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# Chapter 3
# Aboriginal Digitalities: Indigenous Peoples and New Media

**Armida de la Garza**

**Abstract** This article goes beyond considerations of digital media supporting identity and community to discuss the ways in which digital technology itself resembles and even parallels traditional indigenous means of producing and sharing knowledge and of experiencing time and space. Drawing from examples ranging from Aztec maps that represented time-space units simultaneously, through discussing indigenous codex and glyphs in which visual language is able to convey meaning using simultaneity rather than chronological narration, to the use of performance for durable cultural storage and transmission, this article points to the many areas of convergence between the multimodal communication that digital media increasingly enable and ancestral practices of indigenous peoples around the world.

**Keywords** Indigenous studies · Digital media · Philosophy of space and time

## Introduction

Most research on digital media and indigenous peoples tends to focus on the affordances these media provide to indigenous communities, allowing them to counter stereotypes while also providing "innovative contexts and practices through which new forms of indigenous solidarity, identity and community are created" (Grixti 2011, 344). This is a growing field of research, which I briefly summarize below using examples from videogames, interactive documentary, new media art, and the use of Internet in everyday life, while also discussing the way that indigenous peoples' engagement with new media is expanding these media's narrative, and sometimes technical, capabilities.

The second part of the chapter goes beyond these considerations, to focus on the ways in which digital technology itself resembles and even parallels traditional indigenous means of producing and sharing knowledge and of experiencing time and space. Drawing from various examples, this chapter points to the many areas

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of convergence between the multimodal communication that digital media increasingly enable, and ancestral practices of indigenous peoples around the world. The examples include: Aztec maps that represented time-space units simultaneously; indigenous codex and glyphs in which visual language is able to convey meaning using simultaneity rather than chronological narration; and the use of performance for durable cultural storage and transmission, among others. The chapter concludes by suggesting that this convergence will become the ground for multiple and fruitful synergies.

## Digital Media and Indigenous Identity

Video gaming and Aboriginal stories and storytelling techniques meet in AbTec, short for Aboriginal Territories in Cyberspace, a foundation aimed at training Aboriginal youth in new media production that reaffirms community and identity. Participants in AbTec's workshops have designed video games that take advantage of the repetition structure of some Iroquois legends to build complex, multilevel gaming experiences like The Otsi!. Its narrative centers on an Iroquois hunter that is on a mission to stop the Flying Head, a monster terrorizing the territory where he lives. The game takes players from the story of the Flying Head's origin through to its confrontation with the hunter. In each level, the player meets a creature from a different Kahnawake legend: the Tree People, the Monkey Dog, and the Hoof Lady, among others, so that the game also works as an immersive medium to learn about the legends. AbTec's founders, Mohawk artist Skawennati Fragnito and Jason Edward Lewis of Cherokee ancestry contend the study of Aboriginal storytelling techniques is crucial, as this lays the groundwork for embracing networked technology as potential sites of cultural expression—and cultural expansion. In their words (Lewis 2014, 66):

> It is important that participants learn that the storytelling techniques in their community lie on a continuum with those of digital media, and that they do not lie on either side of some insurmountable cultural or epistemological divide.

Italics or inverted commas for these two names of games? 2

Quoting the success of video games such as Braid and Passages, games that have unexpected approaches to time and teleology, Lewis further suggests that the grammar for video games remains up for grabs, and we can still end up with tools that are better able "to accommodate substantially new systems and structures for computationally based approaches to communicating [Indigenous] stories" (Lewis 2014, 72). This is what, in a different context, Srinivasan (2006, 513) calls "mapping a cultural discourse to an organization of databases" that serves the cultural needs of Indigenous communities.

In the realm of film making, advantage is taken of the many traditional Indigenous narrative structures in which simultaneity is a feature of characters and beings. Characters are fluid and capable of transforming, and they are also capable of occupying multiple states at once. (Foster 2014, 103) From this perspective, interactive digital technologies with potential for layering, for simultaneous and multiple variations,

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can take advantage of non-Western narrative forms, incorporating their strategies into their structure and thus expanding what is traditionally understood as a mode or genre. Indigenous film maker Steven Foster's interactive documentary Prince George Métis is a vivid example of this. It shows the Elders discussing technology along with indigenous traditions. Although it can be viewed by one single person on a computer at a time, it really comes to life when played simultaneously on multiple screens controlled by various members of the audience, thus challenging the individualized authorship and linear structure of most documentaries.

