

# The Drew Review



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The Drew Review, the annual research journal for the undergraduates of the Drew University College of Liberal Arts (CLA), publishes the undergraduate research from the previous calendar year. We aim to showcase the intellectual vibrancy of the students of the CLA.

The board currently consists of seven editors, selected by faculty nomination, application, and invitation. Published students can apply for a position on the board, with the remaining positions filled by faculty nomination and student application with a writing sample.

Submissions to the Review require a faculty nomination. Students who believe their work is exceptional should approach their professor for a nomination. The Drew Review accepts papers of no more than twenty-five pages in October and February from the previous semester. This year, we received thirty-nine submissions and have selected ten for publication.

As we are a double-blind, peer-reviewed journal, all submissions should be sent as a Word document to the corresponding editors without naming the student author or professor for whom the essay was written in the body of the essay. The student author's name and paper title should be in the faculty nomination. Images and graphs will be published in black and white and must be compatible with Word. It is the author's responsibility to ensure that all images can be reproduced. All published essays will use in-text citations referencing a works cited bibliography, and the specific citation style is dependent on the discipline of the particular essay. Students can expect to be asked to make revisions prior to publication.

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**Polyphonic Singing in Context: Throat-Singing  
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Ian Nadler (CLA 2018)**

**Abstract**

Observed by various cultures worldwide, polyphonic singing is a vocal technique in which multiple simultaneous sounds are produced by a single singer. The Republic of Tuva developed one of the most diverse and noteworthy polyphonic vocal styles, known as Tuvan throat-singing. While Tuva maintains an extensive variety of throat-singing voices, each style was generated to mimic some aspect of nature as a means to practice animism. However, polyphonic voice would not be possible without certain fundamental patterns dictated by the physics of sound. The harmonic series, for example, which is commonly known as the overtone series, is the frequency pattern that any complex sound naturally follows and which gives rise to unique tone color or timbre. Each voice gets its exclusive timbre from the different harmonics it produces, but polyphonic singing takes advantage of those generated harmonics within the voice. Focusing on the Tuvan culture's approach to the polyphonic voice through a technical analysis of throat-singing techniques provides a framework within which to extrapolate purpose for polyphonic singing in other cultures.

From providing the human species with the ability to communicate through language, to allowing us to produce music independently by singing, the versatility of the voice is extensive. It is through this versatility that individuality arises in the music of various cultures. There is no disputing that singing is a universal expression of music that has developed globally in some capacity in all cultures; however, singing is not approached in the same way in each culture. Polyphonic singing is a perfect example of this lack of uniformity.

Not all cultures developed this singing style, but rather it developed using varying techniques in different cultures, and its functional use varies depending on the culture. Polyphonic singing, simply put, is a vocal technique that allows a singer to produce two or more pitches simultaneously. This vocal approach is observed in cultures of Central Asia including Tuva, Mongolia, and Tibet, as well as in the South African Xhosa Women, the Dani people of New Guinea, and even in some Western cultures. While the predominant Western polyphonic technique, overtone singing, is wide spread, the most noteworthy style of polyphonic singing originated in the Tuvan region of Russia. This style is the most extensive, with three major technical approaches -- khöömei, sygyt, and kargyraa -- and with numerous substyles within each approach. Whether polyphonic singing is used as a part of a religious ritual, to demonstrate an appreciation for nature, as a status symbol, or even as a way simply to demonstrate vocal mastery, a technical analysis of major Tuvan throat-singing styles can help us determine the cultural purpose for these polyphonic vocal techniques within the Tuvan culture, and identify how these approaches may share similarities to polyphonic singing of other world cultures.

Even though Tuvan throat-singing may be the most well-known throat-singing culture of today, the people of Tuva were not the sole progenitors of throat-singing.

Throat-singing itself originated from the Turk-Mongol people of the Southern Siberian and Central Asian regions (Pegg 32). Essentially, Mongolian cultural influence upon the Tuvan people influenced the creation of Tuvan throat-singing. The Turkish word *Khöömei*, which is the basic Tuvan throat-singing style, was originally the Mongolian word *xöömei*, further supporting that the Mongolian culture actually introduced throat-singing to the Tuvan tribe. This likely occurred due to the great degree of cultural mixing throughout ancient history in this region, which can be attributed to the highly nomadic nature of both peoples, and their contact via intersecting trade routes and well-documented tribal warfare (Tongerren 84). For centuries to follow, until the Chinese Manchu Empire ended in the early 1900s, Tuvans and Mongols were actually unified politically (Tongerren 121), providing another contributing explanation regarding their overlap, especially evident in the throat-singing traditions of each group. When considering the polyphonic technique, superficial beauty is easily identifiable in the sonority generated, but there must be more to the Tuvan use of throat-singing than aesthetic pleasure.

