

RESEARCH REPORT

Ply, Markedness, and Redundancy: New Evidence for How Andean Khipus Encoded Information

Sabine Hyland

ABSTRACT Khipus are knotted-cord devices once used in the Andes for communication and recording information. Although numbers can be read on many khipus, it is unknown how other forms of data may have been recorded on the strings. Scholars currently debate whether elements of cord construction, such as the direction of ply, signified meaning on khipus and, if so, how. Testimony from an Aymara-speaking khipu maker, collected in 1895 by Max Uhle and recovered from Uhle's unpublished field notes, combined with the analysis of his actual khipu provides the first direct evidence that ply was a signifying element in khipus. Moreover, the evidence suggests that ply signified through a principle of markedness in which S ply corresponded to the unmarked (more valued) category while Z ply corresponded to the marked (less valued) category. [*writing systems, khipu, Andes, Aymara, Max Uhle*]

RESUMEN Los quipus son artefactos de nudos acordonados que antes se usaron en los Andes para la comunicación y el registro de información. Aunque se pueden leer números en muchos quipus, no se sabe cómo otras formas de información pueden haber sido registradas en las cuerdas. Investigadores actualmente discuten si elementos de la construcción de la cuerda, tales como la dirección de la fibra tienen significado en los quipus y si así es, cómo. Testimonio de un hablante del Aymara que hacía quipus, recogida en 1895 por Max Uhle y recuperado de sus notas de campo no publicadas, combinados con el análisis de su real quipu proveen la primera evidencia directa que la dirección de la fibra fue un elemento significativo de los quipus. Sobre todo, la evidencia sugiere que la fibra indicó que a través de un principio de marcación, la fibra S correspondió a una categoría no marcada (con mayor valor) mientras la fibra Z correspondió a una categoría marcada (de menor valor). [*sistemas de escritura, quipus, Los Andes, Ymara, Max Uhle*]

Khipus are systems of knotted cords used in the Andes to record accounting data as well as historical and narrative information (Ascher and Ascher 1981; Urton 2003:3). Khipu usage peaked during the Inka Empire (ca. 1400–1532 C.E.), continuing throughout the Spanish colonial period and into the 20th century (Curatola and De La Puente 2013; Salomon 2004). Numbers can be read on many of the 789 extant khipus (Urton and Brezine 2011) according to the knot system decoded by Leland Locke (1923), but there is no consensus as to how other forms of data may have been recorded on the strings. Scholars continue to debate whether khipus were primarily personal memory aides or

whether they recorded information through widely known conventions that made them “readable” by others besides their creators (Brokaw 2005; Niles 2007).

Researchers have speculated that meanings may have been encoded on khipus through elements of cord construction, specifically through the direction of ply—that is, whether the two or more strings that comprise a cord were twisted together in such a way that the direction of the strands mimicked the middle bar of the letter “S” (S ply), or the letter “Z” (Z ply). Although Marcia Ascher argued that differences in ply direction were probably not used to signify differences in meaning (Ascher 2005), Gary Urton

has hypothesized that the distinction between S ply and Z ply may have been an important signifying element in khipus (Urton 2003:62–67). However, it has not been known how ply direction may have signified meaning nor has there existed any direct proof from khipus to support this hypothesis (Brokaw 2005). In 1895, the German anthropologist Max Uhle collected a khipu from the Cutusuma hacienda in Bolivia and interviewed its creator about its meaning. Uhle's unpublished field notes contain significant new information about this khipu, material that was not included in his 1897 article on the Cutusuma khipu (Uhle 1897). Combining this previously unpublished data with an analysis of the Cutusuma khipu itself reveals the first documented evidence of ply directionality having significance on an Andean khipu; this holds implications for our understanding of how meaning was encoded on khipus.

