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Cover Page Footnote

My fieldwork at Chavín has been conducted as a researcher formally associated with the Programa de Investigación Arqueológica y Conservación Chavín de Huántar (PIACCdH – Chavín de Huántar Archaeology and Conservation Research Program), directed by Dr. John W. Rick with various Peruvian co-directors, authorized by the Ministerio de Cultura del Perú (Peruvian Ministry of Culture). Many thanks to my collaborators and supporters in this long-term investigation. My 2016-17 Weatherhead Fellowship at the School for Advanced Research (SAR) in Santa Fe, NM, contributed significantly to the development of this work.

Conch Calls into the Anthropocene

Pututus as Instruments of Human-Environmental Relations at Monumental Chavín de Huántar

Miriam A. Kolar

Pututus (conch-shell musical horns) are known in the Andes as annunciatory devices enabling their players to call across long distances. However, the sonic and gestural versatility possible in pututu performance constitutes dynamical evidence for nuanced archaeological interpretations of these multifaceted and ritually associated instruments. Pututus were documented in texts with drawings created during the Spanish conquest and colonization of the Andes, and intact shell horns have been excavated from monumental architecture in Perú preceding the Inca by more than two millennia. At the Andean Formative center at Chavín de Huántar, Perú, whose well-preserved ceremonial complex was active during the first millennium B.C.E., pututus were depicted in stone and on decorated ceramics. To date, 21 intact shell horns have been excavated at this UNESCO World Heritage site. The use-worn, identity-projecting, and symbolically notched Chavín pututus provide physical and acoustical evidence for functional interpretations of a multimodal ritual communication technology. In this article, I take a cross-disciplinary approach to examine the Chavín pututus with respect to site archaeology and its particular Andean highland setting, exploring the intersection of their materiality and dynamical potential, in context.

Chavín's built environment and associated materials evince past strategies for environmental negotiations that foreshadow present-day discourse regard-

ing the Anthropocene. I argue that Chavín's site-excavated *Strombus pututus* were tools for ritual communication that link diverse ecologies with human interventions toward environmental control. Intrinsic to site ritual, the Chavín pututus were pivotal in the expression of human-ecological (re)positionings. Archaeological engagement of both sonic and environmental concerns is at stake in my exploration of human-environmental interdynamics and their conceptualization, rooted in the material culture of monumental Chavín and its setting. The human-environmental positionality of Chavín's monumental architecture relates to the ecological materiality of pututus in their anthropic transposition from marine animal to (super)human vocal transformer and proxy: a technology of air transformation and wind interaction as well as sound production. Environmental interventions via Chavín architecture and performance using these multimodal instruments manifest strategic realizations of human dominance while communicating negotiation within its flow-directing ritualscape. The Chavín pututus harbor cosmological significance whose details are mired in the uncertainty of archaeology, yet whose materiality conveys reference and function: they are communication instruments that interrelate humans and ecosystems. In the ancient Andes, the Chavín pututus functioned as ritual technologies for humans asserting agency in ordering their cosmos.

Foreshadowing the Anthropocene in the Andean Formative Period

A vantage recently hailed as the Anthropocene¹ frames my archaeological case study of ritual sonics at monumental Chavín de Huántar. Human-environmental relations were articulated in the material culture of this Andean gathering center active 3,000 years ago, epitomized by symbolically potent sound-producing conch shells. In an unorthodox cross-disciplinary exploration that leverages acoustical science and performance study, I interrelate the following topics: sonic communication, music making, religious and ritual practices, experimental and experiential archaeology, human-environmental interactions, and ecological conceptualizations. My study draws on twelve years of archaeological research and eight seasons of archaeoacoustical and music archaeology fieldwork I have conducted at Chavín to reconstruct culture-making processes and infer social structures from remnant materials in site-contextualized assemblage. Dynamical analyses of archaeological materials in the context of physical settings reveal the importance of sonic technologies and musical expression to transcendental world-building in the prehistorical “ritualscape”² at Chavín.

Archaeological engagement takes diverse forms, from expert scrutiny of physical materials to public consumption of interpretative reconstructions. Present issues influence our hindsight; ideologies and societal preoccupations drive archaeological interpretations. In doing archaeology, we construct narratives from material fragments of past lives, relevant to our own situations. Discourse regarding human-environmental relations with respect to climate change brings heightened

relevance to a theme well established in archaeology. Patterns of human-environmental relationships, especially as site-specific or regional evidence, are extrapolated diachronically in archaeological interpretation to explain social shifts and movements of people. Anthropological archaeology traces human responses to environmental factors and ecological dynamics, primarily through studies of cultural materials and human remains. Material culture offers durable traces of past understandings of human-environmental relationships that can only be accessed inferentially, from evidential convergence.

Recent, globally scaled discussion about human-environmental relationships reinforces the relevance of anthropologically focused environmental science. Evaluation of the Anthropocene requires scrutiny not only of its proposed mechanics from an Earth-system perspective, but of the factors that drive and enable humans to configure environments, from localized placemaking to broader ecosystemic manipulations. Ecological changes due to human activities have been identified much earlier than commonly cited markers of the Anthropocene, such as industrialization. A recent study leveraged data science techniques to cross-compare regional knowledge from over 250 archaeologists with land-use expertise, demonstrating that humans effected global ecological changes by at least 3,000 years ago, and plausibly over the past 10,000 years. This project is framed as research “toward the common goal of understanding early land use as a driver of long-term global environmental changes across the Earth system, including changes in climate.”³ In contrast, geologists have argued that past climatic events demonstrated stratigraphically were

not driven by humans, albeit human-influencing.⁴ Across fields, debates continue. The complementary study of past human dealings with their environmental relationality requires local specificity, and produces knowledge on the scale of human experience, my focus here.

Zooming in on the material culture of particular archaeological sites entails detailed examinations that expose evidence for past humans' conceptualizations of ecological relationships. A shift of research perspective from numerically focused data science to humanistic anthropology relates human-environmental trends and climatic events to individual experience and social structures, on local and regional scales. A synchronic approach—here, examining the dynamical potential and functionality of site-contextualized cultural materials in one archaeological case study—can reveal humans' calculated ecological interventions toward anthropic re-positioning in a particular place and within a specific timeframe. Archaeological materials foreshadow the diverse human-environmental conversations at present, from scientific discourse on the Anthropocene to its ideological extension in the postmodern transhumanist proposition that human agency will transcend itself.⁵

Diverse forms of evidence indicate that sonic technologies were a crucial component of “alternative” world-building⁶ both rooted in and enforced by human-environmental positioning at the Andean Formative ceremonial center at Chavín de Huántar.⁷ An intangible cultural substrate, sound is both a dynamical informant and a human communication medium that can be leveraged in explicit and subversive ways⁸ to facilitate relationships between humans and environmental constituents, among people, and between individuals

and cultural materials. Although sound itself cannot be preserved, things that make and shape sound persist and can be evaluated in terms of their acoustical features and psychoacoustical correlates. Sound-producing instruments enable humans to make sound, produce visual gestures, and articulate environmental settings and social proxemics, among other anthropologically significant functions. Static material culture stands as evidence of human activities in the distant past, including the communication of cosmological beliefs through *intangible culture*, expressive actions, and processes that involve physical materials and places.⁹ “Material engagement,” archaeologist Colin Renfrew has observed, “considers the processes by which human individuals and communities engage with the material world through actions that have simultaneously a material reality and a cognitive or intelligent component.”¹⁰ In prehistorical archaeology, we can only trace experiential concerns through expressions in materials and their correlates in material dynamics, substantiating our inferences through evidential corroborations. Expressions of human-environmental and intrahuman relationships that are embedded in archaeological materials may be revealed or suggested through the investigation of human-material interaction affordances, through either experiments¹¹ or models.¹² In the case of material sonics, archaeoacoustical techniques based on acoustical and auditory science facilitate physics-based reconstructions of sound from material culture and empirically relevant analyses.¹³

In its fundamental relationship with diverse forms of communication, sound—or its absence, silence—is salient to reli-

gious performance.¹⁴ Sonic dynamics would have been pivotal to ritual at the monumental Andean Formative center at Chavín de Huántar, especially to communicate nonverbally.¹⁵ A massive human intervention in a geologically and climatically turbulent Andean mountain setting,¹⁶ the seismically engineered stone-and-earthen-mortar architecture of this supposed religious complex has persisted since its development over several hundred years during the first millennium B.C.E. Chavín’s builders transposed materials and structures from its sierran environment¹⁷ in flow-controlling forms – an interpretative paradigm I propose and explore in this article. Extending from the bedrock of a narrow highland valley, Chavín architecture (see Fig. 1) marks and amplifies the convergence of two rivers via subterranean engineering that diverted the Mosna River

and funneled water from the converging Wacheqsa River into it through a complex system of stone-lined canals. Several thousand meters of canals, with patterns of associated access stairways and architectural hydraulic manipulations, suggest elaborate water ritual, including plentiful sacrificing of finely constructed, hand-burnished and relief-sculpted ceramics.¹⁸ The buildings have withstood repeated earthquakes and alluvial injection, with evidence of a retrofit repair associated with the end of monumental occupation.¹⁹ Through innovative architectonic and hydraulic engineering,²⁰ Chavín evinces its builders’ awareness of their role as risk-managing constructors²¹ of a “place apart,”²² activated in ritual as “an intentionally constructed alternative reality”²³ where people from diverse sites and regions congregated to support an experientially distinct ideological system.



Figure 1: Monumental stone-and-earthen-mortar architecture of the UNESCO World Heritage site at Chavín de Huántar, Perú, as it appeared during the sierran rainy season a few years ago. During monumental occupation, building facades were lined with sculptural anthro-zoomorphic tenon heads (*cabezas clavas* in Spanish), with polished stone surface treatments on some areas, including the so-called Black and White Staircase in the right lower corner of this photo taken from southeast of Building A, with the countersunk, square-shaped Plaza Mayor in the foreground. Photo by José Luis Cruzado Coronel.

Social structuring devices operational to Chavín's ritual machinery included multisensory communication technologies via architecture and objects.²⁴ Archaeo-ethnomusicological evidence at Chavín converges on one particular form of sound-producing instrument, the *Strombus* marine-shell musical horn,²⁵ the only definitive soundproducer both site-excavated²⁶ and graphically depicted from its monumental epoch, in more than a century of site archaeology (see Fig. 2).²⁷ The presence and plentiful depictions of these specifically crafted and engraved marine-shell “natural horns,” known in the Andes as *pututus*, imply specific environmental associations and manipulations at a sierran site climatically distinct from their distant ocean source. Material-dynamical explorations of these instruments in site settings produce functional information relevant to the significance of *pututus* at Chavín. Relating diverse forms of Chavín archaeological evidence with the sonic performance

potential and multimodal materiality of these *pututus* suggests ritual uses that far exceed normative assumptions about conch-shell horns in western scholarship.

At Andean Formative Chavín, *pututus* were a specifically procured, crafted, and emplaced communication technology, transported far from the ocean to this remote highland site. These conch-shell horns were engineered and skill-requisite ritual instruments with social, religious, musical, and conceptual implications. Disentangling these factors and identifying specific symbolical meanings requires knowledge beyond what is archaeologically recoverable. However, evaluating relationships among forms of archaeological evidence—especially site-instrument dynamical interrelationships, for realistic use interpretation of these *pututus*—produces nuanced assessments of plausibility. Reframing the discussion of Chavín ritual via exploration of its communication technologies injects new,



Figure 2: Chavín *pututus* on display at the Museo Nacional Chavín (left) and another in its 2001 excavation context (right). Photos by José Luis Cruzado Coronel and John Rick / Programa de Investigación Arqueológica y Conservación Chavín de Huántar (PIACCdH). Composite figure previously published in article by Kolar, *Acoustics Today* (14/4: 29; Fig. 1).

relevant questions into the study of human-environmental relations in the ancient Andes. Although the specific cosmological significance of these pututus to Formative Chavín's human population cannot be known, in their materiality and ritual situation, these prominent instruments convey human-ecological concerns across millennia.

Sonic Contextualization of the Chavín Pututus: Beyond Signs and Signaling Instruments

"A *huaca* can be defined as a thing (object, feature on the landscape, water source, and even human remains) that has a potential or an actual force recognized by Andean peoples. A *huaca* in this sense acquires a relationship between humans that must be kept in equilibrium."²⁸

A Chavín pututu may be best understood as a portable and potent *huaca*,²⁹ having transcended the finite life of a gastropod within a marine ecosystem and entered an existence of prolonged objectification as a ritual object and instrument of cosmological relations in the Andes.³⁰ A physically inscribed, versatile soundproducer and vocal extension for its performers, a Chavín pututu can be wielded by a skilled performer to produce myriad sonic expressions, in addition to its most iconic voicings.³¹ In ritual use contexts, the sounding of a Chavín pututu would have enacted a physical and symbolic relationship between the instrument and its performer, as well as those who less directly sensed its activation.³² Notoriously, pututus were sounded around and within the architectonic *huaca* that is a stone-and-earthen-mortar imposition onto Andean bedrock, the monumental archaeological center at Chavín de Huántar. Chavín is located in the Peruvian department

of Ancash's Callejón de Conchukos, a narrow valley between the glacial peaks of the Cordillera Blanca (White Mountains) and the dark escarpments of the Cordillera Negra (Black Mountains). Two mountain ranges and at least twelve days' journey by foot from the ocean, Chavín's sierran environment would have been foreign to marine animals and their artifact shells.³³

Canonical and effective for communicating across Andean valleys, the iconic conch call—its ubiquitously reproduced, powerful sounding tone—is merely one manner of performing a pututu. An extensive range of expressive techniques, including the projection of breath and human vocalizations, percussive soundings that enable rhythmic articulation, flutter-tonguing, and diverse exploratory ways of making sound³⁴ have been observed in use by living musicians in the Andes. Such a range of soundings makes this instrument useful across distinct acoustical settings, and for communication purposes beyond signaling outdoors. Practices I reference here have been documented in Chavín pututu research with master musician and sound healer Tito La Rosa,³⁵ in fieldwork collaborations with pututu performers from diverse backgrounds, observations of pututus in Peruvian public events, in a new ethno-archaeomusicological study about Chavín sound-producing instruments in collaboration with Andean performers having varied musical backgrounds,³⁶ and in highland ceremonies in rural Hatun Q'ero as documented by Peruvian ethnomusicologist Martha Paola Acosta-Díaz.³⁷ Experimental performance demonstrates the sonic and gestural possibilities that these instruments offer, enabling the evaluation of their specific functionality in associated archaeological settings. Observational studies

of instrument use provide an empirical counter to the assumption of performance practices on the basis of theory or music history. Demonstrated practices may be inferred pertinent to Chavín depending on their functionality within acoustical settings of the site, and with respect to other material factors.

Chavín's well-preserved architecture enables experimental explorations of sound-production possibilities, based on mechanics, using both site-excavated soundproducers and modern replicas. In tandem, acoustical measurements and analyses provide comprehensive and scientifically repeatable assessments of the dynamical features of performance contexts and hypothetical conditions based on archaeological evidence. Use-potential evaluations of archeological materials can reveal contextual likelihoods given converging forms of evidence. Archaeological performance studies can also be informed by situationally relevant ethnological analogy, a basic tool for archaeological inference. However, the potential for anachronistic assumption underlies any reconstructive research practice, such as performance testing. Given the prehistorical situation of Chavín, reconstructions are best grounded in archaeological materials, with respect to the site's highland valley setting and what is known of its temporal context.