When uninformed Western musicians first hear throat-singing, the unique quality of the sound produced intrigues them; however, that is not the sole intention of this technique in Tuvan culture (Barras & Gouiffès 60). Originally, Tuvan herdsman and hunters exclusively used throat-singing because they believed the throat song pleased their horses, quickening their pace (Tongerren 56). However, this has changed in modern times; now, Tuva allows people of all professions to practice and perform throat-singing, from carpenters to miners (56). As a nomadic culture, the people still interact constantly with their external environment and that is where the true purpose for Tuvan throat-singing lies.

Animism's strong spiritual underpinning has been integral to the belief system of the Tuvan people since before throat-singing's inception. Animism entails a belief that natural structures and phenomena have spirits (Levin & Edgerton 80). As a means to convey this spirituality, Tuvan society made use of throat-singing, using the sonorities produced to mimic nature. They use their singing as a way to connect with nature, almost as a form of sonic meditation. It is commonplace in animism to believe that animals, the weather, or even landscapes possess spiritual power. By emulating the sounds found in nature, Tuvan throat singers believe humanity can obtain this raw power by connecting to spirits. This tendency towards mimicry is substantiated through the development of the different styles of throat-singing in Tuva, where a number of the styles are meant to emulate aspects of nature like rushing water or the galloping of horses. Tuvan throat-singing performers commonly seek solitary refuge when performing their singing (Tongerren 56). In doing so, they can connect intimately with the earth through their songs.

Animistic practice is more of a societal ideal of the Tuvan people, not directly linking to a specific religious observance; however, there have been documented cases of the use of throat-singing in shamanistic study. In this religion, throat-singing is used in ritualistic contexts by shamans, or kham as they are called in Tuvan, to interact with different spirits, beyond nature spirits associated with animism, in their beliefs (Tongerren 80). Using throat-singing for such ritualistic practice is quite common due to the high prevalence of shamanism within Central Asian cultures. When shamans are referenced, the idea of spiritual healing often coincides, but the Tuvan people do not actually believe that throat-singing itself possesses any specific healing power. Shamans just use singing as a tool in conjunction with ritual practice to facilitate spiritual healing or even combat possession in some cases (Glenfield

iv). They do, however, believe that soft production of *khöömei* or *sygyt* aids in the delivery process of childbirth (Tongeren 81). While little substantiates this claim, it is ironic that singers use throat-singing in this way to help women in this way, particularly because, historically, women could not throat-sing. However, when looking at gender roles in the singing practice today, evidence shows a cultural shift in gender roles among the Tuvan people.

Misogynistic prejudice does not limit female presence in professional throat-singing; it results from a Tuvan cultural misconception. From a technical standpoint, when it comes to overtone singing, women drew the biological short straw. Men have the advantage because, anatomically, women tend to have shorter vocal cords and a smaller pharyngeal “tube” for resonance between their lips and vocal cords. This results in two main issues: first, they have a smaller resonating body with which to amplify the sound they produce, and in turn the harmonics they generate, so their voices are quieter (Tongeren 30). Second, women’s average pitch is about an octave higher than men’s, which limits the number of harmonics they can generate.

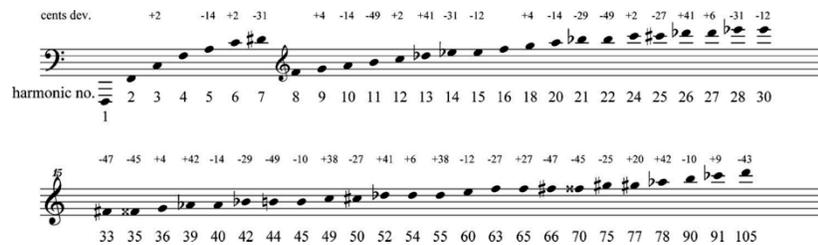
Overtone singing is best produced in frequencies going up to 2000 Hz and women generally start higher in the frequency range; therefore, they have fewer harmonics to access (30). However, this can be remedied through the practice of *kargyraa*, a technique that allows for women to lower their base frequency by about an octave or more, similar to the range of the average male singer. It is important to note, though, that *kargyraa* can be more difficult for women to learn due to the absence of these lower frequencies in the female voice. It can be done generating a timbre unique from the male voice’s production of *kargyraa* (Cope 40). Tuvans believed that throat-singing caused infertility, which explains why such a strict taboo against women throat-singing existed for such a

