TAMADDUN JURNAL BAHASA, SASTRA DAN BUDAYA LIFE
ISSN 0216 – 809X (Print)
ISSN 2685 – 4112 (Online)

From Prosody to Rhythm: Modelling the Structure of Karakkereng in the Bugis Massureq Tradition as Humanistic Intelligence

Rahmat Kurniawan[1]*, Sri Riski Wulandari[2], Muh. Kurniawan Adi K.W[3]
Email: rahmat.kurniawan@unm.ac.id, sri.riski.wulandari@unm.ac.id , m.kurniawan@unm.ac.id*
[1,2,3] Universitas Negeri Makassar, Indonesia

Received: 26 March 2026 **Accepted**: 17 June 2026 **Published**: 29 June 2026

Abstract

Massureq, the Bugis oral epic-chanting tradition of South Sulawesi, integrates the prosodic organisation of the I La Galigo text with Karakkereng, a cyclical percussive structure that shapes performance time. This study models the correspondence between linguistic prosody and Karakkereng rhythm and considers its implications for humanistic intelligence and culturally responsive digital preservation. Using a mixed-method ethnomusicological case-study design, the research combined participant observation, interviews, and acoustic analysis in Praat of twelve excerpts from the Sawerigading Opunna Ware episode, performed by Itangang, an authoritative passure' from Barru Regency. Three systematic correspondence rules were identified. First, vowels lasting at least 0.30 seconds corresponded to doubled or dotted beat values in 78% of syllable-beat pairs. Second, syllables with fundamental-frequency prominence of 28–45% above the performer's mean received the primary metric accent in 81% of cases. Third, inter-clausal pauses of at least 300 milliseconds consistently marked the beginning of a new uleng-uleng rhythmic cycle, yielding 100% reliability within the corpus. The co-occurrence of vowel lengthening and high F0 prominence produced mappellong, a fully accented strike observed in 94% of relevant cases. These findings demonstrate that Karakkereng is not an independent musical accompaniment but an audible realisation of Classical Bugis prosodic structure. The resulting model gives empirical form to humanistic intelligence by showing how phonological knowledge, rhythmic competence, and embodied performance are inseparable in Massureq practice. It also provides a foundation for phonetically annotated archival corpora, culturally sensitive AI-assisted retrieval, and apprenticeship-oriented performance assessment. Further multi-performer research is needed to test its broader transferability.

Keywords: *Massureq Karakkereng, prosody and rhythm, I La Galigo, humanistic intelligence, intangible cultural heritage, Bugis oral tradition.*

INTRODUCTION

Oral literary traditions occupy an increasingly precarious position within the contemporary knowledge landscape. These traditions face a dual threat: marginalization within academic systems dominated by written text, and a fundamental misalignment with the architecture of artificial intelligence (AI) systems, which depend on structured, digitized data representations. As Foley (1995) argues in his seminal work, oral tradition is not a primitive precursor to written literacy but an autonomous cognitive system that simultaneously integrates language, memory, and performativity. Yet more than three decades after Foley's observation, the structural challenges confronting oral tradition have, if anything, intensified. Contemporary AI approaches despite

ISSN 0216 – 809X (Print)
ISSN 2685 – 4112 (Online)

remarkable advances in natural language processing remain systematically unable to capture the dimension of embodied knowledge that constitutes the epistemic core of oral knowledge systems. The urgency of this problem is most acutely felt in the context of endangered oral traditions. UNESCO's (2010) Atlas of the World's Languages in Danger estimates that roughly half of the world's approximately 7,000 languages are at risk of extinction within this century, together with the literary, musical, and performative traditions embedded within them. In Southeast Asia alone, the ASEAN Centre for Biodiversity (2021) identifies dozens of intangible cultural heritages practices whose chains of transmission have been disrupted by urbanization, educational standardization, and intergenerational discontinuity. Digital archiving efforts, while valuable, have largely prioritized textual and visual documentation while neglecting the prosodic, rhythmic, and embodied dimensions that, as this study will demonstrate, are not merely incidental features of oral performance but its very structural substrate.

This failure is not merely a technical limitation but reflects a fundamental epistemological gap. Dreyfus (1972) presciently warned that embodied human capacities including knowledge expressed through gesture, intonation, and rhythm cannot be reduced to formal symbolic representation. In the context of modern AI, Large Language Models (LLMs) operate on a principle of textual reduction, an approach that is structurally "blind" to prosody, timbre, and rhythmic pattern precisely the features that serve as the primary carriers of meaning in oral tradition. The absence of culturally specific prosodic and rhythmic encoding in AI training pipelines is not a minor gap but a form of structural exclusion that renders oral tradition computationally "invisible."