In a similar vein, installations such as the one by Cree new media artist Archer Pechawis also hybridize media forms and contents. In this case a traditional hand drum is wired to a digital audio sampler, thus incorporating sound bites into traditional powwow songs that were meant to communicate with the dead. As put by the artist, "the protocols that govern the ceremonial use of drums are as specific as the protocols that govern traffic on the Internet" (Pechawis 2014, 41). Notably, indigenous new media artists frequently use digital technology that is regarded as futuristic to address the past, to put forward versions of history from indigenous perspectives. The exhibition suggestively entitled "If History Moves at the Speed of its Weapons, then the Shape of the Arrow is Changing" (2010), featured graphic scores representing the trajectory of each weapon used in the Great Southwest Rebellion in 1680, when the tribes of what is today Santa Fe, New Mexico, resisted Spanish colonialism. The artists used an algorithm to transform ballistic data of the revolt-era weapons into sound, so that the spear-thrower became a square tone, the rock and sling, a sawtooth tone and so on. The speed of each weapon was transformed into the speed of the sound tone traveling through the air. Digital technology was instrumental in both the analysis and modeling of the weapons, in that it allowed the weapons as sound to be highly accurate renderings of the originals, and to have a palpable impact: "the weapons' piercing tones were acutely heard and felt while the armaments themselves remained unseen" (Hopkins 2014, 122).

Beyond the realm of digital art, the use of the Internet on a day to day basis also provides evidence of the way digital technologies support indigenous identities and cultures. Laurel Dyson's comprehensive overview of the use of the Internet by indigenous communities identified some 350 million indigenous peoples living in 70 countries around the world, many of whom have some sort of online presence, and notably with quite a few counted among the early adopters who first set up websites in the late 1980s (cf. Dyson 2013). The Cherokee, Zapotec, Sami, Mapuche, Yoeme, Wendat, Tonga and Maori are among the groups discussed by Dyson, who notes as the main uses of the online presence the reaffirmation of indigenous identity, in both in-reach and outreach modalities; reconnecting with the indigenous diaspora; indigenous cyberactivism; and fostering language learning (Dyson 2013, 259–265). To reaffirm their cultures, indigenous peoples use message boards and chat facilities to transform the sites from purely information-providers into tools for communication, creating virtual spaces for shared meanings and providing information to outsiders that includes even some e-commerce and the promotion of tourism, thus realizing the potential of the Internet "to simultaneously generate income and [to try to] control the outsider view of their identities" (Dyson 2013, 260). Further,

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the Internet is credited with enabling forms of collective organization within and between indigenous communities to raise issues such as land rights, rights to self-determination, environmental issues and so on, creating pan-indigenous movements, and organizations that would not have been possible before.

But if video games, interactive documentaries, artistic installations, and exhibitions and the daily use of the Internet already show very fruitful interactions between indigenous communities and new digital media, there is a much deeper affinity between them that becomes evident when the forms of producing, storing, disseminating, and transmitting knowledge are taken into account. This perspective is rarely discussed, and it is to these elements of convergence that we now turn.

## Convergence Between Multimodal Communication and Indigenous Epistemologies

To begin with, the material basis of the digital network must be discussed. There is an argument that it can in fact be traced back to the knowledge systems of the First Nations of the world. In one account the story begins with hunter-gatherers exploring the field for food and resources, including of course information on the terrain, other tribes in the vicinity and so on. With time, the paths they followed became trade routes, as they established networks and trade languages and built a knowledge base around what they knew about each other. So,

> When the first Europeans came to 'explore' the land, our ancestors naturally led them along these well-established paths, which, over time […] became roadways and thoroughfares. With the advent of the telegraph and the telephone, wire was hung along these thoroughfares that literally became the beginnings of the physical network that now allows more and more packets of information to move as freely as our ancestors [did before] (L'Hirondelle 2014, 153).