Whether or not specific performance practices would have been preferred at Chavín cannot be known with certitude; however, the work of archaeology is to evaluate the plausible, and to propose evidentially based interpretations that in part, define context. Therefore, starting from the greatest range of sounding potential of the Chavín pututus, I relate

their physical-mechanical features with site materials and acoustical settings to circumscribe site-relevant performance techniques and sonic efficacies. This is archaeological contextualization of musical/sound production, from a material-functional perspective; aware of, and mediating, anachronistic biases. Human creativity tends to disrupt norms and exceed rather than conform to expectations; therefore, the role of experimental archaeology within an archaeological science paradigm is to assume the human capacity for innovation and contextual responsiveness, rather than to reproduce anachronistic knowledge. My study investigates the functional potential of the Chavín pututus with respect to their material contextual evidence, particularly their relationship with site spaces, the sierran environment, and the larger Andean sphere of ecological knowledge as represented in Chavín materials.

Several common and pervasive presumptions about sound and music³⁸ preface studies of Andean conch horns including the Chavín pututus, which have more frequently been called "trumpets" in prior archaeological discourse. Categorically "annunciatory" and sometimes "musical," where they appear publicly, pututus represent Andean "tradition." In present-day ceremonial use and heritage reconstructions in Perú, pututus typically serve as a decorative accessory rather than an operational element. In these events, their sonic utility is limited to convocational functions such as announcing the presence of important figures, and cultivating ambiance.³⁹ If not performed briefly as a symbolic gesture by a leader, pututu performers are musicians who serve ancillary roles: pututus provide

accompaniment or emphasis in ceremonial activities in which nonverbal soundmaking is not prioritized. Defining the pututu as an announcing device across archaeological and music archaeology literature has normalized a concept that can be traced to historicized Inca iconicism of the recent past,⁴⁰ rather than developed from Chavín archaeology and knowledge of the sounding mechanics of these pre-Inca, site-excavated instruments. In tandem, reproducing European musicological and present-day commercial paradigms to differentiate Chavín “musicians” from other ritual actors—as well as assuming an accompaniment rather than integral model for ritual sonics—has reinforced an archaeologically unsubstantiated model of prehistorical pututu players as subservient to more powerful figures. Identifying and dropping such anachronistic presumptions—and instead exploring the Chavín pututus as site-situating archaeological materials, in dynamical relationship with their settings—re-engages the potent sonic materiality of these multifaceted ritual instruments.

Andean archaeological and heritage discourse reinforces the obvious characteristics of conch-shell horns—foremost, their powerful, tonal projection, and less frequently, their essential relationship with water. In a comprehensive pan-Andean survey of pre-Hispanic trumpets, Andean music archaeologist Mónica Gudemos has asserted that, parallel to their powerful iconic sounding, pututus have long symbolized wealth and power.⁴¹ Non-archaeoacoustical discussion about the Chavín pututus has emphasized a few key features of the instruments to support models of Chavín ritual, considering them to be supporters of ritual

ambience rather than communication technologies. Following archaeometric methods, my site-contextualized analyses reveal material and functional factors that greatly expand estimations of pututus’ expressive performance potential, relevant to the use of pututus for both sound production and other forms of ritual communication at Chavín.⁴² Examining these pututus as mediating tools—ritually significant objects with particular visual-symbolic significance as well as sonic functionality: *multimodal communication technologies*—reveals overlooked evidence for Chavín’s ritualscape and its multifaceted positionings of human–environmental relations. Only through a dynamical and multimodal understanding of the pututus at Chavín can we make appropriately site-contextualized inferences regarding their cosmological relevance and significance. A material-dynamical investigation of pututus at Chavín contributes functional knowledge that is missing from the literature on pututus and musical instruments in the ancient Andes, with implications for heritage representations and historical interpretations, as well as Chavín archaeology.

The ubiquitous and limiting announcement paradigm for pututus appears to constrain present-day Peruvian usage of conch-shell horns in public events and ceremonies, and perhaps more broadly across South America. A signifier of Andean heritage, pututus invoke indigeneity; their historical presence is dominated by references to the broadly disseminated drawings of Felipe Guamán Poma de Ayala, the sixteenth-century chronicler of the Spanish Inca conquest and colonial conflict.⁴³ Both heritage evocations and scholarly treatments have followed these

historicized definitions. Throughout Andean archaeological discourse, where pututus are mentioned, they signal, announce, and call across distances or call to attention. Gudemos has identified their sonic power with socio-political status.⁴⁴ Music archaeologist Anna Gruszczyńska-Ziółkowska's discussion of Inca pututus as "instrumentos de toque"—signaling instruments—implemented in battle and for other projections of political power, is commonly referenced; however, in the same text, without elaboration, Gruszczyńska-Ziółkowska notes that pututus also carry a magical significance.⁴⁵ In a discussion of Moche shell "trumpets" that are ceramic skeuomorphs of marine-shell horns, Gudemos has posed that for shell horns, "the ability of the player allows the production, although limited, of different tones through different lip pressures and breath intensities."⁴⁶ In the Chavín literature, impressive loudness and "noise" as a principal characteristic has been cited by both Chavín expert John Rick⁴⁷ and Andean archaeologist Alexander Herrera, who has further proposed that their function was "signalling key points or lapses within sequential acts of collective worship" in a setting in which Herrera asserts "we need to imagine their thundering sound as overlaying that of rushing water emanating from underground canals."⁴⁸ Whereas these scenarios are plausible, they assert as essential only the most canonical understanding of pututu functionality.

To date, the most extensive and multimodally salient archaeological interpretation of pututus within a discussion of Chavín ritual was not developed in a typical scholarly text, but in a graphic novel drawn by Peruvian archaeologist Miguel Ortiz, produced in 2015 by the Chavín

archaeological program led by Rick with Peruvian archaeologist Augusto Bazán, who together collaborated on the story. In this prehistorical narrative aimed at students and popular audiences, pututu players are featured across various ceremonial contexts, performing roles such as greeting the arrival of visitors, creating loud sounds inside the galleries, and processing with offerings, indicated via variations of "THUUUUU."⁴⁹ Their feathered costumes mirror depictions of pututu players carved in stone at the site, and have been recreated as an accessory for site pageantry, such as the inauguration of the 2019 archaeological symposium about Chavín, in which feathered pututu performers created an ambient drone as background to an earth-honoring ceremony chanted in Quechua. Although integral in these interpretations, pututu performers are nonetheless restricted to subservient roles as ritual accessories. What is the evidence for projecting this particular conceptualization of pututu performance back to Formative Chavín, where pututu players are among the most prominently represented figures in its iconography (see Fig. 3, next page)?

Of the non-acoustical, materialist discussions of the Chavín pututus, Andean archaeological scholar and musicological specialist Mélanie Ferras has ventured farthest interpretatively, in a discussion that "highlight[s] the symbolic aspect of the choice of the pututu as one of the central artifacts of ritual practices in Chavín." Arguing against what she characterizes as the "utilitarian" objectification of pututus by chroniclers of the Inca, Ferras has proposed with poetic precision that the Chavín pututus emblemized power through their control by humans who directed water movement at the power center of Chavín: "these artifacts are symbolic markers of the origin of

power in Chavín de Huántar, water and its control... the ingenuity of the pututu comes from the fact that they not only symbolically represent the aquatic element, but with their powerful sound, they also manage to materialize it, approaching the natural sound of water.”⁵⁰ Ferras’s interpretation incorporates material archaeological evidence in situating the importance of pututus to Chavín as intrinsic to water ritual, concluding that “the presence of this concentration of pututus and their many graphic representations take on their full meaning: these artifacts are symbolic markers of the origin of power in Chavín de Huántar, water and its control.... The human blowing in the pututu recreates the sound of the water, appropriates it, and thus re-performs the control he exerts on it.” Ferras’s acknowledgment of the mimetic potential of pututu sounding is important to fostering discourse beyond the calling paradigm. In her study, Ferras built upon

Chavín themes proposed by Peruvian archaeologist and Chavín specialist Luis G. Lumbreras⁵¹ that were also explored in the initial Chavín pututu study by Andean archaeologist Parker VanValkenburgh, an extensive, non-acoustical characterization of the instruments and the production strategies implied in their creation.⁵² Ferras has incorporated recent archaeological findings, including Rick’s developing work on water ritual,⁵³ in her article associated with the development of her doctoral dissertation that situates the Chavín pututus with respect to their broader Andean temporal context.⁵⁴ By aligning the pututus’ sound production with aquatic sonics, both Herrera and Ferras propone a water-ritual-enhancing role for the pututus. Herrera emphasizes impressive sonic display, whereas Ferras argues for the ceremonial activation of pututus calling for water, or ritually signaling water through sonic mimesis.



Figure 3: *Pututu*-playing personages are positioned as if in procession on human-level facing stones encircling the interior wall of Chavín’s 21-meter-diameter, countersunk Circular Plaza, a ceremonial locus where *pututus* figure prominently in diverse forms of evidence. Photo by José Luis Cruzado Coronel and Miriam A. Kolar.

The first analytical study concerning the Chavín pututus focused on their demonstration of Chavín's interregionalism through object morphology and iconology.⁵⁵ In response to their excavation, VanValkenburgh, then a student of Rick, conducted an extensive physical study of each shell, tracing iconographical associations and inferring a range of production methods for the prominent apical notches (the “Chavín cut” in each shell's upper lip)⁵⁶ that characterize the pututus excavated from Chavín (and three similar pututus from a related site, Kuntar Wasi, that Ferras has since considered in more detail).⁵⁷ Although ergonomic (“handgrip”)⁵⁸ and performance (“enhanced frontal vision”)⁵⁹ functions have been suggested for this feature, multiple functions are not contradictory, and I agree with Rick that these notches seem to mark the pututus as belonging to Chavín.⁶⁰ Ritual notching would be consistent with a kind of initiation rite or other ceremonial activity to integrate the pututus (and likely their associated humans) in site ritual, possibly related to interregional competition, and/or community building, among plausible functions corroborated by VanValkenburgh's iconographical situating.

To further interpret the notching of the Chavín pututus, I suggest that a particular form follows particular functions, and that multiple purposes are likely, perhaps one initially suggesting another that then became encoded. Here, I pose a sculptural-representational interpretation for the notch, corroborated by audience members of my public presentations about Chavín during post-lecture discussions. The apical notches on the Chavín pututus create the appearance of an avian wing emerging from the shell's lip. On some of the pututus, this visual-

mimetic gesture is physically underscored by linear carvings along shell striations, perhaps transforming these pututus' structural indentations into representations of wing feathers (see Fig. 4).⁶¹ A connection between aquatic animals and airborne fauna, worked into these pututus' form, mirrors the much-discussed Chavín graphical trope of compositing features from distinct living beings to create mythological superbeings. Pututu wings make explicit a connection between these instruments of air and creatures of the air, capable of flight, suggesting a conceptual figuration of soundings as flight; as airborne agency.

The amalgamated, supernaturally potent predatory beings depicted in Chavín iconography have long intrigued scholars. Both Lumbreras and Andeanist Richard Burger, who established a chronology for its ceramics based on his excavations of residential Chavín⁶²—as well as their Andeanist colleagues Rebeca Carrión Cachot,⁶³ John Rowe,⁶⁴ Donald Lathrap,⁶⁵ Henning Bischof,⁶⁶ Peter G. Roe,⁶⁷ Gary Urton,⁶⁸ and Mary Wiesmantel,⁶⁹ among others—have emphasized supernatural



Figure 4. A Chavín *pututu* on display at the Museo Nacional Chavín. The pronounced notch to the upper/apical lip combined with linear engravings suggests the contours of an avian wing and feathers. Photo by José Luis Cruzado Coronel.

interpretations of Chavín's visual culture. Whereas Chavín's figural iconography depicts agents of ecological dominance, these evocations of apex predators occur in mythical or imagined combinations, including anthropoid figures who hold what have been interpreted as *Strombus* and *Spondylus* sea shells, and the locally sourced "San Pedro" cactus (*Echinopsis pachanoi*). Combinations of features from different predators have been posed as evidence for intentionally encoded ideas (e.g., Rowe's "kenning"/substitution model),⁷⁰ shamanic transformation (e.g., Torres' metaphorical-metamorphical discussion and Weismantel's reconfigured animism),⁷¹ and even as suggesting that their depicors lacked actual experience with the animals represented and instead interpreted them from descriptions or traded goods.

Chavín's anthro-zoomorphic beings have been read as evidence for consciousness-transforming ritual practices;⁷² the giant stone "tenon heads" once pegged into the tops of building facades frequently depict upturned eyes, grimaces, and mucus trails descending from nostrils, all ethnographically observed features from the consumption of botanical psychotropics in Amazonian shamanic practices.⁷³ In the context of these features, Chavín's amalgamations of living beings have been interpreted as evidence of psychotropically enhanced ritual transformations between human/nonhuman predatory animal/divinity states. Andean art historian Constantino Manuel Torres has argued in detail for these shamanistic interpretations, noting that "transformation, or the acquisition of zoomorphic attributes, is a common thread running through the literature on shamanism....It is not only transformation into jaguar or bird, but also

the accumulation of diverse zoomorphic traits."⁷⁴ Andean anthropologist and visual culture theorist Mary Weismantel has proposed that Chavín's "stones did not just offer images that represented a shamanic vision; by offering an encounter with a body both like and unlike their own, the stones actually materialize shamanic looking as a bodily, sensory experience."⁷⁵

Given the vast array of depicted superbeings with kinetic implications within Chavín's elaborate built environment, such transformations were likely enacted at Chavín. The production of transformations, shamanic and theatrical, requires humanly manipulable tools, in both the tangible form of physical objects and the intangible medium of performance. At Chavín, these transformations would have been interactive with its architecture and highland setting. Pututus would have been multimodally functional in such a ritual context, serving simultaneously as animate/animable symbols and as objects of sensory interaction that facilitated or accompanied the transformation of their human performers into/as amalgamated superbeings. In this context, the distinct carvings on each pututu somehow related pututus with their (super)human associates.

Apart from VanValkenburgh's detailed study that links similarities in the iconographic elements of pututus with graphics from Chavín-associated sites, and further discussion by Ferras that highlights the powerful zoomorphic representations on some shells,⁷⁶ the signification potential of the pututus' engravings has not been explored with respect to their sociological implications. Each pututu's imagery suggests work by a different craftsperson (or people), perhaps representative of diverse sites or polities,⁷⁷ strong supporting

evidence for the idea of Chavín as a center of convergence among elite regional leaders or other individuals of means to have acquired these rare prestige goods. Rick has suggested that the distinct carvings on each pututu, while demonstrating interaction among power centers, may further relate to competition among them.⁷⁸ I return again to the material-contextual focus of my study, and point out the persistence of graphics on the shells despite notching that seems to have occurred after their decoration, because some engravings seem to have extended through the excised areas. These graphics facilitated messaging that was not erased despite other modifications to the pututus.

The preservation of identity-projecting visual signage on these instruments—within Chavín’s system of social ordering and access-resource control—is consistent with the positionality of pututus as status markers. Not only were they rare prestige goods with particular sound-producing potentialities, but pututus are graphically depicted across Chavín iconography; they are one of only a few objects held by anthro-zoomorphic, superhuman figures (as shown in Figs. 3 and 8). I propose that the human-pututu relationship was socially pivotal at Chavín, in keeping with patterns of hierarchical control and superhuman projections reiterated across site materials. Sociopolitically, the Chavín pututus would have facilitated elite status and simultaneously provided a multimodal mechanism for projecting that status. A pututu performer’s versatility, nuance, and sensitivity to contextual acoustics—including interaction dynamics with other pututus—would have functionally substantiated that individual’s pututu association, legitimizing the relationship/status through ritual production; through

performance of symbolic relationships. The following discussion of site archaeoacoustics, performance experiments, and music archaeology propels my argument.