UHLE AND THE CUTUSUMA KHIPU

Uhle, who had trained as a philologist at the University of Göttingen, carried out his initial fieldwork in Bolivia under the auspices of Adolf Bastian at the Royal Museum of Ethnology in Berlin (Dauelsberg 1984). In March 1895, Uhle travelled through Bolivia searching for khipus and Andean antiquities, sponsored for the first time by the Free Museum of Science and Art in Philadelphia instead of by the Berlin Museum (Loza 2001). During his previous expedition to the Lake Titicaca area (September 1894–January 1895), Uhle had purchased herders' khipus, and he hoped to acquire more ethnographic khipus on this trip. On the March 1895 expedition, Uhle travelled with a local administrator, Anastacio Jurado, to the Cutusuma hacienda near the southeastern shore of the lake. There, Uhle persuaded the Aymara-speaking herder responsible for the previous year's livestock to bring out the khipu containing the hacienda livestock records for 1894. During a lengthy session, in which Jurado translated the Indian's Aymara language into Spanish, Uhle questioned the herder about the significance of the khipu, recording this information verbatim in Spanish in his field journal. Uhle then purchased the Cutusuma khipu for the museum in Pennsylvania.¹

Uhle's article on the Cutusuma khipu described the basic principles of how the khipu functioned (Uhle 1897). Uhle stated that the khipu was monochrome white and recorded numbers of sheep. There are three sizes of knots on the khipu: large knots correspond to hundreds, medium knots to tens, and small knots to ones. In Uhle's drawing of the khipu (Figure 1), the topmost cord, which subdivides into three strings, has a value of 387 (three large knots, eight medium knots, and seven small knots); this represents the number of ewes (*“borregas”*). The next cord, which likewise subdivides into three strings, has a value of 285 (two large knots, eight medium knots, and five small knots) and represents the rams (*“carneros”*), according to the article. The males are identified as such, Uhle explains, because their cord is always located between the females and the lambs. Uhle stated that all of the remaining cords represent different groups

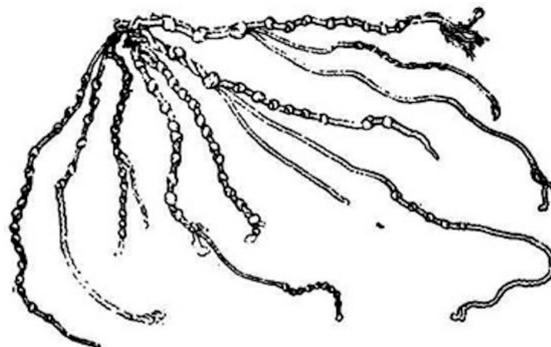


FIGURE 1. Uhle's drawing of the Cutusuma khipu (adapted from Uhle 1897).

of lambs, with numerical values of 121, 99, 86, 60, and 170, respectively. The knots on these remaining five cords are either medium sized or small, so the cord representing 121 lambs, for example, contains 12 medium knots and one small knot. It should be noted that it would be very unusual for a 19th-century Andean herd with 387 ewes to have 536 lambs. Peruvian sheep breeds have low ovulation rates, and the incidence of twins under natural pasture conditions is extremely low (Vivanco 1986). As discussed below, Uhle's field notes reveal that the last three cords actually refer to dairy cows rather than to lambs.

Uhle's primary interest was in demonstrating the continuity between ethnographic khipus like Cutusuma's and the Inka khipus described by the Spanish chroniclers (Loza 2001). The focus of his 1897 article was to explain that modern khipus used knots to represent numbers of items just as Inka khipus did, according to the chroniclers. He wanted to show that the further study of modern herding khipus could advance our understanding of Inka khipus. He was not concerned with specifics about the livestock represented nor was he interested in aspects of the khipu, such as ply, not mentioned in colonial chronicles. Nowhere in his published article about the Cutusuma khipu (Uhle 1897) or in his field notes about the khipu (Uhle 1895) does Uhle ever mention ply as a factor.