long portion of their history; however, in modern Tuva, more and more women have begun to practice throat-singing professionally (Levin & Edgerton 82). Because of this broader use, the practice of throat-singing in Tuvan culture has developed its own structural characteristics, which speak to the influences of culture on musical practice.

With capitalism's spread to areas of Central Asia in the 1990s, the practice of throat-singing in Tuvan culture has gone through a musical transition. There has not been a massive upheaval of past tradition, in that a focus on mimesis of nature still prevails, but now that the Tuvan people realize musical performance can yield monetary reward, stage performance is becoming more commonplace (Tongeren 237). Thus, many professional throat singers have moved from the rocky steppes to luxurious concert halls, and many groups have even performed in places like Japan or the United States. As a result of this touring, Western musical concepts influenced many of these groups, resulting in a generation of bands like Yat-Kha, a traditional Tuvan/rock fusion band (Yat-Kha). While some look at these rapidly changing trends in the throat-singing tradition with antipathy as the genre strays from their spiritual intentions, for others, exposure to a new culture's music only enhances the Tuvan people's ability to appreciate their own musicality, facilitating a more diverse perspective. Non-Tuvan musicians should also appreciate this recent instance of cultural diffusion in that it has allowed Westerners the opportunity to experience the unique polyphonic styles of Tuvan music. Music would not exist without the physics of sound. In music, sound is broken down into four major aspects: loudness or amplitude, pitch or frequency, duration or interval of time, and timbre or the compilation frequencies within the oscillating waveform. Without the harmonic series, timbre would not exist and all sound would be pure

sine wave tones. However, that is simply not how musical sound exists. The harmonic series can be calculated mathematically whereby it starts with the fundamental frequency and follows a general pattern. Consider this example: orchestras typically tune to an A4, which sounds at 440 Hz. This will be our fundamental frequency. To calculate the harmonic series from this pitch, we follow the following procedure. The first overtone sounds one octave above the fundamental. This pitch has a frequency twice the fundamental, i.e. 880 Hz. The third overtone sounds a perfect twelfth above the fundamental at a frequency three times the fundamental, i.e. 1320 Hz. The fourth overtone sounds a perfect fifteenth at a frequency four times the fundamental, and so on ad infinitum. This pattern is depicted visually in Figure 1. What is important to note is that all of these higher frequencies sound at the same time, just at lower and lower amplitudes as the overtones get higher (Wannamaker 99). Modern pianos use equal temperament, and is the tuning system to which Western listeners are accustomed, but the harmonic series actually follows the mathematical structure of tuning.

FIGURE 1: HARMONIC SERIES



*Harmonic series musically notated with F1 as the fundamental. The numbers above each harmonic indicate the magnitude and direction of cent difference relevant to equal temperament at which each harmonic sounds from: Wannamaker, Robert. "The spectral music of James Tenney." Contemporary Music Review, Vol. 27, 2008, pp. 99*

When playing an A4 in concert pitch on a clarinet versus, for instance, a saxophone, one is playing the same fundamental of 440 Hz, but what makes these two instruments' timbres differ is the relative amplitude of the certain overtones produced when sounding that fundamental A4. The cylindrical structure of the clarinet dampens the even-numbered harmonics, whereas the conical shape of the saxophone allows for those even harmonics to be amplified, giving the saxophone a denser timbre. The voice is no different from these instruments: each voice gets its unique timbre from the different overtones it produces, but overtone and throat-singing take advantage of those generated harmonics within the voice. In overtone or throat-singing, the mouth is manipulated into different shapes by the singer, using different formant placement to amplify certain overtones in the harmonic series, while sustaining the fundamental pitch. Formants are mouth shapes generally used to generate different vowels in speech, but are also used in overtone singing as a filter to dampen the unwanted harmonics while singing (Levin & Edgerton 82). With a general understanding of how throat-singing is generated, one can begin to ascertain the role the musical structure will play.