Pututus at the “Sounding Temple”: Performance and Contextual Affordances in Chavín Ritual

Testament to the technological prowess of its constructors, the stone-and-earthen-mortar architecture of the monumental center at Chavín de Huántar visually dominates its narrow highland-valley river plain, having withstood repeated landslides and earthquakes since the first millennium B.C.E.⁷⁹ Recognized as a UNESCO World Heritage site since 1985,⁸⁰ Chavín welcomes tourists year-round under the auspices of the Peruvian Ministerio de Cultura (Ministry of Culture) and has hosted archaeological fieldwork since the early twentieth century.⁸¹ Contextually appropriate conservation⁸² is prioritized in current site research led by archaeologist John Rick of Stanford University with several Peruvian co-directors, a program in its twenty-sixth year in 2019, to which I have contributed as an associated researcher, leading archaeoacoustics and music archaeology investigations at the site since 2008.

Chavín’s archaeological reputation as “the sounding temple” comes not from its pututus, but from hypothesized architectural acoustics and a sonic observation claimed to have been made during experimental hydraulics testing of the under-staircase canal that flanks its Circular Plaza. In their 1976 publication, Peruvian archaeologist Luis G. Lumbreras, with colleagues Chacho González and Bernard Lietaer, posed “a hypothesis about an acoustic sound-producing system, and

a hypothesis about a hydraulic system to feed it” within Chavín architecture, which includes “tubes for sound to exit resonance rooms,” but they did not conduct acoustical measurements or make further tests.⁸³ Historical recognition of ritualized sonics at Chavín dates to sixteenth- and seventeenth-century European explorer-missionaries’ discussions of an “oracle site” where a so-called demon spoke. An account from 1691 describes Chavín as “a building that is very feared and greatly venerated and they call it the house of the *huacas*” where “they [the *huacas*] spoke and answered the men [who were] their children, and [they spoke] to the heads of lineage that exist today among the Indians of this land.”⁸⁴

Despite the importance of sonic communication to these historical and archaeological claims, archaeoacoustical investigations were not engaged at Chavín until our acoustical project formed in 2007 at Stanford University, spurred by discussions with Rick initiated by composer and computer music pioneer John Chowning.⁸⁵ Sonic inquiry had been re-sparked by Rick and team’s 2001 excavation of the Chavín pututus, 20 intact, decorated marine-shell horns also known as “shell trumpets” that grounded evidence for sound-producing instruments at the site beyond its previously known graphical depictions.⁸⁶ Upon their discovery, Rick charted the playable pututus’ sounding tones with his guitar tuner and enlisted an acoustician to metrically evaluate their sound-producing potential. David Lubman, a fellow of the Acoustical Society of America (ASA) whose work on the Kukulcan Temple staircase chirp at the Maya site Chitzén Itzá was one of the earliest and most widely publicized archaeoacoustical studies,⁸⁷ ran spectral analyses on Rick’s

audio recordings. In his preliminary study, Lubman calculated a plausible sound transmission range for such instruments and presented his findings at a meeting of the ASA in 2002.⁸⁸ Lubman’s estimations provided Rick with metrics and a scientific basis for claims about the pututus’ loudness and transmission range, useful descriptors that conform to normative definitions of the instrument.

Following on his initial loudness-limits approach to the instrument, Rick wanted to know more about the functionality of pututus at Chavín, and in discussion with Chowning, invited researchers from Stanford University’s Center for Computer Research in Music and Acoustics (CCRMA) to engage a comprehensive study of the 19 Chavín pututus then housed in the Museo Nacional Chavín and to conduct exploratory fieldwork starting in 2008.⁸⁹ During our initial investigations, audio scientist and applied mathematician Jonathan S. Abel led digital signal processing analyses at Stanford, in collaboration with computer musician and vocal acoustical modeling specialist Perry Cook. Cook performed the pututus in the systematic measurement sessions at Chavín that I organized, assisted by audio scientists Patty Huang and Jyri Huopaniemi, and documented in photos and videography by José Cruzado, Cobi van Tonder, and Stacie Brink. Rick called on Peruvian master musician Tito La Rosa as an expert performer to join our evaluations of the pututus in the museum (see Fig. 5). In addition to acoustical measurements of the excavated pututus, in which shells player Cook demonstrated a range of sounding techniques, our group commenced on-site testing with shell-horn replicas, joined by performance theorist Chris Chafe, director of CCRMA. The

complementary and overlapping expertise among our team strengthened the rigor of our methodological decisions. Our initial research plan was to adapt established experimental acoustics methods to Chavín's extant architecture and sound-producing instruments, both for documentation and to validate reconstruction estimates in planned computational acoustical modeling. During our group's initial visit inside Chavín's interior "gallery" architecture, Rick demonstrated that pututus can serve as vocal amplifiers rather than tonal sound producers by using one to simulate feline roars in reference to the site's plentiful feline depictions.



Figure 5: Peruvian master musician and sound healer Tito La Rosa performing a Chavín *pututu* as part of 2008 musical acoustics research at the Museo Nacional Chavín. Photo by José Luis Cruzado Coronel.

Rick's megaphonic illustration of pututu functionality leveraged on-site experimental performance to pose an alternative practice to tonal production, descriptively referred to by Cook in systematic measurement research as "toots" and "blasts."⁹⁰ Among their extended range of sonic articulations, *Strombus* pututus can amplify human vocal production, enhance mimetics of nonhuman animals, and transform human breath into wind- and water-like sounds.⁹¹ In his 2008 research performance of Chavín pututus where these instruments

are preserved and displayed in the Museo Nacional Chavín, La Rosa initiated long-tone, circular-breathing-supported playing of each Chavín pututu by blowing breath through the instrument without producing tonal sound. He amplified the sonic gesture of his breath as if joining it with wind, a metonymical association I make here, without knowledge of La Rosa's intention. This master musician's performance choreography, sending amplified breaths toward each of the cardinal directions, emphasized a specific relationship with the Andean sierran setting common in earth-honoring ceremonies.⁹² We cannot know whether these performance techniques or my readings of their symbolic relationality map to Chavín pututu performance 3,000 years ago; yet, they constitute demonstrations of the sonic-expressive potential of pututus that can also be tested in site acoustical settings, and with respect to other archaeological materials.

Evaluations of an instrument's sounding potential – in these examples, the contrasting demonstrations by Rick, Cook, and La Rosa on *Strombus* pututus – vary depending on the technique and experience of researcher-performers. Peruvian archaeological logistical specialists and pututu players Riemann Ramírez and José Cruzado, who have worked with me to produce on-site performance experiments over several field seasons at Chavín, have mastered some specific techniques that La Rosa did not employ, including rhythmic articulations such as mouth-corner fluttertonguing, which creates a complex sound distinct from canonical tonal blasts. These and other experimental performance tests we have engaged demonstrate specific interaction dynamics of Chavín pututus (and their functionally representative present-day

Strombus replicas) with performance settings. For example, in Chavín's interior architecture, the short reverberation times across all but the lowest frequencies, with modal-resonance reinforcement of pututu sounding tones (1) sustains low-frequency tonal drones, yet (2) permits accentuated clarity in gestures with higher-frequency energy, such as Rick's broadband feline roar, or breath-based expressions.⁹³ La Rosa's research performance in the Museo Nacional Chavín demonstrated how that space's long reverberation times with discrete echoes are acoustical effects that become central to expressive timing: La Rosa synchronized performance gestures, including his breathing patterns, with the return of echoes and the sustained tones created by the powerful reverberation in that voluminous concrete museum. Ramírez's and Cruzado's site performance experiments have demonstrated how pututu gestures can be modified to produce or obscure distance cues, such as with echo sequences in the outdoor Andean environment and on terraces and plazas among building facades.⁹⁴ Spatial-environmental acoustics do not determine performance practices, yet these and other experiments have documented how acoustical feedback strongly influences the selection and timing of sound production and musical gestures. The built environment, whether or not constructed to enable specific acoustical effects, contributes to the sonic communication substrate in accordance with particular affordances.

Functional analyses of instrument and architectural acoustics and their performance interactivity align with the empirical scientific approach prioritized in archaeometric fieldwork at Chavín

guided by Rick over the past quarter-century. In publications that detail metrical data toward functional explanations of Chavín's built environment, Rick discusses how "different architectural layouts with varying scales, inter-visibilitys, decoration, and other features would have been effective for specific ceremonies and their cultic outcomes."⁹⁵ Rick's sociostructural interpretation "defines a set of enactors," designers, leaders, and participants in Chavín religion whose intentions and desired outcomes can only be speculated; what can be known most specifically derives from "architectural contexts [that] give hints about the strategy of the planners and the experience of the participants."⁹⁶ Rick has characterized the religious organization of Chavín as "a variant of a secret society—in many ways, a cult that relied heavily on restrictive control of information within a limited membership with implications for rights and privileges such as access to resources."⁹⁷ In earlier research, Rick collaborated with his former doctoral student, archaeologist Sylvia Rodríguez Kembel (who conducted a comprehensive laser-scanning-mapping project to produce a new site chronology),⁹⁸ to lay the groundwork for a theory of Chavín as a cult initiation and training center⁹⁹ whose social structure relied on a "tradition-based convincing system."¹⁰⁰

Drawing out a detailed cross-temporal architectural analysis, in their 2004 article, Kembel and Rick proposed that while Chavín's exterior architecture projected "the authority of Chavín's leaders" its experientially focused interior spaces constituted an

internal landscape of galleries using a range of natural elements to communicate a message of power to

visitors. Twisting, disorienting, multi-level galleries, with walls encased in multi-colored plaster and decorated with niches, form the artificial setting for what we believe to have been a ‘multimedia’ display designed to convince visitors of the power of the site, its deities, and their human representatives: anthracite mirrors strategically directing light into galleries through ventilation shafts from the exterior . . . smoke easily transferred from one gallery to the next via internal ventilation shafts, internal water canals purportedly sending roars of sound into the galleries . . . and visually elaborate stone decoration and art, all experienced during ritual drug use . . . would have provided a full sensory impact – and probably overload. With these elements, the leaders at Chavín de Huántar gained control over the visitors’ environment.¹⁰¹

Ritual performance of Chavín’s built environment—the dynamical activation of architectural and landform surroundings through theatrically valent interactions—could produce sensory effects associated with recognition of environmental risk and the demonstration of its control.

Ritualized activations of a designed environment activate the human–environmental conceptualizations it manifests. Archaeologist Daniel Contreras, who led fieldwork in Chavín’s West Field sector while a doctoral student of Rick, has developed an environmentally situated sociopolitical analysis. Contreras proposed that

the ritual structures and landscape suggest that ritual at Chavín served both strategic purposes (i.e. the legitimation of authority...) and apotropaic purposes (i.e. dialogue and relationship with supernaturals/deities). Ritual, in this context, may also be understood as a rational response to situation in a risky environment—or, more specifically, to

a conception of nature as perverse. The landscape itself, as well as the architecture within it, was thus an important medium of communication, whether the target of that communication was elites, commoners, or supernaturals (or all of those simultaneously).¹⁰²

In subsequent work, Contreras further developed his interpretation of Chavín’s human–environmental positionality, proposing that “the construction of Chavín’s setting was a statement of capacity—such a project visibly projected the ability of those behind it, not only to mobilize labour and plan massive construction, but also to negotiate with an animate landscape from a position of relative strength and to manage a reciprocal relationship with the animate environment, not simply as a supplicant, but as a partner.”¹⁰³ Building on Contreras’s point, I propose, via a dynamical assessment of converging material factors, that one such negotiation was specifically enacted through pututu performance. Ritual enactment using ecologically representative objects and materials translates conceptualizations of human–environmental relationships into symbolical interactions.

The environmental interactivity evinced and communicated in landscape modification and architectural development at Chavín might be understood as both product of and instrument for a religious organization that Rick has described as “an evolved shamanism” where authorities or cult “priests” legitimized their power through sensorial powerplays.¹⁰⁴ Peruvian archaeologist Christian Mesía-Montenegro, who excavated ritual production areas at Chavín while a doctoral student of Rick,¹⁰⁵ has situated this religious model anthropologically and sociologically:

...authority at Chavín was derived from recourse to shamanistic practices. According to ethnographic research, shamans generally serve their society in a manner that dispenses with explicit manifestations of a position of power in that society; they pursue the same livelihood-related activities as the society's other members. According to Rick, Chavín's authorities presented themselves as successors to a pre-existing shamanic tradition which they actually carried much further: they no longer served it but made it serve them; that is, they succeeded in constructing an image which purported to perpetuate ancient traditions, whereas in fact, they were upending the existing systems and directly benefitting as a result.¹⁰⁶

Mesía-Montenegro's emphasis on the duality of shamanic-quotidian identity provides a sociopolitical model to fit Chavín evidence: shamans might be perceived as humans having superhuman potential; humans who had acquired the capacity for superhuman transformation. Superhumanization at Chavín would thus have served as both a social mobilizer and authority-legitimization strategy that leveraged pututus and other site technologies not accessible to quotidian humans. Access to these tools—and specialized skill in using them—thus indicated elite status, and could facilitate higher social movement in Chavín's ritual corporation. In accordance with this model, the Chavín pututus are positioned as multimodal ritual tools to facilitate and project elite status, mobilizing the symbolical relationships expressed in site materials by facilitating the performance of superhuman transformations, thus enabling major social leverage at Chavín.

If the pututu functioned as a ritual tool in transformations operational to Chavín's

hierarchical machinery—even facilitating that corporate structuring as well as ritual functions—what were those transformations, and how did they work? In their emphasis on features enabling physical dominance, such as fangs and claws, Chavín's supernal multibeings are decisively power-projecting. What might be implied, then, by the pututu with facial features and fangs that is held by a snake-haired personage on one of Chavín's stone plaques? One way to read this depiction is that it asserts a corporate hierarchy, beyond humans, reaching cosmologically: the fierce, snake-haired superbeing holding the fanged pututu is controlling a fierce nonhuman being that is similarly supernal to its marine counterpart. In Chavín graphics, winged humanoids hold pututus with their spires removed (to make submissive instruments/vocal channels), and fiercer, more zoomorphic personages grasp spire-intact, animated conch shells. Across representations, hierarchically tuned power plays characterize Chavín knowledge design in its dissemination materials, crossing communication modalities¹⁰⁷ with purposeful demonstrative currency.

Rick's site interpretations interrelate multimodal factors in a narrative about strategic design: "At Chavín, much of the development of technology—for example, ceramic, stone, bone, shell, acoustic, constructive, hydraulic developments—seems tightly linked to a driving need to innovate in ritual contexts, acts, and effects."¹⁰⁸ Sensorially potent representations of beings with amalgamated power features would have enabled their promoters to enliven cosmological narratives—perhaps aligning themselves as supernaturals, or claiming intermediary status—thereby constructing or reinforcing Chavín ideologies via both materials and performances to justify

their positionality as world-builders (cosmological agents). As a pivotal operator in multimodal expression, sonic culture—especially performed, interactive narratives built from physical-sonic demonstrations rather than verbalizations of meaning—would have supported, leveraged, and superseded static visual messaging.