THE CUTUSUMA KHIPU AND UHLE'S FIELD NOTES

The analysis of the Cutusuma khipu in the University of Pennsylvania Museum of Archaeology and Anthropology (Object 36392) combined with Uhle's unpublished notes (Uhle 1895) yields more information about this khipu than does the published article. The Cutusuma khipu, made of sheep's wool, has two levels of cords (Figure 2). The "top level" is comprised of two separate cords, each cord consisting of five Z spun strings plied together with a final S twist.² The two cords are tied together in the middle with a large knot that forms a "handle" for the khipu (Figure 3). On one half of these two cords are knots recording the ewes, written as *“ovejas”* in Uhle's notes (Jurado's translation of the Aymara loan word *uwija*; see Uhle 1895); there are three

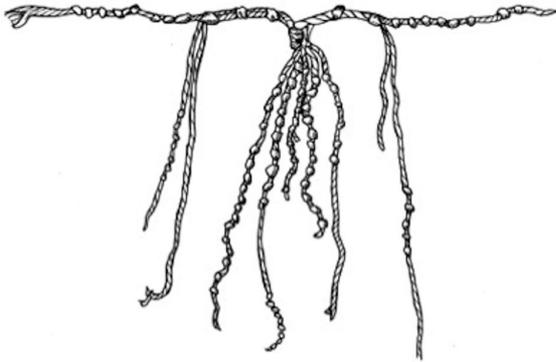


FIGURE 2. *Cutusuma khipu*. 1894. Object n. 36392, image n. 24339, University of Pennsylvania Museum of Archaeology and Anthropology.



FIGURE 3. *Cutusuma khipu* (the two top cords tied together at the “handle”).

large knots each representing 100 ewes. Then, as the cord splits into thinner segments, there are eight medium knots each representing ten ewes and then seven small knots each representing one ewe (total = 387; see Figure 2). The knots on the two cords on the other side of the handle record the castrated male sheep, referred to as “*machos cavaos* [sic]” (“*machos capados*”; castrated males) in Uhle’s (1895) notes. (Male sheep must be castrated to be manageable as herd animals.) Nearest the handle are two large knots each representing 100 males. As the cord splits into thinner segments, there are eight medium knots each representing ten males, and then five small knots each representing one male (total = 285; see Figure 2). Significantly, the only structural difference between the two halves is that the two cords in the side representing the male animals are Z plied together as a final twist while the cords in the female side remain two separate cords with a final S ply (Figure 3). The direction of final ply appears to relate to the gender of the animals, such that S ply = female animal and Z ply = male animal (castrated).

The “lower level” of the *Cutusuma khipu* contains two sets of single cords. One set of two single cords is tied with brown thread to the cord of males near the handle. The knots on these two cords indicate the lambs that were taken from their dams once they were weaned. According to Uhle’s field notes, each cord indicates the lambs kept in a separate pen: 121 in one pen; 99 in the other enclosure (Uhle 1895). These cords are composed of Z spun strings plied together with a final S twist.

A set of three single cords is tied with white thread to the handle (Figure 4). Uhle’s notes state that these cords represent the hacienda’s “*lecheras*” (dairy cows). One cord records 85 animals, one 60, and another 170. As dairy cows, all the animals are female. However, the cord with 85 cows



FIGURE 4. “*Lecheras*” close-up. Cords for (from left to right): dry cows; daily milkers; occasional milkers.

has a final S ply, while the cords indicating 60 cows and 170 cows each have final Z twists. Uhle’s notes explain the differences among the cords (Uhle 1895). The 60 cows on the first cord with a final Z ply are dry (“*los* [sic] *que van sin ordeñando* [sic]” [those that are not milked]), and the 170 cows on the other cord with a final Z ply are not milked daily (“*no todos los días ordeñan*” [they are not milked everyday]) (Uhle 1895). Meanwhile, the 85 cows on the cord with the final S ply were milked daily.³ On these cords of the khipu, the direction of ply corresponds to the milking status of the cows rather than gender: final S ply = milked daily while final Z ply = not milked daily.