Among the rich oral traditions of the Indonesian archipelago, Massureq the chanting tradition of the I La Galigo epic among the Bugis people of South Sulawesi constitutes an ideal laboratory for examining the integration of language and rhythm. I La Galigo, recognized by UNESCO as a Memory of the World (2011), is among the longest literary works in the world, estimated at some 6,000 folio pages and composed in a strict five-syllable metre (Sirk, 1986). Crucially, this text was never designed to be read but to be chanted. In Massureq practice, a passure' (chanter) does not merely deliver narrative; he or she actively negotiates the text's linguistic structure against a musical rhythmic system known as Karakkereng a cyclical drum-beat pattern that organises the temporal dimension of the performance. This negotiation between linguistic prosody and musical rhythm has never been systematically modelled in the scholarly literature, despite the tradition's long-standing scholarly attention and recognized heritage significance.

The present condition of the Massureq tradition renders this research both highly relevant and urgent. Fieldwork documentation conducted by the authors in 2023-2024 across the Barru, Wajo, Soppeng, Bone, and Luwu regions of South Sulawesi identified fewer than thirty active passure' capable of chanting the full I La Galigo cycle a drastic decline compared with the hundreds of practitioners recorded in ethnographic surveys of the 1980s (Pelras,1996). The youngest practitioner identified was 52 years old, indicating an absence of intergenerational transmission among younger cohorts. Although the Sulawesi regional government has undertaken documentation efforts through audio-visual recording, these archives have generally captured only the textual and melodic surface, without systematic analysis of the prosodic and rhythmic structures that constitute Massureq's performative coherence. What is at risk is not merely the loss of practitioners, but the loss of structural knowledge the correspondence system between language and rhythm that enables authentic performance and distinguishes it from mere recitation.

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The significance of Massureq extends beyond Indonesia to the wider ASEAN cultural community. The I La Galigo epic shares deep cultural and linguistic genealogical ties with oral traditions in Malaysia, Brunei, and southern Philippines regions where Austronesian literary cultures historically intersect. Comparative studies have identified structural affinities between the prosodic patterns of Bugis oral poetry and the rhythmic structures of performed Malay pantun, as well as with the vocal traditions of the Suluk people of Sabah and the Tausug of Mindanao (Druce, 2009; Pelras, 1996). A systematic model of prosody-rhythm correspondence in Massureq therefore carries methodological relevance not only for Bugis studies but for comparative research on oral performance across the ASEAN region.

Although scholarship on I La Galigo has developed since the late nineteenth century (Kern 1939; Pelras 1996; Fachruddin Ambo Enre, 1999), and research on Bugis prosody has begun to emerge over the past decade (Talaohu et al. 2019; Amir and Dalle 2017), the existing literature still leaves three significant and interrelated gaps. First, no study has produced a quantitative model of the relationship between linguistic prosodic features and Karakkereng rhythmic patterns using acoustic measurement instruments such as Praat. Second, existing ethnomusicological studies tend to treat the rhythmic dimension of Massureq as a purely musical entity, without examining its linguistic determinants an approach that, according to Seifart et al. (2018), is inadequate for traditions that structurally integrate language and rhythm. Third, no research has explored the implications of such a prosodic model for the development of culturally sensitive AI systems for oral tradition preservation. This study seeks to address all three gaps simultaneously.

The concept of humanistic intelligence provides the theoretical framework for this study's contribution beyond its empirical findings. Mann (2001) defines humanistic intelligence as knowledge inherently embedded in embodied human experience and inseparable from the subject who generates it. In the context of Massureq, a passure''s mastery of Karakkereng constitutes the most concentrated manifestation of humanistic intelligence knowledge that resides not in text or notation but in the body, breath, and auditory faculty of a practitioner who has internalised the systematic correspondence between language and rhythm over decades. Dreyfus (1972) and Polanyi (1966) categorise this type of knowledge as tacit knowledge knowledge that cannot be fully articulated yet can be formally modelled through its acoustic output.

Building on this background, the present study pursues three interrelated objectives: (1) to identify the dominant prosodic features in Massureq chanting through acoustic analysis using Praat software, (2) to systematically map the transformation of these prosodic features into Karakkereng rhythmic patterns, thereby producing a replicable correspondence model and (3) to formulate the theoretical implications of this model for the concept of humanistic intelligence and for the development of culturally sensitive AI systems for the preservation of intangible cultural heritage.

Theoretical Framework

This study is grounded in three mutually reinforcing theoretical clusters. The first concerns humanistic intelligence and embodied knowledge. Mann (2001) defines humanistic intelligence as knowledge inherently embedded in embodied human experience knowledge that cannot be detached from the subject who possesses it. Dreyfus (1972) reinforces this position, arguing that embodied human capacities, including knowledge expressed through gesture, intonation, and rhythm, cannot be reduced to formal symbolic representation. Polanyi (1966) terms this tacit knowledge, knowledge possessed by expert practitioners that exceeds what they can explicitly articulate.