How pututus fit within Chavín's hierarchical chains-of-being associations underlies the ways that pututus could have sonically expressed dominance; yet their acoustical fit with site settings is equally important, given their use-wear evidence and sound-producing potential. A facile assertion of loudness fails to address with specificity the range of ritual settings that Chavín's other cultural materials evince. Conch-shell horns—Chavín's emblematic sound producers—can generate powerful sounds that demand attention, but that is only one use for an instrument that facilitates many sonic expressions, within a built environment whose range of structural and acoustical settings imply contrasting ritual functions. When performed by adept players, *Strombus pututus* produce myriad sounds in frequency and gesture, across a dynamic range from near inaudibility to around 96dBA and even up to 110dBA at one meter without acoustical reinforcement.¹⁰⁹ The sonic nuance possible in pututu performance—explored in relationship with the monumental architecture and material culture of Chavín—constitutes evidence for communication strategies and experience design operational to the transformational experiences required for world-building in this “place apart;”¹¹⁰ a deliberately multimodal “ritualscape.”¹¹¹

Chavín's well-preserved built environment has enabled comprehensive architectural-acoustical research to test,

document, and characterize both interior spaces and exterior areas. Of particular relevance to site ritual, the Lanzón Gallery encloses the Lanzón, a vertically oriented, 4.5-meter-high granite monolith, relief-carved into a fanged, anthro-zoomorphic figure with upturned eyes, clawed hands, and snakes around its head. Its name in Spanish indicates its lance-like form; in the archaeological literature this engraved monolith has been agnostically termed the “Great Image” by Rowe.¹¹² However, both its naming and structure may imply skeuomorphical representation, especially with a ceremonial agricultural implement that pierces the ground, according to Andean art historian Tom Cummins.¹¹³ Evidence for increasing architectural envelopment of the Lanzón over time supports claims of its heightening importance (or its role in fomenting mystery) at a site where access to spaces was further restricted over time.¹¹⁴ A hidden, access-controlled image-being shrouded in architectural mystery, this towering *huaca* has been proposed as an apex of a ritual journey with an oracular function.

The ceremonial locus of the Lanzón Gallery and the countersunk Circular Plaza to its east—an area with a convergence of pututu-related evidence—would have been a sensorially intensified “place apart,”¹¹⁵ faced with relief-carved, then-colorfully adorned plaques encircling its 21-meter-diameter, sound-focusing walls. When intact, its polished stone floor and isolation from the exterior environment and other site spaces by tall, rectilinear side walls would have emphasized stillness and silence, with the potential for contrasting loudness through sound-making activities that would lose very little acoustical energy in a lengthy sequence of reverberations among polished

stone surfaces. Such a place enabling an extensive acoustical dynamical range, where sensoria could be controlled to extremes, would have been instrumental in producing the sudden perceptual contrasts that direct people's attention and produce heightened affective responses. Sound sensing—both via auditory perception and also through physical vibrations felt throughout the body—is neurologically linked to visual psychology, yet provides connections among other sensory modalities, to produce holistic perceptions and strongly encoded memories.¹¹⁶ The presence of pututus, in and around this sensorially catalytic architecture, underscores the importance of sound-sensing in Chavín ritual.

Converging material evidence associates the Chavín pututus with the Circular Plaza: they were excavated in two small galleries adjacent; several fossil sea-snail shells adorn the plaza floor, whose surface stones were arranged in a polished black-

and-white design; pututu performers are featured on engraved stone plaques lining the plaza walls (Fig. 4). However, it is architectural acoustics that dynamically corroborate pututu associations here: three horizontal ducts opening on the wall and staircase between the Circular Plaza and the Lanzón Gallery mechanically facilitate the sounding tones of pututus to pass through, while filtering out frequencies important to the definition of many other sounds, such as human speech. The central duct, opening on the impressive staircase that overlies what has become known as Chavín's "acoustical canal," further emphasizes sonic frequencies in the articulation range of the Chavín pututus. In initial discussion of my measurement and analysis of these built acoustical features (diagrammed in Fig. 6), I emphasized their perceptual implications; the ritual communication channel that they facilitate:

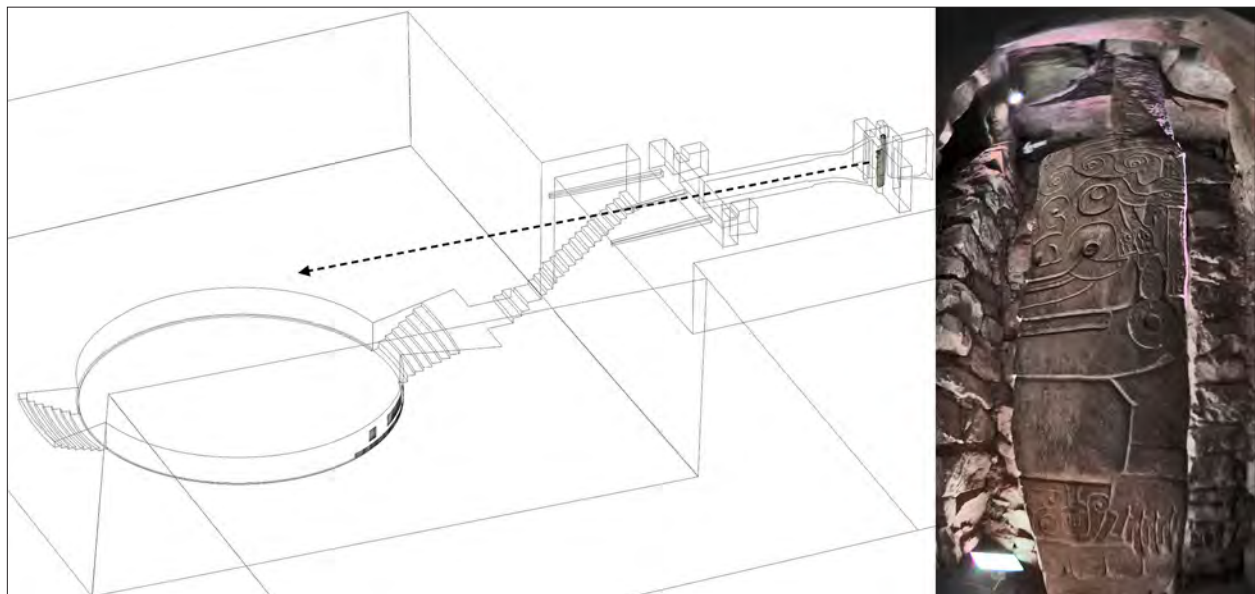


Figure 6: Architectural reconstruction of Chavín's Lanzón Gallery and Circular Plaza (left), highlighting the direct sound transmission path from the area around the Lanzón monolith through the gallery and out into the plaza, with the 4.5-meter-high granite figure depicted in place and shown in a fisheye photo (right). Reconstruction by Miriam Kolar and José Luis Cruzado Coronel from in-situ measurements and with architectural data courtesy of Silvia Rodríguez Kembel. Model, illustration, and photograph by José Cruzado; composite figure previously published in article by Kolar, *Acoustics Today* (14/4: 34; Fig. 6).

... the central duct is the shortest transmission path for sound produced inside the gallery, on its central axis, to enter the outside world [of the Circular Plaza] . . . sound produced inside the Lanzón Gallery impresses an outside listener most prominently from the direction and location of the central duct's opening on the staircase. Due to the psychoacoustical precedence effect, sound would seem to emerge from the location of the Lanzón, the "Great Voice" of Chavín, its proposed oracle.¹¹⁷

Visually, the Lanzón cannot be appraised except from within its gallery; however, given that sound travels where images cannot, sound made in proximity to the Lanzón could be directed into the Circular Plaza as an indication of presence—a sonic representation of the idea of the Lanzón, or perhaps a ritualized channeling of its voice. Knowledge that the Lanzón existed somewhere inside the monumental buildings¹¹⁸ would have primed site visitors to anticipate Lanzón-associable signals produced from the interior and directed outwards. Bidirectional communication would also have been possible, although hierarchical frameworks throughout Chavín suggest that directionality of sound moving outwards was privileged. Sound-sensing, rather than vision, would have been an effective and mystery-promulgating transmission modality for directing information from the Lanzón's location to exterior locations and awaiting constituencies.

Acoustical analyses of the ducts that interconnect the Lanzón Gallery and Circular Plaza reveal a mechanism that specifically links pututu soundmaking with architectural design at Chavín. Other examples of architectural acoustical enhancement of pututu sound relate

especially to the ways in which acoustical feedback affects performance choices—dynamics that can tangibly alter how humans use pututus to produce sound. The acoustical resonances supported by the width and height dimensions of Chavín galleries and canals, typically in the range of one to three meters, amplify tones in the most readily produced range of pututu performance. My experimental work with replica *Strombus* pututus in collaboration with José Cruzado (see Fig. 7, next page) demonstrated and produced documentation of a particular "resonance compliance" effect between pututus and gallery architecture, and also between pairs of pututus.¹¹⁹

The acoustical resonance compliance effect physicalizes power dynamics: either between architecture and instrument-performer, or between performers of instruments. Pututus and corridors, when energized with sound, are filled with vibrating air; their walls, whether on the scale of the instrument or the building, enclose vibrating air columns during soundmaking. The fundamental frequency at which such an acoustically energized enclosed air column vibrates due to its rigid boundaries is, in acoustical terms, its resonance frequency. Two such vibrating air columns, when brought into proximity, can join together, creating one vibrating air column. Prior to this acoustical coupling, the resonance frequencies within each separate enclosure were most likely perceptually distinct from each other, but, as the mechanical principle of resonance compliance describes, on coupling, the higher-energy vibration dominates and the two columns transform into one, perceptually synchronizing.

When performed in the modally resonant Chavín galleries, pututus' tones can change in compliance with resonances enforced by

the architecture around them: “Present-day pututu players have reported the experience of their instruments’ tones being ‘pulled into tune’ with these architectural resonances. This eerie effect is both sonic and sensed, an acoustic experience that is not only heard, but felt through the body, an external force that seemingly influences the way the instrument is played.”¹²⁰ Two pututus performed together in close proximity, with bell/lip openings closely aligned, can exhibit a similar effect: the pututu having greater sound power at the dominant resonance frequency may compel compliance of the other pututu. In such a dynamic, the weaker pututu loses autonomy of its internal air column, which becomes part of an external, more powerful acoustical vibratory system, in this case controlled by the stronger

pututu. This effect, although perceptible by listeners, is especially pronounced for performers: the player of the pututu that shifts in tone often experiences a cessation of the horn’s tone before compliance, like having one’s voice silenced, before the performer rejoins the now collective sound-making event in unintended unison.¹²¹

Enlivening Chavín through performance reconstructions with *Strombus pututus* has revealed functionalities and bolstered theoretical arguments for the sensory design of its ritualscape.¹²² The specificity of pututu sounds to diverse acoustical settings at Chavín suggests that these instruments—and perhaps their expressive, multifaceted performance techniques—were anthropic innovations in the production of Chavín’s experiential transformations and cosmo-



Figure 7: In performance experiments in the Laberintos Gallery inside Chavín’s monumental architecture, José Cruzado Coronel (left) and Miriam Kolar (right) perform *Strombus pututus* similar to instruments excavated at the site. Architectural acoustical resonances and the interaction of instruments result in the coupling of air columns between the two *pututus*, and within the corridor (resonance compliance of three acoustical systems). The perceptual result is synchrony. Photo from 2012 video by Cruzado and Kolar (Kolar, “Pututus, Resonance and Beats”).

logical interventions. At Chavín, “overt manipulation of the physical world [was] a clear demonstration of power, whereas the manipulation of unseen experiential effects via architectural forms that create distinct acoustic experiences [was] a subversive tool”¹²³ for sensory influence. The intangible cultural affordances of the Chavín pututus in their monumental context—the physically and symbolically flow-controlling, ancient virtual world of Chavín de Huántar—stem from the combination of their material-ecological basis and their dynamical reappropriation as ritual technologies in Chavín’s built environment.

Transformative Flows: Sonic Transcendence at Chavín

Sound, water, and humans move in flows throughout a dynamically considered Chavín, where paths for these flows were structured in earth-and-stone channels for communication, materials, and people, in ritual movement and processes. Materially and metaphorically, “flow experiences” are suggested by Chavín’s material culture; ethnographical analogies used for its shamanistic religious models reference behaviors and affects associated with flow experiences. Converging evidence suggests that flow-state-inducing rituals at Chavín would have involved participants in a variety of roles, from entrainees in rhythmical music and dance, to leaders as entranced pututu performers, a theatrical realization of the superhuman transformations inferred from the site’s visual culture. Here, I propose a model for trancing pututu performers—ritually immersed, “evolved shamans,” following Rick’s interpretation—as ritual leaders at Chavín.¹²⁴

In an exploration of making meaning from music making, ethnomusicologist and Andean music specialist Thomas Turino has detailed how musical interactions across cultures fit the theory of optimal experiences, or flow, as defined by psychologist Mihaly Csikszentmihalyi, who “asserts that flow experiences result in both a temporary transcendence and a cumulative expansion of the self.”¹²⁵ Immersed in flow, music makers and deeply involved audiences—especially those moving in rhythmic synchrony with sonic vibrations and production gestures—experience a form of altered consciousness. Csikszentmihalyi’s studies have documented how temporal perception shifts for those in flow, where immersion in a physically and emotionally optimized activity transcends quotidian experience. In a popular synthesis of his “quarter-century of psychological research on happiness,”¹²⁶ Csikszentmihalyi has noted that “quite often people mention experiencing self-transcendence in flow,” a lack of self-awareness related to their concentrated immersion, “a distortion of the sense of time...resembl[ing] a dream state.”¹²⁷ Flow-state experiences are associated with meditation and the contemplative practices of many religious traditions, and given architectural evidence for the sensory isolation of individuals or small groups, it is likely that Chavín ritual would have included such practices. There are many ways that sonic performance and sound stimuli can induce flow; a range of pututu performance techniques could have been employed in flow-inducing ritual at Chavín. In supporting meditation, pututus could have been used to produce droning sounds that change slowly over time, or emphasize stasis, which is acoustically enhanced by resonances inside gallery cells where meditators could be isolated.

However—and more compelling in its implications for pututu performers at Chavín—experiential flow dependent upon both repetitive performance and sonic perception has been widely associated with trance states in shamanic practices and ritual musics.¹²⁸

Superhumanized pututu players—whether theatrical roleplayers and/or immersed participant-facilitators within Chavín’s evolved shamanistic ritual model—fit ethnographical descriptions of trancers, musical performers demonstrably immersed in flow states, exuding affect, continually in motion, creating extraordinary multimodal displays, and compelling the participation of others. Ethnomusicologist Judith Becker, whose cross-cultural and cross-disciplinary study of music, emotion, and trancing examines ethnographic, historical, and neurobiological accounts, notes that Csikszentmihalyi’s “flow” definition “aptly describe[es] the skillful movement of many musicians. His list of the attributes of flow suggests trancing as well.”¹²⁹ Becker asserts that “the interpenetration of music with trancing is ancient and universal....Trancing can be empowering for all concerned, attesting to the divine presence in one’s midst, legitimizing the religious beliefs and practices of the community, and often bestowing deep satisfaction on the individual trancer.”¹³⁰ Chavín optimized conditions for musical trancing: its pututu performers would have been engaged in theatrical, ritualized sound production, in a highly designed, immersive environment that featured graphical depictions of transformed superhumans. Chavín’s architectural and visual conditions emphasized multisensory effects and contrasts, augmented by

the probable consumption of botanical entheogens/hallucinogens. Sensory stimulation would have been focused in particular ways, channeling experiences in ritual flows.

