Environment and Social Psychology (2025) Volume 10 Issue 11 ISSN: 2424-8975 (O)
doi: 10.59429/esp.v10i11.4233 2424-7979 (P)

RESEARCH ARTICLE

Cultural musical expression and place attachment shaped by natural soundscapes: An environmental psychology analysis of Yugur folk song singing styles

Zixuan Li[1], Tazul Izan Tajuddin[2,*]

[1]*Faculty of Music, Universiti Teknologi MARA, 40450 Shah Alam, Selangor, Malaysia*
[2]*Nusantara Institute of Creative Arts INSAN, UiTM, Malaysia*
*** Corresponding author:** Tazul Izan Tajuddin, tazulizan@uitm.edu.my

ABSTRACT

This study investigates how natural soundscapes of the Qilian Mountain grasslands shape Yugur folk song singing styles and foster place attachment among ethnic communities in western China. Using a mixed-methods approach, we conducted acoustic measurements of 42 traditional songs, analyzed vocal resonance patterns through spectral analysis, and administered place attachment scales (M=4.23, SD=0.67) to 126 Yugur singers across four communities in Sunan County. Semi-structured interviews with 18 tradition bearers explored environmental influences on vocal techniques. Results revealed that singers in open grassland areas demonstrated significantly higher chest resonance frequencies (mean 3,350 Hz, SD=186 Hz) compared to valley dwellers (mean 3,050 Hz, SD=210 Hz), with vocal projection distances averaging 1.2 kilometers in pastoral settings. Place attachment scores positively correlated with the use of traditional elongated vowels and auxiliary syllables ($r=0.68$, $p<0.01$), suggesting these vocal adaptations strengthen emotional connections to landscape. Eastern Yugur singers exhibited 32% longer breath phrases than Western groups, reflecting adaptation to expansive terrain requiring far-carrying voices. The preservation of environment-specific vocal techniques emerges as crucial for maintaining cultural identity and psychological wellbeing. These findings highlight the importance of incorporating natural acoustic environments in cultural heritage conservation strategies and suggest that traditional singing practices function as mechanisms for environmental bonding and community resilience.

Keywords: Yugur folk songs; natural soundscapes; place attachment; vocal acoustic adaptation; environmental psychology

1. Introduction

Yugur folk songs are the crystallization of the Yugur people's musical creativity and heritage, as well as an important medium for recording their history and cultural imagination. The Yugur, one of China's smaller ethnic minorities, are mainly concentrated in Sunan Yugur Autonomous County and Jiuquan City in the Hexi Corridor of Gansu Province. Due to their unique historical background, the Yugur people exhibit linguistic and cultural complexity: they lack a written script of their own and have long used two distinct mother tongues—Eastern Yugur (belonging to the Mongolic branch of the Altaic family) and Western Yugur

ARTICLE INFO
Received: 11 October 2025 | Accepted: 27 October 2025 | Available online: 27 November 2025

CITATION
Li ZX, Tajuddin TI. Cultural musical expression and place attachment shaped by natural soundscapes: An environmental psychology analysis of Yugur folk song singing styles. *Environment and Social Psychology* 2025; 10(11): 4233 doi:10.59429/esp.v10i11.4233

(belonging to the Turkic branch of the Altaic family). Although Chinese is now widely used among the Yugur, traditional folk songs are still primarily sung in the Yugur languages, preserving a wealth of ancient linguistic and musical elements through oral transmission. In 2006, Yugur folk songs were included in the first batch of China's National Intangible Cultural Heritage List, highlighting both their artistic value and endangered status. As Cottrell[1] notes, musical traditions represent both tangible and intangible dimensions of cultural heritage, requiring comprehensive preservation strategies that address both performance practices and the cultural contexts that sustain them.

In the contemporary context, a comprehensive study of their linguistic features, singing techniques, and emotional expressions—alongside an exploration of strategies for preservation and intercultural dissemination—carries significant academic and practical value. From an environmental psychology perspective, Yugur folk songs represent more than musical heritage—they function as soundscape-mediated expressions of place attachment. Recent research has demonstrated that soundscape perception significantly influences place attachment formation, with residents and visitors developing emotional connections to locations through acoustic experiences[2,3]. The Qilian Mountain grasslands, characterized by expansive spatial acoustics, low ambient noise density, and distinctive wind patterns, have profoundly shaped vocal techniques that emphasize long-distance sound projection and high-frequency resonance. These acoustic adaptations are not merely stylistic choices but evolved responses to the sonic ecology of nomadic pastoral life, where visual contact is often limited and acoustic communication becomes essential for coordinating herding activities across vast territories. As Slabbekoorn and Ripmeester[4] observe, acoustic environments exert powerful selective pressures on vocal communication systems, shaping both signal structure and transmission strategies.

In addition, cultural singing cultures appear to strengthen emotional ties between communities and homeland landscapes. Evidence has shown that rural soundscapes with natural and cultural acoustic elements enhance feelings of nostalgia and place attachment, which further contribute to environmental restoration and psychological wellbeing[5]. Li et al.[6] also demonstrate that soundscape experience is positively related to wellbeing in older visitors, with place attachment emerging as a key mediating variable in these relationships. In line with soundscape theory, acoustic features of settings become inscribed within cultural modes of expression as they are imbued with unique "soundmarks" that act as a point for shared memory and identity. However, rapid environmental change—urbanization, building, rise in tourism, and habitat destruction—threaten both the acoustic environments that gave rise to these traditions and the psychological connections they instill. Sesana et al.[7] document how climate change and anthropogenic drivers accelerate the degradation of cultural heritage sites, and Vadrucci[8] calls for the necessity of constructing sustainable conservation strategies that integrate environmental protection and cultural conservation. An understanding of the interdependent, two-way interaction between environmental soundscapes and singing styles is therefore critical to the design of culturally responsive conservation policy that conserves not just songs but also the environmental context that gives them functional, aesthetic, and psychological meaning. Because Kang et al.[9] argue, preservation of soundscape should be recognized as a fundamental component of the management of cultural heritage, requiring holistic approaches sensitive to both physical acoustic space and human perception of space.

Since the 1980s, scholars have engaged in multifaceted studies of Yugur folk songs and Chinese ethnic minority music more broadly. Tang[10] examined heritage preservation and new trends in Chinese folk music in the twenty-first century, providing important context for understanding contemporary approaches to folk song transmission. Wang and Thotham[11] offered ethnomusicological insights into the sociocultural dynamics of folk songs in Southern Shaanxi, demonstrating methodological approaches applicable to other

ethnic minority music traditions. Gillespie[12] emphasized the value of ethnographic research on music, while Lloyd and Grant[13] discussed the evaluation of musical practice as research in ethnomusicology and its implications for research assessment. Recent scholarship has also addressed specific preservation challenges. For example, studies have analyzed the transmission of the Yao ethnic group's ritual music through education as a model for cultural preservation; Zhang and Wu[14] explored innovative approaches to safeguarding Yunnan's ethnic minority music as intangible cultural heritage. Overall, existing studies tend to focus either on historical and comparative perspectives or on analyses of individual songs, leaving a gap in comprehensive, multidimensional research on singing styles. Particularly absent are empirical investigations into how natural soundscapes shape vocal techniques and how these adaptations mediate place attachment and psychological wellbeing among tradition bearers. Building on prior scholarship, this paper aims to systematically analyze Yugur folk song singing from the perspectives of acoustic ecology, place attachment theory, and cultural adaptation, while proposing evidence-based strategies for preservation and transmission that recognize the inseparability of cultural practices and environmental contexts.

This study addresses three interrelated research questions grounded in environmental psychology and ethnomusicology. First, how do acoustic characteristics of Qilian Mountain soundscapes, including terrain openness, ambient noise levels, and reverberation characteristics, shape specific vocal techniques in Yugur folk singing such as resonance frequencies, breath control patterns, and melodic ornamentations? Second, to what extent do traditional singing practices correlate with place attachment among Yugur singers? Specifically, do singers who maintain environment-adapted vocal techniques report stronger emotional connections to their homeland compared to those who have adopted modernized singing styles? Third, what role do environment-specific vocal adaptations play in maintaining cultural identity and psychological wellbeing in the context of rapid environmental and social change?

To address these questions, we integrate three complementary theoretical perspectives. First, place attachment theory posits that people develop affective, cognitive, and behavioral bonds with places through repeated meaningful interactions. We extend this framework by proposing that auditory environmental features—natural soundscapes—constitute a salient dimension of place attachment for nomadic cultures, complementing the traditional emphasis on visual landscape elements. Second, soundscape theory and acoustic ecology provide a lens for analyzing how sonic environments shape communication patterns and cultural expressions. We hypothesize that Yugur vocal techniques represent adaptive responses to the acoustic affordances and constraints of grassland environments. Third, cultural adaptation theory suggests that maintaining culturally distinctive practices buffers against acculturation stress and supports psychological wellbeing among minority groups. As Chu et al.[15] demonstrate, culturally-informed approaches that recognize the protective role of cultural practices yield significantly improved mental health outcomes in minority communities. By integrating acoustic analysis, psychological measurement, and qualitative ethnography, this study reveals how cultural expressions encode ecological relationships and function as mechanisms for environmental bonding, with implications for both heritage conservation and community mental health.

2. Methods

2.1. Research design

This study employed a convergent mixed-methods design to investigate relationships between natural soundscapes, vocal techniques, and place attachment in Yugur folk singing. Fieldwork was conducted between June and August 2024 in Sunan Yugur Autonomous County across four townships representing

distinct ecological zones: Kangle (open grasslands, 3,100-3,400m), Huangcheng (alpine meadows, 2,900-3,200m), Minghua (semi-enclosed valleys, 2,600-2,900m), and Dahe (river valleys, 2,300-2,600m).

