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# Notational production rules in the Muisca culture iconography, Colombia

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## Resumen

Este artículo explora los componentes no estéticos de las expresiones artísticas indígenas Muisca, con un enfoque en la información numérica codificada en su iconografía. Se presentan varios ejemplos de artefactos que exhiben evidencia de cantidades numéricas, como paneles de arte rupestre, textiles y objetos de la industria lítica, sin embargo, los volantes de huso son considerados principalmente en este análisis preliminar debido a su naturaleza monocromática y simplificada. La presencia de secuencias de elementos y composiciones en estos artefactos, incluyendo triángulos, trazos, espirales y cabezas de pájaro, sugiere la posible existencia de una gramática subyacente que rige la producción de estas expresiones. Se sugiere adoptar una perspectiva epigráfica para comprender mejor los aspectos formales de estas representaciones antes de explorar su semántica. En última instancia, este enfoque podría proporcionar una mejor comprensión de cómo se incorporan los significados en el sistema.

**Palabras clave:** Muisca, Arte Indígena, Información Numérica, Volantes de huso, Semasiografía

## Abstract

This paper explores the non-aesthetic components of Muisca indigenous artistic expressions, with a focus on numerical information encoded within the iconography. The paper presents various examples of artifacts that exhibit evidence of numerical quantities, such as rock art panels, textiles, and lithic industry objects, however, spindle whorls, a category of artifacts characterized by their monochromatic and simplified nature, are primarily considered in this preliminary analysis. The presence of sequences of elements and compositions in these artifacts, including triangles, strokes, spirals, and bird heads, suggests the potential existence of an underlying grammar governing the production of these expressions. The paper suggests adopting an epigraphic perspective to better understand the formal aspects of these representations before exploring their semantics. Ultimately, this approach could provide a better understanding of how meanings are embedded into the system.

**Keywords:** Muisca, Indigenous Art, Numerical Information, Spindle Whorls, Semasiography

## Introduction

Indigenous peoples have long been recognized for their artistic practices and contributions to the world's cultural diversity. The Muisca, a precolumbian indigenous people from the Eastern Andes of Colombia, are no exception. Their artistic production is one of the most notable for the Intermediate Area, characterized by diverse canons encompassing rock art, spindle whorls, ceramics, cloth, metallurgy, and metallurgy moulds. These artistic expressions appear to serve multiple purposes beyond their aesthetic value. Notably, the iconographic productions contain active components of numerical information, suggesting that they were used to encode specific information, adding another layer of complexity to the artistic expression. The primary objective of this work is to present a preliminary analysis of such non-aesthetic components, investigating the potential existence of an underlying grammar that governs the production of such expressions. In order to do this, one category of artifacts, namely spindle whorls, will be primarily considered. It should be noted that the contribution of this work to Cultural Astronomy is not immediate; rather, it aims to provide some methodological tools for the development of future studies of the astronomical and calendrical traditions of the Muisca Culture.

## Numeric expressions

Examples of artifacts showing evidence of numerical quantities are numerous. For example, Figure 1a shows a rock art panel

from the Town of Iza (province of Boyacá), where the presence of thirty strokes around a symbol resembling an “hourglass” plausibly suggest a lunar account. In Figure 1b, a similar disposition of strokes is found in the decoration of a conch trumpet, currently in the collection of the Archaeological Museum of Sogamoso. Its spiral surface is covered with a strip of symbols, divided on 9 sections, where 5 of them exhibit circles surrounded by strokes. The number of strokes alternate between 7 and 8, values probably associated to the calendar (Izquierdo, 2009). On the side of textiles, a cloth (Figure 1c) originally found in the Town of Gachancipá and now in the British Museum collection, portrays ten anthropomorphic motifs where a “crown of feathers” stands out. Similar to the conch, the number of strokes, (in this case, feathers) vary between 15 and 16 per crown. Interestingly, the feathers could take a colour green or yellow, not always in the same proportion for each crown, indicating a second layer of numerical information. In Figure 1d, another textile, originally from the Town of Belén (province of Boyacá) and now in the Pasca Museum collection, draws attention, as it resembles a “page” of tabulated data. This cloth shows 5 rows with symbols, where again, the stroke-around-circle composition is present. On the side of the lithic industry, Figure 1e shows a handstone, originally from the Town of Choachí (province of Cundinamarca), now in the collection of the National Museum of Colombia, and previously referred as “Choachí Stone” (Izquierdo and Morales 2006). It portrays 4 concentric rings of carved symbols. The inner ring features 18 triangles, pointing towards the center of the composition, akin to the strokes in the other artifacts. The next