Polyphonic singing is actually quite a general term. In analyzing the Latin roots that make up the word, "poly" means more than two or many, and "phon" means sound. In sum, "polyphonic" means many sounds. By adding singing to the word polyphonic, it then refers to singing techniques which produce more than one sound. This can be achieved in one of three main ways. First, the performer simply sings and then begins to whistle at the same time, so most do not even mention it when referencing polyphonic singing. Subharmonic singing is the second and most difficult method, which requires the controlled vibration of different sphincters in the larynx depending upon the style of subharmonic singing used, whether it be strohbass,

kargyraa, or growl singing (Ken-Ichi 1). The third and most popular method has performers first sing and then manipulate their mouths, which is the vocal resonating space, to amplify certain frequencies of the harmonic series. When polyphonic singing is discussed, the two most common genres are overtone singing and throat-singing. Overtone singing, a Western musical practice, solely uses the third polyphonic singing method of harmonic series manipulation to generate the second tone. Throat-singing uses the harmonic series in addition to certain styles that also incorporate subharmonic singing.

Musical structure is a telling attribute indicating certain values of a culture. In countless cultures, pentatonicism reflects a recurring scalar pattern seen in musical structure. The pentatonic scale comes in a variety of different forms, but it consistently entails up to only five unique pitches. In contrast, the Western system is predominantly diatonic, using seven unique pitches and possessing a set interval structure. A popular example of pentatonicism that is well known can be noted in the popular spiritual “Amazing Grace”. However, pentatonicism, while not exclusively Asian, is typically associated with Asian cultures, fittingly for this case. Tuvan throat-singing is no exception to the pentatonic tonal tendency, which can be heard in the harmonic pitches most frequently used in the melodies they generate. The overtones most commonly isolated together in Tuvan throat-singing melodies are the 6th, 7th, 8th, 9th, 10th, and 12th harmonics, carefully avoiding the 11th harmonic. This makes a pentatonic pattern, since the 6th and 12th harmonics are the same pitch an octave apart (Levin Grove). Importantly, of those harmonics, the majority of melodies use the 7th quite sparingly (Levin and Edgerton 87).

Western music theory further supports the aesthetically pleasing pentatonic patterns that these throat-singing melodies tend to follow. By analyzing the intervals of each of these harmonics relative to the fundamental sound, mostly pleasant, or consonant, intervals are observed (Clendinning & Marvin 106). Using *Figure 1* as reference for this discussion (for simplicity all intervals will be presented within a single octave), the 6th harmonic is described as a perfect 5th (P5) from the fundamental, it would really be a perfect 19th. Building sequentially from that P5 generated between fundamental and the 6th harmonic, one hears a minor 7th (m7) for the 7th harmonic, an octave for the 8th harmonic, a Major 2nd (M2) for the 9th harmonic, a M3 for the 10th harmonic, and another M5 for the 12th harmonic. Aside from the m7, which is created by the 7th harmonic that is the least frequently used in this pentatonic group, each of the previously mentioned intervals are among the most commonly used in all modern Western music. While not a direct correlation, the popularity of these intervals in Western culture is predominantly due to the positive emotional associations we have with them.

Looking from the opposite perspective of harmonics that are avoided in these Tuvan melodies, such as the interval generated by the 11th harmonic being a tritone as well as the m7 generated by the 7th harmonic, one can justify why these singers choose to shy away from these tones. The tritone in Western music is often referred to as the devil's interval due to its unpleasant sonority, and a m7 is not much better (Clendinning & Marvin 107). Taking Western analysis one step further, in the context of equal temperament, the instability of the 7th and 11th harmonics can be further substantiated. As mentioned previously, the harmonic series does not follow the equal temperament tuning system to which Western ears are accustomed. As a result, the 7th harmonic falls 31 cents flat of the pitch that

would make the interval between the fundamental and this harmonic a true m7, and the 11th harmonic falls 49 cents flat of the pitch that would make the interval between the fundamental and this harmonic a true tritone (Figure 1). In the equal temperament system, there are 100 cents between each semitone, therefore being 50 cents away from a semitone is the most out of tune any pitch can be because it falls a quarter tone away, or halfway between two semitones. Therefore, the 7th and 11th harmonics are so far flat that even an untrained ear can hear how the intervals they create sounds mistuned and unpleasant.