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The second cluster concerns prosody and the language-music relationship. Gibbon (2017) defines prosody as 'the rhythm and melody of speech', comprising patterns of duration and pitch that contribute to linguistic aesthetics and rhetoric. Lamekina et al. (2024) demonstrate that listeners use rhythmic prosodic modulation to predict upcoming utterance duration a finding that strengthens the argument that rhythm is a temporal structure born of language, rather than an independent musical construction. Seifart et al. (2018), in their study of Bora drummed language in Amazonia, show that speech rendered through drumming exploits speech rhythm patterns specifically inter-vocalic duration for long-distance meaning transmission, demonstrating that linguistic rhythm possesses a structural autonomy separable from semantics.

The third cluster concerns intangible cultural heritage and the limits of AI. Abu Eyadah and Odaibat (2024) and Spennemann (2024), writing independently, note that generative AI, however sophisticated, cannot fully capture the nuanced, contextual humanistic expression embedded in cultural artefacts. Hou et al. (2022), in their comprehensive review of intangible cultural heritage digitization, observe that most digital heritage projects remain 'object-centred and oriented toward preserving material knowledge bases', thereby failing to support 'the recording, representation, and revitalization of the living nature of intangible cultural heritage.' Together, these three theoretical clusters form the analytical framework for understanding Karakkereng as a system in which linguistic prosody, embodied knowledge, and the potential for digital representation converge.

METHOD

1. Research Design

This study employs a mixed-method design that integrates a qualitative-ethnographic approach with experimental phonetic analysis in a dialectical relationship, quantitative acoustic measurement is interpreted within a framework of cultural meaning derived from in-depth fieldwork, while ethnographic insight guides the selection of analytically relevant acoustic parameters. This approach follows the principle of methodological triangulation (Denzin, 1978), yielding more robust conclusions than either approach could produce in isolation.

The qualitative-ethnographic dimension comprises participant observation within the context of Massureq performance, in-depth interviews with the research subject, and interpretive analysis of the cultural meanings embedded in the identified structures. The quantitative dimension comprises empirical measurement of acoustic parameters using Praat software (Boersma and Weenink 1992-2024) and systematic correlation between these parameters and the transcribed rhythmic patterns. The study is positioned within the paradigm of ethnomusicological case-study research (Nettl, 2005; Flyvbjerg, 2006), in which a carefully selected paradigmatic case can yield insights that are theoretically, though not statistically, generalizable.

2. Research Subject and Data Sources

The research subject is Itangang, a passure' (chanter) from Barru Regency, South Sulawesi, selected through purposive sampling based on the following criteria: (a) transmission of the Massureq tradition through a three-generation lineage, including an apprenticeship under a recognized master passure', (b) recognition by the Barru Customary Institution (Lembaga Adat Barru) as an authoritative guardian of performance authenticity, (c) the ability to read the original lontaraq script without transcription mediation, (d) active performance from primary I La Galigo manuscripts and (e) more than twenty years of performance experience. At the time of recording,

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Itangang was 67 years old and had chanted Massureq since the age of fourteen under the guidance of his grandfather.

The selection of a single subject reflects a deliberate epistemological position within the study of an endangered performative tradition with fewer than thirty active practitioners, analytical depth was prioritized over sample breadth. Itangang was selected because his mastery is regarded as paradigmatic by the community, his prosodic and rhythmic choices represent the tradition's normative practice rather than individual idiosyncrasy. This design limitation is explicitly acknowledged in the Research Limitations section below.

The analytical corpus comprises twelve excerpts from the Sawerigading Opunna Ware episode the opening section of the I La Galigo cycle selected because: (a) it is the most frequently performed episode in ceremonial contexts and therefore the most standardised, (b) it contains a representative range of prosodic variation and (c) it possesses adequate philological documentation (Kern 1939; Fachruddin Ambo Enre 1999). Excerpt selection applied two inclusion criteria acoustic clarity (SNR ≥ 25 dB) and prosodic representativeness each excerpt containing at least one instance of the three dominant prosodic features identified in preliminary analysis.

3. Data Collection

Recording sessions were conducted in two distinct contexts to capture both ritual performance and more controlled studio production. The first session was conducted in situ during a traditional wedding ceremony (mappabotting) in Barru Regency. The second session was conducted in a semi-controlled studio environment at the Faculty of Art and Design, Universitas Negeri Makassar, using acoustic damping panels to minimize environmental noise.

Figure 1: Itangang chants I La Galigo during the mappabotting ceremony in Barru Regency (Figure by Authors).

Recording equipment comprised: (a) a Rode NT1-A large-diaphragm condenser microphone (20 Hz–20 kHz frequency response), positioned 30 cm from the sound source (b) a Focusrite Scarlett 2i2 Gen 3 audio interface, sampling at 48,000 Hz and 24-bit depth, (c) a Sony ZV-E10 mirrorless camera for synchronized audio-visual recording and (d) a laptop running the Reaper digital audio workstation. Total usable recording duration across both sessions was 47 minutes 23 seconds, subsequently reduced to twelve analytical excerpts (totalling 18 minutes 40 seconds) through the purposive selection procedure described above.