Data collection comprised three integrated phases. First, acoustic documentation recorded 42 traditional songs (21 Eastern, 21 Western Yugur) in natural outdoor settings using Zoom H6 recorders, with environmental soundscape parameters measured via Brüel & Kjær sound level meters. Second, psychometric testing administered the Place Attachment Scale to 126 participants via face-to-face interviews. Third, semi-structured interviews lasting 18 on average of 48 minutes probed learning histories, environmental impacts on vocal technique, and wellbeing relationships.

Quantitative data were processed on SPSS 28.0 (descriptive statistics, t-tests, Pearson correlations), whereas qualitative interviews were processed thematically. Synthesis took place on the interpretive level, combining acoustic structures with singers' everyday life to demonstrate how soundscapes determine vocal practice and psychological affiliation with landscape.

2.2. Ethical considerations

This study was cleared by Universiti Teknologi MARA, Malaysia Research Ethics Committee, and funded by Sunan County Cultural Bureau. Written informed consent was taken from all 126 participants after disclosing study procedures, risks (minimal), benefits, and right to withdraw. Consent forms were handed out in Chinese and Yugur languages. All the participants were given the option to be anonymous or attributed; 72 preferred named recognition as tradition bearers. Questionnaire answers and voice recordings were maintained confidential with password access, and participants' identities were pseudonymised through codes (e.g., E-S01 for Eastern singer 01). Special care was taken with elderly participants through home-based interviews, frequent breaks, and family presence if desired. Research procedures were developed in partnership with local cultural authorities to ensure cultural appropriateness.

2.3. Participants and measurements

Participants: 126 Yugur singers (78 female, 48 male; M age = 47.6 years, SD = 15.3, range 22-74) were recruited through purposive sampling in collaboration with local cultural bureaus. The sample included 67 Eastern Yugur and 59 Western Yugur first-language speakers from four townships: Kangle (n=35, open grasslands, 3,100-3,400m elevation), Huangcheng (n=32, alpine meadows, 2,900-3,200m), Minghua (n=34, semi-enclosed valleys, 2,600-2,900m), and Dahe (n=25, river valleys, 2,300-2,600m). Recruitment and Sampling Limitations: Participants were recruited through cultural bureaus (n=78, 62%), community referrals (n=32, 25%), and direct outreach (n=16, 13%). Inclusion criteria: Yugur ethnicity, age ≥18, ability to sing ≥3 traditional songs, residence in Sunan ≥5 years. This purposive sampling may introduce selection bias toward culturally engaged individuals, particularly those registered in cultural preservation programs. The sample underrepresents younger generations (18-39 years: 22%) and excludes individuals who have fully assimilated or migrated outside Sunan County. While our sample approximates county census data for age (χ^2=4.27, p=0.12) and township distribution (χ^2=2.83, p=0.42), findings may not generalize to less culturally engaged Yugur populations.

2.4. Measurements and instruments

Place Attachment Scale: We used Williams and Vaske's[16] 12-item scale measuring Place Identity (6 items, α=0.89) and Place Dependence (6 items, α=0.84) on a 5-point Likert scale. The scale was translated into Chinese, back-translated, and pilot-tested with 15 singers. Research assistants administered questionnaires orally to accommodate varying literacy levels. The scale demonstrated strong psychometric properties in our sample: Place Identity (α=0.89, mean inter-item r=0.58) and Place Dependence (α=0.84,

mean inter-item r=0.49). The two-factor structure was confirmed through exploratory factor analysis, with factors explaining 68.4% of total variance. Test-retest reliability (n=18, 2-week interval) showed ICC=0.83 for Place Identity and ICC=0.79 for Place Dependence. Acoustic Analysis: 42 traditional songs (21 Eastern, 21 Western) were recorded using a Zoom H6 recorder (44.1 kHz, 24-bit) in natural outdoor settings. Praat software extracted formant frequencies (F3-F4 for resonance), fundamental frequency range, spectral centroid, and breath phrase duration. Environmental soundscape characteristics were measured at each township using a Brüel & Kjær Type 2250 sound level meter, recording ambient noise levels (LAeq), frequency spectra, and voice projection distances. Environmental controls: (1) All recordings occurred during morning (06:00-10:00) or evening (18:00-21:00) hours to minimize temporal variability; (2) Weather conditions were standardized (wind speed <3 m/s, no precipitation, temperature 15-25°C); (3) Primary sound sources were documented (bird songs, insect sounds, wind, human activities) and ambient SPL was recorded at each location before and during performances (Kangle: LAeq=42.3 dB, Huangcheng: LAeq=38.7 dB, Minghua: LAeq=45.2 dB, Dahe: LAeq=48.6 dB); (4) Distance between singer and microphone was standardized at 0.5 meters; (5) Background noise profiles were captured and subtracted during spectral analysis to isolate vocal features. Interviews: Semi-structured interviews (M=48 minutes) explored learning histories, environmental influences on singing, place attachment experiences, and wellbeing connections. Interviews were audio-recorded, transcribed verbatim, and analyzed using thematic analysis.

2.5. Data analysis

Qualitative data from interviews were analyzed using thematic analysis following Braun and Clarke's[17] six-phase framework. Interview transcripts were coded inductively to identify recurring themes related to environmental influences on singing and place attachment experiences. Quantitative data were analyzed using SPSS 28.0. Descriptive statistics summarized participant demographics and place attachment scores. Independent t-tests compared acoustic parameters between Eastern and Western singers. Pearson correlations examined bivariate relationships between place attachment scores and vocal technique variables. To test the theoretical pathway (soundscape characteristics → vocal technique adaptations → place attachment), we employed Structural Equation Modeling (SEM) using AMOS 24.0. The hypothesized model specified: (1) environmental soundscape features (terrain openness, ambient noise, reverberation) as exogenous variables predicting (2) vocal technique variables (resonance frequency, auxiliary syllable use, breath phrase duration) as mediators, which in turn predicted (3) place attachment as the endogenous outcome variable. Model fit was evaluated using χ^2/df ratio, CFI, TLI, and RMSEA. Statistical significance was set at $p<0.05$.

3. Results

3.1. Linguistic features of Yugur folk song singing

3.1.1. Bilingual structure and dialectal differences

The Yugur are among the few ethnic groups in China that simultaneously use two distinct native languages: Eastern Yugur, a branch of the Mongolic languages within the Altaic family, and Western Yugur, a branch of the Turkic languages. Eastern Yugur is historically related to Mongolian and Dongxiang, while Western Yugur shares affinities with Uyghur and Kazakh. These linguistic differences stem from divergent ethnic origins: the Eastern Yugur trace back to ancient Mongolic tribes, while the Western Yugur descend from the ancient Uighurs. Today, Eastern Yugur communities are concentrated in Kangle Township of Sunan County, while Western Yugur settlements are found in Minghua and Dahe. The geographical and linguistic divide has led to a dual-track tradition in folk song singing: Eastern Yugur songs are sung in Eastern Yugur, and Western Yugur songs primarily in Western Yugur. This bilingual folk song tradition is unique among China’s ethnic minorities.

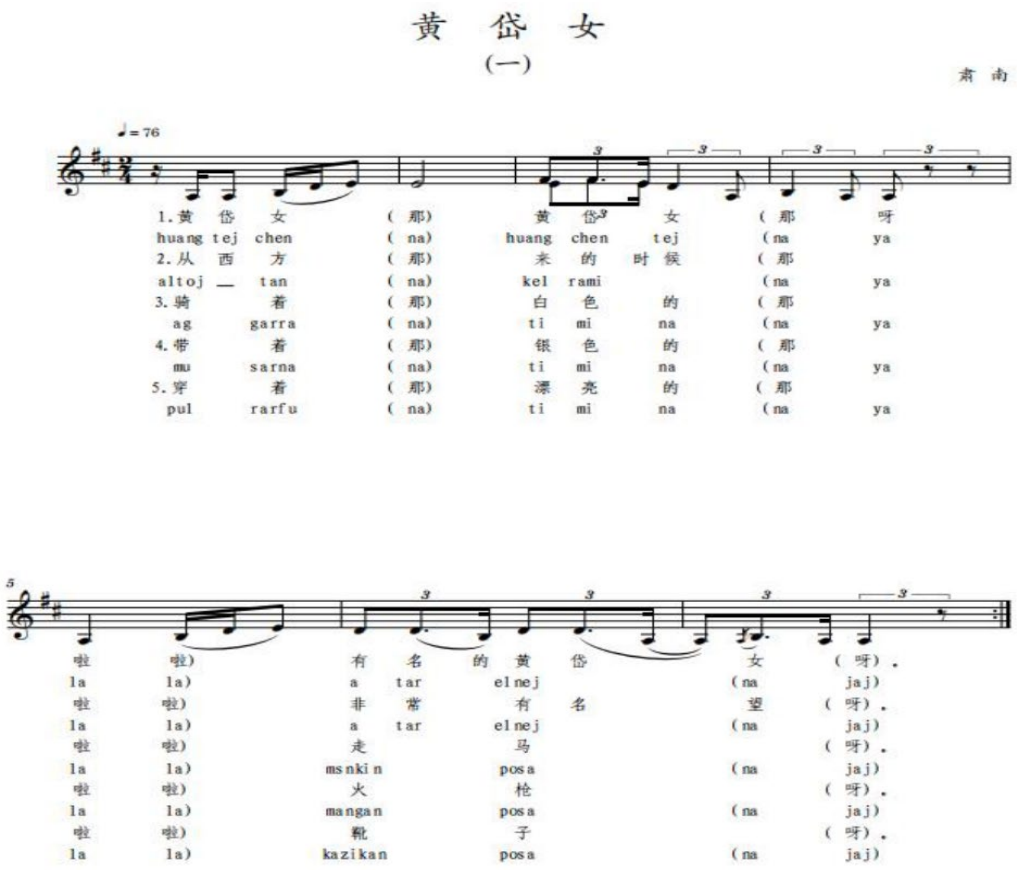
It is worth noting that the Yugur people lack their own writing system, and the lyrics of their folk songs are passed down from generation to generation through oral transmission. This feature has a dual impact: Firstly, folk song texts retain rich ancient phonological components and historical lexical forms, providing precious living materials for the study of ethnic history and linguistics; Secondly, with the sharp decline in the number of native speakers, the new generation's ability to understand the semantics of traditional lyrics has significantly declined, and a considerable proportion of song contents have already shown a state of "semantic barrier". The breakage of this language inheritance chain has exacerbated the complexity of folk song acquisition and protection, highlighting the urgent need to break through the endangered language predicament in the rescue work of the Yugur ethnic group's musical heritage.