Initially, it seems that the meaning of the direction of final ply (S or Z) changes at the different levels of the khipu. However, Urton's suggestions about the possible significance of S and Z ply on Inka khipus explain the role of ply direction in the Cutusuma khipu more exactly and parsimoniously. Urton has hypothesized that ply and other signifiers such as knot direction function according to Roman Jakobson's and Nikolai Trubetzkoy's theory of markedness (Urton 2003:143–154). Markedness is the state of standing out as unusual or less valued in comparison to a more ordinary or regular form. Markedness theory includes the study of relations between pairs of binary opposites that are ranked hierarchically. The unmarked term, which is higher ranked, is more general; the marked term, which is less valued, is more narrowly defined. The more general unmarked form is also a default form. Across languages, it is often the case that in a gendered binary pair, the male component is generic and unmarked while the female is marked (e.g., man–woman; dog–bitch); however, the opposite can occur as well in which the female is generic and unmarked and the male is marked (e.g., duck–drake; nurse–male nurse). Based on ethnographic research, Urton argues that the concept of markedness—a pattern of semantic distinction founded on binary oppositions—is pervasive in the Andes; furthermore, he speculates that ply direction indicates markedness.

Joseph Greenberg has postulated that the unmarked term occurs more frequently than does the marked term (see Urton 2003:143–154). Because a final S ply is more common than a final Z ply in Inka khipus, Urton hypothesized that a final S ply corresponds to unmarked categories while a final Z ply corresponds to marked categories. However, he has not had evidence to demonstrate this hypothesis nor has he been able to present a model of how his theory of markedness would actually work on a khipu.⁴

At the top level of the Cutusuma khipu, the direction of final ply denotes a distinction between the female (*ovejás*) and the male animals (*machos capados*). For Andean shepherders, the female animals, which can bear young and thereby increase the herd, are more highly valued than the males, whether the latter are castrated or not. For example, during the *haywarisqa* ceremony held in the southern Andes to increase the camelid and the sheep herds, the participants pray specifically for more female animals (Flores Ochoa 1974:250). It therefore fits Urton's theory for the cord of the higher ranked unmarked category—the females—to have a final S twist, while the cord of the narrower, marked category—the castrated males—has a final Z twist.

Likewise, on the second level of the Cutusuma khipu, dairy cows—literally “milkers” (*lecheras*)—are assumed to give milk regularly under normal circumstances. In a binary opposition between those cows who give milk regularly and those who do not, the former represent the general unmarked category, while the latter signify the less valuable marked category. Urton's theory predicts what we see on the Cutusuma khipu—that the cord recording the daily milkers

has a final S ply while the cords recording the dry cows and the occasional milkers has a final Z ply.

The difference between the female and male adult sheep was encoded not only through ply direction but also through cord placement. In the Paucartambo region, Carol Mackey observed a herder using three separate features—starting number, cord color and relative location—to identify the beginning of his khipu (Mackey 2002:335). In the Cutusuma khipu, the difference between the ewes and the male sheep, indicated initially through the distinction between S ply and Z ply on the two cords tied together, was further specified by the herder's subsequent placement of cords. The two cords recording the lambs were tied onto the cord recording the males. According to Uhle's notes, “The knots with the males always begin in the middle” (*“Los nudos de los machos comienzan siempre en medio”*; see Uhle 1895); that is, the cord with the adult male sheep is in the middle between the ewes and the lambs. In this way, a distinction that has already been made through the difference between final S ply and final Z ply (the distinction between female and male animals) is reinforced with an indicator based on the relative position of the cord. This suggests that redundancy—the use of two or more separate features to indicate the same meaning—may be an aspect of khipu semiosis meriting further study.

CONCLUSION

We are indebted to Uhle, and to the ethnological tradition in which he was trained by Bastian, for taking such meticulous field notes on his interview with the Aymara creator of the Cutusuma khipu. This analysis of Uhle's unpublished field notes alongside the actual Cutusuma khipu demonstrates that the direction of ply can be a signifying feature of Andean khipus. Moreover, the evidence suggests that a final S ply corresponds to unmarked categories while a final Z ply corresponds to marked categories. This finding about the importance of ply follows the recent discovery that knot direction can be a signifying element on khipus, with S knots corresponding to the upper moiety (the unmarked category), while Z knots correspond to the lower moiety (the marked category; see Hyland et al. 2014).