The idea that musical flow-state and trance experiences were pivotal to some ritual experiences at Chavín aligns with non-sonic interpretations that alterations of consciousness characterized site ritual. Material archaeology from Chavín highlights objects and depictions of affect that have been ethnographically associated with the consumption of entheogens/psychotropics, including its iconic anthro-zoomorphic beings interpreted as depictions of shamanic transformation.¹³¹ Psychotropics/entheogens derived from botanical hallucinogens were arguably prepared and ingested at Chavín using stone mortars and pestles, tablets, and bone snuff tubes, among other site-excavated objects identified as associated paraphernalia.¹³² Chavín’s experientially immersive and acoustically specific built environment would have enhanced flow-state experiences via spaces conducive to profound sensory stimulation and attention focusing, produced through physical isolation of people within space- and access-restricted interior architecture,¹³³ as well as architectural acoustics that emphasize quiet or acoustical contrasts, amplify specific frequencies in zones of resonance, and produce contexts unlike the quotidian. Across these settings, immersive multimodal sensing experiences, such as those involving people in simultaneous production of sound and movement, could induce flow states with the potential to alter individual consciousness, as well as reinforce social unity in the case of group ritual. As Turino has observed in ethnomusicological discussion: “At such moments, moving

together and sounding together in a group creates a direct sense of being together and of deeply felt similarity, and hence, identity, among participants.”¹³⁴

Beyond the expressly theatrical and symbolic sonics operational in Chavín’s ritually activated environment, sound would have facilitated a range of experiential dynamics, as well as practical communication functions, including verbal language. The prominence of sonic-rhythmic devices in shamanic practices suggests the use of similar attention-focusing soundmaking in Chavín ritual. Rhythmic, rattling soundproducers are frequently associated with shamanism and trance states in ethnographic accounts, and in art historical discussions of archaeological objects.¹³⁵ It is no coincidence that such instruments rely upon haptic coordination, providing sensory feedback to their performers through the sense of touch and interrelated perceptions. Pututus can be performed rhythmically, either by breath-driven articulation techniques, or by percussively producing what some present-day lip-valve instrument players refer to as the instrument’s “popping” tone, by striking the mouthpiece with the flattened palm of one’s hand (one gesture Cook used to produce an impulsive measurement of pututu acoustics in our 2008 study).¹³⁶ In discussion of the first acoustical measurements of Chavín galleries, we observed that “preliminary measurements at Chavín show a short reverberation time, dense and energetic early reflections, and low inter-aural cross correlation. The short reverberation time would enable rhythmically articulated playing of *Strombus* shell trumpets found on site.”¹³⁷ Rhythmic sounding of pututus is a practice consistent with a performative aspect common to

shamanic ritual, and supported by Chavín’s interior architectural acoustics. Inferentially corroborating evidence may be found in one artifact sound-producing object whose association with Chavín is contested due to its unknown provenance: a ritual spoon/rattle decorated with a pututu player sitting atop what has been interpreted by Burger as a “shaman’s stool,” a plausible ritual implement not identified in Chavín excavations, perhaps due to its likely construction from nonpersistent materials.¹³⁸

Superhuman transformations and objects ethnographically associated with shamanism and musical trancing stand out in Chavín’s material record. Implied through visual imagery and ritual tools, control of human transformations parallels control of nonhuman beings and dominance over the environmental elements reconfigured in Chavín constructions. Through its material associations in ritual activation, a pututu interconnected humans, nonhuman beings, and environmental dynamics. This is a network of cosmological relationality expressed visually, sonically, and performatively; traceable through graphics that were propaganda for Chavín thought production: signs and symbols within a system of directed messaging that also leveraged animated, performative participation in the immersive Chavín ritualscape.

The relationships I call attention to here involve tangible if (re)constructed beings and actions: among the composited personages carved into Chavín stone are humanoid figures, some with fangs, wings, tails, and clawed feet: of the known depictions of pututu players, the three that clearly perform pututus (one on the cornice stone shown in Fig. 8, and two on plaques decorating the Circular Plaza, Fig. 3) have

wings (and note that the cactus-staff bearer does not). That these humanoid pututu players were depicted as able to take flight and thus dominate the air—the winds—is no coincidence: pututu performance requires breath, and breath transformed through a pututu in the Andean sierra can enter the wind more powerfully than a human voice if tonally performed, with physical immunity to the effects of windshear,¹³⁹ a prominent climatic effect in the Andean highlands. If performed to produce breath sounds, these airy pututu gestures ricochet among the hard stone surfaces of Chavín's immense building facades before dissipating into the wind.

Pututus directly relate with air, as it flows through them in performance; performed, they inject the air around them with sounding and breath transformed into airflow that sonically articulates the features of its surroundings. Chains of physical dynamical associations such as these reveal contours of symbolical expressions without explaining their significance. The functional, material basis of these dynamical analyses—events

which can also be understood as sensed phenomena, even without the explanations of acoustical science—indicates specific conceptual linkages through environmental activation. Can we consider these functional estimations to be clues regarding contextual priorities of past humans? The work of archaeological interpretation is to substantiate their likelihood through converging material factors.

Although we cannot ascertain meaning from stone carvings, the prominent positioning of pututu-personages and superhuman beings suggests that Chavín operationalized these images; well-established models for site ritual founded in material evidence corroborate my contention that Chavín ritual leaders would have leveraged associated narratives. Real-life instantiations of such beings may have been produced by theatrically and psychotropically enlivening them through ritual enactments; performances could have induced trancing and other flow-state experiences, further deepening the otherworldly power of Chavín by incarnating



Figure 8: Winged, seashell-bearing personages are depicted on this relief-carved cornice stone that would have projected outward along a building exterior, in a skyward position to be seen from below. The left-most figure holds a *pututu* to its mouth. Photo by José Luis Cruzado Coronel and Miriam Kolar.

its graphical culture. By experimentally performing *Strombus pututus* in Chavín settings, we test some proposed elements of site ritual, out of social and temporal context, but in relationship with remnant material and environmental constituents, revealing relationships otherwise still and silent. Archaeologically integrated, site-situated archaeoacoustical performance reconstructions enable empirical testing and observation of symbolically charged sound making, reactivating ritual settings, and reinstating flows of information linked to past cosmological expressions through Chavín's monumental channels.

Wind, Water, and World-Building at Chavín: An Interpretation

Monumental Chavín activated and expressed power dynamics through architectonic-environmental positioning, graphical amalgamations of predatory animals and fiercely appointed humanoid personages, objectified-transformed beings-as-pututus, and demonstrable sonic icons produced via architectural and instrumental acoustics. Human-environmental relations were expressed throughout Chavín materials, and are corroboratively evinced in their particular functional assemblages at the site. Control of the sierran substrate, stone, is manifest in Chavín's stone-and-earthen-mortar architecture, and dramatically highlighted where stone was cut and polished, creating a supernatural lithic surface on certain sections of building facades and portals, staircases, and the floor of the Circular Plaza. Control of water—which arrives in Chavín from rivers and sky, flowing through and over Chavín's restructured ground¹⁴⁰—characterizes ritual locations throughout the site, some of whose activities would have been only heard by non-participants, while others could have

been selectively visible. Chavín's aquatic relationality is communicated through its canals, its pututus, and its crocodilian imagery, with a supernal cayman reinforced as both a repeated visual symbol and sonic icon¹⁴¹ produced by the roaring of water flowing through the "acoustic canal" under the Circular Plaza staircase and other stone-lined canals.

Chavín's reconfigured stone and water channeling effectively repurposes ecological elements fundamental to Chavín's highland environment, where airflow—also structured throughout Chavín's architecture, by way of the so-called ventilation shafts, the predominantly horizontal ducts that interlace its buildings—facilitates human life and the hydrologic cycle that makes water available for Chavín ritual manipulations. Wind is essential to water: wind signals and propagates storms that bring rain to the Andes. Wind ritual, therefore, necessarily complements water ritual at Chavín. Pairings are important to Chavín, constructed architectonically and visually, as in the black-and-white stone delineations of staircases, symbolical entryways, and plaza flooring. The dynamical-environmental pairing of wind and water fits this materially patterned internal logic both structurally and functionally.

The importance of air and the Andean wind to Chavín has been overlooked in its discourse. Airflow is a theme expressed architecturally, instrumentally, and iconographically, consistent with Chavín's representations of prowess over other environmental domains. Operational to Chavín's water-directing canal system and the performance of its water-originating pututus, airflow is specifically channeled by horizontal ducts throughout the site, and plausibly emphasized via ritual

smoke that could have been produced under vertical chimney-like structures that have small ledges at their bases.¹⁴² The air-filled space of the sky provides a cosmological emplacement for figures depicted in site iconography, situating the avian zoomorphic power features (beaks and claws) that have been amalgamated with many of Chavín's supernatural apex predators who effectively control water (crocodilians) and earth (felines), as well as the air/sky (raptors). Chavín's control of the winds—unseen, but heard and felt, like sound, and sound-generating—is signaled by raptors. Avian apex predators prevail across Chavín iconography, and are seemingly impersonated or superseded by the anthropomorphic winged figures who carry shells: humans coopting avian features while also reanimating transposed marine life (as shown in Fig. 8). Pututus held to the lips of these personages receive and channel the anthropic wind that is breath, into the Andean air and the cosmological beyond. What such a gesture would have indicated cannot now be known, yet it would have transformed a multifaceted assemblage of human–environmental, cosmologically potent symbols in ritual performance, focusing sonic expression into the wind.

Recently excavated materials from the Chavín sector known as the Esplanade may depict airflow-as-breath, personifying wind under human control. A relief-carved plaque¹⁴³ and two tenon heads with pursed lips¹⁴⁴ depict humanoid figures emitting something from their lips, filling/covering a space larger than their bodies, movements articulated with directionality from their bodies outwards (see Fig. 9). One figure's expulsion has jagged contours, while the other's curves: this difference must have conveyed particular distinctions now

inscrutable. The expulsive linear patterns are twisted articulations of flows suggestive of many Chavín-associable themes—waves, smoke, lightning, stems of plants; purging, serpent bodies, rhythmic movement—perhaps akin to the twisting emblem down the back of the Lanzón that has been interpreted as a spine or a symbolically twisted cord (to articulate only a few formal associations with the archaeological context). Interpretations aside, what can be seen is that these figures are depicted as engaging with flows, seemingly emitting stuff of material consequence to Chavín, expressive of dynamism, interactivity, and potency.

The pututu, activated in Chavín ritual performance, interconnected its performer with air by emitting breath and voicings into the air; in this way a pututu performer could command, address, embody, or otherwise



Figure 9: An engraved stone excavated from Chavín's northeastern Esplanade in 2014 depicts two humanoid figures with curvy and jagged lines as if emanating from their mouths (for scale, the smallest division of the north arrow is 1 cm). The photo from which this image was cropped (courtesy of John Rick) appeared as Figure 55 in that season's annual public bulletin, captioned: "Figure 55. Detail of the base of the cyst, now removed, with representation of two personages spewing rays and waves from their mouths. The formal limits of the stone, and probably of the representations themselves, constrain the figures which extend to [two] extremes" (author's translation), (PIACCDH 2014:50).

engage with the winds that bring rain, via the specific channel of the pututu. An ocean-sourced object connected to an earthbound human, a performed pututu could project (super)human intentionality through the air it drove acoustically. Through material association, a conch-shell horn connects its performer to ocean water, its origin; visually, the notched “winged” lip of a Chavín pututu evokes the potential for flight; dynamically, it launches human-directed airflow into the sky, the origin of water-as-rain, invoking an activation-completion of the hydrologic cycle through the ritual action of breath-driven performance. Acoustically immune to windshear,¹⁴⁵ the tonal sound of a *Strombus* pututu transcends the reach of the human voice in the sierran environment, yet this instrument affords myriad sonic gestures across the range of human audibility, making it versatile in acoustically distinct site settings.

A Chavín pututu in the ceremonial locus of the Lanzón-Circular Plaza, whose under-staircase canal acoustics might transform the building into a supernatural cayman, could serve as a symbolic mediator between the ocean waters of its coastal provenance and the cayman-commanded freshwaters of the Amazonian *selva* (rainforest), far from sierra Chavin, yet present in Chavín’s visual representations of plants and animals associated with those ecosystems. Disparate elements of the Andean cosmos would have been symbolically interconnected via Chavín pututu performance referential of the cycling of water. Chavín pututus could thereby invoke a process fundamental to all forms of life, calling attention to the ecological underpinnings signaled by weather patterns and climatic events. Chavín’s role as world-view generator and cosmological mediator would have

been manifest in this performed interconnection of wind-water symbols, with the pututu as ritual instrument for communication across environmental-cosmological domains. Pututu performers, stone-grounded human(oid) facilitators of wind-water channeling, would thus have served as cosmological transducers, ritually actuating and communicating environmental relations.

Extending this wind-water model in correspondence with the directionality of the Chavín valley’s flowing rivers, I propose that in outdoor/terrace/plaza settings, a key performance orientation faced east or northeast. Considering pututus as communication tools—proxies for the human voice, or extensions of human breath—implies a directionality in their address that corresponds acoustically to the opening of the instrument’s bell (shell lip).¹⁴⁶ There is a functional facing direction for pututu performance—either to the front of the performer, or in the direction of the bell/shell lip opening—as well as several acoustically contrasting orientations for positioning pututus with respect to their performers.¹⁴⁷ If Chavín pututu performance sought to engage with the water-bearing environment, to communicate with the winds or send influence along the flowing waterways outside of the complex, it would be environmentally significant to perform pututus northeastward into the prevailing winds and in congruence with the flows of its rivers. Performing pututus toward the direction from which storms typically enter the narrow Chavín valley would symbolically direct air-transformed-by-sound beyond the Cordillera Negra that separates Chavín from the distant rainforest. Chavín’s north-flowing, converging rivers initially flow

east (the Wacheqsa) and north (the Mosna), joining at the northeastern extreme of the Chavín plain to send waters that flowed through Chavín's canals outward toward the rainforest. Many discussions of the Chavín monumental complex suggest that its location at a joining of rivers is symbolically aligned with the Andean cosmological concept of *tinku*, described by Andeanist Catherine Allen as "an encounter of opposing yet complementary forces" in which "an asymmetrical relation is forcibly balanced to produce a harmonious one."¹⁴⁸ The journey of waters, and its association with wind, could be symbolically engaged via (super)human breath transformed through pututus.

Anthropomorphic representations excavated in the site's northeastern sector support this windward-waterway model that I argue constituted a key orientation for Chavín ritual. Chavín's sculptural stone tenon heads, with their larger-than-life,

pegged-to-the-walls presence, oversaw the northeastern Esplanade, a sector with a variety of functionally uncertain features. Ferras has posed that "tenon heads [having pursed lips] relate to the use of the pututu, and that the representation of the movement of the breath is part of a sonic dynamic, materialized by the sound of the pututu and by the graphic representations that accompany it, whether in depictions of pututus on the stelae, or in the blowing tenon heads, that are metonymies of the produced sound."¹⁴⁹ These pursed-lip tenon heads (see Fig. 10) once presided over the Esplanade, oriented toward the intersection of rivers and their selvan-directed courseway.