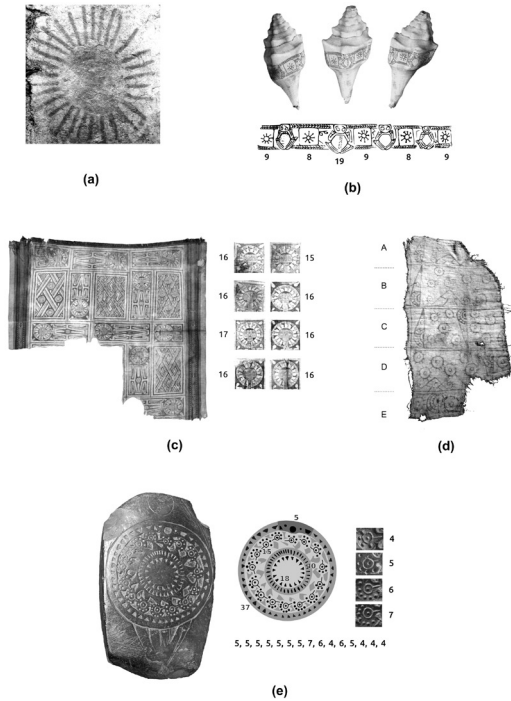


Figure 1. Muisca artifacts with numeric information. (a) Rock art from Iza, Boyacá (photo by the author). (b) Conch trumpet, Archaeological Museum of Sogamoso (photo by the author). (c) Cloth from Gachancipá, British Museum (photo by The British Museum, with permission). (d) Cloth from Belén, Boyacá, Pasca Museum (photo by Diego Martínez, with permission). (e) Choachí Stone, National Museum of Colombia (photo by the author).

ring exhibits 40 strokes, and the outer ring has 37 triangles. The third ring is particularly complex, featuring 15 compositions where the motif of a bird-head draws the attention, as each head is surrounded by dots, similar to the feathers of the textile from Gachancipá. Like in the textile, the number of dots varies among the values 4, 5, 6, and 7. Muisca spindle whorls show a use of space that resembles the Choachí Stone. In these

category of artifacts the presence of numerical information is rather conspicuous, as they recurrently portrait numerical sequences of elements like triangles, strokes, spirals, and feature compositions similar to Choachí Stone's bird head.

This archaeological evidence is very suggestive, and might complement the understanding of the Muisca calendar and their astronomical traditions, as already discussed in detail by Izquierdo (2009, 2011), however, while delving into the eventual astronomical aspects of these artifacts is important, it should be preceded by addressing two fundamental questions: What is the nature of this encoding? What rules must be followed to 'read' this data? This preliminary step is crucial because, in this uncharted territory, formulating interpretations without methodological points of reference can lead researchers to biases and preconceptions. Therefore, this work will primarily focus on addressing these questions. In order to tackle this, the use of theoretical concepts from epigraphy will be highly beneficial for our purposes.

## An epigraphic look

The traditional interpretation of the Muisca representations has focused on their artistic value, where geometric, zoomorphic and anthropomorphic themes are understood as the representation of mythological ideas (Triana, 1970; Jiménez de Muñoz, 2009; Ballestas Rincón, 2009). Here, I suggest that instead of jumping straight into interpretation, the analysis of these representations should initially be

centred on figuring out whether exist production rules that govern this system and the functional relationships between its components. This approach could provide a better understanding of how meanings are embedded into the system, even if we are not yet able to discern them. In simpler terms, let us focus on grammar before exploring semantics.

Some enthusiasts may argue that these representations could be a form of "writing", topic that could lead into a lengthy debate. For now, it suffices to consider them as a *semasiographic* system. Regardless of whether or not these representations qualify as writing, we must stop regarding them as mere decorations and instead view them as inscriptions. Adopting an epigraphic perspective will enable us to shift our analysis towards understanding the function and meaning of these representations.