Ethnographic herders' khipus descended from ancient herders' khipus, which formed part of the broader matrix of corded knowledge in the Inka Empire (Brokaw 2010:260–162, 270). It is most likely that ancient herding khipus would have shared basic semiotic principles with other, more complex types of Inka khipus, such as those that recorded tribute and census data as well as biographies and narratives. This new evidence about the significance of ply direction and markedness reveals that the ancient Andeans had a greater range of techniques available for encoding information on khipus than was previously known; moreover, this analysis of ply direction reveals that this particular technique was based on semasiographic principles, rather than on phoneticism. Recovering Uhle's fieldwork from over 100 years ago provides new insights into how Andean khipus encoded

information, bringing us one step closer to eventual decipherment.

Sabine Hyland *Department of Social Anthropology, University of St. Andrews, KY16 9AL, United Kingdom; sph@st-andrews.ac.uk; http://www.sabinehyland.com*

NOTES

Acknowledgments. The author would like to thank the staffs of the University of Pennsylvania's Museum of Archaeology and Anthropology, of the University of St. Andrew's library, and of the Ibero-Amerikanisches Institut for their assistance. Richard Burger, William Hyland, Michael Chibnik, and four anonymous *AA* reviewers provided very helpful comments on an earlier draft.

1. All of the khipus that Uhle collected for the Museum of Ethnology in Berlin have been lost, presumably destroyed in World War II (Loza 2001).
2. *Spin* refers to the direction of twist of the fibers in a single spun yarn (e.g., a single S-spun strand). *Ply* refers to a unit of plied yarn (e.g., one of the strands in a two-ply yarn) or the process of twisting (plying) two or more strands together to make a plied cord. The final *twist* or final *ply* refers to the most visible direction (Drooker and Webster 2000). Interviews with Andean weavers reveal that the direction of ply is intentional in Andean textiles.
3. The final Z plied cords representing the 60 dry cows and the 170 semidry cows are distinguished from each other by the direction of knots on the cord. The six knots on the "dry" cord are all S knots; on the "semidry" cord, ten knots are S knots and seven knots are Z knots. It is likely that the knot direction referred to a characteristic of the cows in which S knots = the unmarked category and Z knots = the marked categories (Hyland et al. 2014). The characteristic indicated by the knot direction would probably not be moiety ownership of the cows (e.g., S knots = upper moiety; Z knots = lower moiety) because the cows belonged to the hacienda. Knot direction probably signified another characteristic, specifically whether cows had been given alcohol to induce milk, a common Andean practice (Froemming 2006). Referring to the cords recording the dairy cows, Uhle's informant stated: "*los [sic] que van sin ordeñando [sic] las curdan [sic]*" (lit., "those that are not milked are made drunk"; *curda* is a lunfardo word meaning "borrachera," common in popular music of the period; see Uhle 1895). In this case, S knots would correspond to "drunken" cows (unmarked) while Z knots would correspond to "nondrunken" cows (marked). The knots on the cord of daily "milkers," who would not have needed alcohol, are all Z knots. Without antibiotics to prevent udder infections, dairy cows must be dried off or milked sporadically for longer periods of time than in modern dairy farming; this accounts for the seemingly large percentage of the dairy herd that is dry and semidry.
4. The best evidence has been that, in Tupicocha, the khipu of the senior segment of the Satafasca lineage has mainly a final S twist, while that of the junior lineage has predominantly a final Z twist (Salomon 2004:159).