Whether or not pututu performance is indicated by these anthropic tenon heads' gesture, the action of their pursed lips most fundamentally suggests moving air-as-breath. However, in the Chavín context, such representations have been argued to



Figure 10: Two pursed-lip tenon heads were excavated from Chavín's northeastern Esplanade in 2013. A version of this photo (courtesy of John Rick) appeared in that season's annual public bulletin from the archaeological project, with the following caption: "Figure 37. When they discovered the second tenon head, it began to rain" (35, author's translation). I do not know my colleagues' intended point in this note about rain, yet their statement demonstrates Chavín fieldworkers' conceptual association of these sculptures with environmental factors.

convey affect and actions associated with entheogenic/psychotropic consumption, an interpretation that does not preclude mine. In situ, these heads loomed over an area where diverse canals run various courses, directly positioning them as overseers of flowing water. In such a location, these “blowing” tenon heads of the east façade of Building C might be as representative of environmental winds – or Chavín’s supernal command of them – as of the human wind-generation performance gesture elemental to pututu performance that Ferras has emphasized, a visual evocation that parallels the sonic transformation of human breath to wind via pututu performance. Multiple simultaneous meanings are possible, and likely. Such multimodal symbolic reinforcement was a messaging strategy employed elsewhere at Chavín, in the architectural-acoustical evocation of a super-cayman. Hydraulic sounding¹⁵⁰ of the under-staircase canal separating the Lanzón Gallery from the Circular Plaza could have instantiated a larger-than-life roaring icon that physically reinforced the idea of prominent crocodilians displayed across site graphics.¹⁵¹ The personification of winds through anthropomorphism in the pursed-lip tenon heads – wrought larger than life, in superhuman proportions, and positioned above human activities in an expressly ritual space – parallels other Chavín world-building strategies that project anthropic influence onto reconfigured Andean environmental models.

A supernal cayman, sounding through Chavín architecture, projects Chavín’s expression of dominance over the selvan waters of the Amazonian basin; Chavín’s ritual objectification and performance of oceanic pututus subjugates representations of waters from disparate climates within a

sierran setting foreign to both – a location associated with glacial waters that Chavín rechanneled within its canal system and thus controlled. Chavín’s geographical siting positions it above most earthbound waters: near the highest Andean peaks, approaching the sky, this water-infused stone monument intensified and refigured hydrologic dynamics. I propose that Chavín represented its hydrologic dominance not only via grounded flows of water through its canals, but via airborne expressions through its pututus. Asserting their ecological influence, Chavín’s leaders leveraged the site and engaged in rituals to perform control over the nonhuman world as well as other humans, via fierce beings depicted visually, instantiated sonically, and perhaps embodied in their own shamanic transformations. Beings represented in stone impersonated and reanimated environmental forces that Chavín commanded through ritual means. Yet beyond graphics and architecture, the pututu, a vital ritual technology, a pivotal tool in the transformation of human breath, could distinctly voice cosmological activations. The *Strombus* pututu epitomized Chavín’s communicative power.

In summary, I offer an interpretation of the cosmological positioning facilitated by *Strombus pututus* in Chavín ritual. A living conch is an animate product-being of the water; therefore, a Chavín-transformed, human-blown conch shell is a reanimated (re)producer of wind, a ritual device through which human-generated air joins the surrounding environmental air through a sounding, transformational conduit. Through a Chavín pututu, its (super)human performers voiced virtual flight by joining breath with wind. Through its notching and voicing, the pututu was transformed into a winged instrument of flight, figuratively

enabled to join wind via its sounding. The performed pututu transduced Chavín forms and human actions, connecting water (the shell's origin) with (performer's) breath (emitted through the pututu) into the winds that bring rain earthward to enter the ground and flow through earthen rivers and Chavín canals. In this way, a (super)human performer of a Chavín pututu could propel human agency throughout nonhuman domains, symbolically engaging with and thus directing or mediating the hydrologic cycle. Chavín required water to work; winds bring much-needed water when earth is dry, sustaining life as well as ritual.

Future-Flying Pututus

Interpretations aside, the Chavín pututus were humanly shaped and voiced; they could extend and transform human vocal expression, and with the intersection of their materiality and performance, they objectify human–environmental relationships. Conch horns were once sea animals, and thus evoke water by their prior ecological dependency. Shells of marine life, their living efficacies were (re)instantiated as multifunctional ritual communication instruments at Chavín. Inscribed objects with visual markings expressive of their creators, the Chavín pututus visually projected identities of individuals, polities, or places. These features are certain, regardless of how we interpret their significance. Given their Andean situation, anachronistically applying the term *huacas/huacos* to the Chavín pututus is not inappropriate: the potential power of these pututus is material, as evinced by their creation three millennia ago. The actual power of pututus at Formative Chavín was manifest through ritual performance, perhaps in the symbolic interconnection of water with air, a cosmological gesture:

an assertion of human agency to influence ecological dynamics.

Relief-carved stones at Chavín portray winged, anthropomorphic figures with pututus held to their lips. Whether representative of transformed humans performing rituals, deities, or mythological personages, these are superhuman projections in the context of a sensorially immersive environment; an ancient realization of a virtual world whose architecturally distinct settings respond acoustically to an analogous variety of pututu sounds; a place whose architecture and imagery work together to heighten human perceptual responses to pututus.¹⁵² Those who commanded—held, performed, spoke through—pututus activated Chavín spaces and enlivened site images in strategic ways.

Pututus can be used to produce transcendent experiences. Via rhythmic intonation, a pututu performer or listener can cognitively entrain.¹⁵³ From perceptually immersive soundmaking, as enhanced by gallery resonances or through echo sequences in plazas, pututu performers may both attain flow-state experiences and evoke consciousness-altering experiences in others, including the emotional entrainment observed in some ritual performance.¹⁵⁴ The breath-pattern control required for virtuosic techniques such as circular breathing has the potential to create both immediate and lasting physiological changes in performers,¹⁵⁵ relating to flow-state alterations in consciousness and trancing. Performing a pututu creates both auditory and haptic feedback for the performer, a multimodal experiential activation of spatial-instrumental acoustical interdynamics. Pututus performed together—or even a pututu performed with another

soundmaker – can produce acoustical wave-interference effects such as the amplitude variation called “beating,”¹⁵⁶ and also the psychoacoustical effect known as “difference tones,”¹⁵⁷ an auditory distortion of sound alternately understood as auditory hallucination: given particular stimuli, the auditory system generates the perception of tones that are not present acoustically. Such experiential transformations induced via pututu performance parallel – and could have co-enhanced – the botanically induced psychotropic/entheogenic ritual evinced through a variety of Chavín materials.

Performing pututus elicits environmental responses – especially acoustical feedback, heard and felt – that in Chavín ritual would have reinforced the sense of emplacement in a unique and specific environment. In outdoor and semi-enclosed contexts, discrete echoes from large walls and landform rockfaces repeat pututu soundings and thus reiterate their voicings.¹⁵⁸ Within Chavín’s interior, architectural acoustical resonances amplify pututu sounding tones and prolong the lower-frequency intonations readily created by the performance technique of inserting one’s hand in the bell/shell lip,¹⁵⁹ thereby extending the length of the instrument’s bore/interior cone to create an acoustical transformation of the instrument that produces lower tonalities. In key ceremonial locations, pututus may have produced specifically encoded messaging: duct acoustics emphasize pututu sound transmission between the Lanzón Gallery and the Circular Plaza, filtering out higher frequencies and allowing sounds in the fundamental range and first articulation peak of the Chavín pututus to pass, effectively making any non-pututu sounds pututu-like.¹⁶⁰ Noisy, wind-like breath sounds and rhythmic percussive articulations are

reinforced by echoes that ricochet among wall surfaces, such as around the Plaza Mayor, commanding attention or enhancing cognitive entrainment, among other effects. Heightened sensitivity to acoustics – be it via psychological priming from Chavín’s multimodal messaging strategies, psychotropics/entheogens, flow-state concentrations of auditory/sound-sensing attention, or other forms of experiential conditioning – would have further induced immersion in Chavín’s transformational ritualscape, for both pututu performers and their followers.

Elite social status could be gained via these ritually operational conch-shell horns; those capable of performing pututus would be differentiated from others with physical access to pututus but without the ability or privilege of playing them. Performance ability and knowledge of certain techniques – especially how to optimize acoustical interactions in each performance setting for culturally valued or sensorially captivating effects – would have demonstrated prowess and legitimized the pututu performer’s special access to this elite power tool. Via the leveraging of spatial-instrumental acoustics, sonic communication could be facilitated by those adept at manipulating Chavín’s ritual communication technologies. Sociopolitical power dynamics could be reinforced via compulsory acoustical conditions created by Chavín architecture. Through acoustical design, Chavín pututu performers were ensured sonic communication between otherwise physically separated locations. The pututu as a Chavín-optimized communication technology (and reciprocally, Chavín architecture, as a pututu-leveraging environment) facilitated an elite form of virtual spatial access and control between architecturally distinct site locations.

Pututu performance, a ritual technology and tool for individual differentiation at Chavín, could transform humans into superhuman controllers of an ancient virtual world created by humans, for humans; a ritualscape whose cosmological and religious meanings remain encoded, yet whose material associations offer interpretative clues. Chavín exemplifies concerns highlighted in present-day discussions of the Anthropocene: its material culture expresses conceptualizations of human-ecological influence enacted in the prehistorical Andes, especially via its *Strombus* pututus. Converging forms of archaeological evidence suggest that through ritual soundings, Chavín pututu performers served as transcendental agents of human-environmental relations. In my interpretation, a *Strombus* pututu, an extension of human breath—positioned to influence Andean ecology through its wind-water associations and multifaceted Chavín contextualizations— injected human agency into the hydrologic cycle. Through pututus, Chavín expressed and communicated relationships in a way that legitimized Chavín, mediating between forms of being and ecological processes, perhaps understanding them on a continuum.

Surpassing their archaeological reputation as sound-signaling devices and visual indicators, the Chavín pututus were technologies of anthropic ecological interventions in their time. Today, they retain the power to attract and direct our attention: what we notice about these carved marine shells—and the associations we construct around

them— indicates our interpretative priorities and associative proclivities. How we deal with these exceptional artifacts of human expression reflects our present-day values, epistemological alignments, and individual concerns. Time has repositioned the Chavín pututus to inform us about the people who once used them in specific relationships with each other and their environments, enacting ecological and cosmological interventions through the creation, ritual handling, and performance of pututus. The Chavín pututus call to us out of context, yet their present recontextualizations provide us new opportunities to honor their prior significance while engaging with them on new terms, as is the trajectory of lasting material culture, and its transformative potential across time. Engaging with the Chavín pututus even as they appear out of time highlights the potential of archaeology as it intersects with current issues: curiosity about previous lives on Earth, and contemplation regarding the relevance of those lives to living and future humans.

Emblems of Chavín, *Strombus* pututus evince prowess in communicative nuance, both as soundproducers and as ritual technologies in Andean Formative world-building by which humans sought to supersede humanness and influence ecological processes. Vocal proxies for those who once performed them, the Chavín pututus resound with us today, harkening a future in which human-environmental negotiations will be as crucial to human survival as they were in the ancient Andes.

NOTES

1 For my purpose of anthropological discussion, I take an ecological perspective on the usage of the term *Anthropocene*: that anthropic environmental transformations reciprocally impact human society as well as other life forms, on local and global scales, across varying time scales. Dominant threads in discourse around the Anthropocene include the “Earth systems science” definition, e.g., as discussed by Will Steffen (Nov. 11, 2016) in a lecture at the Stockholm Resilience Center: <https://www.stockholmresilience.org/research/research-videos/2016-11-01-the-anthropocene-where-on-earth-are-we-going.html>. Here, Steffen interrelates the “Human Enterprise,” measured by population, economic growth, freshwater use, energy use, urbanization, globalization, transport, and communication, with the “Earth System” measured via greenhouse gases, ozone depletion, climate, marine ecosystems, coastal zone, nitrogen cycle, tropical forest, land systems, and biosphere integrity. The epochal assignment “Anthropocene” has been contested by geological scientists who assert that humans have not significantly altered the earth’s stratigraphy, as defined by the International Commission on Stratigraphy, the largest and oldest constituent scientific body in the International Union of Geological Sciences: <http://www.stratigraphy.org/> (accessed Jan. 28, 2019).

2 I previously introduced the Chavín “ritualscape” concept to encompass the experiential possibility space of ritually related elements constructed, practiced, and otherwise dynamically engaged at Chavín: Miriam A. Kolar, “Sensing Sonically at Andean Formative Chavín de Huántar, Perú,” *Time and Mind: The Journal of Archaeology, Consciousness and Culture* 10/1 (2017): 39–59. doi:10.1080/1751696X.2016.1272257.

3 As presented in the multi-authored article with corresponding authors Erle Ellis and Lucas Stephens of the ArchaeoGLOBE Project, “Archaeological Assessment Reveals Earth’s Early Transformation through Land Use,” *Science* 365/6456 (2019): 897–902. doi:10.1126/science.aax1192.

4 For example, as discussed regarding the 2018 decision of the International Commission on Stratigraphy (ICS) to declare a new age within the Holocene epoch, the Meghalayan, rather than naming a new epoch, as advocated by many scientists. The article compares perspectives of researchers in several fields. Paul Voosen, “New Geological Age Comes under Fire: Timing and Extent of Ancient Drought Used to Define the Meghalayan Are Uncertain,” *Science* 361/6402 (2018): 537–38. doi:10.1126/science.361.6402.537.

5 As in discourse around “transhumanism,” which varies from physical augmentations of humans to complete virtualizations of human intelligence-as-consciousness; e.g., Max More and Natasha Vita-More, *The Transhumanist Reader: Classical and Contemporary Essays on the Science, Technology, and Philosophy of the Human Future* (Chichester, UK: Wiley-Blackwell, 2013).

6 Following architectural discussions in Silvia Rodríguez Kembel and John W. Rick, “Building Authority at Chavín de Huántar: Models of Social Organization and Development in the Initial Period and Early Horizon,” in *Andean Archaeology, Blackwell Studies in Global Archaeology*, ed. Helaine Silverman (Cambridge, MA: Blackwell, 2004); John W. Rick, “Chavín de Huántar: Evidence for an Evolved Shamanism,” in *Mesas & Cosmologies in the Central Andes*, ed. D. Sharon, San Diego Museum Papers, vol. 44 (2006): 101–111 and my archaeoacoustical treatment of Chavín as framed by explorations of sonic communication: Kolar, “Sensing Sonically.”

7 As detailed in Miriam A. Kolar, with John W. Rick, Perry R. Cook, and Jonathan S. Abel, “Ancient *Pututus* Contextualized: Integrative Archaeoacoustics at Chavín de Huántar, Perú,” in *Flower World – Music Archeology of the Americas*, vol. 1, ed. Arnd Adje Both and Matthias Stöckli (Berlin: Ekho Verlag, 2012), 23–53; and Miriam A. Kolar, “Acoustics, Architecture, and Instruments in Ancient Chavín de Huántar, Perú: An Integrative, Anthropological Approach to Archaeoacoustics and Music Archaeology,” in *Music & Ritual: Bridging Material & Living Cultures*, ed. R. Jiménez, R. Till, and M. Howell (Berlin: Ekho Verlag, 2013), 147–62.

8 As argued by Miriam A. Kolar in “Archaeological Psychoacoustics at Chavín de Huántar, Perú” (Ph.D. diss., Stanford University, 2013).

9 The United Nations Educational, Scientific and Cultural Organization (UNESCO) defines Intangible Cultural Heritage (ICH) online: <https://ich.unesco.org/en/what-is-intangible-heritage-00003> (accessed March 5, 2019).

10 Colin Renfrew, *Prehistory: The Making of the Human Mind* (New York: Random House, 2007), 104.

11 E.g., the cross-disciplinary methodology I have detailed regarding sound studies in Inca archaeology: Miriam A. Kolar, “Situating Inca Sonics: Experimental Music Archaeology at Huánuco Pampa, Peru,” in *Flower World – Music Archaeology of the Americas*, vol. 6, ed. Matthias Stöckli and Mark Howell (Berlin: Ekho Verlag, 2019), 11–43.

12 In the archaeological literature, archaeologist and science theorist Michael Brian Schiffer exemplifies a rigorous approach to modeling experiential features from materials: see, e.g., his “Research on Technology: History and Overview,” in *Behavioral Archaeology: Principles and Practice*, ed. Michael Brian Schiffer (London and Oakville: Equinox Publishing, 2010), 89–90.

