative position. To do so, I opened each sample in Praat and converted it from stereo to mono. I set the program for a spectrographic visual display of up to only 10,000 Hz. For each sample I then located and analyzed three sustained [a] vowels occurring at different points in the recitation. The purpose of looking at these three [a] vowels was to note the consistency of the anti-formants and the formants relative to them. Figure 2 below, taken from Phrase 1A of competitor one, depicts this visual display. The red lines indicate bands of formants and the almost white areas are the anti-formants. I determined the frequency range of the formants and anti-formants by placing the cursor just on the outside of the red lines and of the white areas.11

9 From earlier investigations, I had determined that frequencies above 10,000 Hz did not perceptibly contribute to the sound quality and, by limiting the visual display to 10,000 Hz, I was able to see more detail in the salient frequency range. It should also be noted that I wanted to display the amplified frequencies between 0 and 10,000 Hz since in at least one case a formant seemed to start at 150 Hz. However, clearly “O” was not going to affect the sound of the call, since there are no nasals such as “p” or “t” in the call, which might register a “O” reading. So, setting this display between 0 and 10,000 Hz was simply meant to display all the amplified frequencies above 0. Also, I wanted to display amplified frequencies just above 0 Hz and below 10,000 Hz, despite the fact that studies indicate a normal hearing range for audibility in speech is between 200 Hz and 6000 Hz (Beranek, 1947). There are three reasons for this extended display. First, while audibility in speech has provided some data about minimum standards for understanding articulation of words, sung timbre relies on the interaction of a greater extension of amplification of frequencies; sung sound can and does happen at the extremes of vocal ranges. Second, the study of timbre is not necessarily about understanding of a word at a minimum range. It is about how all of these frequencies interact to achieve the unique timbre of every instrument and voice, hence it is a more individualized examination of the sound. Finally, in terms of allowing the visibility of the lower range, between 0 and 200 Hz, I could examine more closely how the anti-formants have located the spectral centroid in the lower frequency ranges. This last point may be the most salient for the purposes of this discussion, since a key result of the presence of anti-formants is the compression of formants below the anti-formant into fewer formants and more intense amplification of the lower frequencies.

10 All these samples were taken from the first half of the recitation because the requirements of the competition were that competitors modulate to a second makam halfway into the recitation. Therefore, by limiting the comparative analysis to the first half of the recitation, I hoped to minimize variables such as the effect of modulation. It should be noted that modulating from one makam to another in the call to prayer deviates from standard practice in the Istanbul recitation tradition. In standard practice, modulation without return to the opening makam is not done. However, for the purposes of the competition, competitors were required to demonstrate knowledge of two makams and told specifically when to modulate in the text. Modulating for purposes of the competition was acknowledged by organizers as being outside the scope of standard recitation practice.

11 Typically formants are described using a formant’s center frequency. However, in this study I have described the formants as bands of frequencies. This is due to the reductive method of analysis I employed in which I eliminated bands of frequencies to see the contribution each made to the overall sound. I acknowledge that this way of referring to formants is not general practice.

[Figure 2: Waveform and spectrograph of competitor one with formants (in red) and average pitch (in Blue); the white bands represent anti-formants. The reading on the left screen in red print (‘1076 Hz’) represents the placement of the cursor at the time the screen was copied. The overall duration of the recitation is at the bottom center of the frame. Above it is the duration of this sample and, on either side of this number, in blue print, are the starting and ending times of this particular sample.]

I then determined the spectral centroid for the spectrum (both for the entire recitation and for points occurring in the three [a] samples). The spectral centroid is a measure of the spectrum’s mean; that is, where the energy placement of the spectrum tends to fall, something which would be affected by the anti-formants and may indicate particular manifestations of the preferred voice of the Turkish call to prayer. To do so, I first used the software to generate an average spectrum for the entire recitation. Figure 3 below demonstrates the average spectrum for competitor one:

12 One problematic feature of Praat’s visual display is that it offers two different scales on each side of the frame. Therefore, when looking at formants, the scale on the left (in red text with an upper limit of 10,000 Hz) should be consulted. When looking at the fundamental, the scale on the right (in blue text with an upper limit of 500 Hz) should be consulted.
For each sample, I then undertook a filtering process in order to determine the effect of the anti-formants on auditory perception of the sound quality. I first filtered everything including and above the anti-formants to see how salient that acoustic information was to overall sound quality. Figure 5 below represents the filtering of the anti-formants and all frequencies above it for competitor one. The method used was band pass filtering in which all frequencies below a certain range were allowed to remain while the others were removed.

Having removed these frequencies, I placed an un-filtered sample immediately next to the filtered one and listened through headphones. If there was no perceptible difference between the filtered and unfiltered sample, I noted that the frequencies below the anti-formants were the only salient ones and then moved on to the next sample. If, however, there was a difference in the sound quality after filtering all frequencies above the anti-formants (which was often the case), I then methodically re-introduced bands of frequencies until I determined at which point in each sample the frequencies were no longer contributing to voice quality.