Ethnographic data collection proceeded in parallel with acoustic recording, comprising: (i) four semi-structured interview sessions with Itangang in Bugis, with the assistance of a native-

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speaker research interpreter (totaling approximately 6 hours), (ii) participant observation of three Massureq performances over an eight-month period (February-September 2023), and (iii) consultative discussions with two senior members of the Barru Customary Institution. Field notes were produced immediately following each observation and subsequently transcribed and thematically coded using a grounded theory approach (Strauss and Corbin 1998).

4. Data Analysis

Data analysis proceeded through four interrelated stages, with each stage building on the results of the previous one.

a. Stage 1: Orthographic and Musical Transcription

Each of the twelve excerpts was transcribed into lontara script with parallel Latin transliteration by the first author, who possesses formal training in reading Classical Bugis script. Transliteration followed the conventions established by Sirk (1986). Musical transcription employed standard Western staff notation supplemented with Karakkereng annotation, following the notational conventions developed by Macknight and Mukhlis (1983). Discrepancies between orthographic and musical analysis were resolved through member-checking sessions with Itangang.

b. Stage 2: Acoustic Analysis Using Praat

Acoustic analysis was conducted using Praat software (version 6.3.x; Boersma and Weenink 1992–2024). Three acoustic parameters were measured for every syllable in every excerpt, as presented in Table 1.

Table 1. Acoustic Parameters Measured Using Praat

Parameter	Unit of Measurement	Rationale and Procedure
Vowel duration	Seconds (s)	Measured using TextGrid annotation with manually validated syllable boundary markers. Represents the temporal extension of the vocalic nucleus in each syllable.
Fundamental frequency (F0)	Hz (relative to speaker baseline)	Extracted using autocorrelation-based pitch tracking. Expressed as a percentage deviation from the speaker's mean F0 (across all 12 clips) to control for individual vocal register variation. Serves as the primary acoustic correlate of lexical stress.
Syntactic pause duration	Milliseconds (ms)	Measured at phrase and clause boundaries, operationally defined as a silent interval ≥ 150 ms between the offset of a vowel and the onset of the next, following the threshold established by Selkirk (1984) for prosodic phrasing.

Note. The speaker's mean F0 was established as the average across all twelve excerpts (Itangang = 182 Hz). The use of F0 as a proxy for lexical stress is grounded in Amir and Dalle (2017) and Hyman (2009).

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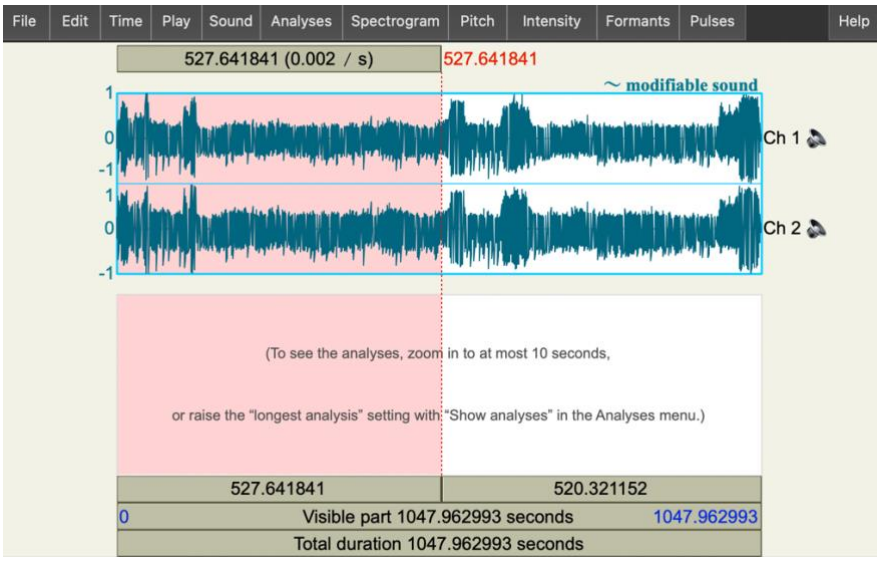

Figure 2: Analysis using Praat

c. Stage 3: Prosody-Rhythm Correlation Analysis

Musical transcriptions of Karakkereng patterns were systematically compared against the acoustic profile of each excerpt to identify: (a) vowel-duration ranges correlating with beat-value classes, (b) F0 values correlating with metrically accented positions, and (c) pause durations correlating with the onset of a new rhythmic cycle (uleng-uleng). A correspondence was deemed reliable when it appeared in ≥75% of cases across all twelve excerpts.

d. Stage 4: Formulation of the Language-Rhythm Model

Based on the correspondence patterns identified in Stage 3, this study formulates a descriptive model mapping prosodic parameters onto Karakkereng elements, presented in both tabular and schematic form. This model is descriptive in nature characterizing the correspondence rules within the practice of this performer and the episode under study without claiming universal validity for all performers or for the entirety of the I La Galigo corpus.