13 For an overview of archaeoacoustical field methods, with Chavín examples, see Miriam A. Kolar, “Archaeoacoustics: Re-Sounding Material Culture,” *Acoustics Today* 14/4 (2018): 28–37.

14 Among many pertinent examples, a functional example from a cognitive archaeological perspective is the routinization of joint/communal performance common to many religious musical participation contexts, as discussed by Robert Turner, who argues for music “as ritualized language” (pp. 37–38) in “Ritual Action Shapes Our Brains: An Essay on Neuroanthropology,” in *Ritual, Performance and the Senses*, ed. Michael Bull and Jon P. Mitchell (London and New York: Bloomsbury, 2015), 31–44. In an examination of the social functionality of religious music, ethnomusicologists Philip V. Bohlman and Jeffers Engelhardt critique the intellectual and scholarly assumptions that underlie “the ubiquitous pairing of music and religion as reified entities in our scholarship” (p. 4). Their framing calls attention to the diverse ways that religious sound crosses boundaries between individual experience and social contexts, proposing that “it follows that transcendence ends up exclusively in the domain of religion, irrespective of the fact that, as a category, religion sets in motion an acoustic dialectic of the sacred and the wordly and might encompass too much or not enough of people’s spiritual, musical, moral, and social lives” (p. 5). “An Introduction,” *Resounding Transcendence: Transitions in Music, Religion, and Ritual*, ed. Jeffers Engelhardt and Philip V. Bohlman (New York: Oxford University Press, 2016), 1–25.

15 Discussed previously in Kolar, “Sensing Sonically.”

16 Daniel A. Contreras, “Sociopolitical and Geomorphologic Dynamics at Chavín de Huántar, Peru” (Ph.D. diss., Stanford University, 2007). Contreras’s detailed study evaluated “the material remains of the anthropogenic landscape associated with the site to explore Chavín’s interaction with and perception of its environment, and consider the role of the dynamic environment, and modification thereof, in the site’s sociopolitical trajectory” (p. 4).

17 Specific local examples discussed in Kolar, “Archaeological Psychoacoustics at Chavín de Huántar, Perú,” 58–62.

18 Recent findings with new interpretations are detailed in John W. Rick, “The Nature of Religious Space at Chavín de Huántar,” in *Rituals of the Past: Prehispanic and Colonial Case Studies in Andean Archaeology*, ed. Silvana A. Rosenfeld and Stefanie L. Bautista (Boulder: University Press of Colorado, 2017), 21–50.

19 In a conservation publication, John Rick and colleagues noted Chavín’s dynamical environmental positioning and negotiation: “In order to demonstrate their power, local leaders intentionally built Chavín in a zone of high risk of hillside creep, massive landslides, and river flooding. They were successful in overcoming nearly all of these challenges, but in the end the site was seriously damaged, probably by seismic action” (p. 1). John Rick, John Hurd, and Julio Vargas-Neumann, “Chavín de Huántar, a Past Challenge to Nature, a Current Challenge to Archaeological Conservation,” paper presented at the 11th International Conference on the Study and Conservation of Earthen Architecture Heritage, Universidad Católica del Perú, 2012.

20 Luis G. Lumbreras, Chaco González, and Bernard Lietaer, “Acerca de la función del sistema hidráulico de Chavín,” *Investigaciones de campo*, no. 2 (Lima: Publicaciones del Museo Nacional de Antropología y Arqueología, 1976); John W. Rick, “Context, Construction, and Ritual in the Development of Authority at Chavín de Huántar,” in *Chavín: Art Architecture and Culture*, ed. William J. Conklin and Jeffrey Quilter, Monograph 61 (Los Angeles: Cotsen Institute of Archaeology, University of California, Los Angeles, 2008), 3–34; Rick, “Evidence for an Evolved Shamanism”.

21 Daniel A. Contreras, “Landscape Setting as Medium of Communication at Chavín de Huántar, Peru,” *Cambridge Archaeological Journal* 25/2 (May 2015): 525, and “Sociopolitical and Geomorphologic Dynamics,” “(Re)Constructing the Sacred,” and “Diversity in Ritual Architecture.”

22 Rick, “Context, Construction, and Ritual in the Development of Authority,” 32.

23 Rick, “Evidence for an Evolved Shamanism,” 110.

24 Of which there are substantial extant examples that have been interrelated in Chavín research and with archaeoacoustical detail; e.g., Rick, “Context, Construction, and Ritual in the Development of Authority”; Kolar et al., “Ancient *Pututus* Contextualized”; Kolar, “Archaeological Psychoacoustics at Chavín de Huántar, Perú” and “Sensing Sonically.”

25 Referred to in some literature as a “*Strombus* trumpet,” following colloquial and non-musical usage (e.g., Rick, “Context, Construction, and Ritual in the Development of Authority”); although in musical acoustics terms, such conical-interior instruments are horns, whereas trumpets have cylindrical bores that open in a flare.

26 John W. Rick, “The Evolution of Authority and Power at Chavín de Huántar, Perú,” in *The Foundations of Power in the Prehispanic Andes*, Archaeological Papers of the American Anthropological Association 14 (2004), ed. Kevin Vaughn, Dennis Ogburn, and Christina A. Conlee, 71–89.

27 However, this distinction may be updated pending analyses of new research. During the 2019 field season, the director of the Museo Nacional Chavín called to my attention a ceramic “trumpet” associated with the early 20th-century site research conducted by renowned Peruvian archaeologist Julio C. Tello, and also invited me to conduct an acoustical and musical performance study of carved bones that had previously been characterized as snuff tubes, but were re-identified as sound producers. Our investigation of these objects, pending publication, offers new acoustical and performance evidence for other classes of aerophones associated with Chavín, beyond pututus. Also, post-Chavín settlements at the site may have produced ceramic whistles, objects to be further studied from excavations of remains identified in fieldwork as “Mariash-Recuay” by archaeologists Lumbreras and Rick (personal communication, 2012).

28 Henry Tantaleán, *Peruvian Archaeology: A Critical History*, trans. Charles Stanish (Walnut Creek: Left Coast Press, 2014), 157.

29 In present-day colloquial usage around Chavín de Huántar, in the Ancash region of Perú, *huaco* (object) is often differentiated from *huaca* (place); the former to designate a tangible artifact associated with an archaeological site, or any other cultural material associated with the distant past, though both carry spiritual or metaphysical associations. More broadly in the Andes, this distinction may also be common usage, as per discussion about nomenclature surrounding *huaquero*: <https://traffickingculture.org/encyclopedia/terminology/huaquero-2/> (accessed March 11, 2019).

30 My definition, here, raises a question about how to consider the recorded “intangible cultural” reproductions of archaeological engagements with the Chavín pututus that are now circulating as electronic media, such as audio and video recordings of research performances, as well as the derivative creative

expressions that may incorporate or reference these media (a new chain of representations, with material relationship by way of produced sound). For details on the presence and distribution of pututus in Andean archaeology, there is a notable survey of over 200 pututus of shell and ceramics, by Alexander Herrera, Juan Pablo Espitia Hurtado, Jorge Gregorio García Moncada, and Alejandro Morris, “Arqueomusicología de las trompetas de caracol andinas de concha y cerámica: Distribución, organología y acústica,” *Flower World—Music Archaeology of the Americas*, vol. 3., ed. Matthias Stöckli and Mark Howell (Berlin: Ekho Verlag, 2014), 141–68.

31 Kolar et al., “Ancient *Pututus* Contextualized”; Kolar, “Acoustics, Architecture, and Instruments in Ancient Chavín de Huántar, Perú.”

32 Miriam A. Kolar, “*Pututus*, Resonance and Beats: Acoustic Wave Interference Effects at Ancient Chavín de Huántar, Perú,” *The Journal of the Acoustical Society of America* 136: 2270. doi:10.1121/1.4900202. Presented at the 168th meeting of the Acoustical Society of America, Indianapolis (November 2014). Popular version of paper 4pAAa2: <https://ccrma.stanford.edu/groups/chavin/ASA2014.html>.

33 Sadie Weber, “El *Pututu*,” *ReVista: Harvard Review of Latin America*, “Music” (Winter 2016): 44–45.

34 Although non-tonal performance of horns is known as applying “extended techniques” in European musicology and contemporary art music, such practices are common in other traditions.

35 Kolar et al., “Ancient *Pututus* Contextualized”; Kolar, “Acoustics, Architecture, and Instruments in Ancient Chavín de Huántar, Perú.”

36 Research conducted by Kolar with Andean colleagues in 2019 at the Museo Nacional Chavín; publication pending.

37 Martha Paola Acosta-Díaz, “À propos de la conque andine: Organologie, fonctionnement et sons de la conque de Hatun Q’ero (Cusco, Pérou)” (Master’s thesis, University of West Paris / Mémoire de Master 2 Ethnomusicologie et Anthropologie de la Danse, Université Paris Ouest Nanterre La Défense, Paris, 2015).

38 Anthropologist and Andean music specialist Michelle Bigenho has described this problem as “*the music box*: within anthropology’s classificatory schemes, the music concept tends to overpower everything else. Even if studies pose key questions about state restructuring, law, nationalism or racism, once music enters the picture, the whole inquiry is pushed into the music box. Music as an object of study ends up

haunting such projects, even when researchers are asking other questions of broader interest.” “Outside the Music Box: A Manifesto,” *Anthropology News*, January 2011: 12.

39 Including their infrequent performance as background accompaniment to electronically amplified/featured sonics, as during the inaugural event in Chavín’s Plaza Mayor for the 2019 “Simposio Internacional Chavín: 100 años de Arqueología desde Julio C. Tello hasta nuestros días: Avances y Perspectivas,” Aug. 9–10, 2019, Chavín de Huántar, Áncash, Perú.

40 See Kolar, “Situating Inca Sonics,” for a discussion of pututu historicization, in the context of experimental music archaeology at the Inca administrative center, Huánuco Pampa, a UNESCO World Heritage site in Perú.

41 Mónica Gudemos, “Trompetas andinas préhispanicas: Tradiciones constructivas y relaciones de poder,” *Anales del Museo de América* 17 (2009): 184–224.

42 Kolar et al., “Ancient *Pututus* Contextualized”; Kolar, “Situating Inca Sonics.”

43 The 1615 autograph manuscript facsimile, annotated transcription, documents, and other digital resources are available on the Guaman Poma website of the Royal Library, Copenhagen, Denmark: <http://www.kb.dk/permalink/2006/poma/info/en/frontpage.htm>, with the iconic depiction of a pututu performed by an Inca chaski (messenger) on drawing 138/page 352 of the text: <http://www.kb.dk/permalink/2006/poma/352/en/text/> (accessed Nov. 14, 2018).

44 Gudemos, “Trompetas andinas préhispanicas.”

45 Anna Gruszczyńska-Ziółkowska, *El poder del sonido: El papel de las crónicas españolas en la etnomusicología andina* (Cayambe: Ediciones Abya-Yala, 1995), 129–30.

46 Mónica L. Gudemos, “Huayllaquepa: El sonido del mar en la tierra,” *Revista española de antropología americano* 31 (2001): 101 (author’s translation). Gudemos’s seminal study of Moche pututus relates coastally provenanced ceramic instruments to their marine-shell precursors. For a detailed musical acoustics discussion of relevant performance physics, see Neville H. Fletcher and Thomas D. Rossing’s chapter “Lip-Driven Brass Instruments,” which describes the mechanics of lip-valve performance, detailing how lip tension and breath pressure allow a player to control the sounding of natural horns and trumpets; in Fletcher and Rossing, *The Physics of Musical Instruments*, 2nd ed. (New York: Springer Science+Business Media, 1998), 455–58.

47 E.g., Rick, “The Evolution of Authority and Power,” 79, 86.

48 Alexander Herrera Wassilowsky, “*Pututu* and *Waylla Kepa*: New Data on Andean Pottery Shell Horns,” *Studien zur Musikarchäologie* 7 (2010): 57, ed. Ricardo Eichmann, Ellen Hickmann and Lars-Christian Koch.

49 John W. Rick, Augusto E. Bazán, and Miguel Ortiz, “Chavín: Camino al centro del mundo,” 2nd ed., ed. Lisseth Rojas Pelayo; graphic novel produced by the Programa Arqueológico Chavín de Huántar, with support from the Compañía Minera Antamina (Lima, Perú, 2017 [2015]), 37, 49, 55–57.

50 Mélanie Ferras, “Les *pututu* de Chavín de Huántar (Ancash, Pérou): Théâtralisation, réactualisation et pouvoir,” 124-Sorbonne, Carnet de l’École Doctorale d’Histoire de l’Art et Archéologie, Sorbonne University Letters, 2018: <https://124revue.hypotheses.org/journees-doctorales/2018-2/archeologie/melanie-ferras> (accessed Dec. 15, 2018) (author’s translation).

51 Lumbreras et al., “Acerca de la Función del Sistema Hidráulico de Chavín”; Luis G. Lumbreras, *Chavín: Excavaciones arqueológicas*, vols. 1 and 2 (Lima: Universidad Alas Peruanas, 2007).

52 Nathaniel Parker VanValkenburgh, “The Sound of Interregionalism in the Late Initial Period and Early Horizon: Twenty *Strombus galeatus* Trumpets from Chavín de Huántar, Perú” (Honors thesis, Stanford University, 2003).

53 John W. Rick, “Innovation, Religion and Authority at the Formative Period Andean Cult Centre of Chavín de Huántar,” in *Religion and Innovation: Antagonists or Partners?* ed. Donald A. Yerxa (London and New York: Bloomsbury Academic, 2016), and “The Nature of Religious Space.”

54 Mélanie Ferras, “Pratiques musicales et sonores des Andes centrales préhispaniques: Une contextualisation archéologique et sociale” (Ph.D. diss., Université Paris Sorbonne, 2019).

55 VanValkenburgh, “The Sound of Interregionalism.”

56 Cook et al., “Acoustic Analysis of the Chavín *Pututus*,” 13; Kolar et al., “Ancient *Pututus* Contextualized,” 32–33.

57 VanValkenburgh, “The Sound of Interregionalism”; Ferras, “Les *pututu* de Chavín de Huántar.”

58 VanValkenburgh, “The Sound of Interregionalism.”

59 Kolar et al., “Ancient *Pututus* Contextualized,” 32.

60 Ibid.

61 For other examples, refer to the Chavín pututus pictured on pp. 338–39 of the Rietberg Museum’s exhibition catalog, edited by Peter Fux, *Chavín: Peru’s Enigmatic Temple in the Andes* (Zurich: Scheidegger & Spiess, 2013).

62 Richard Burger, *Chavín and the Origins of Andean Civilization* (London: Thames and Hudson, 1995 [1992]), 146–49.

63 Rebeca Carión Cachot, “La cultura Chavín: Dos nuevas colonias Kuntur Wasi y Ancón,” *Revista del Museo Nacional Antropología y Arqueología* 2/1 (1948).

64 John H. Rowe, *Chavín Art: An Inquiry into Its Form and Meaning* (New York: University Publishers, 1962).

65 Donald W. Lathrap. “Gifts of the Cayman: Some Thoughts on the Subsistence Basis of Chavín,” in *Pre-Columbian Art History*, ed. Alana Cordy-Collins and Jean Stern (Palo Alto: Peek Publications, 1977), 241–67.

66 Henning Bischof, “Context and Contents of Early Chavín Art,” *Chavín: Art, Architecture, and Culture*, ed. William J. Conklin and Jeffrey Quilter, Monograph 61, Cotsen Institute of Archaeology (Los Angeles: University of California, Los Angeles, 2008), 107–41.