Others have pointed to the practice of Potlatch common among North American Indians, particularly in the Pacific Northwest coast of Canada and the United States,[1] which proved fundamental to Marcel Mauss's influential theorisation of what he termed "the gift economy" (Mauss 1950 [2001]). Potlatch involves indigenous aristocrats competing for power and prestige by holding annual competitions to redistribute their wealth among the people; or, if in winter, to destroy a larger proportion of their goods in bonfires to warm the tribe, the winner being the one who can part with the most goods. The status of a given family is raised not by having the most resources, but by distributing the most resources. This behavior has been compared to the altruism of hackers, open software developers, wiki editors, and 'answer persons' in usernet groups (Berger 2012), and indeed to the whole digital commons project, in which sharing is crucial.

[1] Comprising the Heiltsuk, Haida, Nuxalk, Tlingit, Makah, Tsimshian, Nuu-chah-nulth, Kwakwaka'wakw and Coast Salish cultures. It must be stressed that the use of potlatch varied widely among the different tribes.

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## *Visual Language, Indigenous Codex and Glyphs*

Apart from the material basis of the network and the behaviors it fosters, the content itself is also often encoded using visual languages, which were crucial to indigenous peoples. Digital media foreground the screen. Space, size, color, shape, and a variety of icons comprise the new tools for communication. As recent research on color has shown, it is increasingly entering even the previously monochrome world of written text: the structure of texts in websites, magazines, and other media is now signaled by means of layout, typography, and color. Color helps to segment text by creating frames, provides salience, cohesion, and can signal genre, as when a text is designed for children (Van Leeuwen 2011, 93). Color schemes have become a source of meaning, more than individual colors.

Moreover, visual language is often perceived as instantaneous, perhaps on account of its nonlinearity. Photography, for instance, is said to be moving away from being a means of recording memories, to become more like spoken language, as photographs are turning into "the new currency for social interaction" (Yamada Rice 2012, 162), heightening the sense of immediacy. Especially among the young, more and more images and less and less words are now exchanged by SMS. A hypothesis is even being advanced that screen media are a better fit to globalized societies, since their speed and reliance on the visual can easily overcome language and geographical barriers. Moreover, modes of communication are no longer viewed only as representations of phenomena in which each one brings specific affordances, but also as tools that mediate thinking. It is useful to recall that as trans- and interdisciplinary frameworks replace the old discipline-centered terms of reference to pursue research in academia, it is figures like Leonardo Da Vinci who are becoming the new models. Using mainly drawings and sketches as tools to think through, Da Vinci was able to advance fields of knowledge that later became separated into 'arts' and 'science', but which the most cutting-edge approaches today are once again seeking to bridge (Grey and Malins 2004, 93). It can be argued that the capabilities for visual expression and its attendant modes of thinking that the digital media are promoting is instrumental in fostering these changes.

Visual languages in which color played a large part also constituted the main means of expression in some indigenous societies. Before the arrival of the Spaniards to what is today Central and South America, Indigenous people used pictorial and iconic documents, the Codex (3.1), to preserve and transmit knowledge. Highly flexible in nature, for they acted as templates on which either narrative content, maps or mathematical operations could be recorded, Codex frequently employ visual language to convey meaning using simultaneity rather than chronological narration. The materials used were various dyes and pigments and deer leather or 'amate' paper, folded into as many pages as necessary. Before the conquest, the painted books, or Codex, could be divided into three broad categories: religious books and guides for living, practical documents, and historical books. Nearly all Codex in the former category, especially the ones related to prayers, songs, divination or dreams, were destroyed during the Conquest. However some of the latter—around five hundred—

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survived, and new genres were developed under Spanish rule, since the Spaniards initially promoted them and the Indigenous people thought in mainly visual terms. These were Catholic catechisms, legal suits and the Codex Tudela, an encyclopedia. Indeed, it is said Catholic priests initially accepted only painted confessions, or, as put by the priests, indigenous people were told "to bring their sins written down in figures, because writing in figures is something they know and understand" (Hill 1998, 159). The way the grammar of the Codex changed before and after the Conquest continues to be the subject of study today. Although language written in words was originally absent from the pre-conquest Codex, several of the surviving Codex were later annotated. In 2003 when CD-ROMs were still widespread, it was noted that they shared some similarities with Codex: both aimed to store, preserve, transmit, and disseminate knowledge with a mainly iconic, pictorial, and oral language, and both allow different entrance paths, nonlinear, determined by the user (Leon Portilla 2003).