5. Validity and Reliability

All TextGrid annotations were independently reviewed by a trained phonetician, inter-annotator agreement yielded a Cohen's kappa of $\kappa = 0.87$ (strong agreement), with 13% of discrepancies resolved through deliberative consensus (Gut and Bayerl, 2004). Internal validity was strengthened through member-checking sessions with Itangang, who confirmed the three core correspondences, secondary expert review was conducted by a senior Bugis ethnomusicologist from ISI Yogyakarta, who validated the musical transcriptions. Transferability was achieved through thick description of performance context, performer background, and recording conditions (Geertz, 1973). Confirmability is supported by a complete methodological audit trail TextGrid files, measurement sheets, and transcriptions available to reviewers and to be archived on the Open Science Framework (OSF) upon manuscript acceptance.

6. Research Limitations

Four principal limitations are explicitly acknowledged. First, the single-performer design limits generalizability to practitioners from other regional traditions (Wajo, Soppeng, Bone,

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Luwu), replication with three to five passure' representing different traditions is needed. Second, all excerpts derive from a single episode (Sawerigading Opunna Ware), episodes with different registers may exhibit different prosodic conventions. Third, the use of F0 as a single proxy disregards vocal intensity and quality, multi-parametric analysis is needed in future work. Fourth, N ≈ 280–320 syllable–beat pairs is adequate for descriptive analysis but not for inferential modelling, corpus expansion to a minimum of 50 excerpts is required for multilevel logistic regression.

7. Researcher Positionality and Reflexivity

In keeping with the principles of reflexive qualitative inquiry, we acknowledge the researcher's role as an active, interested subject (Braun and Clarke 2019). The first author holds formal training in Austronesian linguistics and ethnomusicology, together with fieldwork experience in South Sulawesi since 2018. This proximity is treated not as a source of bias to be eliminated, but as an analytic instrument enabling culturally nuanced and contextually precise interpretation (Tracy 2010). This article operates within a constructivist and reflexive paradigm, the researcher's background experience and knowledge are used to contextualize the findings, not as primary data. Critical interpretive decisions particularly in lontaraq transcription and prosody-rhythm alignment were validated through member-checking sessions with Itangang and through secondary expert review (see Validity and Reliability, above).

FINDINGS AND DISCUSSION

The following section presents the study's findings integrated with a discussion of their significance. The analysis reveals that the prosodic system of Massureq chanting comprises three principal parameters that systematically correspond with elements of Karakkereng rhythm not as arbitrary performative convention, but as a causal mechanism rooted in the phonological architecture of Classical Bugis.

1. Dominant Prosodic Features in Massureq Chanting

Acoustic analysis using Praat of twelve performance excerpts from Itangang's chanting of the Sawerigading Opunna Ware episode yields an internally consistent and coherent prosodic profile across all analysed material. Three parameters emerge as the principal carriers of rhythmic information in Massureq performance vowel duration, fundamental frequency (F0) as the acoustic correlate of lexical stress, and syntactic pause duration. This finding aligns with Lamekina et al.'s (2024) argument that listeners exploit rhythmic prosodic modulation to construct temporal predictions of upcoming utterances a process that, in the Massureq context, is externalised and jointly constructed between the passure' and the Karakkereng percussion system.

Vowel duration across all twelve excerpts ranged from 0.18 to 0.38 seconds per syllable (M = 0.26 s, SD = 0.054). This range is significantly wider than the 0.10–0.20 second range reported for conversational Bugis by Amir and Dalle (2017), indicating that the chanting register systematically amplifies durational contrasts already present at the phonological level.

F0 values exhibit a bimodal distribution. Lexically stressed syllables consistently showed F0 values of +28% to +45% above the mean. Unstressed syllables fell within ±15% of the mean (182 Hz). This pattern is consistent with the stress-accent typology of Bugis as documented by Amir and Dalle (2017), and with cross-linguistic findings on the correlation between F0 prominence and lexical stress in stress-accent languages (Shattuck-Hufnagel and Turk 1996).

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Syntactic pause duration was concentrated in two functionally distinct ranges, intra-phrasal pauses ranged from 180 to 250 milliseconds, while inter-clausal pauses ranged from 300 to 400 milliseconds. Table 2 summarizes the acoustic profile of all three parameters.