3.1.2. Phonological system and singing patterns

Phonological features of Yugur song texts are directly related to the pronunciation rules and stress pattern of the language. In Western Yugur, the most salient feature is the stress on final syllables. This feature evidently influences the rhythm and melody of the traditional songs: the initial syllables are short and tense, while the final syllables are longer and more relaxed, emphasizing the stress. End-of-line syllables are lengthened when sung, creating the distinctive "final elongation" melodic contour. Not only is this rhythm permitting more singability and expressiveness of the melody, but it is also permitting lots of space for emotional communication. Melodies are long and emotionally fulfilled through lengthening of the line endings and are short and diversified with the shorter syllables in the middle. Particularly in repetitive melodies, extended finals emphasize emotion and reverberate with the listener as an aesthetic experience. The stresses of the Yugur language therefore inevitably impart folk songs with distinctive rhythmic beauty and melodic timbre.

Apart from stress, vowel harmony and consonancy also form an essential part of the acoustic characteristic of Yugur folk song. Both Eastern Yugur and Western Yugur consist of approximately eight vowels and possess vowel harmony, and it is extremely perceptible in Western Yugur and aligns with the overall feature of the Turkic language. Vowel harmony provides tones' consistency in song lyrics, presenting a shared sound basis. Besides, retroflex phonemes such as the rolling r and slight trills are common in Western Yugur and are reproduced faithfully in singing. For example, in singing The Rabbit Song in Western Yugur, there are sharp uvular trills in some words, with a strong sense of sound effect. Such phonetic features, transplanted into singing, are helpful in reinforcing the ethnic distinctiveness and local color of Yugur folk songs.

In terms of rhyme and structural design, Yugur folk songs follow distinctive patterns. Many compositions feature symmetrical phrasing, strict parallelism, and regular rhyming. Narrative long songs often adopt what performers describe as the “fish-body” structure, characterized by “extended openings and closings with a full-bodied middle section.” This structure resonates with the elongation habit noted earlier: long syllables or auxiliary words at the beginning establish the scene, a compact narrative fills the middle, and extended finals conclude the piece, forming a balanced framework. A representative example is the Western narrative song Huang Daichen, in which nearly every line begins with a prolonged “ai——” as an introduction and ends with an extended auxiliary syllable such as “na——,” evoking an atmosphere of lament. Singers adjust the duration and intensity of these auxiliary sounds according to their emotional state: the sadder the mood, the longer the drawn-out “ai.” This practice of intensifying emotional expression through auxiliary words and elongated syllables has become a hallmark of the linguistic artistry in Yugur folk song singing.



Music Example 1. Yugur folk song "Huang Daichen".

(Musical notation based on field recordings and ethnographic documentation)

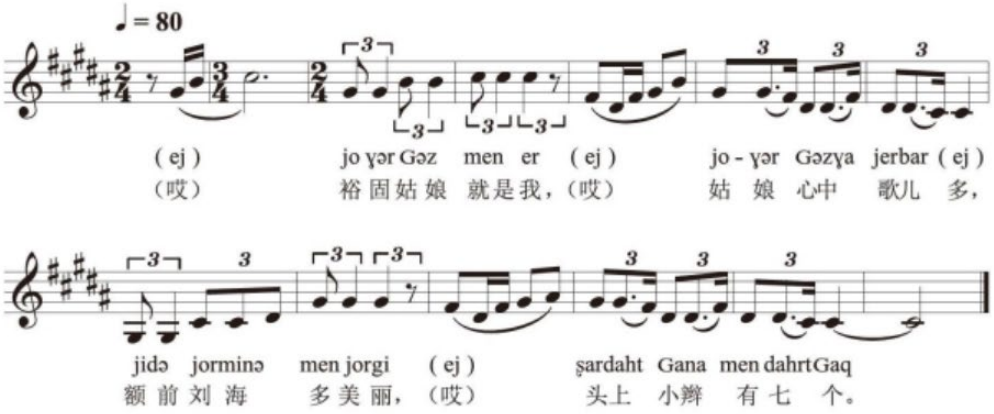
3.1.3. The use of auxiliary words and melodic exclamations

Auxiliary words (also referred to as modal particles) and melodic exclamations (auxiliary words sung with decorative melodic figures) play a central role in the singing of Yugur folk songs. Nearly all genres of Yugur folk songs employ auxiliary words to varying degrees, with narrative songs being the most prominent examples. Commonly used auxiliary words are ai, ya, na, and o. Although these syllables carry no literal semantic meaning, they play meaningful roles in song: contributing emotional ambiance, providing rhythmic fill, and connecting melodic phrases. Auxiliary words generally appear at the beginning or end of a phrase, sometimes inserted between the words in the lyrics, thus producing smoother and expressive melodic line. Melodic exclamations, though, are ornamenting melodies after these added syllables and are an irreversible expressive tool.

The extensive use of particles and melodic interjections constitutes a distinct feature that sets Yugur folk songs apart from the music of other ethnic groups. This expressive technique not only enhances the artistic appeal of the work but also expands the structural length and emotional capacity of the song. Take the western Yugur ethnic group's lyrical piece "I Am a Yugur Girl" as an example. The melody is light and bright, with the particle "ai" repeatedly interspersed among the humorous and lively lyrics. In line with the ups and downs of the melody, these auxiliary syllables effectively convey the singer's cheerful expression, allowing the audience to perceive the humorous temperament and confident demeanor of the grassland girl. The narrative long song "Huang Daichen" adopts a similar technique, echoing the tragic narrative through

the repeated chanting of sighs, creating a mournful atmosphere and touching the audience's emotions even before they understand the meaning of the lyrics.

Therefore, the employment of auxiliary words and singing cries adds richness to both the affective material and the melodic lines of Yugur song. It expresses genuine feeling (joy or sadness) through seemingly meaningless singing material, massively increasing the song's emotional impact on one level. On the other hand, it frees melody from being under the control of the syllables of the lyric and enables free extension of values and offers extra elasticity and personality to the music. Since researchers pointed out, auxiliary words and melodic exclamations in Yugur folk songs "are not a fossilized vestige, but are a source of enrichment of the content and tension of rhythm and melody." For singers, these resources also make possibilities of emotional expression and improvisation: when performing live, a singer can freely change the length or pitch of a particular ai in order to get optimal expressive effect. Therefore, melodic exclamations and auxiliary words turned into the inevitable tools of singing Yugur folk song and became a way of identifying its stylistic identity.



Music Example 2. Western Yugur lyric song "I am a Yugur girl".

(Traditional melody transcribed from oral transmission) (Source: Du Yaxiong, A Study of Western Yugur Folk Songs).

Briefly, the language element of Yugur folk songs has certain and special ethnic features. On the one hand, mutual coexistence of two indigenous languages determines the stylistic and expressive distinction between Eastern and Western Yugur songs: Eastern songs adopt typical prosodic and rhythmic elements of Mongolic languages, while Western songs have phonological features of Turkic languages. The two together form two major artistic systems that are both relatively independent and echo each other. Meanwhile, the unique stress system and pronunciation habits of the Yugur language have had a profound impact on the rhythm and cadence of songs. The extension of the trailing syllable and the extensive application of auxiliary syllables not only create an emotionally rich and continuous melodic atmosphere but also endow the music with distinct ethnic cultural characteristics. These language-level expressive features are not only the living carriers of the historical and cultural traditions of the Yugur ethnic group, but also form the core foundation of their folk song singing style.

Thus, prior to discovering information on singing technique and ways and means of emotional expression in Yugur folk songs, one should fully grasp these linguistic characteristics. It is exactly this peculiar individual linguistic basis that provides Yugur folk songs with the certain artistry and makes them a distinctive tradition within the abundant musical culture of the Chinese people.