Discussion

In most samples, at least one anti-formant is present (only in one very short excerpt from competitor eight was there no anti-formant). The anti-formants tend to occur somewhere between 3000 and 5000 Hz; this is their placement in competitors one, three, four, five, seven, eight, and nine. Competitor two’s anti-formant is much lower, between 1500 and 2500 Hz, and competitor six’s anti-formant is placed in a slightly lower frequency range at 2400-3400 Hz. Several competitors exhibit a second anti-formant in a higher frequency region (generally

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13 I relied on my own auditory perception in this process. In future studies, it would be more ideal to sit with indigenous listeners and ascertain their responses to the filtering process.
formants tend to be created in the male voice in the following frequency ranges:^{15}
Formant One: 150-850 Hz
Formant Two: 500-2500 Hz
Formant Three: 1500-3500 Hz
Formant Four: 2500-4800 Hz (Nave, 2000)

But an examination of the competitors' formants reveals that below the frequency of 5000 Hz there generally appear to be no more than two very strong formants, which means that formants three and four have merged into just two formants. Also, formants three and four in the samples are moved into higher frequency ranges, above the anti-formants, as scholarship indicates to be a related effect when anti-formants are created.

Therefore, Turkish preferred voices may introduce some sort of nasality throughout the entire recitation, always doing so in the same manner, which in turn creates an acoustic picture with consistently placed anti-formants. This means of production seems to be somewhat unusual and tends to concentrate the most salient and intensely amplified harmonics below 5000 Hz. Moreover, the winning muezzin, competitor five, exhibits the ability to concentrate all of the most important acoustic information below the anti-formants.

Given these results, I hypothesize the following: the presence of nasality throughout the recitation may be a Turkish manifestation of a tone quality referred to in Arab voice scholarship as "ghunnah." Ghunnah is an Arabic term for a type of nasalization. This type of nasalization in Arab genres is often used as a vocal ornament, and, because it is so strongly associated with religious genres (particularly recitation of the Koran), logically could manifest itself in this context. This vocal placement, when used in a religious setting, is, according to scholars, more consistently used than it is in secular genres. Ghunnah is a type of nasalization that requires resonance in both the head and the mouth simultaneously and is differentiated from another type of nasalization "khunna," which is sound placed solely in the nose. This second type of nasalization is not a preferred sound (Danielson, 1997; Sawa, 2004; Racy, 1977). Taking into consideration that ghunnah exists as a standard placement for the voice in sacred genres, it may be that this manifestation of anti-formants relates to this aesthetic preference for a type of nasalization—one which has not yet been thoroughly examined spectrographically and therefore may fall outside of what is understood as the traditional spectrographic manifestation of nasalization. It may also be that the presence of anti-formants is not uniquely Turkish and may in fact be pan-Islamic. However, as previously stated, other evidence of anti-formants has not been identified in non-Turkish samples. It may also be possible that this placement of the voice in Turkey represents the preferred Turkish interpretation of call-to-prayer recitation timbre, one which intensifies a preferred Arab ornament and makes it an ever-present element of the recitation's timbral features.

Conclusions
Interviews with practitioners and listeners indicated that recitation artists who recite in a higher register are representative of an Istanbul style. This assertion is supported by analysis of the ranges employed by competitors. Spectrographic

^{14} It should also be noted that scholarship on vowel production in spoken Turkish and Arabic does not indicate the regular presence of anti-formants (Ladefoged, n.d).

^{15} These formants refer to English speakers and may differ slightly in Arabic. However, the open [a] vowel is common to both languages and should be fairly similar.
analysis also reveals the presence of anti-formants throughout the recitations of several preferred recitation artists. These anti-formants correlate to a means of production, a nasalization of the sound, which suggests that accomplished reciters tend to place their voices in this region and that this type of production is typical of beautiful voices; still, however, it is a curious phenomenon given the consistent appearance of anti-formants that do not correlate with nasalized vowels and consonants in the text of the call to prayer. Nonetheless, this concentration of the sound creates the anti-formants, resulting in a greater intensity of frequencies below 5000 Hz, along with a lower spectral centroid in the voices (generally below 1500 Hz). Formants one through four also tend to “merge” into one or two formants and others are pushed above the frequency of the anti-formants. Frequencies below 5000 Hz tend to be most important in contributing to resonance and vowel quality.

Extending the Research

There are many avenues that can be taken to extend this project and more fully examine the nature of the beautiful voice in call-to-prayer recitation. In terms of spectrographic analysis, the next step is to confirm whether or not the range used and the presence of the anti-formant tends to define a preferred Istanbul sound. To do so, systematic comparative studies with recitations from other traditions should be undertaken; to date I have observed that no other call-to-prayer recitation styles seem to create anti-formants, but this work has not been undertaken systematically and has relied on recordings made under differing conditions. Another important step towards confirming the salience of the anti-formant to the Istanbul style of recitation is through a series of investigations in which indigenous listeners listen to and comment on the filtering process that I conducted. Finally, because several listeners and practitioners related the perception that there is a Turkish accent, more work should be completed in order to understand the role of this accent in the perceptual and productive domains, to what extent it shapes the sound of recitation, and how it can be described more effectively.

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