In the context of precolumbian studies, epigraphy has been mostly centred in the study of Maya writing (Coe, 1993, 2005), however, attention has been paid to semasiography in the case of Mixtec codices (Boone and Mignolo 1994), more recently, renewed interest in 'alternative forms of writing' beyond Mesoamerica has been expressed (Boone and Urton 2011).

## Deep and Surface Structures

Considering this, even in the context of semasiography, an epigraphic analysis can be benefited of borrowing useful concepts

from linguistics, typically applied to the study of "true writing". In the field of linguistics, the concept of "Underlying Representation" is utilized in the context of spoken language to refer to the abstract form of a word before any phonological processes take place (*morpheme*), while a "surface representation" denotes the phonetic representation of the word (*phoneme*), in this way, different phonemes representing the same morpheme, are called *allophones*. Similarly, the term *grapheme* represents the underlying representation of written language, defined as the "smallest functional unit of a writing" (Coulmas 1999). The surface representation of graphemes consists of *glyphs*, which are tangible graphic symbols associated to a specific grapheme. *Allographs* are occurrences of different glyphs representing the same grapheme. Notice that these concepts are in line with the Chomskyan ideas of "deep structure" and "surface structure" (Chomsky 2006). In this work it is proposed that the concepts of *grapheme*, *glyph* and *allograph* still apply to semasiography, which is the methodological core of adopting an epigraphic perspective on its study. In this context, a glyph is identified by two hierarchical components: the *token*, which is a formal graphical element, discretely differentiated from others, and the *theme*, a given combination of one or more tokens that repeats along the corpus (Figure 2e). Despite the ultimate goal of epigraphy is to identify the graphemes of an inscription, this work, due to its preliminary nature, will discuss only on the detected tokens, themes and glyphs of the Muisca representations, more specifically those present in their spindle whorls.

## A proposed grammar

Spindle whorls are rotating counterweights attached to a vertical stick or spindle, intended to create a tool for spinning fibers into threads. Unlike other kind of Muisca art expressions like ceramics or textiles, spindle whorl decorations are monochromatic, simplified, and in most of the cases, free of aesthetics. These traits make spindle whorls a very valuable object of study, due to their simplified nature, as they expose minimal core aspects that allows us to look for an underlying grammar or set of production rules of this representation system. In this work, the collection of muisca spindle whorls of the Archaeological Museum of Sogamoso originally studied by García, (1971) and then catalogued by Silva (1985), was considered for the study.

We find eight volume types, each one presenting one to four surfaces (see Figure 2a). In this work, special attention is given to the surfaces. An important aspect to recognize is that spindle whorl surfaces possess directionality. This is defined by the general direction that points to the top of its rotation axis, represented by the spindle. This direction is labelled with the letter "I" and is derived from the word "inwards" because it tends to converge towards the inner hole of the whorl when projected onto the surfaces (Figure 2b).

In its "deep structure", the grammar of the Muisca representation has two essential elements: *structuring of space* and *use of space*. The structuring of space is characterized by three aspects. The first one is the presence of such "inwards" direction, which is indispensable for understanding the orientation

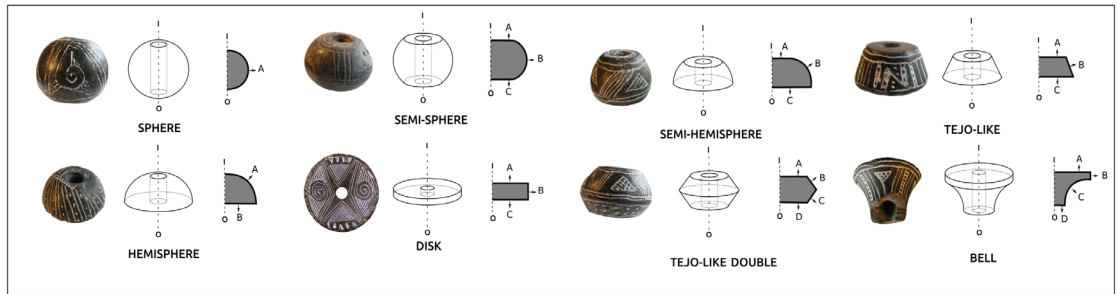
of spindle whorl surfaces. The second aspect is the ability of these surfaces to be mapped onto a rectangular grid, regardless of the volume's shape, and always preserving the "inwards" direction, this grid is denominated *Fundamental Grid* (Figure 2c). The third aspect is the partitioning of the *Fundamental Grid* into three sections: the *inwards section*, the *core section* and the *outwards section*. This tripartite structure is denominated as the **ICO** structure (Figure 2d).