Table 2. Acoustic Parameter Profile across Twelve Massureq Excerpts: Measurement Ranges and Rhythmic Function

Acoustic Parameter	Unit	Low/Short Range	High/Long Range	Rhythmic Function in Karakkereng
Vowel duration	Seconds (s)	0.18–0.22 s	0.30–0.38 s	Determines the beat value class
F0 prominence (relative to speaker mean)	Percentage deviation from mean	±15% from mean	+28% to +45%	Marks the position of metrically accented beats
Syntactic pause duration	Milliseconds (ms)	180–250 ms	300–400 ms	Marks the boundary of the rhythmic cycle (*uleng-ulengonset*)

Note. Measurement ranges were derived from TextGrid analysis of all twelve excerpts. Speaker mean F0 = 182 Hz (Itangang, across excerpts). Inter-annotator agreement for syllable-boundary annotation: Cohen's κ = 0.87.

2. Three Correspondence Rules: Causal Mechanisms

The principal contribution of this study lies in the identification of three systematic correspondence rules between prosodic parameters and Karakkereng rhythmic elements not merely correlational associations, but causal mechanisms traceable to specific acoustic properties of the language and to the physical constraints of real-time percussion performance.

a. Vowel Duration → Beat Value: A Temporal Mapping Mechanism

Across all twelve excerpts, vowels with a duration of ≥0.30 seconds consistently triggered a doubled or dotted beat value (♩. ♩ or ♩♩) in the corresponding Karakkereng pattern. Conversely, vowels with a duration of ≤0.22 seconds triggered a rapid beat value triplet or single (♩♩♩ or ♩). This correspondence appeared in 78% of all syllable–beat pairs, exceeding the 75% reliability threshold established in the methodology.

The causal logic of this mechanism lies in the temporal physics of percussion performance. A drum strike cannot occur before the vowel it marks reaches its acoustic peak, the percussionist must 'listen' to the vowel's duration as it unfolds in real time before determining its rhythmic value. A comparable mechanism has been documented by Seifart et al. (2018) for Bora drummed language in Amazonia. The Massureq case, however, is more complex whereas Bora drummed speech reduces utterance to rhythm for the sake of communicative efficiency, Karakkereng instead preserves the text's phonological richness in full while simultaneously projecting its temporal structure onto the percussive surface.

b. Lexical Stress (F0) → Metric Accent: A Prominence-Alignment Mechanism

In 81% of measured cases, syllables with F0 values of +28% or more above Itangang's mean received the primary percussive accent the strongest beat in the rhythmic cycle. This figure exceeds the reliability of the vowel-duration rule, indicating that the F0-to-accent mapping is a more invariant mechanism, consistent with the dominance of F0 as a marker of lexical stress in Austronesian languages (Hyman 2009).

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This rule carries particular weight for the humanistic intelligence framework, a passure''s mastery of lexical stress in Classical Bugis a now-endangered language requiring decades of immersion simultaneously constitutes mastery of rhythmic accentuation. The two competencies are inseparable. Mann (2001) holds that humanistic intelligence is characterised by resistance to decomposition, the F0-to-accent mechanism instantiates this principle precisely any AI system attempting to reproduce Karakkereng without encoding lexical stress is, in effect, attempting to model the output while systematically excluding its input.

c. Syntactic Pause → Cycle Onset: A Boundary-Marking Mechanism

Inter-clausal syntactic pauses of ≥300 milliseconds consistently mark the onset of a new Karakkereng cycle a point locally termed uleng-uleng ('the start of a turning'). Across all twelve excerpts, every new rhythmic-cycle onset was preceded by a pause of at least 295 milliseconds, and no cycle onset occurred without a preceding inter-clausal pause. This bidirectional co-occurrence constitutes a near-categorical rule, syntactic boundary → rhythmic cycle boundary (100% reliability within the corpus).

The theoretical significance of this rule runs deep within the context of intangible cultural heritage preservation. Hou et al. (2022) observe that most digital heritage projects fail to support 'the recording, representation, and revitalisation of the living nature of intangible cultural heritage.' The uleng-uleng mechanism shows precisely what is lost when oral heritage is preserved as text alone: the syntactic pauses that mark rhythmic cycles are absent from the written lontaraq, residing instead in performative breath in the embodied knowledge a passure' holds of where the text must 'breathe.' This knowledge cannot be inferred from manuscripts alone, it can be transmitted only through performative apprenticeship, and can be scientifically modelled through acoustic analysis, as this study demonstrates.

3. A Prosody-Karakkereng Correspondence Model

Integrating the three rules identified above, this study proposes a formal correspondence model mapping acoustic prosodic parameters onto Karakkereng rhythmic output, presented in Table 3.