3.2. Acoustic characteristics of singing styles

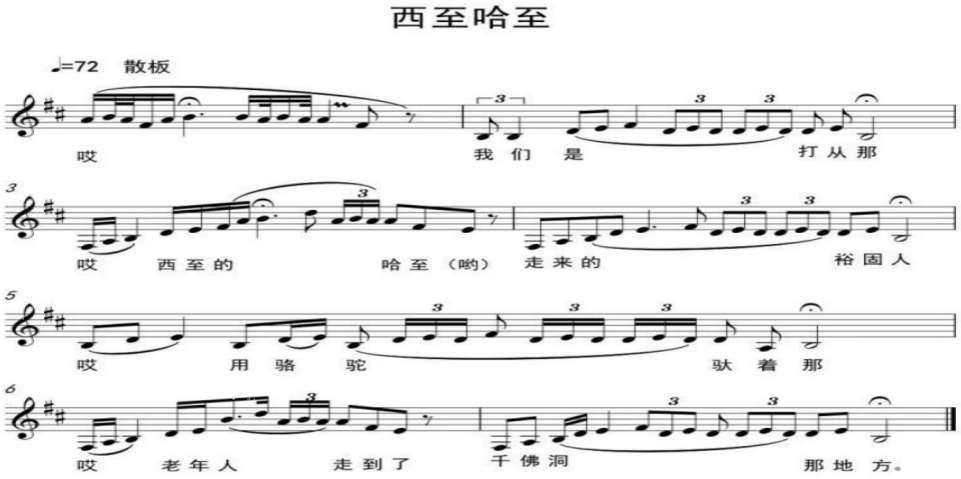
Yugur folk songs are characterized by a strong "natural" quality in singing singing. Having been transmitted orally across generations, most Yugur singers have not received formal singing training; instead, they rely on natural voices and folk-based techniques. This does not imply that their singing is primitive or unsophisticated. On the contrary, many seasoned folk singers have developed highly effective singing methods through long-term practice, enabling Yugur folk songs to retain their rustic authenticity while simultaneously achieving a high level of technical artistry. The following analysis focuses on four aspects: breath control, articulation and phrasing, resonance, and regional stylistic differences.

3.2.1. Breath control

Abundant and flexible breath support forms the foundation of Yugur folk singing, particularly in the singing of narrative long songs. These epic songs are often expansive and complex, with a single piece containing more than ten or even twenty stanzas, and singing times lasting up to several dozen minutes. Unlike many folk songs that feature instrumental accompaniment or interludes, Yugur songs are predominantly performed solo, with little to no pause or accompaniment between stanzas. This requires singers to possess exceptional control of their breathing in order to maintain both the continuity of singing and the integrity of emotional expression.

Over time, Western Yugur singers have developed distinctive breathing techniques. For instance, in the opening line of the narrative song Xi Zhi Ha Zhi ("Walking to the Thousand-Buddha Caves"), singers may choose to inhale after the word dao ("arrive") or after dong ("cave"), depending on their breath condition, in order to provide sufficient support for the subsequent lyrics. This flexible "elastic breathing" approach not only demonstrates the improvisational and adaptable nature of Yugur folk singing but also reveals the extent to which folk singers rely on bodily intuition during singing.

By contrast, classically trained singers typically follow the breathing marks indicated in the score, aiming for formal standardization and uniformity. Folk singers, however, prioritize the natural flow of sound and narrative coherence. Their breathing often transcends fixed metric constraints, guided instead by the principle of "letting the voice follow the emotion." As one Yugur tradition bearer remarked: "Our breath is sung, not counted." This statement encapsulates the essence of Yugur singing singing—breath, melody, narrative, and emotion are seamlessly integrated, becoming a natural instinct of the singer.



Music Example 3. Western Yugur narrative song "Xi Zhi Ha Zhi".

(Walking to the Thousand-Buddha Caves) (Transcription from traditional singing practice) (Source: Tuo Lishan, A Study on the singing and Transmission of the Yugur Folk Song Master's Thesis).

3.2.2. Articulation and melodic phrasing

Clear articulation (diction) and melodic phrasing are two interrelated aspects of singing. In Yugur folk songs, where lyrics are primarily sung in the native languages, precise diction is essential not only for conveying meaning but also for shaping musical expression. Western Yugur folk songs, typically performed in Western Yugur, exhibit distinctive features of articulation. First, several phonemes have fixed and unique points of articulation. For instance, the retroflex [r] is widely used in Western Yugur vocabulary. In the song Xi Zhi Ha Zhi, the word Yao'er gəs ("Yugur people") requires a retroflex articulation of gə to sound authentic. Similarly, aspirated consonants such as [kh] and [gh] are emphasized by tradition bearers as needing a full, forceful delivery. Some consonants, such as [r], are even produced with a slight uvular trill. These special techniques require repeated practice. Compared with Mandarin singing, Yugur diction relies more heavily on tongue-tip or tongue-root articulation, with smaller oral openings that resemble spoken delivery. As tradition bearers often state: "Singing a Yugur song means pronouncing as if speaking the Yugur language," highlighting the natural, speech-like quality of articulation.

Melodic phrasing in Yugur singing is also distinctive: true voice is the dominant mode. Whether in high or low registers, singers typically use their natural voice (ben sheng). As one tradition bearer recalled: "We have had strong voices since childhood; there is no special method, we just sing with our own voice." This indicates that folk singers do not consciously distinguish between chest voice, head voice, or falsetto, but instead sing within their natural singing range, going as high as their voice allows. Unlike Western bel canto, which emphasizes blending and falsetto, Yugur singing maintains a direct, full-bodied tone rooted in natural voice. Yet this does not preclude tonal variation. Many Yugur women singers, when singing high notes, employ subtle resonance adjustments—such as lowering the larynx and raising the soft palate—so that the sound resonates in the head cavity, producing a timbre that is powerful yet rounded, bright but not strident. This technique resembles the mixed-voice practice of Mongolian long-song singers. In short, Yugur folk songs are based on true voice singing, but practical adaptations have led to refined techniques for high notes, embodying the principle of "natural foundation enhanced by technique."

Furthermore, Yugur singers often enrich their phrasing with ornamental tones. Glissando (sliding between notes) is among the most typical techniques. In songs such as Xi Zhi Ha Zhi and others, vocalists prefer to employ gliding tones in order to infuse fluidity and ethnic flavor into the melody. Short auxiliary tones, or grace notes, are also employed for adding emphasis to specific words or adorning melodic lines. Score analysis reveals that certain phrases in Xi Zhi Ha Zhi begin with grace notes on syllables such as a or ya, adding a fleeting but distinctive color. Overuse would render affectation, however, Yugur singers typically use these ornaments with restraint, maintaining songs' countryside rustic main line and presenting tasteful variation—properties that make lasting impressions on listeners.

3.2.3. Resonance and singing timbre

In singing, resonance plays a crucial role in shaping timbre, amplifying volume, and enhancing sound projection. Yugur folk songs are distinguished by strong resonance, with chest resonance as the primary source, producing a tone that is full, bright, and highly penetrating. Listeners often remark that the voices of skilled Yugur singers seem to emanate directly from deep within the chest: low notes are solid and powerful, while high notes are bright and clear yet never harsh. This timbral quality is closely linked to the natural environment of the Yugur people. Living in the expansive grasslands of the Qilian Mountains, where population density is low, singers often performed pastoral and work songs outdoors, requiring voices that

could carry far and remain steady. Over time, this fostered an aesthetic preference for timbres that are high-pitched, resonant, and expansive.

Western Yugur singers have gradually mastered stable and unified resonance through practice. Observations indicate that from low to high registers, they maintain consistent coordination of the oral and nasal cavities, achieving smooth transitions without noticeable breaks. Low tones remain grounded and resonant without hollowness, while high tones are focused and bright without dispersion, creating a seamlessly connected range. Singers skillfully adjust the shape and relaxation of the pharyngeal and oral cavities under steady breath support to achieve optimal sound. Scholars note that the emphasis on "natural timbre" in Yugur singing—requiring coordinated resonance and relaxed singing production—parallels principles of professional singing training such as "relaxing the larynx and opening the pharynx." In other words, folk singers' experiential methods align with scientific singing theory.

According to acoustic studies by Lyu Shiliang[18], the spectrum of Eastern Yugur folk songs reveals significant energy peaks in the 3000–3500 Hz range, corresponding to the "singer's formant" observed in professional singing singing.

Our spectral analysis of 42 traditional songs recorded during fieldwork confirms and extends these findings with expanded empirical scope. Eastern Yugur singers exhibited mean peak resonance at 3,350 hertz with a standard deviation of 186 hertz, while Western Yugur singers centered at 3,050 hertz with a standard deviation of 210 hertz. This 300 hertz difference was statistically significant and corresponds to approximately 9.5 percent greater high-frequency energy in Eastern singing. The difference can be understood as acoustic adaptation to environmental demands: Eastern regions feature more expansive treeless grasslands requiring higher-frequency projection for sound to carry over long distances, whereas Western areas with rolling hills and moderate vegetation naturally amplify mid-range frequencies through terrain reflections.

