

# Ethnomathematics and Symbolic Thought

## The Culture of the Dogon<sup>1</sup>

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**Abstract:** This paper deals with the following aspects of the culture of the Dogons (Mali): the specific mythological context and the related cognitive system; fundamental poles in the Dogon numerical symbology; the density of 5's significance; the spiral as a choreography of thought; ethnomathematics "logosymbols" as "event" and social meaning; educational implications (transcultural expression of thought and feeling).

**Kurzreferat:** *Ethnomathematik und symbolisches Denken: Die Kultur der Dogonen.* Der Beitrag behandelt folgende Aspekte der Kultur der Dogonen (Mali): der spezifische mythologische Kontext und das zugehörige kognitive System, grundlegende Pole der numerischen Symbolik der Dogonen, die Bedeutung der 5, die Spirale als Choreographie des Denkens, ethnomathematische "Logosymbole" als "Ereignis" und ihre soziale Bedeutung, Implikationen (transkultureller Ausdruck des Denkens und Fühlens).

**ZDM-Classification:** A30

### 1. The dogon

Mali has different kinds of ethnic groups. After the dryness of 1970, its nomad population (Touareg, Peuhl and Moor) decreased significantly. Among the sedentary population there are two main groups: the Mandingue (Bambara, Malinké, Dioula) and the Sudanese (Dogon, Saracollé, Bonzo, Sonrai).

The territory of the Dogon is situated between the Mali city of Mopti and the border of Burkina Faso. The cliffs of Bandiagara are a main place of Dogon's life. The Dogon are traditionally characterized by their sharpness, vivacity, agility and resistance.

Usually, the Dogon can understand quite well several tongues (Bambara, Bozo and Peuhl, namely), but their daily tongue is radically different from those that are spoken by their neighbours. They have a second kind of language, a secret and rhythmic language (Sigi So), just known by certain initiated persons and used in specific ritual ceremonies.

### 2. A cognitive system based on a principle of exponential duality

Although Dogon thought has been researched for many years, we are still far from appreciating the secret wealth of their hidden knowledge. Furthermore, among the Dogon this knowledge has been appearing progressively in different stages of initiation, the most perfect of which are only reached by some exceptionally gifted individuals.

Dogon mythology is based on a dualised unity – or an original uni-duality – represented by an infinitesimally small form of living atom (*kize uzi*), which turns into the egg of the world (*aduno talu*) where the cosmos comes

from. This atom is symbolised on earth by the seed of the *Digitaria Exilis* (Palau Marti 1957: 53–55).

There are two main versions of the creation. Both refer to Amma, the supreme Lord the heavenly regions, and to the appearance of sets of twins who became the ancestors of the Dogon people. Regardless of whether Amma married the earth and made it fertile with his divine seed (rain), or man developed from the egg of the world, the principle of duality always appears through the first set of twins, Nommo, (one male and the other female). This duality is reinforced by the two collar bones from which the embryo of man developed, (where duality is translated as axial symmetry) and by the two complementary "half-placentas" from the egg of the world or primordial matrix. Double duality is immediately apparent as each of these "half-placentas" produces a hermaphrodite couple. These couples became the 4 mythical ancestors who in turn gave origin to the first 80 descendants.

When dealing with the general and totalising character of 4, we can see how these 4 ancestors joined in chains of symbolic correspondence, not just in 4 tribes, 4 trees and 4 social institutions, but also in the 4 cardinal points and the 4 fundamental elements.

Amma used 4 elements, contained in the initial living atom, to create the substance that later became vivified through the "parole": "la parole" being the life of the world, born of water (Dieterlen 1982: 18).

Earth was sullied by the introduction of trouble by Nommo's rival, Ogo (also known as Yurugu or the Pale Fox) who came down to earth after appropriating the 8 seeds initially created by Amma and after having stolen the secret of "la parole" (Dieterlen 1982: 17; Beaudoin 1984: 70).

Curiously, Ogo's revolt seems to have been caused by his particular form of birth: he was born a male from one half of the original egg, but without a female twin who would have integrated him into the principle of normal duality. The world was re-purified by Amma through the death and resurrection of Nommo. Nommo's sacrificed body was divided and thrown in the 4 directions of space.

The development of the original mythical duality explains the symbolic importance of 8 by multiplicative unfolding, and intrinsically joins the semantics of spatial representations that is an ever-present in Dogon thought. An analysis of the symbolic dimension of  $2^n$  ( $1 \leq n \leq 3$ ) will form part of a separate study. However, attention must be paid to the set of numerical entities that do not derive from the principle of duality, but which also play a major part in Dogon symbolic thinking.