For the use of space, it is important to consider that the graphic primitives, or tokens, identified in the studied corpus, fall into two categories denominated as "stems" and "simple tokens". The stems category, is essentially composed by two symbols: the *long single line* and the *long double line* (Figure 2f). The simple tokens category is comprised by the *filled triangle*, *spiral*, *circle*, *wedge*, *dot*, and short versions of the single and double line (Figure 2g). Three rules govern the use of space in the fundamental grid: the first one states that *stems* only appear inside the "inward" and/or "outward" sections, the second dictates that *simple tokens* only appear in the *core section*. The third indicates that another full **ICO** structure can be nested inside a *core section* (Figures 2h-j).

Considering now the "surface structure" of the fundamental grid, it is important to consider that, when projecting it back into the original surfaces of the spindle whorls, the shape of the **ICO** structure could be distorted. This process of distortion is more apparent in nested **ICO**, where the inward or outward sections could collapse, without necessarily altering the essence of the **ICO** structure, where the collapsed sections still count as empty sets (Figure 3a).

Specific shapes are formed as a result of various deformations that the **ICO** structure may undergo. These shapes serve as "spatial contexts" that have the potential to indicate

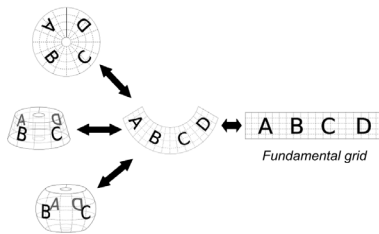
"semantic containers" (Figure 3b) which are labelled as *Ring*, *Arc*, *Neck*, *Triangular*, *Semitriangular* and *Square*. Combinations of these "spatial contexts" conform metastruc-



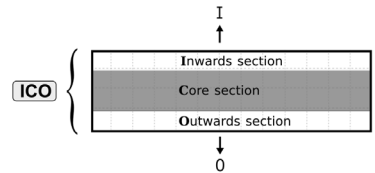
(a)



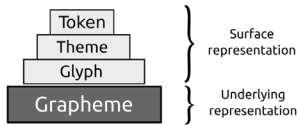
(b)



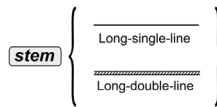
(c)



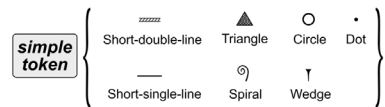
(d)



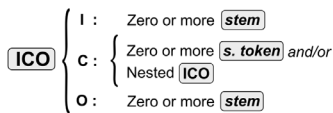
(e)



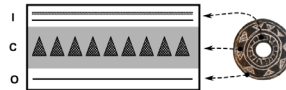
(f)



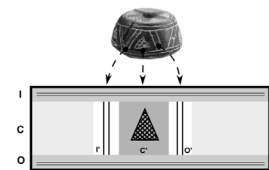
(g)



(h)



(i)



(j)

Figure 2. (a) Spindle whorls volumes and surfaces. (b) Spindle whorl directionality. (c) Fundamental surface. (d) ICO structure. (e) Surface and Underlying representations. (f) Stem tokens. (g) Simple tokens. (h) Positioning rules of tokens inside the ICO structure. (i) Example of token positioning in the ICO. (j) Example of ICO nesting.

tures denominated as layouts. These layouts are labelled too as *FullRing*, *2Arc+2Triangle*, *3Arc*, *4Triangle+4Neck*, *2Arc+2Neck*, *Strip* and *MiscaGrid* (Figure 3c).