For perspective, when looking at the preferred harmonics in the pattern none of them falls more than 14 cents away from their respective semitone, which is a frequency variation that is imperceptible to most untrained ears. Rigid Western musical analysis can only reveal so much about this ancient musical style. Throat-singing was created long before the rules of Western musical theory had even been defined; therefore, analyzing the mode of transference can elucidate more about the cultural impact on this polyphonic style.

Aside from its pentatonic nature, most throat-singing tunes have a character similar to folk music in that they are transmitted orally, are unique to the culture, tell tales of nature, and are constantly evolving with time through oral tradition. In fact, due to the lack of rigid form, the freedom of throat-singing compositionally facilitates a highly improvisational nature (Tongerren 67). Performance in many cases often requires original creation on the performer's part since there is not an extensively documented common repertoire. There are also extended pauses of up to 30 seconds in throat-singing, which is strange to a Western ear since one might think that these divide the unitary musical melody. However, Tuvan performers do not see each phrase as belonging to one overarching musical idea, but rather each phrase is its own

original sonic portrait and the phrases can interact with one another. Aside from allowing the performer to catch his or her breath, a major purpose for the pause is for the performer to listen to the ways in which the past phrase is interacting with nature and ambient sound (Levin & Edgerton 87). The performer then uses that preceding sonority to formulate a response in his or her next phrase, once again conveying the focus of the spiritual connection to nature in a format comparable to a conversation, where the performer is waiting for nature to respond in those breaks.

When it comes to familiarity, throat-singing is the norm in Tuvan culture and is so common that it is held with the same regard as Western modal singing. As such, children are fascinated by it at early ages, but quickly get used to its prevalence as they move into adulthood (Tongeren 57). Unlike Western trained musicians, throat-singing teachers in Tuva use a very hands-off, non-detail-oriented approach. Clearly it is quite effective since some children are able to produce the khöömei voice by two years of age, but generally the student learns almost exclusively by watching and listening to a teacher sing, receiving very little direct technical instruction (70). Their hands-off approach is due to their lack of a formally defined musical teaching style. Music is taught by imitation of an experienced singer, and the little guidance received is through word of mouth. After a demonstration, the “teacher,” who would be more of an elder singer providing an example as a Western student might see it, would likely say “You see,” meaning the student should gather all they need just from listening to the master (Tongeren 70). This exposes the role of mimicry in this society as seen not only in the music, but in the pedagogy of throat-singing. Looking at the Tuvan word *chylandyk*, which are the first sounds made by children when they are attempting to produce the khöömei sound through imitation of an elder

singer, the mimicry learning practice can be seen (Tongeren 69). Still, it is intriguing that students do not really master their voices until their late teens to early twenties. For instance, at age 13, children are able to produce the harmonics of sygyt voice but cannot control the fundamental or the specific harmonic pattern desired.

Even the concept of musicality in Tuvan culture is foreign in comparison to the accepted Western conception of the idea. In fact, Tuvan culture does not even have a word for music that equates to the Western term, but rather refers to the idea of music as the sounds of their world that they are in turn offering back to the world itself (Levin NPR Podcast). In addition, there are no set words for drone or overtone like there are in Western culture, which is surprising due to the fact that these musical constructs are fundamental to the production of their throat-singing style (Tongeren 71). Tuvans developed an understanding of these ideas by practicing the techniques themselves. Each performer embarking on his or her own journey comes to a personal perspective of what these sonorities mean to him or her individually. Generally, they are using their musical performances as a means to connect spiritually with nature. Creative skill comes predominantly from intuition and experience with the throat-singing style, not a detail-orientated anatomical understanding of what they are producing from their throats, or how to notate the melodies they produce. This is partially the reason why research delving into understanding their unique polyphonic voices is not extensively documented. As the structural form of Tuvan throat-singing developed, different unique voices became integral to the practice.