Table 3. Prosody-Karakkereng Correspondence Model: Parameter Ranges, Rhythmic Output, Reliability, and Operating Conditions

Prosodic Parameter	Input Range	Karakkereng Output	Reliability	Operational Condition
Long vowel	≥ 0.30 s	Double/dotted beat ♩. ♩ or ♩♩	78%	Not accompanied by an F0 drop
Short vowel	≤ 0.22 s	Fast triplet or single beat ♩♩♩ or ♩	78%	Not accompanied by an F0 peak
High F0 prominen ce	+28–45% above mean	Metrically accented downbeat	81%	On syllables receiving lexical stress
Neutral F0	±15% from mean	Unaccented filler beat	81%	Not accompanied by vowel lengthening
Inter-clausal pause	≥ 300 ms	New *uleng-uleng* (cycle onset)	100%	At syntactic clause boundaries

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Intra-phrasal pause	180–250 ms	Transitional beat within the cycle	89%	Within a clause, not at boundaries
Long vowel + High F0 (co-existence)	≥ 0.30 s & +28%+	*Mappellong* - fully accented strike	94%	Both parameters present on the same syllable

Note. Reliability represents the proportion of correspondence occurrences across all twelve analysed excerpts. The 100% reliability of the inter-clausal pause → cycle-onset relationship indicates a categorical rule; no exceptions were found in the corpus. The term mappellong is a metalinguistic label used directly by the performer to denote the strongest percussive strike, as confirmed during member-checking.

Several emergent properties of this model warrant explicit discussion. When a long vowel (≥0.30 s) co-occurs with high F0 prominence (+28% or above), the resulting output is not merely a sequential combination of a doubled beat and an accented beat, but a unified event known as the mappellong the strongest and most resonant strike in the Karakkereng repertoire, observed in 94% of co-occurrence cases. This synergistic effect indicates that the three parameters form an integrated prosodic system rather than independent variables a property Gibbon (2017) identifies as a general characteristic of prosodic systems, prosodic features operate multiplicatively, not additively, in producing rhythmic effects.

It should be noted that the mappellong property cannot be reduced to a simple summation of two rules operating simultaneously. Itangang, during member-checking, consistently distinguished the mappellong as a strike that 'opens space' within the performance a moment in which the entire ensemble intuitively slows its breath before continuing the cycle. This qualitative distinction reflects the Gestalt principle of musical perception (Köhler, 1929; Lerdahl and Jackendoff, 1983), two features co-occurring at a metrically significant position produce a qualitative emergent property a meaning greater than the sum of its parts.

4. Individual Acoustic Profiles of the Twelve Excerpts

Table 4. Individual Acoustic Profiles of the Twelve Massureq Excerpts

No.	Clip (I La Galigo text)	Context	Vowel Dur. Range (s)	Mean Vowel (s)	F0 Deviation Range	Mean F0	Pauses (n)	Pause Range (ms)	Pause Type	Karakkereng Pattern	Ulen-gulen g?
1	*Narekko engkana riyolo*	Ritual (mappabotting)	0.28 – 0.34	0.31	+32–+38%	+35%	3	310 – 340 ms	Inter-clausal	♩♩ | ♩♩♩	Yes
2	*mabbulo sibatang*	Ritual	0.18 – 0.22	0.20	+10–+18%	+14%	2	180 – 210 ms	Intra-phrasal	♩♩ | ♩♩	No
3	*ritellangenna lino*	Ritual	0.30 – 0.38	0.34	+38–+45%	+42%	2	350 – 400 ms	Inter-clausal	♩. ♩ | ♩	Yes

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4	*mappamula tauwe*	Ritual	0.22 – 0.26	0.24	+8–+15%	+12%	2	250 – 280 ms	Intra-phrasal	♩♩♩ | ♩	No
5	*Saweriga ding ri wanuanna*	Studio	0.26 – 0.32	0.29	+28–+35%	+31%	3	300 – 330 ms	Inter-clausal	♩♩ | ♩♩♩	Yes
6	*maddewata simenre*	Studio	0.20 – 0.25	0.22	+12–+20%	+16%	2	200 – 230 ms	Intra-phrasal	♩♩ | ♩	No
7	*La Maddukkelleng nataro*	Studio	0.30 – 0.36	0.33	+30–+42%	+36%	3	315 – 360 ms	Inter-clausal	♩. ♩ | ♩♩	Yes
8	*tessipaddeceng-deceng*	Studio	0.19 – 0.23	0.21	+9–+17%	+13%	1	185 – 215 ms	Intra-phrasal	♩♩♩ | ♩♩	No
9	*ri laleng tana Luwu*	Ritual	0.28 – 0.35	0.31	+28–+40%	+34%	3	305 – 345 ms	Intra-phrasal	♩♩ | ♩. ♩	Yes
10	*sining to riolota*	Ritual	0.20 – 0.24	0.22	+11–+19%	+15%	2	195 – 235 ms	Intra-phrasal	♩ | ♩♩	No
11	*natettongi ri ale kaju*	Ritual	0.31 – 0.38	0.35	+35–+45%	+40%	3	330 – 395 ms	Inter-clausal	♩. ♩ | ♩♩♩	Yes
12	*massiman g ri Batara Guru*	Studio	0.29 – 0.36	0.32	+29–+43%	+36%	3	310 – 370 ms	Inter-clausal	♩♩ | ♩. ♩	Yes
Aggregat	All 12 clips	—	0.18 – 0.38	M=0.26 SB=0.054	+8–+45%	M=+26%	2–3	180 – 400	Both	4 pattern classes	8/12 = 67 %