67 Peter G. Roe, “Recent Discoveries in Chavín Art: Some Speculations on Methodology and Significance in the Analysis of a Figural Style,” in *Chavín Art*, Museum of Anthropology Miscellaneous Series No. 48 (Greeley, CO: University of Northern Colorado Museum of Anthropology, 1983), 1–41.

68 Gary Urton, “The Body of Meaning in Chavín Art,” in *Chavín: Art, Architecture, and Culture*, 217–36.

69 Mary Weismantel, “Seeing Like an Archaeologist: Viveiros de Castro at Chavín de Huántar,” *Journal of Social Archaeology* 15/2 (2015): 139–59.

70 Rowe, “Chavín Art.”

71 Constantino Manuel Torres, “Chavín’s Psychoactive Pharmacopoeia: The Iconographic Evidence,” in *Chavín: Art, Architecture, and Culture*, 239–59; Weismantel, “Seeing Like an Archaeologist.”

72 Rick has discussed this extensively: e.g., “Evidence for an Evolved Shamanism,” and “Innovation, Religion and Authority.”

73 E.g., discussions by Alana Cordy-Collins, “Chavín Art: Its Shamanic Hallucinogenic Origins,” in *Pre-Columbian Art History: Selected Readings*, ed. Alana Cordy-Collins and Jean Stern (Palo Alto: Peek Publications, 1977), 353–62; and Torres, “Chavín’s Psychoactive Pharmacopoeia.”

74 Torres, “Chavín’s Psychoactive Pharmacopoeia,” 257.

75 Weismantel, “Seeing Like an Archaeologist,” 147.

76 Ferras, “Les pututu de Chavín de Huántar.”

77 As posed by VanValkenburgh (“The Sound of Interregionalism”), discussed by Kembel and Rick (“Building Authority at Chavín de Huántar,” 70) and further explored by Ferras (“Les pututu de Chavín de Huántar”).

78 John W. Rick, “Religión y Autoridad en Chavín de Huántar,” in *Chavín*, ed. Peter Fux, Spanish version of Rietberg Museum catalog adapted for the Peruvian Exhibition at the Lima Art Museum (Lima: Asociación Museo de Arte Lima, 2015), 179.

79 Contreras, “Sociopolitical and Geomorphologic Dynamics.”

80 Rick et al., “Chavín de Huántar, a Past Challenge to Nature.”

81 E.g., discussions by Richard L. Burger, “Chavín de Huántar and Its Sphere of Influence,” in *Handbook of South American Archaeology*, ed. Helaine Silverman and William H. Isbell (New York: Springer Science+Business Media, LLC, 2008), 681–703; and Mesía-Montenegro, “The Discovery of the Temple.”

82 Rick et al., “Chavín de Huántar, a Past Challenge To Nature.”

83 Lumbreras et al., “Acerca de la Función del Sistema Hidráulico de Chavín” (author’s translation).

84 Burger, “Chavín de Huántar and Its Sphere of Influence,” 681.

85 The Chavín de Huántar Archaeological Acoustics Project website is <https://ccrma.stanford.edu/groups/chavin/>.

86 A recently discovered *Strombus Lobatus galeatus* pututu during the 2018 field season brings the total now excavated to 21, documented in a 2019 acoustical and performance study I conducted with Peruvian colleagues, pending publication.

87 David Lubman, “Archaeological Acoustic Study of Chirped Echo from the Mayan Pyramid at Chichén Itzá,” *The Journal of the Acoustical Society of America* 104 (1998): 1763. doi:10.1121/1.424061.

88 Published as both David Lubman and John W. Rick, “On the Use of *Strombus* Trumpets Found at the Ancient Peruvian Center Chavín de Huántar,” presented by Lubman at the First Pan American/Iberian Meeting on Acoustics, Cancún, Mexico (2002); and John W. Rick and David Lubman, “Characteristics and Speculations on the Uses of *Strombus* Trumpets Found at the Ancient Peruvian Center Chavín de Huántar,” *The Journal of the Acoustical Society of America* 112 (2002): 2366. doi:10.1121/1.4779586.

89 Our 2008 preliminary archaeoacoustical fieldwork and pututu documentation at Chavín was the only group visit by the initial Stanford acoustics team for a project that has incorporated researchers of many different affiliations through both musical acoustics and archaeology connections. My leadership of this project resulted in my relocation to the Andes for four years during my doctoral studies.

90 Perry R. Cook, Jonathan S. Abel, Miriam A. Kolar, Patty Huang, Jyri Huopaniemi, John W. Rick, Chris Chafe, and John M. Chowning, "Acoustic Analysis of the Chavín *Pututus* (*Strombus galeatus* Marine Shell Trumpets)," *The Journal of the Acoustical Society of America* 128: 2359. doi:10.1121/1.3508370. Presented at the 160th meeting of the Acoustical Society of America, Cancún, Mexico, November 2010.

91 Music archaeologist Arnd Adje Both has corroborated these observations in his study of Mesoamerican conch trumpets, citing organologist Curt Sachs's 1940 discussion of the range of techniques observed ethnographically: "While wind sounds can be produced by breathing through the trumpet and gurgling sounds by shaking a shell filled with water, the instrument can also be used as a megaphone and voice distorter by breathing, speaking or singing through the blowing hole, supposedly one of the oldest techniques of using the shell" (p. 267). In "Shell Trumpets in Mesoamerica: Music-Archaeological Evidence and Living Tradition," *Studien zur Musikarchäologie IV*, ed. Ellen Hickmann and Ricardo Eichmann (Rahden, Westphalia: Verlag Marie Leidorf, 2004), 261–77.

92 Tito La Rosa's breathing-into-pututu technique can be heard in his research performance of Chavín pututus included as the soundtrack to the "context" video about Chavín archaeoacoustics by José L. Cruzado Coronel and Miriam A. Kolar: <https://ccrma.stanford.edu/groups/chavin/video/Chavin.m4v>.

93 As discussed in Abel et al., "On the Acoustics of the Galleries," and Kolar, "*Pututus*, Resonance and Beats."

94 Kolar et al., "Ancient *Pututus* Contextualized"; Kolar, "Archaeoacoustics."

95 John W. Rick, "Innovation, Religion and Authority," 24.

96 Rick, "The Nature of Religious Space," 23.

97 Rick, "Innovation, Religion and Authority," 12.

98 Silvia Rodríguez Kembel, "Architectural Sequence and Chronology at Chavín de Huántar, Perú" (Ph.D. diss., Stanford University, 2001).

99 Kembel and Rick, "Building Authority at Chavín de Huántar," 69.

100 Rick, "The Evolution of Authority and Power," 79.

101 Kembel and Rick, "Building Authority at Chavín de Huántar," 66–67.

102 Contreras, "Sociopolitical and Geomorphologic Dynamics," 244.

103 Daniel A. Contreras, "Landscape Setting as Medium of Communication at Chavín de Huántar, Peru," *Cambridge Archaeological Journal* 25/2 (May 2015): 525.

104 Rick, "Evidence for an Evolved Shamanism."

105 Christian Mesía-Montenegro, "Intrasite Spatial Organization at Chavín de Huántar during the Andean Formative: Three Dimensional Modelling, Stratigraphy and Ceramics" (Ph.D. diss., Stanford University, 2007).

106 Christian Mesía-Montenegro, "The Discovery of the Temple, and Early Attempts at Interpretation," in *Chavín: Peru's Enigmatic Temple in the Andes*, 124.

107 A comprehensive examination of human communication modalities is given by Ruth Finnegan, *Communicating: The Multiple Modes of Human Communication*, 2nd ed. (Oxon and New York: Routledge, 2014).

108 Rick, "The Nature of Religious Space," 45.

109 As documented for the *Strombus pututu* calibration measures in Miriam A. Kolar, R. Alan Covey, and José Luis Cruzado Coronel, "The Huánuco Pampa Acoustical Field Survey: An Efficient, Comparative Archaeoacoustical Method for Studying Sonic Communication Dynamics," *Heritage Science* 6/9 (2018). doi:10.1186/s40494-018-0203-4. Also measured in 2017–18 fieldwork at Chavín, using replica horns made from *Strombus Lobatus galeatus* as studied by Cook et al., "Acoustic Analysis of the Chavín *Pututus*..." which fit within the characteristics range of Chavín pututus; detailed in Kolar et al., "Ancient *Pututus* Contextualized."

110 Rick, "Context, Construction, and Ritual in the Development of Authority," 32.

111 Kolar, "Sensing Sonically."

112 Rowe, "Chavín Art."

113 Tom Cummins, "The Felicitous Legacy of the Lanzón," in *Chavín: Art, Architecture and Culture*, 279–304.

114 Kembel, "Archaeological Sequence and Chronology."

115 Rick, "Context, Construction, and Ritual in the Development of Authority," 32.

116 Multimodal messaging in the ritual context at Chavín is the topic of Kolar, "Sensing Sonically."

117 Kolar et al., “Ancient *Pututus* Contextualized,” 44.

118 As suggested in a discussion of Chavín propaganda, Kembel and Rick, “Building Authority at Chavín de Huántar,” 69.

119 Kolar, “*Pututus*, Resonance and Beats.”

120 Ibid., <https://ccrma.stanford.edu/groups/chavin/ASA2014.html>.

121 Ibid.; as demonstrated in this documentation of experimental music archaeology research conducted by Miriam Kolar and José Cruzado: https://ccrma.stanford.edu/groups/chavin/ASA2014/Fig10_Kolar_Cruzado_PututusResonanceLaberintos_3312_byKolar.m4v.

122 A brief theoretical framing of the adoption of these principles from psychology to experimental archaeoacoustics is given in Kolar, “Situating Inca Sonics.”

123 Kolar, “Archaeological Psychoacoustics at Chavín de Huántar, Perú,” 58.

124 Rick, “Evidence for an Evolved Shamanism.”

125 Thomas Turino, *Music as Social Life: The Politics of Participation* (Chicago and London: University of Chicago Press, 2008), 4, 30–31, 233.

126 Mihaly Csikszentmihalyi, *The Evolving Self: A Psychology for the Third Millennium* (New York: Harper Collins 2018 [1993]), xi.

127 Ibid., 185–86.

128 As explored in the ethnographical, multidisciplinary discussion by Judith Becker, *Deep Listeners: Music, Emotion, and Trancing* (Bloomington: Indiana University Press, 2004).

129 Ibid., 161.

130 Ibid., 1.

131 Rick, “Evidence for an Evolved Shamanism.”

132 Cordy-Collins, “Chavín Art: Its Shamanic Hallucinogenic Origins”; Torres, “Chavín’s Psychoactive Pharmacopoeia.”

133 Rick, “Evidence for an Evolved Shamanism” and “Context, Construction, and Ritual in the Development of Authority.”

134 Turino, *Music as Social Life*, 43.

135 Art historian Rebecca Stone describes jaguar-trance shamanism and associated mimetic rattles in *The Jaguar Within: Shamanic Trance in Ancient Central and South American Art* (Austin: University of Texas Press, 2011), 122–24.

136 “Each shell was excited with ‘impulses’ made by the player rapidly slapping his open palm onto the shell mouthpiece, and continuing to hold the palm firmly there to keep the shell end closed until the impulse response in the bore died away (a few hundred milliseconds maximum)” (Cook et al., “Acoustic Analysis of the Chavín *Pututus*,” 4).

137 Abel et al., “On the Acoustics of the Galleries,” 1.

138 See discussion in Kolar et al., “Ancient *Pututus* Contextualized,” 27–28.

139 An acoustical discussion of *pututus* and windshear is given in Kolar et al., “The Huánuco Pampa Acoustical Field Survey.”

140 For a discussion of Chavín underground engineering, see the discussion in Rick, “Context, Construction, and Ritual in the Development of Authority,” 10–20. See also the proposed environmental-actor/negotiation model with sociopolitical interpretations in Daniel Alexander Contreras, “(Re)Constructing the Sacred: Landscape Geoarchaeology at Chavín de Huántar, Peru,” *Archaeological and Anthropological Sciences* 9/6 (2014). doi:10.1007/s12520-014-0207-2.

141 I introduced a discussion of the multimodal context for sonic icons at Chavín (following Peirce) in Kolar, “Sensing Sonically.”

142 For example, the vertical shafts with small ledges at their bases just west of the conservation-roofed opening of the Rocas canal on the terrace at the northeastern corner of Building A, not far from the Circular Plaza.

143 Cataloged as “Artifact 1, Level 3, Cor. A, W-1,” discussed on p. 49, and shown in Figs. 54, 55, and 56 (p.50-51) of Proyecto de Investigación Arqueológica y Conservación en Chavín de Huántar, *Boletín de fin de temporada de campo 2014*, ed. John W. Rick and Augusto E. Bazán (Huaraz: Asociación Ancash, 2014); hereafter cited as PIACCdH 2014.

144 Proyecto de Investigación Arqueológica y Conservación Chavín de Huántar (PIACCdH), *Boletín de fin de temporada de excavaciones 2013* (PIACCdH: Lima, 2013); hereafter cited as PIACCdH 2013.

145 Kolar et al., “The Huánuco Pampa Acoustical Field Survey,” 22–23.

146 See discussions of the Chavín *pututus*’ acoustical radiation analysis in Cook et al. “Acoustic Analysis of the Chavín *Pututus*,” 8–11, and Kolar et al., “Ancient *Pututus* Contextualized,” 31.

147 Kolar et al., “Ancient *Pututus* Contextualized,” 31–34.

148 As detailed in the ethnographic, iconographic, and historical discussion of Inca *queros* and *pacchas* (drinking vessels) by Catherine J. Allen, “The Incas Have Gone Inside: Pattern and Persistence in Andean Iconography,” *RES: Anthropology and Aesthetics* 42 (Autumn 2002): 192.

149 Ferras, “Les *pututu* de Chavín de Huántar” (author’s translation).

150 Considering current debates about the functionality of hypothetical hydraulic mechanisms

at Chavín, I wish to clarify that by site hydraulics, I mean water-flowing structures, whether actuated via engineered systems or through the manual pouring of water over and through site architecture.

151 Kolar, "Sensing Sonically."

152 Kolar et al., "Ancient *Pututus* Contextualized"; Kolar, "Archaeological Psychoacoustics at Chavín de Huántar, Perú," "Acoustics, Architecture, and Instruments in Ancient Chavín de Huántar, Perú," and "*Pututus*, Resonance and Beats."

153 See summary discussion of rhythmic entrainment in Becker, "Deep Listeners," 127–29.

154 Turner, "Ritual Action Shapes Our Brains," 44.

155 Tiffany Peng, C. Douglas Phillips, Jonathan P. Dyke, and Michael G. Stewart, "Mechanics of Circular Breathing in Wind Musicians Using Cine Magnetic Resonance Imaging Techniques," *Laryngoscope* 125/2 (2015): 412–18.

156 Kolar, "*Pututus*, Resonance and Beats."

157 As discussed in the context of pututu performance in Herrera et al., "Arqueomusicología de las trompetas de caracol andinas de concha y cerámica," 158.

158 See discussion of echo studies at Chavín in Kolar et al., "Ancient *Pututus* Contextualized," and also in Kolar, "Archaeoacoustics."

159 As demonstrated by Tito la Rosa in this research performance at the Museo Nacional Chavín, documented by Cobi van Tonder for the Chavín de Huántar Archaeological Acoustics Project in 2008: https://ccrma.stanford.edu/groups/chavin/ASA2014/Fig6_VIDEO_TitoLaRosa%20_performsChavinPututu_byCVT.m4v.

160 Kolar et al., "Ancient *Pututus* Contextualized."