An additional aspect of the use of space is the concept of *Negative Space*, which refers to the physical space surrounding an **ICO** structure that emerges following a distortion. This becomes apparent when two different contexts are juxtaposed. The use of such meta-spaces appears to indicate the placement of "extraordinary" contexts, potentially containing metadata (Figure 3d). Themes and corresponding glyphs are created by strategically placing tokens within the **ICO** structure using methods of *juxtaposition*, *attachment* and *stacking*

(Figure 3e). During this process, a specific rule is observed regarding the *Triangle* token: its tip must always point towards the "I" direction of the surface. However, sometimes this rule is intentionally broken, typically in association with negative spaces, resulting in an *inversion*. Stacking often occurs within nested **ICO** substructures, and in these cases, groups of tokens are piled on top of each other.

## Themes

A preliminary inventory of themes can be elaborated by analyzing the corpus

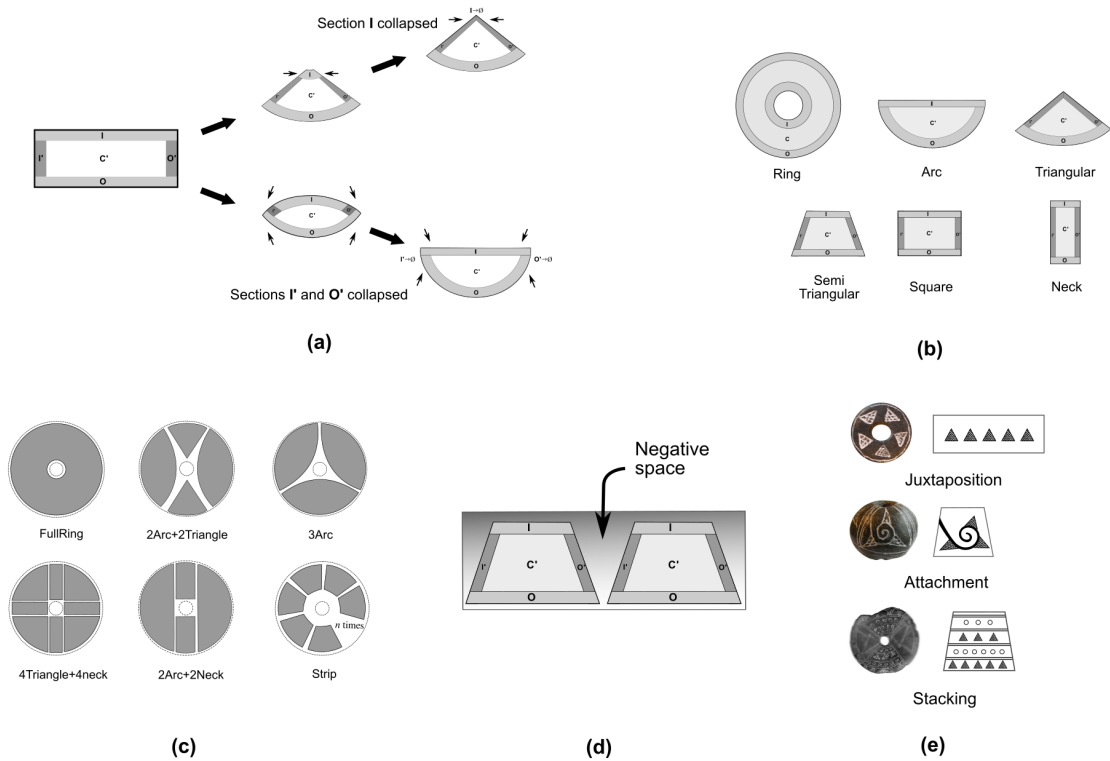


Figure 3. (a) ICO deformation. (b) Spatial contexts. (c) Spatial layouts (d) Negative space. (e) Token composition strategies.