The Mendoza Codex (c. 1541)[2] for instance, post-conquest, contains a history of Aztec rulers and their conquests along with a description of daily life. Each plant icon represents a place, each human figure a ruler, and other icons depict tributes and dates. Perhaps on account of its perceived kinship with digital media, the Mendoza Codex has recently been digitized, taking advantage of the zooming functions and hypertext to further its study. The digital version is open to users' annotations, sharing, and discussions, and it is also being hailed as a means to 'virtually repatriate' the Codex, which has been located at the Bodleian Library at Oxford University since 1659. On the other hand, the Codex of the Mixtec, from the region of Oaxaca in Mexico, tended to depict a series of events in narratives that could move around easily in time and space, as they relied on signs that changed when protagonists, places or dates changed. In other words, it was the sequence of events that provided the backbone of the story, not the place nor the time. This approach to storytelling has been called the 'res gestae' (Hill 1998, 243) as it is an event-oriented way of narrating, quite different from the linear narration.

Maps were another genre of Codex. But in contrast with medieval Western maps, which rendered space as a continuous and given surface, and as an expanse to be traveled across, Aztec Codex for maps represented time-space units simultaneously, as 'place-moments,' enabling the perception of space as a meeting point of histories, as processes not frozen in time (Massey 2008, 5–7). This is exactly the perception of space that GIS mapping and GIS-based applications that rely on satellites now enable: space as a meeting point of histories that can be discovered, a stock that in fact keeps growing with users' additions. The map-based history of the Aztecs systematically arranged places on the painting surface with respect to their geographic location, attaching in this way the events to the places where they happened (Fig. 3.1).

Many of the cartographic Codex combined this tableau with a single line of events leading to the map, as a tour. This arrangement is exactly what features like storytelling with Google Maps allow users to do today. Further, in her account of the

[2] An app can be downloaded at http://www.codicemendoza.inah.gob.mx, accessed 8 November 2015.

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**Fig. 3.1** Tloltzin map, featuring the arrival of the Chichimecas, early sixteenth century, pictorial, and iconic. Courtesy of Dorothy Sloan Rare Books, Austin, Texas, USA

origins of modern cartography, Karen O'Rourke has remarked upon the fact that it developed out of the rectilinear marking out of itineraries in antiquity, adding that the Aztec maps of the period, which show "footprints and sketches [of] each day's meals, battles and river crossings,' working as much as history books as geographical maps, are strikingly similar to the itinerary maps that computers generate these days" (O'Rourke 2013, xix). Locating the origin of the footprints and deciphering the icons for the various places as registered on the itineraries allows for the maps to be read.

## *Epistemological Convergence*

Although the visual language employed by the Codex is long lasting in relation to oral speech, and can be read by anyone who shares the code, both of which are features of writing, it was not considered as such. It is only alphabetic writing that has long been recognized as writing proper; and further, credited with allowing scientific knowledge to emerge. The argument states that so-called oral cultures transmitted culture predominantly through face-to-face interaction, and therefore had a more pragmatic approach to language, with knowledge not related to maintaining tradition quickly discarded. A large body of knowledge could thus not emerge. Alphabetic

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writing on the other hand allowed the objectification of culture, and this created the conditions for its critique and the hierarchies of knowledge which eventually resulted in science being granted the status of truth (Goody 1968). Under this paradigm, indigenous knowledge was long awarded the status of belief or worse, superstition.

However, the present turn away from the written word and into the visual image, another site of convergence, and the raising awareness of alternative systems of writing that have long prevailed in the East, such as ideograms, have increasingly put these views into question. The positivist paradigm that reigned unchallenged in science for the past 300 years is giving way to views that take uncertainty and chance into account, such as chaos and complexity theory. In particular, the advent of Western science's awareness of quantum mechanics has resulted in scientists, physicists, philosophers, and academics coming to terms with views long held by indigenous peoples; or, as Cheryl L'Hirondelle puts it, "increasingly meeting with the Elders and indigenous thinkers." The Western world is finally coming to understand "how our [indigenous] ancestors embedded and encoded […] ceremonies, languages, worldviews, and metanarratives as complex algorithms that refer back to the very creation of the universe" (L'Hirondelle 2014, 170). In this regard, the latest discoveries in physics, such as the Higgs boson particle and the superstring theory would seem to scientifically validate knowledge that indigenous peoples have long taken for granted. The Higgs bosson particle, sometimes dubbed 'the God particle,' accounts theoretically for the conversion of mass to energy and vice versa. The Superstring theory postulates ten dimensions—that is, an extra six to the readily observable dimensions of length, width, depth, and duration. Both these theories provide examples of convergence between the scientific knowledge that makes digital media possible and indigenous knowledge, as indigenous languages sometimes included words for concepts similar to these. Leroy Littlebear, former Director of the American Indian Program at Harvard University and Professor Emeritus of Native Studies at the University of Lethbridge, puts it thus (quoted in Pechawis 2014, 43):