REFERENCES CITED

- Ascher, Marcia
2005 How Can Spin, Ply, and Knot Direction Contribute to Understanding the Quipu Code? *Latin American Antiquity* 16(1):99–111.
- Ascher, Marcia, and Robert Ascher
1981 *Mathematics of the Incas: Code of the Quipu*. Ann Arbor: University of Michigan Press.
- Brokaw, Galen
2005 Toward Deciphering the Khipu. *Review of Signs of the Inka Khipu: Binary Coding in the Andean Knotted-String Records*. *Journal of Interdisciplinary History* 35(4): 571–589.
2010 *A History of the Khipu*. Cambridge Latin American Studies, 94. Cambridge: Cambridge University Press.
- Curatola, Marco, and José Carlos de la Puente
2013 Estudios y materiales sobre el uso de los quipos en el mundo andino colonial [Studies and materials concerning the use of khipus in the colonial Andean world]. In *El Quipu colonial: Estudios y materiales* [The colonial Khipu: Studies and materials]. Marco Curatola Petrocchi and José Carlos de la Puente, eds. Pp. 9–32. Lima: Pontificia Universidad Católica del Perú [Pontifical Catholic University of Peru].
- Dauelsberg, H. Percy
1984 Cuadragésimo aniversario de la muerte de Max Uhle [Fortieth anniversary of the death of Max Uhle]. *Revista Chungará (Chile)* 12:173–178.
- Drooker, Penelope Ballard, and Laurie D. Webster, eds.
2000 *Beyond Cloth and Cordage: Archaeological Textile Research in the Americas*. Salt Lake City: University of Utah Press.
- Flores Ochoa, Jorge A.
1974 Enqa, enqaychu illa y khuya rumi: Aspectos mágico-religiosos entre pastores [Enqa, enqaychu illa and khuya rumi: Magico-religious features of pastoralism]. *Journal de la Société des Américanistes* [Journal of the Society of Americanists] 63:245–262.
- Froemming, Steve
2006 Traditional Use of the Andean Flicker (*Colaptes rupicola*) as a Galactagogue in the Peruvian Andes. *Journal of Ethnobiology and Ethnomedicine* 2(23). <http://www.ethnobiomed.com/content/2/1/23>, accessed May 28, 2014.
- Hyland, Sabine, Gene A. Ware, and Madison Clark
2014 Knot Direction in a Khipu/Alphabetic Text from the Central Andes. *Latin American Antiquity* 25(2): 189–197.
- Locke, Leland
1923 *The Ancient Quipu or Peruvian Knot Record*. New York: American Museum of Natural History.
- Loza, Carmen Beatriz
2001 El modelo de Max Uhle para el estudio de los quipus [Max Uhle as a model for the study of khipus]. In *Max Uhle y el Perú antiguo* [Max Uhle and ancient Peru]. Peter Kaulicke, ed. Pp. 123–158. Lima: Pontificia Universidad Católica del Perú [Pontifical Catholic University of Peru].

Mackey, Carol

- 2002 The Continuing Khipu Traditions: Principles and Practices. *In* *Narrative Threads: Accounting and Recounting in Andean Khipu*. Jeffrey Quilter and Gary Urton, eds. Pp. 321–347. Austin: University of Texas Press.

Niles, Susan A.

- 2007 Considering Quipus: Andean Knotted String Records in Analytical Context. *Reviews in Anthropology* 36(1):85–102.

Salomon, Frank

- 2004 *The Cord Keepers: Khipus and Cultural Life in a Peruvian Village*. Latin America Otherwise: Languages, Empires, Nations series. Durham: Duke University Press.

Uhle, Max

- 1895 *Field Journal*, no. 39. P. 52. Berlin: Bibliothek, Ibero-Amerikanisches Institut.
1897 A Modern Kipu from Cutusuma, Bolivia. *Bulletin of the Free Museum of Science and Art* 1(2):51–63.

Urton, Gary

- 2003 *Signs of the Inka Khipu: Binary Coding in the Andean Knotted-String Records*. The Linda Schele Series in Maya and Pre-Columbian Studies. Austin: University of Texas Press.

Urton, Gary, and Carrie J. Brezine

- 2011 Khipu Typologies. *In* *Their Way of Writing: Scripts, Signs, and Pictographies in Pre-Columbian America*. Elizabeth Hill Boone and Gary Urton, eds. Pp. 319–352. Washington, DC: Dumbarton Oaks.

Vivanco, H. W.

- 1986 Recent Developments in Reproductive Techniques of Sheep and Goats. *In* *Small Ruminant Production in Developing Countries*. Vivian M. Timon and J. P. Hanrahan, eds. FAO Animal Production and Health Paper, 58. Rome: Food and Agriculture Organization of the United Nations.