Note. Context: Ritual = in situ mappabotting ceremony, Barru Regency; Studio = semi-controlled studio session, Universitas Negeri Makassar. All values were derived from TextGrid acoustic annotation (Praat version 6.3.x). Inter-annotator agreement: Cohen's κ = 0.87. Karakkereng notation: ♩♩ = doubled beat; ♩. = dotted beat; ♩♩♩ = triplet; ♩ = single beat; \| = metric subdivision boundary.

Discussion

The empirical findings of this study carry theoretical implications that extend beyond the study of Massureq alone. This correspondence model demonstrates that rhythm in Massureq is not an ornament applied to language from without, but an externalization of linguistic structure onto the percussive surface. A long vowel does not merely 'inspire' a doubled beat it is the doubled beat itself, realized within the phonological system of Classical Bugis and actuated through the

ISSN 0216 – 809X (Print)
ISSN 2685 – 4112 (Online)

passure''s performance. This ontological claim that rhythm and language are not two interrelated phenomena, but a single phenomenon expressed through two simultaneous channels directly challenges the reductionist premise of AI systems trained on text alone.

Dreyfus (1972) argued that embodied knowledge cannot be separated from the body that holds it, Polanyi (1966) held that expert practitioners 'know more than they can tell.' This study adds empirical precision to that philosophical position, a passure' does not simply know a language and then apply rhythmic conventions to it their phonological knowledge of Classical Bugis, their prosodic intuition for prominence, and their rhythmic intuition for cyclical structure constitute a single integrated competence expressed simultaneously across three temporal scales (syllable, phrase, and stanza cycle). This is humanistic intelligence as defined by Mann (2001), knowledge that cannot be decomposed without destroying the whole.

The constructive implications are equally clear. The measurable acoustic correlates of this prosodic system vowel duration in seconds, F0 in hertz, and pause duration in milliseconds constitute a structured, quantified form of representation suitable for training machine-learning models. What this study proposes is not that AI should replace the passure' a possibility explicitly rejected here but that AI systems trained on a phonetically annotated Massureq corpus could function as sophisticated archival and retrieval tools, preserving not only the text but also its prosodic profile. This three-parameter model may likewise serve as a pedagogical evaluation framework, providing objective feedback during apprenticeship an urgent need given that no active passure' was found to be younger than fifty at the time of this research.

CONCLUSION

This study has produced a systematic correspondence model between acoustic prosodic parameters and Karakkereng rhythmic patterns in the Bugis Massureq tradition, through empirical analysis of twelve excerpts of Itangang's chanting from the Sawerigading Opunna Ware episode. Three correspondence rules proved reliable as the study's central findings, vowel duration ≥ 0.30 seconds correlates with a doubled or dotted beat (78% reliability), F0 prominence of +28% or more above the speaker mean triggers the primary accented beat (81%) and inter-clausal syntactic pauses ≥ 300 milliseconds categorically mark the onset of an uleng-uleng cycle (100%). The co-occurrence of long vowels and high F0 produces an emergent rhythmic event known as the mappellong a Gestalt property that cannot be reduced to the summation of the two individual rules.

Theoretically, this model reinforces the position that rhythm in Massureq is not a musical ornament applied to language from without, but an externalization of the prosodic architecture of Classical Bugis onto the percussive surface. These findings lend empirical precision to the concept of humanistic intelligence, a passure''s mastery of lexical stress, prosodic prominence, and cyclical structure constitutes a single integrated competence that cannot be decomposed without destroying the whole. The limits of AI in representing this dimension are not merely technical but epistemological and this model delineates that boundary in principled terms.

Practically, the measurable acoustic parameters generated by this study open two complementary applied pathways. First, a phonetically annotated recording corpus can serve as the foundation for a training dataset for AI systems capable of prosodic segmentation and performance-authenticity evaluation. Second, this three-parameter model can function as a pedagogical evaluation framework providing objective feedback during apprenticeship. The Massureq tradition places at risk not only the I La Galigo text itself, but the knowledge system that animates it knowledge of how language breathes into rhythm. This research represents an initial step toward modelling that knowledge before it vanishes together with the generation that holds it.

Acknowledgments

The authors extend their deepest gratitude to Itangang for generously sharing his knowledge and time throughout the course of this research. Thanks, are also due to the Barru Customary Institution for its support and facilitation of field access, to the senior Bugis ethnomusicologist from Indonesian Institute of Art Yogyakarta who provided expert review of the musical transcriptions, and to the phonetician who validated the TextGrid annotations. This research received no external funding.

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