> English, because of its structure, can't explain certain things, [and] therefore [has] a reliance on a foreign language, [mathematics, which] does not happen in Navajo. In other words the language is rich enough that it can explain those seeming paradoxes. That's where I see the collaboration taking place, that's where I see partnerships occurring in science.

## *Haptic Codes and Hyperlinks*

In his seminal study of the way that communication technology affects cognitive organization, McLuhan (1962) famously hailed the advent of electronic culture as a means of liberation from four hundred years of print culture, which he later defined as modern, national, characterized by mass production of writing, the dominance of perspectival images, scientific methods of observation and seeking linear chains of causation. Importantly, he argued, print culture, with its focus on the eye, had brought about sensory alienation. Electronic culture would instead bring about conditions of sensory plenitude, stimulating the haptic and the tactile, and focusing on simultaneity

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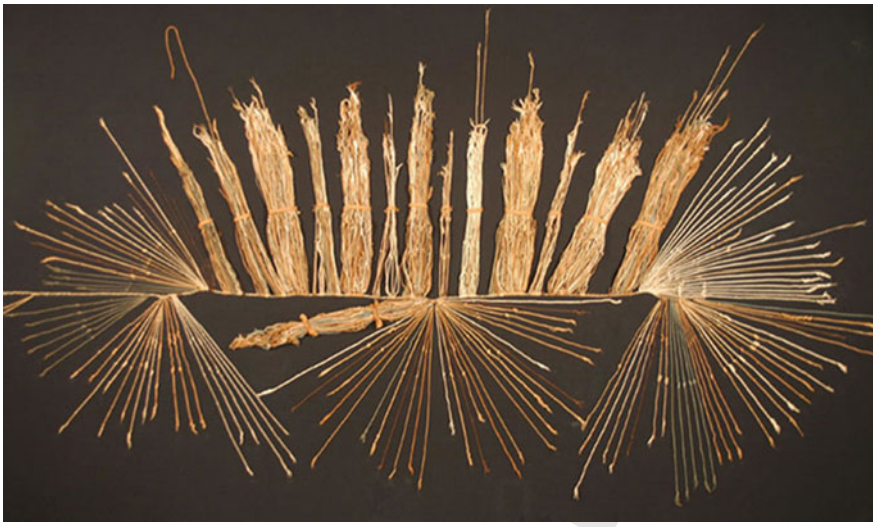


**Fig. 3.2** An Inca Khipu, a knot-based record-keeping mobile device seemingly based on binary code. With kind permission by Prof. Gary Urton, Harvard University

and indivisibility. It is undeniable that the digital age is foregrounding the body and that there is renewed interest in the nature of knowledge as embodied as well as in experiential, practice-based learning that involves all senses. Touching the screen is the main means of interaction with mobile phone and tablet interfaces.

This focus on the haptic and the tactile and the material basis for the transmission of knowledge recalls the Khipu (Figs. 3.2 and 3.3), knotted textile record-keeping devices used by the Inca in what is today called 'South America.' Although they had no written or visual language like the indigenous peoples of Central America, the Inca consolidated a vast empire, Tawantinsuyu or 'The Empire of Four Directions' between 1438 and 1533. This endeavor was greatly facilitated by the use of Khipus. Although they were at first considered simply mnemonic devices for data storage or narration, further study has revealed them to embody a quite complex mathematical language, apart from being light and mobile, easily transportable media that fit what Innis (1951) described as 'space-biased'.