### 3. Some fundamental poles in the complex Dogon numerical symbology

#### • 266

The Dogon have 266 signs that prefigure the categories of everything in the universe, both objects and beings: "these signs, substitutes and images constitute a vast system of correspondances, in which every term is interlocked within what seem to be specific categories; these categories in their turn, whether linked or opposed, are themselves correlated" (Dieterlen 1982: 69; Palau Marti 1957: 56).

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These 266 signs are also called “the 266 parts of Amma’s body” or “the 266 things of the beginning”. They belong to the initial design of the “plan of the world” – that Amma conceived of and drew on the basis of water – symbolically carried out on earth, more specifically in “the field of the ancestors” (Dieterlen 1982: 18, 69; Griaule/Dieterlen 1965: 86–87).

#### • 60

60 is also “involved in the diagram of the world” (Griaule/Dieterlen 1955: 103) yet it also played a part in Amma’s purification of earth, as Nommo’s sacrificed body was divided into 60 parts (Dieterlen 1982: 18).

60 also appears as an essential symbolic value in rain rituals and in the autumn harvest, where 60 Dogon chiefs are present; at funeral ceremonies, where 60 urns are on display; and especially at the itinerant festival of the star *Sigui*, held every 60 years and dedicated to the revelation of the “parole tissée dans l’eau” and to the appearance of death in the world. The 60 year gap between these cyclical festivities corresponds to the time taken by some heavenly bodies to orbit around Sirius, which the Dogon call “the star of *Sigui*” (Dieterlen 1982: 18).

The symbolic efficiency of number 60 extends further to include operative efficiency, as 60 is one of the bases of the *mande reckoning*.

#### • 22

22 is another central pole in Dogon numerical symbolism, around which several different cognicultural organizational systems revolve. For example, 22 dots are represented in the “déroutement des éléments” scheme, as witnesses of the exteriorised and classified world (Dieterlen 1982: 46–47).

In addition it is associated to the cult of the ancestors, which involves the invocation of the 22 members of the first mythical generations (Griaule/Dieterlen 1955: 105). Furthermore, the Dogon acknowledge 22 leading families of living beings and attribute 22 joints to Nommo’s resurrected body (Dieterlen 1982: 21, 61–62). For the Dogon, “the science of clothes” is an account of the mechanism of creation, and the cloth is considered the “centre of the world”: 22 is linked to this knowledge of dressing, as the tunic of the Hogon (religious leader) is made up of 22 squares (Dieterlen 1982: 61).

We must not forget that a man is only considered to be completely adult until he is 22 years old.

#### • 7

The symbolism invested in 7 appears to be linked to the origins of creation. Not only are there 7 orders of reproductive vibrations, but 7 is also the number of segments that prefigure man in the egg of the world (Griaule/Dieterlen 1955: 85, 93; Palau Marti 1957: 55).

It was the seventh ancestor who taught man the “word of Nommo” (Palau Marti 1957: 54). There were 7 animals who had been the allies of Nommo (Griaule/Dieterlen 1955: 104). The future Hogon would retire to a cave for 7 days in preparation for his mission among men (Dieterlen 1982: 84). There were 7 sacred plants, 7 taboos and 7 seeds that Yurugu stole from man.

### 4. The brightness of the forgotten 5

At first sight, 5 does not seem to form a part of the symbolically relevant numerical entities of Dogon thinking. However, in a closer analysis, its implied present reveals a density of significance in a large number of occasions, some of which we will examine below.

#### 5 and temporal maturity

The Dogon venerate the first 5 generations after Nommo, as it is believed that it was during their age that all the social and religious institutions were created. Even today, every individual relates to the 5 generations around his own, the three that preceded him, his own generation and the one that will follow. This cult of 5 generations exists regardless of the individual’s lineage, within the 4 fundamental Dogon lineages (Palau Marti 1957: 56).

Houses have 5 niches on each side of the door, for the express purpose of representing these ancestors (Beaudoin 1984: 90).

The number 5 determines the age groups that are socially recognised by the Dogon, namely, the period from birth until the age of initiation, adolescence, youth, maturity and old age (Palau Marti 1957: 49).