of spindle whorls at the Archaeological Museum of Sogamoso. In Figure 4, these themes are labelled with descriptive, albeit arbitrary names, and grouped based on the similarity of their arrangement. It has been observed that certain themes appear to structurally derive from others. For instance, the *Clamp*, *DoughBody*, and *Greca* themes are variations of the *LineConcat* theme, while the *Face* theme is a specialized case of the *TriangleStack* theme. Notably, the *TriangleStack* theme appears to represent an entire family of compositions where multiple rows of symbols are piled up, nesting many **ICO** substructures. The *BirdHead* theme appears in other artifacts such as the Choachí Stone (Figure 1e) and the cloth from Gachancipá (Figure 1c). It appears to be derived from the *CircleDyad*

theme, which is also present in other artifacts like the Conch Trumpet (Figure 1b) and the Belén cloth (Figure 1d). In spindle whorls, the *BirdHead* is typically paired with a *Triangle* or a *Short Double Line* token. However, in the Choachí Stone and the Gachancipá cloth, the *BirdHead* is situated in juxtaposition to the *RadialBody* Theme. Certain themes appear to be specific to particular spatial contexts (Figure 3b). For example, the *TriangleRow* and *HourGlass* themes only appear in Neck contexts, while the *TriangleStack* theme, due to its geometric nature, is typically found in Triangular and Semitriangular contexts. The *BirdHead* theme is commonly placed in Arc and Triangular contexts, whereas themes like *TriangleSpiral* may appear in any context.

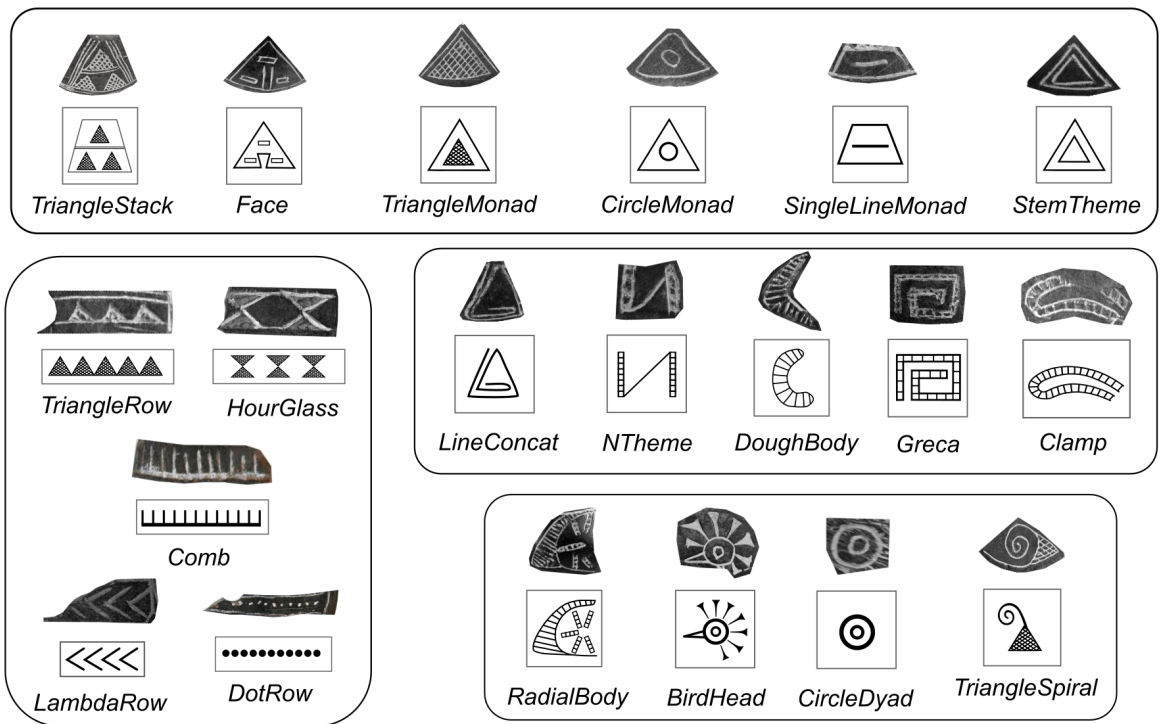


Figure 4. Theme inventory. The themes are grouped by similarity.