Khipus were frequently organized around a central black cord, the color used to represent time. Crimson red was the color of the emperor, purple was used for other chiefs, blue for priests, and religious matters, and so on. But while the work of Ascher and Ascher (1997) has already rendered very interesting interpretations of the ways in which they were used by warehouse keepers and even by narrators, as a kind of three dimensional language, it is the hypothesis put forward by Gary Urton, Professor of Anthropology at Harvard, that is more relevant to us here. Indeed, Urton contends that khipus encoded language in a similar way to the binary code employed by today's computers. Weavers could choose between a number of yes/no conditions to be met, such as using cotton or wool, a spin or a ply direction for a

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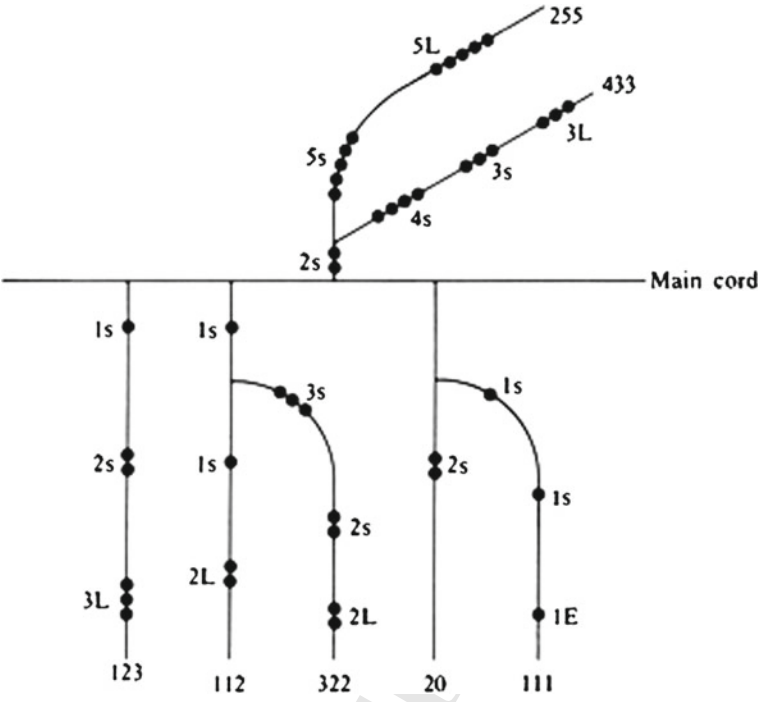



**Fig. 3.3** The Mathematical language of the Khipu. *Source* https://quipus.wikispaces.com/How+It+Works, accessed 15 Apr 2016, CC BY-SA 3.0

string, the direction of the knot attaching the pendant string to the primary one, which could be from the front or from the back, and the direction of the slant of the main axis of each knot. This would provide a seven-bit binary array for each knot, which is enough for 128 permutations (Urton 2003). These could increase to 1536 if the 24 colors that were employed were also considered as part of the coding. Although only 600 khipu's survive, ongoing research is compiling a database of patterns in the arrangements of knots.

In a similar way, Angela Haas has persuasively argued that the wampum, shell beads usually shaped into belts by indigenous peoples of North America, and which were frequently used as money, were also used to record important events or treaties in a three dimensional way. For instance the Two Row Wampum Treaty of 1613 between representatives of the Dutch government and the Iroquois, made in what is today the state of New York. It declared the mutual respect and peaceful coexistence of the two parties, which should from then on be regarded as brothers, and not as fathers (the Dutch) and sons (the Iroquois), as the Dutch had proposed before. It features two parallel purple lines in a white background. Of this system of recording, Haas (2007, 19) writes:

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> In order for wampum to be communicative, a hybridization of the oral tradition and symbolism is woven into the material rhetoric. […] the technologies woven into the belt have communicative agency, as with the colors of the shells and the design patterns. The cultural context and community where the wampum resides is yet another source of meaning that gets encoded […]. Thus wampum is a hypertext of communicative modes—all of which contribute to cultural knowledge production and preservation.

The importance that indigenous peoples accorded to embodied knowledge leads us to the next section, namely the use of performance as a means to preserve knowledge, that is proving most suitable for digital media.

## *Social Memory: Storage and Performance*

Social memory refers to what and how societies remember. Museums, libraries, and archives, with their focus on formal or canonical social memory, suited the relatively slow pace of change of analogue media. But as cultural production increasingly becomes 'born digital,' and the tools and means by which we keep social memory do so as well—such as documentation, records, storage, object management systems, and so on—a crisis of memory is being triggered.