According to Paulme (1985), children are breast-fed for 5 consecutive seasons. The Dogon week has 5 days and local market are held every 5 days. This temporal division of time seems to have a symbolic relation to Nommo’s blood, which ran for 5 days when he was sacrificed. In addition, it took Amma 5 days to resuscitate Nommo, which explains the ritual of the dead (*Dama*) takes place every 5 years in every village. In addition, the Dogon believe that the soul only reaches the land of the ancestors 5 years after death (Beaudoin 1984: 87, 90, 174, 201–203).

The itinerant festivities of the star *Sigui* (related to Sirius and to the appearance of death in the world) were celebrated for 5 consecutive days (Dieterlen 1982: 97).

Consequently, 5 appears as a measure of maturity reached through the achieved or of the cycle of resurrection. Thus it is the symbol of mythical and perfect completion of time, ages and generations, or what might be termed the human face of time.

#### 5 and the purification of earth

Mother Earth – according to one of the Dogon creation myth, was Amma’s wife and shared the temporal and cyclical maturity symbolised by 5 – wore a skirt made of 5 handfuls of fibres at the front and at the back (Griaule 1948: 26).

The organisation and pacification of the world was characterised by 5 attributes, known as the “5 attributes of Nommo”, all of which were associated to the fertility of the earth. Their names were *day*, *humidity*, *fertility*, *order* and *life*. The fifth attribute, *life*, should be noted as the central point where the other four meet. The contrast death/life leads to a new set of attributes assigned to Ogo, Nommo’s rival. These are *night*, *drought*, *sterility*, *disorder* and *death* (Palau Marti 1957: 53). Ogo’s rebellion stained earth. After he had stolen the initial seeds created by Amma and appropriated the secret of “la parole”, he came down from heaven and managed to take control of a field where he dug 5 rows of holes in the damp soil.

In order to free the earth from the disorder that Ogo had brought, the ancestor Lébé Sérou created 5 new parcels of land to the West of the original field. It was here that he planted 5 seeds, before cutting the field off from outside by building a hibiscus hedge. This field, protected from contamination by the Pale Fox (Ogo) was called “the field of the ancestor” (Dieterlen 1982: 20).

From this we can see that 5 was involved at various levels in defense against the Fox’s attacks and in the re-establishment of peace on the purified earth.

**“The counting word”: the symbolic and algebraic link between 5 and the mande reckoning**

Among the various different categories of Dogon words, there is one called the *counting word*, which integrates knowledge relating to numbers and to calculation. This “parole de compte” is intrinsically connected to 5, which is the initial base for Dogon counting. If duality (or symmetrization) is used, the result is  $2 \times 5 = 10$ , which is considered “the whole and perfect number, the representation of unity” (Calame-Griaule 1965: 176; Beaudoin 1984: 203; Griaule/Dieterlen 1955: 103). The abstract unit 10 is, initially, seen as the set of the fingers of two hands. 80, one of the fundamental bases of mande reckoning, is obtained from 8 sets of 10 elements. It is important to note that 80, in Dogon thinking, is not just indirectly linked to 5 through the multiplication  $2 \times 5 = 10$ . A particularly clear explanation can be found in a legend justifying the importance of 80 as the base of calculation for various West Sudanese people: “the ancestors put down 8 cowries with 5 fingers”. This means that 80 was achieved using 5 times the fingers of two hands (Griaule/Dieterlen 1955: 104).

The other base of mande reckoning is, as has been noted, the number 60. The same totalising function that Dogon thinking attributes to 5, appears with special clarity in meta-unity 60. This holistic cardinality causes a unification which is also translated by an indivisible symbolic circularity.

An isomorphic relation between 5 and 60 is thus discovered, which refers back to the purification of the universe by Amma. Amma divided Nommo’s sacrificed body into 60 pieces, which he then split into 4 groups of  $3 \times 5$  elements before throwing them to the 4 winds. It is no coincidence that the Hogon, during certain ceremonial rituals, such as those for rain and the autumn harvest, is surrounded by 60 chiefs “located in the 4 regions of space” (Dieterlen 1982: 95). Since 60 is linked to one astral revolution around the star Sigui (the Dogon name for Sirius), the relation is clarified when we consider that Sigui literally means “the navel of the sky” and Hogon (the centre of the social body) means “umbilical cord” (Dieterlen 1982: 31).

**The spiral, a specifically Dogon choreography of thought**

In both mythical thinking and in the symbolic space of the graphic teaching of the Dogon, the spiral is a key geometrical word with a unique relevance.