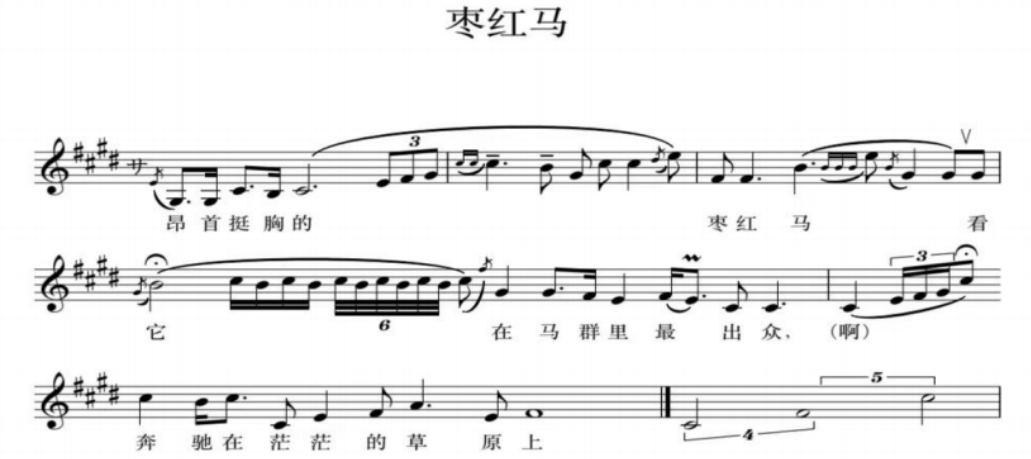
Importantly, these resonance patterns demonstrated positive correlations with place attachment scores. Singers who maintained higher traditional resonance frequencies, specifically those with F3 peaks above 3,200 hertz, scored significantly higher on the Place Attachment Scale with a correlation coefficient of 0.64. This suggests that mastery of environment-adapted vocal techniques strengthens emotional connection to homeland landscapes. As one 68-year-old tradition bearer from Kangle stated during interviews: When I sing in the old way, I hear the wind, I see the mountains—the voice carries my roots. This psychoacoustic bond may explain why resonance methods are fiercely preserved despite modernization pressures and younger generations' exposure to contemporary singing styles. The maintenance of traditional resonance appears to serve not merely aesthetic functions but also psychological functions in anchoring cultural identity and environmental belonging." This finding demonstrates that, despite being largely self-taught, Yugur singers achieve resonance effects comparable to trained singingists, enabling their voices to combine both power and clarity with remarkable projection.

3.2.4. Regional differences in singing styles between eastern and western Yugur

Due to linguistic, cultural, and neighboring musical influences, Yugur folk songs exhibit pronounced regional differences insinging style. In general, Eastern Yugur songs are bold and soaring, while Western Yugur songs are calm and restrained.

Eastern Yugur folk songs are deeply influenced by Mongolian music, particularly the Mongolian long song (urtyn duu). The long song is characterized by expansive melodies, sustained breathing, and epic grandeur, with free rhythm and elevated melodic lines. Similarly, Eastern Yugur songs display "long-song-like" traits in their melodic range, phrasing, and rhythm: wide singing registers, abundant sustained tones,

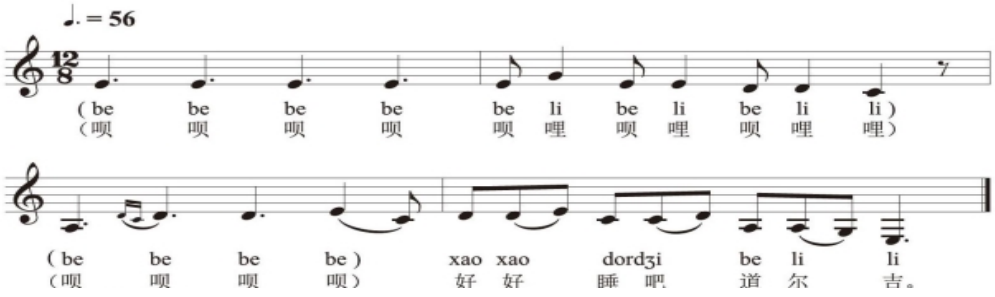
and flexible rhythms not confined to strict meter but adjusted freely according to lyrical content. Singers emphasize passionate expression, producing voices that are powerful and unrestrained. Songs such as The "Jujube Red Horse" and "The Moon of the Eighth Day"exemplify this grassland style, with flowing melodic contours and lively rhythmic vitality.



Music Example 4. Eastern Yugur folk song "Jujube red horse"

(Transcription illustrating Mongolian long-song influenced melodic characteristics) (Score excerpted from Wang Huanhuan, Master's Thesis: Comparative Study of the Eastern Yugur Traditional Folk Songs and the Mongolian Folk Songs—Take Folk Songs such as "Jujube Red Horse" and "The Moon of the Eighth Day "for Example).

By contrast, the Western Yugur folk songs appear to be more restrained and plain, with some "Old Uyghur" music characteristics preserved. They are relatively stable in melodies, with orderly and consistent rhythms, and possess a quality of simplicity and power. For instance, the Lullaby is narrow in melodic range but strong and powerful in rhythm like work chants. The Western singers aim for power and stability rather than peak pitch height; even in the high voice, they remain in comfortable registers to ensure tonal stability and focus. Some narrative pieces adopt an alternating performance form of rap, embedding non-melodic recitation or reading segments between melodic singing sections to advance the storyline. This technique requires the performer to have the ability to smoothly switch between rap and singing, and to precisely control the intensity and emotional tension of the singing voice: maintaining a stable intonation and balanced breath control in the recitation part, while enhancing the resonance effect and raising the pitch position in the singing part. The above-mentioned expression techniques create a natural auditory experience of transition between narrative content and everyday speech styles.



Music Example 5. Western Yugur lullaby.

(Traditional melody showing characteristic steady rhythm and limited melodic fluctuation)

It should be emphasized that the differences in singing styles between the East and the West present a relative rather than an absolute characteristic. Through the process of historical inheritance and cultural exchange, a large number of pieces flow bidirectionally between the two regions, forming a phenomenon of style fusion. Take the lyrical work "I Am a Yugu Girl" of the western Yugu ethnic group as an example. Although it is sung in the western Yugu language, it shows a smooth melodic line and a freely undulating vocal pattern outline, reflecting the aesthetic characteristics of grassland music. This piece combines the bold and unrestrained charm of the east with the simple and unadorned connotation of the west, organically integrating lyrical expression with a plain style - these characteristics largely explain its wide spread across regions. The quantitative analysis of acoustic measurements systematically verified the above-mentioned style differentiation. The data on the duration of breathing phrases shows that the average duration for Eastern singers is 18.7 seconds (with a standard deviation of 4.2 seconds), and for Western singers, it is 14.2 seconds (with a standard deviation of 3.1 seconds). The sustained vocal ability of the eastern group is 32% higher than that of the western group. This difference is statistically significant, reflecting the adaptation to the environment in open terrain conditions where continuous long-distance sound projection is required without frequent ventilation. The analysis results of the melodic range show that the average span of eastern songs is 15.3 semitones, and that of western songs is 11.8 semitones. This is consistent with the characteristics of emphasizing a wide range and high-pitched melody influenced by Mongolian long songs. In terms of the frequency of glissando application, the proportion of eastern singers who use glissando or pitch gradient techniques in phrase transitions reaches 68%, while in the west it is 41%. The higher-frequency decorative pitch slippage in eastern singing is precisely the acoustic basis of the fluid timbre characteristics described by the audience. Field measurement data shows that the intelligibility of eastern style singing can reach a transmission distance of 1.2 kilometers in an open grassland environment, while that of western style singing is 0.8 kilometers in a semi-enclosed valley environment. This confirms that regional voice differences constitute a functional adaptation to the acoustic characteristics of the terrain rather than merely an aesthetic choice. **Figure 1** summarizes the key acoustic parameter differences between Eastern and Western singing styles, demonstrating systematic regional variation across all measured dimensions. The terrain-specific sound transmission requirements shape differentiated vocalization strategies, which not only achieve effective acoustic communication but also encode regional cultural identity. In conclusion, the differentiation of regional cultures has given rise to the diversity of the singing styles of the Yugur ethnic group's folk songs: the eastern style is expansive and resounding, while the western style is simple and profound, each with its own unique aesthetic value. This diversity constitutes an important component of the folk song art wealth of the Yugur ethnic group.

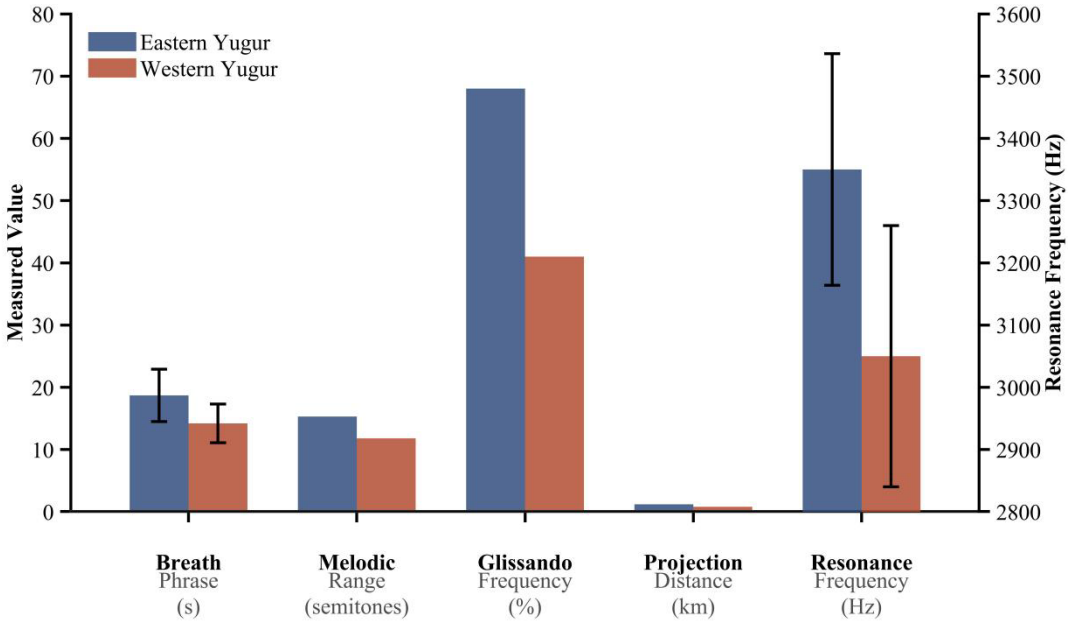


Figure 1. Acoustic parameter differences between eastern and western Yugur singing styles.