While there is a plethora of different unique Tuvan throat-singing styles, three main voices make up the fundamental core of the average Tuvan throat-singing performer. They are khöömei, sygyt, and kargyraa (Tongeren 64). As with most polyphonic singing, the

fundamental is maintained in the voice as a pedal tone while harmonic manipulation generates the melody (31). Khöömei is the main style that is the easiest to learn, similar to Western overtone singing, and is sung in the midrange of the voice generating the lower overtones in the harmonic series, meant to mimic the sound of wind swirling around rocks. Sygyt is sung in the upper part of the vocal range generating high overtones often described as flute- or whistle-like meant to emulate the nature of a breeze or bird song. The third style, kargyraa is the most technically unique form, generated in a completely different manner than the previous two voices. It produces a low subharmonic fundamental frequency meant to ground the singer to the earth, generating a harmonic-rich tone, and producing lower harmonics.

Some musicologists argue that there are two more core voices called borbangnadyr and ezenggileer, but these are more ornamental techniques that can be used in conjunction with one of the other three main voices -- generally khöömei or sygyt -- to produce unique musical effects (66). Borbangnadyr is used to mimic the sound of rushing water, and ezenggileer is meant to emulate the sound of a cantering horse, demonstrating how throat-singing is meant to further a connection with nature. Aside from the main three throat-singing voices, there are endless sub-techniques due to different regional technical approaches, and partially due to many famous throat singers generating their own styles of throat-singing to differentiate themselves, thus making their timbre unique and desirable (Pegg Grove). Kargyraa, for example, has two different substyles, with dag-kargyraa the lower one and xov-kargyraa the higher one, and they are referenced as mountain and steppe kargyraa, respectively. A technical appreciation for each style can cement a link to the purpose of throat-singing in Tuvan culture and how polyphonic singing is generated.

Technical production of these core voices, seems easy when watching a professional, but can take years to master. The main aspect that separates Eastern throat-singing from Western overtone singing is the use of the squeezed voice technique that allows for airflow control (Cope 36). Aside from giving throat-singing its unique timbre, the main purpose of the squeezed voice is to amplify the harmonics by limiting the backflow of the sound from reverberating into the throat. The khöömei voice is essentially creating the same resonating space in the mouth cavity as in Western overtone singing while also performing the squeezed voice technique, which is why this is the most simplistic of the main voices (36). Of the remaining two styles, there is much debate over which is more difficult, but each presents its own unique challenges. Sygyt uses the same squeeze voice technique as khöömei while using the tongue to filter out the lower overtones and isolating the high piercing harmonics. This is done by placing the tip of the tongue against the upper gum right above the front teeth, having the sides of the tongue pressed against the upper gums relative to the molars on each side, and then using the rest of the tongue to block the opening between the mouth and the throat, leaving a small opening on either side of the mouth so a very limited airflow is allowed to pass (Levin & Edgerton 82).

By doing this, the resonating space where the harmonic is generated has been made smaller, allowing for the higher harmonics to sound; changing the position of the middle part of the tongue allows for different harmonics to be elicited. The most skilled sygyt singers can come close to eliminating the fundamental frequency altogether, really isolating the whistle harmonics. As mentioned previously, the fundamental in kargyaa throat-singing is created in a completely different way than in the other two voices. The placement of the voice is close, but slightly farther forward than vocal fry. Here the subharmonic fundamental is

generated by getting both the ventricular and vocal laryngeal folds vibrating concurrently using a constant glottal push, whereas in the previous two voices just the normal vocal folds have been vibrating (Ken-Ichi 2). In this technique, since both of these resonating structures are vibrating at the same time, two tones are already being produced. The ventricular folds actually generate a pitch that is half the resonating frequency of the normal vocal folds; thus the two pitches are an octave apart (1). Once this base phonation is achieved, the formants can be manipulated in the mouth to generate different overtones, thus with this style, there are actually at least three tones produced at a time. As such, awareness of the cultural development of polyphonic techniques is revealed.

Polyphonic singing has developed in a myriad of different cultures worldwide, so by focusing on its inception in the Tuvan culture through a technical analysis of their throat-singing techniques, the purpose for polyphonic singing in other cultures can be extrapolated. Cultures world-wide use music to connect to nature. This is a key motivation of Tuvan throat-singing, highlighting different elements of their environment in the multitude of voices they use to emulate different aspects of nature. Certainly, different cultures use the polyphonic techniques for different applications other than the appreciation of nature; however, what is important to note is that by understanding how the technique is performed within a historical context (whether Western, South African, or Central Asian), purpose can be derived. Not all cultures developed a polyphonic method of singing, but thanks to the innate versatility of the human voice, singing is universal to all human musical cultures, linking us closer across this vast world.

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