This relevance should be approached for two principal reasons. First, since the spiral is a specific form of

movement created by the totalizing nature of the centred 4, as we can see in the holistic behaviour of cardinality 4. The development of this circularity is here shown in a continuous form that is open to infinity, of which the spiral is the dynamic expression: *it performs the explicit (un)achievement of movement produced by the force inherent in a centre that affects the surrounding space and is capable of transforming “circularity” into “spirality”*. In Dogon thinking, several types of twisted fringes or cords, ellipsoidal or sinusoidal iterations are connected to this dynamic of the spiral.

The second reason is that this spiral movement prefigures and, in one sense, anticipates the *geometric metaphor which will be proposed, based on pedagogical hermeneutics, with specific reference to transculturality*.

Dogon creation myth is profoundly marked by a movement in spiral. Amma makes the world turn in a spiral form, and the movement of his collar-bones is also in a spiral, starting from the West: Amma occupies the centre, and the movement of his arms describes a three-dimensional spiral in space, which expands in a helicoidal conic structure (Griaule/Dieterlen 1965: 163, 167). The spiral is inscribed within the egg of the world, representing the form that shapes the development of life (Griaule/Dieterlen 1955: 84; 1965: 78). The process of segmenting the egg of the world in spiral form, perfectly integrates the process of creation of Sigui, where “all knowledge lies (Griaule/Dieterlen 1950: 284–285).

The stars and celestial bodies, specifically the Milky Way, are given life by spiral movement, analogous to the sinusoidal rhythms that govern the world and life (Griaule/Dieterlen 1965: 78; Beaudoin 1984: 122). The ritual dances for Sigui, which happen at the most important Dogon festivities, are danced “en rond ou en serpentant”, according to Beaudoin (1984).

The sun, whose placenta is circular, is surrounded by a spiral of incandescent red copper which gives it light and movement. The sun’s rays are called “copper water”, and when they touch the earth, they turn into that metal (Griaule 1948: 23, 147–148). The origins myth tells how Ogo, mistake in his search for his female twin (or lost double soul) describes a spiral movement in the earth’s placenta (Griaule/Dieterlen 1965: 185).

The helicoidal sign that characterizes the various isomorphic placentas, or the plan of universal creation, is projected on the two-dimensional surface of the earth in the form of undulating lines. These lines define the meandering paths of water and wind. Moisture, necessary for procreation, penetrates the earth through serpentine curves, exactly those of the sinuous movement of reptiles (Griaule 1948: 27, 82–83). When the Hogon dies, the priest shapes the holy clay from the “field of the ancestors” into a serpent in a position of rest, that is to say, curled up. The Hogon’s armet is an iron spiral (*senye*) which represents “the path of Nommo’s blood” after his sacrifice (Dieterlen 1982: 71). The Dogon believe that during menstruation, “the spiral does not turn in the woman’s womb”, thus making her temporarily barren (Griaule 1948: 80).

The movement of the copper spiral that moves the sun is the main base for design in weaving. The symbolic

importance of clothing for the Dogon has already been mentioned: we can now add that the fibre of the cloth is considered to be a primary form of “parole”. We have also seen how “the word was woven into the movement of water”, so it is no surprise that “water moves in the wavy line of the weft” (Dieterlen 1982: 97; Griaule 1948: 80, 89). According to some authors, “the weaving produces a spiral pattern from the centre of the crown to the edge, which symbolises the path followed by the original seed (Griaule/Dieterlen 1955: 100).

This analogy between spiral movement and development of seed is revealed with particular clarity in the case of the *sene* seed. The germination follows a pattern represented by the centred 5, but can also be represented by a set of concentric ovals (geometrically, a discontinuous form of the spiral) or equated to “the spider’s web” (Griaule/Dieterlen 1965: 218, 278), through the designs in Fig. 1.

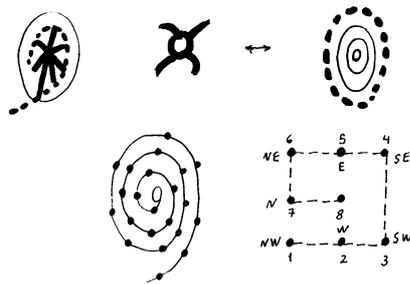


Fig. 1

The segmentation of the egg of the world by the first 7 vibrations (Griaule/Dieterlen 1955: 84) or the spiral of the “déroutement des éléments” contained in the original embryo and including the 22 points considered to be the “witnesses of the exteriorised and classified word” (Dieterlen 1982: 46–47), examples of the spiral’s symbolism within the scope of the Dogons’ graphic teachings. This can also give another meaning to more pragmatic or mundane matters, such as giving numbers to the  $2 \times 5$  front pillars of houses, related to the 8 cardinal points (Griaule 1948: 120–121).