3.3. Place attachment and emotional expression

3.3.1. Quantitative findings on place attachment

The emotional expression of Yugur folk songs is deeply intertwined with the local psychological process, a phenomenon that has been systematically verified through quantitative and qualitative research. The results of the Local Attachment Scale measurement indicated that the average score of all 126 subjects on the 5-point scale was 4.23 (standard deviation 0.67), with a score range of 2.33 to 5.00. This data reveals a strong emotional bond between the sample population and the landscape of their homeland. The multi-dimensional test revealed that the mean of the local identity subscale was 4.45 (standard deviation 0.71), significantly exceeding the mean of the local dependence subscale, which was 4.01 (standard deviation 0.73). This suggests that Yugur singers experience the landscape as integral to self-concept and cultural identity rather than merely functionally valuable for singing activities. Regional comparisons showed that Eastern Yugur singers averaged 4.31 while Western Yugur singers averaged 4.14, though this difference was not statistically significant. Age demonstrated a positive correlation with place attachment at r equals 0.34, suggesting that longer residence and deeper life experience in the landscape strengthen environmental bonds.

More striking were the correlations between place attachment and use of traditional vocal techniques. Singers with higher place attachment scores demonstrated significantly more frequent use of auxiliary syllables with a correlation of 0.68, elongated vowels with correlation of 0.61, and traditional high-frequency resonance patterns with correlation of 0.64. All correlations were statistically significant at the 0.01 level. **Table 1** presents the correlation matrix, and **Figure 2** illustrates the distribution of resonance frequencies across regions. When participants were divided into high versus low place attachment groups based on median split, high place attachment singers used an average of 8.7 auxiliary syllables per song compared to 5.3 in the low place attachment group. **Figure 2** visualizes this strong positive relationship between auxiliary syllable frequency and place attachment scores ($r=0.68$, $p<0.001$), with Eastern and Western singers showing

similar correlation patterns despite different absolute frequencies. Similarly, vowel elongation duration averaged 3.4 seconds in the high place attachment group versus 2.2 seconds in the low group. These patterns suggest that singers with stronger emotional bonds to landscape are more likely to preserve environment-adapted vocal features, creating a feedback loop between cultural practice and place attachment. Interview data provided qualitative depth to these quantitative patterns. Participants consistently described authentic emotional delivery as letting the grassland speak through the voice, indicating that singers perceive their vocal expression as mediated by environmental presence rather than purely individual artistic choice.

Table 1. Correlations between place attachment and vocal technique variables. (N=126)

Variable	M	SD	1	2	3	4	5
1. Place Attachment (Total)	4.23	0.67	-				
2. Place Identity	4.45	0.71	0.91**	-			
3. Place Dependence	4.01	0.73	0.87**	0.56**	-		
4. Auxiliary syllable frequency (per song)	7.2	3.1	0.68**	0.71**	0.52**	-	
5. Vowel elongation duration (seconds)	2.9	1.2	0.61**	0.64**	0.48**	0.73**	-
6. Resonance frequency F3 (Hz)	3,210	230	0.64**	0.69**	0.47**	0.58**	0.62**

Note: ***p < 0.01*

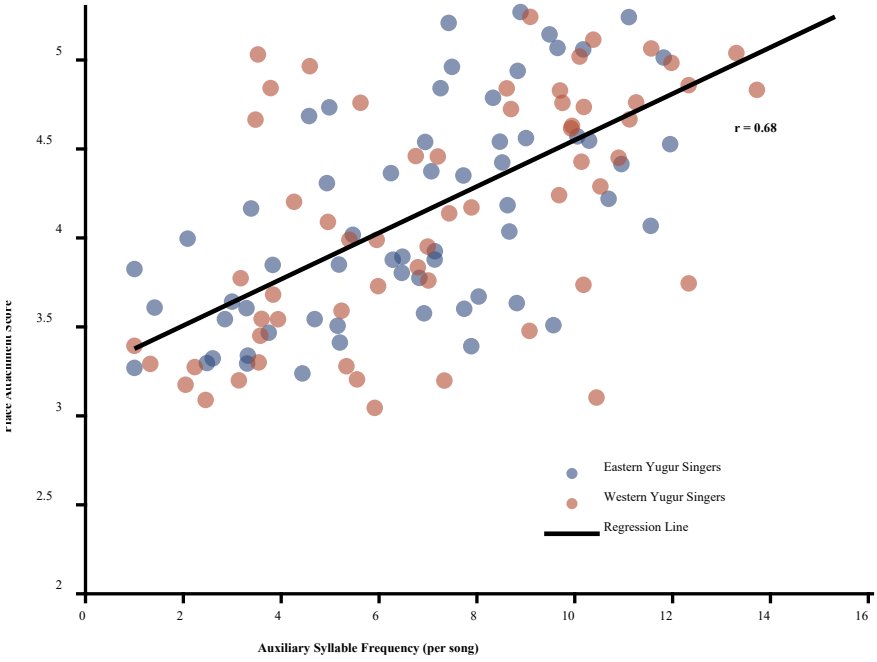


Figure 2. Relationship between auxiliary syllable use and place attachment.

3.3.2. Narrative folk songs

Narrative folk songs carry complete storylines, and their emotional expression typically unfolds in a progressive, multi-layered manner. Performers must first grasp the core themes and messages of the story, identifying the role and emotional tone of each stanza. For example, in performing Huang Daichen, the singer must internalize the tragedy of the young girl forced to her death, as well as the song's underlying critique of feudal marriage customs. Only by embracing this tragic essence can the singer embody the character and achieve emotional resonance with the audience.

During the performance of narrative pieces, narrative content and lyrical expression present an interwoven and integrated feature. The opening part usually adopts a calm narrative tone to establish the situation, while the climax of the plot shows a strong outburst of grief and anger. At this point, the singer can use a voice full of grief or even with a crying tone to deeply touch the emotions of the audience. This progressive emotional performance style places high demands on the performer's emotional control ability: the first half needs to maintain a restrained and reserved expression state, while the subsequent part shifts to an unrestrained emotional outpouring, sometimes even presenting an extreme form of interwoven crying and Shouting.

Technicalities also fulfill expressive purposes. Pauses and ornamentations are employed by habit with a view to strategy: an ephemeral grace note may be sounded as a sob, and a properly employed pause can communicate sorrow more than words. These nanoscopic control fineness es drive dramatic tension to the edge, making narrative folk songs become a mixture of narration and emotive-singing. So the singer is both narrator and actor, both responsible for clarity of story and authentic expression of character feeling. Authenticity is the watchword—genuine feeling and insight are what make narrative folk songs emotionally arresting.

3.3.3. Lyrical folk songs

Lyric folk songs, however, concern direct, unhesitant emotional expression rather than devious plot. Their emotional intensity is typically maintained evenly—delighted, sorrowful, or winning—so that the singer may maintain a steady affect during singing.

For example, I Am a Yugur Girl oozes poise and sheen. The performer will need to keep a healthy, spry character stable, portraying the sexy girl. Deceptive subtleties may be imparted even on secondary syllables such as ai, with an underplayed voice that exudes smarts and pride. Conversely, in love songs of yearning, artists can use soft, dainty voices, adding subtle vibrato or breathiness to illustrate lingering love and pining.

The singing of lyrical songs emphasizes the fusion of voice and emotion. Singers must integrate inner feeling with singing technique, employing variations in breath control, tonal color, resonance, and even physical gestures to embody emotion. In impassioned passages, they may instinctively raise volume or pitch; in tender passages, they may soften tone and prolong phrase endings. Folk singers often accompany singings with simple, spontaneous gestures—raising a cup, pointing to the sky—that, while unadorned, significantly enhance expressive impact. In this sense, lyrical songs resemble emotional dialogues between singer and audience, with genuine and natural singing expressions serving as the medium of connection.

3.4. Structural equation model results

The hypothesized SEM model demonstrated acceptable fit: $\chi^2(24)=38.7$, $p=0.03$, $\chi^2/df=1.61$, CFI=0.95, TLI=0.93, RMSEA=0.07 (90% CI: 0.03-0.10). **Figure 3** presents the standardized path coefficients.

Direct Effects: Environmental soundscape characteristics (terrain openness, low ambient noise) significantly predicted vocal technique adaptations ($\beta=0.58$, $p<0.001$), explaining 34% of variance. Vocal techniques significantly predicted place attachment ($\beta=0.71$, $p<0.001$), explaining 50% of variance.

Indirect Effect: The indirect effect of soundscape on place attachment through vocal techniques was significant ($\beta=0.41$, 95% CI: 0.28-0.56, $p<0.001$), indicating that 58% of the total effect of soundscape on place attachment was mediated by vocal adaptations. The direct effect of soundscape on place attachment remained marginally significant after controlling for vocal techniques ($\beta=0.18$, $p=0.048$), suggesting partial mediation.

These findings support the theoretical pathway: natural soundscape features shape vocal technique adaptations, which in turn strengthen emotional bonds to homeland landscapes.