Initially, in the realm of digital art, ephemerality was embraced with references to Navajo art: "one could ask if a lot of what is by some classified as 'Net Art' should not be seen as […] art just for the moment itself [like] the ceremonial sand drawings of the Navajo, only meant to exist during the ceremony" (Van Tijen 1999). However, when dealing with knowledge rather than with specific artistic products, the crisis in remembering that new media have created can also be regarded as an opportunity to revisit models and practices of social memory, since the means traditionally used by indigenous peoples to store and disseminate knowledge, namely, proliferation and performance, are again proving to be profoundly germane to the needs of digital media cultural production.

Friars that arrived in the 'New' World in the fifteenth century claimed indigenous peoples had no past because they had no writing. Knowledge, such as the carving of masks, playing music, tying knots in robes to signify marriage and so on, with its embodied and performed nature, was not regarded as requiring or signaling expertise. Yet Diana Taylor contends the rift did not lie "between the written and the spoken word, but between the archive of supposedly enduring materials (i.e., texts, documents, buildings, bones) and the so-called ephemeral repertoire of embodied practice/knowledge" such as spoken language, ritual or dance (Taylor 2003, 19). The analogy with the repertoire rightly conveys the way that each performance both repeats and modifies the scripted notation, making each performance at the same time a repetition and a unique iteration, an event. In like manner, it can be argued that those programming open software, contributing to Wikipedia, or using YouTube as raw material for their own videos, constantly engage in the scripting and rescripting of what we can call the digital repertoire.

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> This means that many of the 'bodies' that perform new media—a browser running JavaScript, a Playstation running C++, an Intel CPU running machine language—can be modified and distributed inside emulators and other virtual environments […] as outlandish as preservation through proliferation may sound to civilised ears, it is the practice native to indigenous and new media creators (Rinehart and Ippolito 2014, 169).

It is for this reason that where Taylor claims that books can be burned, but "the performative traditions of indigenous people from Oaxaca to Okinawa live on" (Taylor 2003, 20). Rinehart and Ippolito (2014, 170) add that "the twenty first century may never know the remarkable luminescence of [Eva] Hesse's sculptures[3] but the future of the mapinguary[4] and Mario is assured."

1 The name of the game 'Mario' should be in italics or inverted commas
1

## Conclusions

It seems only fitting to end this chapter with a quotation that summarizes both the kinship of digital media and indigenous cultural practices which I have argued is so close, and the place of originality as another category that has changed meaning when viewed through the prism of computer language (L'Hirondelle 2014, 148):

> I do not invent or claim to be the creator of the information contained here. I am like a compiler who assembles information collected from other sources in order to produce something—this essay is one such result. A compiler, though, is also a computer program that transforms code written in one language into another to translate and transform the original source code to both create an executable program and/or to parse data that may become meaningful.

This chapter, hopefully, has also performed these assembling and translating operations to convey the close kinship between the indigenous epistemologies discussed and the new digital media. Indigenous people communicated orally and with performances, and used visual or haptic 'written' languages that might not have led to establish hierarchies of knowledge or separate 'arts' from 'science,' but that certainly allowed a deep understanding of the world and humanity's place in it. Digital media seem to be bringing about some of these epistemological changes. The many convergences outlined above propound a vast and fertile territory for cross-fertilization. Not only is computer science bound to shed light on the nature of the knowledge stored in Khipus, for instance, and thereby extend our knowledge of the past, but indigenous worldviews may well have a deeper impact on their emerging hardware

[3] 'Expanded Expansions' (1969) by Eva Hesse, is what the Guggenheim catalog describes as 'a sculptural embodiment of opposites united. Both permanence and deterioration operate in the piece: fiberglass poles—rigid, durable entities—are juxtaposed with fragile, rubber-covered cheesecloth' (Guggenheim 2015). Highly acclaimed in its hayday, today it is a rigid skin, wrinkled and decomposing in a wooden sarcophagus at the museum.

[4] A creature that can be considered Brazil's Big Foot, extinct long ago but surviving on the oral accounts of Amazonian indigenous tribes. Paleontologists are allegedly beginning to accept other indigenous stories as valid sources of information on extinct species (Rinehart and Ippolito 2014, 168).

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and software, extending into the future. Clarke (1973, 21) once famously said that "any sufficiently advanced technology is indistinguishable from magic." Or, I would add, from lore of the First Nations of the world.

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