These examples show how the spiral acts at the level of a cognitive model which embraces the entire project of creation conceived of by the “Designer of Things”. It is within the spiral that the word, water and blood, then sun and the stars are all formed and that the weaving of cloth and the development of seeds take place. It is in the spiral that the 8 cardinal points, the 22 main categories of living beings and the 7 initial vibrations take form. The universe is run according to its rhythm, men dance to its rhythm, and the sacred serpent that instructs the chiefs of the people moves to its rhythm.

*This spiral movement is a geometric metaphor, a metaphor that expresses holistic understanding of the world and all things.* At a cognitive level, the spiral is the symbolic image of deep and harmonious knowledge, which in normal life is expressed by the category of “the good word”. According to Calame-Griaule (1965), it is from this category that come music, kindness, pleasure and poetry – a feminine word linked to the loving nature of woman, the solar light and the totalising virtue of the centred 4.

## 5. Ethnomathematics and vivid “Logosymbols”

Ethnomathematics is concerned by the connections that exist between the symbol, the representation and imagery (Morin 1989: 158). The creation of signifiers is not only indivisible from the cognitive action, but the linking between “the concept in the mind” and “the sense-image” is intrinsic (Bronckard 1977: 57; Nattiez 1966: 81; Leach 1976: 19).

According to Cassirer (1985: 108, 117):

“The representation, as presence, is at the same time actualization: what stands before us here and now, announces itself as the emanation and manifestation of a power through the concrete uniqueness of the image.

(...) The more closely we follow the paths taken by the universal function of representation and recognition, the more clearly their nature and specific unity will be revealed to us – and it will be increasingly evident that it is ultimately one and the same fundamental achievement by which the spirit rises to (...) the intuitive world view, to the discursive understanding and objective intuition of reality”.

This complementary relationship between cognition and recognition – or between understanding and representation – develops itself bringing symbolic thought and rational thought together in a dialogical interaction which Morin calls the uni-duality of thought.

A conceptual image is a consensual human fact (Barnes 1990: 225), a phenomenon of a symbolic nature, whose “sailance cognitive” belongs to the level of the “coagulum of sense”, of “relevant mystery” or of “crystal culture” (Bonté/Izard 1991: 158–60; Morin 1986: 159).

Ethnomathematics deals with vivid “logosymbols”. *The logosymbol is vivid as an intentional acting representation or a constant tension feature between event and meaning.* As an intuition of living consciousness, it has an intelligible “soul” which can be translated as “le soi du Logos” (Kearney 1991: 14; Georgin/Wagret 1970: 465).

I believe that *ethnomathematics is concerned with “structural communion” and deals with an accurate “universal significance”* that:

- 1) reveals a profound proximity of transcultural thought/feeling,
- 2) points out a convergence of psycho-conceptual directional forces, where past and present meet,
- 3) inspires a methodological dynamic approach that discloses a new world of possibilities of interaction between cognitive/cultural anthropology and mathematical education through a hermeneutical approach.

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## Vorschau auf Analysethemen der nächsten Hefte

Für die Analysen der Jahrgänge 31 (1999) bis 32 (2000) sind folgende Themen geplant:

- TIMSS
- Computergestütztes Lösen offener Probleme im Mathematikunterricht
- Mathematikdidaktische Forschung im Primarbereich
- Mathematik an Hochschulen lehren und lernen
- Analysis an Hochschulen
- Mathematik in der Ingenieurausbildung
- Theoretische Betrachtungen zu Schulbuchanalysen.

*Vorschläge für Beiträge zu o.g. Themen erbitten wir an die Schriftleitung.*

## Outlook on Future Topics

The following subjects are intended for the analysis sections of Vol. 31 (1999) to Vol. 32 (2000):

- TIMSS
- Computer-aided solution of open problems in mathematics teaching
- Research in primary mathematics education
- Teaching and learning mathematics at university level
- Calculus at universities
- Mathematics and engineering education
- Concepts and issues in textbook analyses.

*Suggestions for contributions to these subjects are welcome and should be addressed to the editor.*