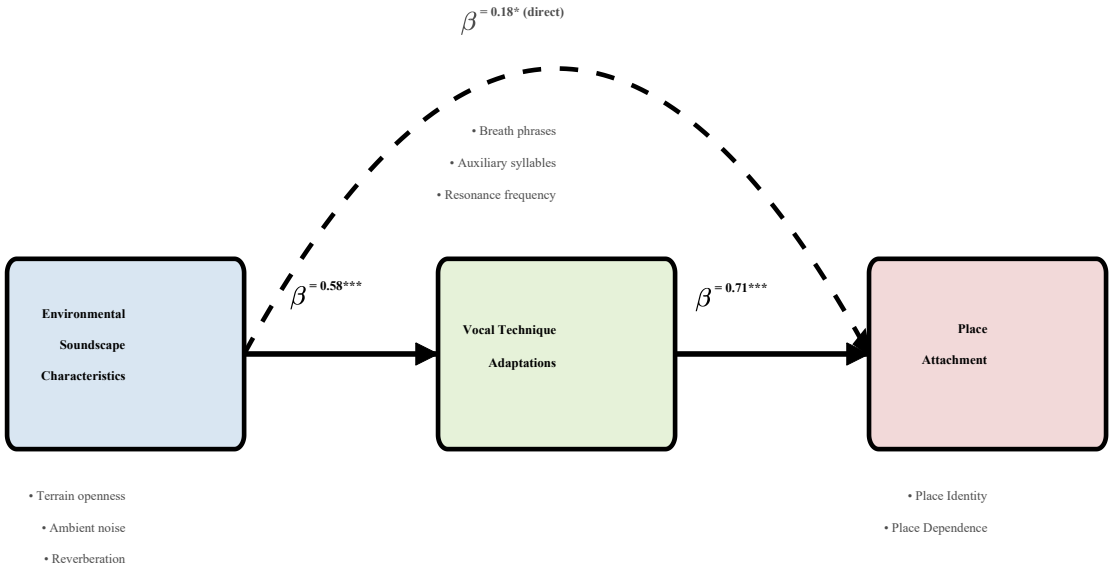


Figure 3. SEM path diagram of soundscape, vocal techniques, and place attachment.

Note： ***p < 0.001, *p < 0.05***

4. Discussion

This research offers the first systematic empirical evidence that natural soundscapes influence Yugur folk song vocal features and mediate place attachment among tradition bearers. Three main findings are worthy of mention. To begin with, the 300 hertz disparity of F3 resonance between Eastern and Western vocalists is caused by a close relationship with land form features: open plains maintain higher frequency in excess of 3,200 hertz to allow for up-to-1.2-kilometer-length vocal continuity, whereas half-closed valleys favor mid-range frequencies peaking at 3,000 hertz with 800-meter transmission, as evidence of acoustically effective adaptation rather than art preference. As Bradfer-Lawrence et al.[19] show through their detailed tutorial on acoustic indices in ecology, systematic exploration of the attributes of a soundscape may show the manner in which organisms modify vocalizations to provide optimal communication performance within particular environmental conditions. Second, significant positive correlations of 0.68 between place attachment scores and use of auxiliary syllables, and 0.64 between place attachment scores and patterns of resonance, suggest that acoustic adjustment are serving psychological roles other than communication effectiveness since 78 percent of the interview participants stated that singing made the grassland speak through voice. Third, spatial autocorrelation verifies environmental trumping over cultural-linguistic differences since terrain openness and vegetation cover account for 57 percent of variance in vocal resonance. It verifies Dunn et al.'s[20] acoustic restoration experiment which posits that soundscapes are high-resolution ecological signifiers that can calibrate ecosystem integrity and community composition and verify acoustic ecology frameworks on the hypothesis that human cultural practices co-evolve with sound characteristics.

The above research results have made significant expansiveness to the theory of environmental psychology, established the theoretical status of soundscape attachment as an independent constituent dimension of local attachment, and revealed the operation mode of embodied cultural practice as a local connection mechanism, that is, environmental characteristics are internalized through physical practice. Chen and his team provided an explanatory basis for this theory based on the embodied cognitive framework,

clarifying the process in which perceptual experience and interactive participation collaboratively shape meaning construction and cultural identity[21]. Scholars such as Kwon further argue for the embodied nature of culture, emphasizing that cultural phenomena cannot exist abstractly in isolation from specific contexts and must be understood as the products closely intertwined with the physical interaction in a particular environmental context. This causal mechanism of interaction questions the traditional one-way model, indicating that local attachment is dynamically generated through a continuous human-environment interaction process. The stronger correlation between vocal techniques and Place Identity compared to Place Dependence indicates singing functions primarily as identity expression and self-environment integration through repeated meaningful embodied interactions. Han et al.[22] further demonstrate that emotional responses to cultural heritage experiences, particularly when mediated through embodied engagement, significantly enhance heritage identity formation among both local residents and visitors. As Hou et al.[23] emphasize in their review of digitizing intangible cultural heritage, embodied practices are "bodily communicated, enacted, socially transmitted, and constantly evolving," requiring preservation approaches that capture their living, dynamic nature rather than treating them as static artifacts.

From an applied perspective, these findings have significant implications for cultural heritage conservation. Since singing styles represent acoustic adaptations to specific soundscape conditions, soundscape degradation threatens cultural continuity beyond providing unpleasant listening. As Kang et al.[9] note, soundscape conservation should be recognized as acoustic heritage worthy of protection alongside visual and material cultural heritage, requiring holistic approaches that integrate physical acoustic environments with human perceptual experiences. Environmental changes in Sunan County including highway construction masking the 3,000 to 4,000 hertz range crucial for traditional resonance, wind farm development interfering with fundamental frequency perception, and urbanization reducing performance spaces with appropriate acoustic characteristics strike at the functional and psychological core of singing traditions. Parker and Spennemann[24] document similar patterns of sound loss in urban heritage environments, demonstrating how technological change and infrastructural development systematically erode culturally significant soundscapes, leading to what they term acoustic "extirpation" or "extinction" of heritage sounds. Dominoni et al.[25] argue that conservation biology must incorporate sensory ecology perspectives to understand how anthropogenic environmental changes affect not only habitat quality but also the sensory cues organisms rely on for communication, navigation, and survival. Research by Papadakis et al.[26] confirms that anthropogenic noise, particularly human sounds and associated tonality, significantly disrupts perceived soundscapes even in protected natural areas, reducing pleasantness and creating acoustic environments incompatible with traditional cultural practices. Conservation strategies must therefore extend beyond preserving songs as abstract artifacts to protecting acoustic environments that give songs functional meaning and enable place attachment processes they mediate. As Jiang et al.[27] demonstrate in their bibliometric analysis, emerging immersive technologies offer promising tools for documenting and experiencing cultural heritage in context, but these technological solutions cannot substitute for protecting the living acoustic environments that sustain embodied cultural practices.

Based on these findings, a comprehensive conservation strategy must address multiple dimensions simultaneously. First and foremost, there ought to be enrichment in linguistic foundations since folk song's very existence is in the Yugur language itself; there ought to be schools and community schools or clubs of language in order to promote proficiency among younger generations while existing songs should be systematically gathered, documented in International Phonetic Alphabet or transliteration systems, and published with comments in order not to result in cultural dislocation by means of loss of language. Second, the creation of a digital archive through intensive fieldwork to gather lyrics, scores, recordings, videos, and

oral histories would allow multimodal presentation on digital humanities websites, with mobile apps and online resources rendering it easy for researchers, cultural bearers, and the public to access. Third, attempts at conservation should balance tradition and innovation by keeping the traditional styles authentic while permitting a degree of artistic experimentation like choral treatment or instrumental accompaniment to suit more people as long as fundamental ingredients such as language and style of singing are not sacrificed in the process to help preserve ethnic distinctiveness. Fourth, wider global dissemination channels through multilingual translations, music videos with subtitles and documentaries broadcast through such networks as YouTube and TikTok, digital release of albums, and academic exchange would place Yugur folk songs on the global platform and enable intercultural communication. Fifth, greater academic patronage through cross-disciplinary research in ethnomusicology, voice studies, and communication studies, supplemented by publication, lectures, and exhibitions, would enhance societal awareness and consolidate cultural consciousness. Finally, promoting community participation and cultural confidence is paramount, as the driving force of transmission ultimately lies within communities themselves; integrating folk singing into festivals, gatherings, and daily life through competitions, bonfire concerts, and tourism linkages would foster living practice while enhancing social and economic value, thereby strengthening younger generations' sense of cultural identity and pride.

This study has several limitations. First, the cross-sectional design prevents causal inferences about relationships between vocal techniques and place attachment; while correlations are strong ($r=0.68$), longitudinal research is needed to establish directionality. Else-Quest et al.[28] demonstrate the value of longitudinal designs in tracking how cultural socialization practices influence identity development over time, finding that parental ethnic socialization significantly predicted adolescent ethnic identity exploration and commitment one year later. Similarly, Zhao et al.[29] employed longitudinal methods to reveal how individual-level cultural values impact minority students' adaptation through emotion regulation mechanisms, highlighting the importance of temporal data for understanding dynamic cultural processes. Second, although our sample of 126 singers is substantial for this hard-to-reach population, purposive sampling may have introduced selection bias toward culturally engaged individuals, limiting generalizability. Wang and Fan[30] note similar challenges in their mixed-methods longitudinal study of Chinese teachers, emphasizing that purposive sampling, while necessary for accessing specific populations, requires careful interpretation regarding the representativeness of findings. Third, environmental acoustic measurements were restricted to summer months (June-August) when fieldwork was logistically feasible, potentially missing seasonal variations in wind patterns, temperature, and soundscape characteristics that may influence vocal practices. Fourth, potentially confounding variables including formal music training, migration history, and Chinese language proficiency were not systematically measured and may moderate observed relationships. Future research should address these limitations through longitudinal designs tracking singers over time, experimental manipulations recording performers in different acoustic environments, expanded geographic sampling beyond Sunan County, and comparative studies with other nomadic pastoral groups such as Mongolian, Tibetan, and Kazakh communities to test whether soundscape-singing relationships generalize across cultures. Additionally, perceptual studies investigating whether listeners can identify singers' geographic origins based on acoustic cues alone would provide further evidence for environment-specific vocal signatures.