# Functional Relationships

In some themes like the *TriangleRow* or the *BirdHead*, the encoding of numbers is evident. Other themes are, however, more abstract and could convey non numerical information. While the meaning of these themes is still speculative, placeholders for meanings have the potential to be identified. For example, some functional relationships can be identified. The inscriptions of the spindle whorls of Figure 5a, are almost the same, except for the value of one stem switching from *single line* to *double line*. This observation suggests that a "global state" of the entire message has changed. Another interesting relationship observed in most cases is that the layouts seem to describe information that is split into opposing pairs. Figure 5b demonstrates this relationship, where *Neck* contexts frequently appear in opposition to *Arc* contexts. This characteristic suggests that the information encoded in the spindle whorls could be expressed in terms of proportions. This aspect could shed light on the understanding of artifacts such as the Choachí Stone. As previously described, the numbers 37 and 40 (located in two Ring contexts) may relate to a lunar account, as the proportion 37:40 corresponds to a ratio that links the time-spans of the synodic and the sidereal lunar months (Izquierdo 2011). Similarly, the values attached to the 15 BirdHeads, along with the value 18, could represent another proportion. It is noteworthy that if the value 19 is assigned to the bird-head theme, the sum of all the bird-heads and their accompanying dots yields 360 (see figure 5c). In this case, the represented proportion is

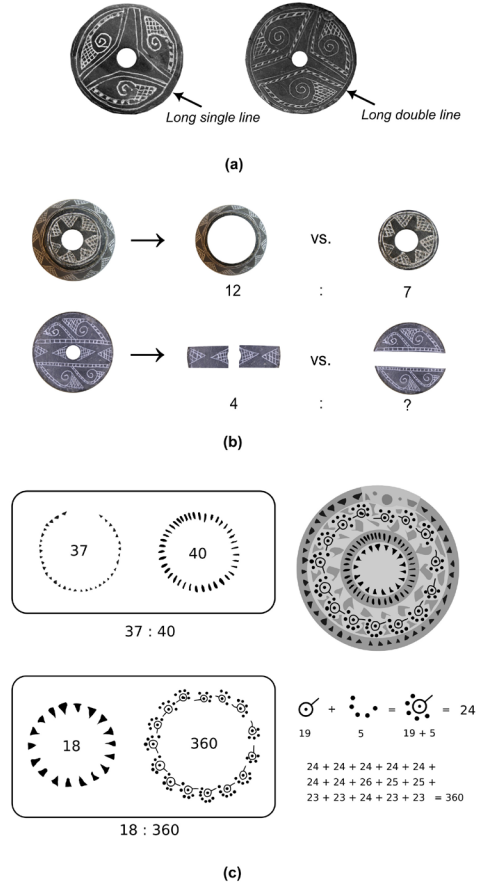


Figure 5. (a) Example of two nearly identical spindle whorls, showing the switch from a Long single line stem into a Long double line stem. (b) Example of spindle whorls with numerical values arranged in two opposed pairs, suggesting the encoding of proportions. (c) Proportion values found in the Choachí Stone.

18:360, which appears to have a solar nature. For the Choachí Stone, it seems we are dealing with astronomical/calendrical information, however, in the case of the spindle whorls, their numeral representa-

tions could be related to other activities like cloth weaving. If so, this suggests the use of a same numerical encoding system in two different applications.

## Concluding remarks

The goal of this work is twofold: first, to highlight the presence of numerical information in the artistic expressions of the Muisca, and second, to demonstrate that the encoding of such information follows a set of production rules that could suggest the presence of an underlying grammar. By adopting an epigraphic perspective, this study sheds light on how meanings were embedded into the system. Although it is still too early to make firm interpretations about the meanings of these artifacts, it is evident that numbers play a crucial role in Muisca iconography. As shown previously, the presence of different spatial contexts embedding families of themes, suggests the existence of a predetermined set of 'discursive subjects' to which the encoded information is addressed.

This work aims to offer methodological insights that could assist researchers in "learning to read" these artifacts and facilitating a comprehensive interpretive analysis of the astronomical significance of the numerical information found in the archaeological evidence. Questions such as: What role do these expressions play within the Muisca calendar? How do they fit into the vigesimal numbering system of the Muisca? are highly relevant. However, due to space constraints, they cannot be fully addressed in the present work. This contribution wants

to serve as an initial stepping stone for future research and its corresponding publications in this interesting topic.

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