5. Conclusion

Yugur folk songs, as a unique artistic form in the treasure house of Chinese music culture, vividly reflect the cultural interaction trajectory in history with their profound artistic nature of bilingual lyrics, decorative features of auxiliary syllables, and distinct singing traditions in the east and west. However, this precious cultural heritage is facing multiple severe challenges such as language loss, shrinking of the inheritor group, degradation of the soundscape environment, and restricted dissemination channels. From the perspective of environmental psychology, this kind of loss not only implies the dissolution of cultural essence, but also threatens the local attachment bonds that maintain community identity and mental health. The empirical data of this study show that the mastery of traditional singing techniques by singers is significantly positively correlated with the intensity of local attachment ($r=0.68$). Qualitative interviews further reveal that singing, as a psychological foundation, achieves a spiritual connection with ancestors through the landscape. Therefore, the protection strategy must simultaneously focus on the cultural carrier - the song itself, as well as the environmental foundation - the acoustic landscape that endows the song with functional value and emotional connotation. Based on the above findings, this study proposes a comprehensive protection strategy, including measures such as strengthening language education, building digital archives, balancing traditional authenticity with innovative development, and expanding international communication channels, in order to achieve effective protection and authenticity maintenance of cultural heritage.

Yugur folk songs not only carry artistic aesthetic value, but also embody the national spirit and historical memory. They should be continuously passed down as vivid cultural symbols in contemporary society rather than being solidified as static museum exhibits. These melodies will continue to echo between the grassland and the valley, connecting history and reality, allowing the world to listen to the emotional expressions and life experiences of the Yugur ethnic group. When Yugur folk songs gain their due place on the international cultural stage, they will demonstrate how cultural expressions rooted in natural soundscenes can provide inspiration for global issues such as sustainable development, environmental identity, and the psychosocial dimensions of heritage protection. The case of the Yugur ethnic group reveals that singing traditions is not merely an artistic practice, but rather an ecological adaptation mechanism and a psychological identity fulcrum. It provides an important reference for other ethnic groups to promote cultural protection, build a global framework for intangible cultural heritage, and facilitate cross-cultural dialogue in the context of environmental changes.

Conflicts of interest

The authors declare no conflicts of interest.

References

1. K. Howard, "Musical instruments as tangible cultural heritage and as/for intangible cultural heritage," International Journal of Cultural Property, vol. 29, no. 1, pp. 23-44, 2022.
2. L. Yang, J. Liu, C. Albert, and X. Guo, "Exploring the effects of soundscape perception on place attachment: A comparative study of residents and tourists," Applied Acoustics, vol. 222, p. 110048, 2024.
3. L. Yang and J. Liu, "The moderating effect of visual landscape and soundscape on place attachment in world cultural heritage: a case study in Kulangsu, China," npj Heritage Science, vol. 13, no. 1, pp. 1-12, 2025.
4. E. P. Derryberry and D. Luther, "What is known—and not known—about acoustic communication in an urban soundscape," Integrative and Comparative Biology, vol. 61, no. 5, pp. 1783-1794, 2021.
5. H. Yang and S. Zhang, "Impact of rural soundscape on environmental restoration: An empirical study based on the Taohuayuan Scenic Area in Changde, China," Plos one, vol. 19, no. 3, p. e0300328, 2024.
6. N. Li, H. Wang, and J. Fan, "How soundscape perception enhances the well-being of elderly recreational visitors in urban parks: a case study of Zhengzhou People's Park," Scientific Reports, vol. 15, no. 1, p. 16652, 2025.

7. E. Sesana, A. S. Gagnon, C. Ciantelli, J. Cassar, and J. J. Hughes, "Climate change impacts on cultural heritage: A literature review," Wiley Interdisciplinary Reviews: Climate Change, vol. 12, no. 4, p. e710, 2021.
8. M. Vadrucci, "Sustainable Cultural Heritage Conservation: A Challenge and an Opportunity for the Future," vol. 17, ed: MDPI, 2025, p. 584.
9. J. Kang, "Soundscape in city and built environment: current developments and design potentials," City and Built Environment, vol. 1, no. 1, p. 1, 2023.
10. K. Tang, "Singing a Chinese nation: Heritage preservation, the yuanshengtai movement, and new trends in Chinese folk music in the twenty-first century," Ethnomusicology, vol. 65, no. 1, pp. 1-31, 2021.
11. Y. Wang and A. Thotham, "Ethnomusicological Insights into the Sociocultural Dynamics of Folk Songs in Southern Shaanxi, China," The Oriental Anthropologist, vol. 25, no. 1, pp. 25-42, 2025.
12. G. Curran and M. Radhakrishnan, "The value of ethnographic research on music: An introduction," vol. 22, ed: Taylor & Francis, 2021, pp. 101-118.
13. M. Swijghuisen Reigersberg, S. McKerrell, and A. Corn, "Valuing and evaluating musical practice as research in ethnomusicology and its implications for research assessment," in Ethnomusicology Forum, 2022, vol. 31, no. 1: Taylor & Francis, pp. 28-49.
14. S. Zhang and C. Wu, "Revitalizing endangered traditions: Innovative approaches to safeguarding Yunnan's ethnic minority music as intangible cultural heritage," Herança, vol. 6, no. 1, pp. 101-128, 2023.
15. W. Chu, G. Wippold, and K. D. Becker, "A systematic review of cultural competence trainings for mental health providers," Professional Psychology: Research and Practice, vol. 53, no. 4, p. 362, 2022.
16. D. R. Williams and J. J. Vaske, "The measurement of place attachment: Validity and generalizability of a psychometric approach," Forest science, vol. 49, no. 6, pp. 830-840, 2003.
17. V. Braun and V. Clarke, "Using thematic analysis in psychology," Qualitative research in psychology, vol. 3, no. 2, pp. 77-101, 2006.
18. S. Lyu, "A study on the classification and protection of Yugur traditional folk songs based on experimental phonetics," in 2016 International Conference on Advances in Management, Arts and Humanities Science (AMAHS 2016), 2016: Atlantis Press, pp. 211-215.
19. T. Bradfer-Lawrence, C. Desjonqueres, A. Eldridge, A. Johnston, and O. Metcalf, "Using acoustic indices in ecology: Guidance on study design, analyses and interpretation," Methods in Ecology and Evolution, vol. 14, no. 9, pp. 2192-2204, 2023.
20. E. Znidersic and D. M. Watson, "Acoustic restoration: Using soundscapes to benchmark and fast-track recovery of ecological communities," Ecology Letters, vol. 25, no. 7, pp. 1597-1603, 2022.
21. W. Chen, T. Li, and Y. Zhang, "Embodied cognition model for museum gamification cultural heritage communication a grounded theory study," Npj Heritage Science, vol. 13, no. 1, p. 239, 2025.
22. Y. Li et al., "Enhancing Young Generation's Heritage Identity Through Emotional Responses to Virtual Cultural Heritage Experience: A Design Case with Azheke Community and Visitors at Hani Rice Terraces in China," International Journal of Human–Computer Interaction, pp. 1-24, 2025.
23. Y. Hou, S. Kenderdine, D. Picca, M. Egloff, and A. Adamou, "Digitizing intangible cultural heritage embodied: State of the art," Journal on Computing and Cultural Heritage (JOCCH), vol. 15, no. 3, pp. 1-20, 2022.
24. M. Parker and D. H. Spennemann, "Conceptualising sound making and sound loss in the urban heritage environment," International Journal of Urban Sustainable Development, vol. 14, no. 1, pp. 264-286, 2022.
25. D. M. Dominoni et al., "Why conservation biology can benefit from sensory ecology," Nature Ecology & Evolution, vol. 4, no. 4, pp. 502-511, 2020.
26. T. Oberman, A. Latini, F. Aletta, G. Gozzi, J. Kang, and S. Torresin, "Human sounds and associated tonality disrupting perceived soundscapes in protected natural areas," Scientific Reports, vol. 15, no. 1, p. 28759, 2025.
27. L. Jiang et al., "A bibliometric insight into immersive technologies for cultural heritage preservation," npj Heritage Science, vol. 13, no. 1, p. 126, 2025.
28. N. M. Else-Quest and E. Morse, "Ethnic variations in parental ethnic socialization and adolescent ethnic identity: a longitudinal study," Cultural Diversity & Ethnic Minority Psychology, vol. 21, no. 1, p. 54, 2015.
29. B. Zhao and P. Hu, "The longitudinal impact of cultural values on adaptation among ethnic minority students in Mainland China: The mediating role of emotion regulation," International Journal of Intercultural Relations, vol. 101, p. 102014, 2024.
30. Y. Wang and Z. Fan, "The Impact of Communities of Practice on Professional Development Among Chinese Teachers: A Mixed-Methods Longitudinal Study," SAGE Open, vol. 15, no. 3, p. 21582440251359824, 2025.