People of My Side ≈ People of the Other Side
Socionumerical Systems in Central Brazil

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Abstract: In this philosophical inquiry into the foundations of Xavante mathematical thought, numbers emerge as categories structured by social praxis in central Brazil. Clans, moieties, age-sets, and specific kin relations can be viewed as conventional symbols, or numerals, representing essential constituencies of the Xavante socionumerical system. As in other Gê-speaking societies of the Brazilian Amazon, Xavante numbers catalyze a set of presuppositions about dialectical mathematical systems whose rationality is informed by the pervasive dualism that governs social interaction for an estimated 8,000 Xavante today. The binary nature of this numerical system is a product of an omnipresent dialectical view of the world, always oscillating between an "us" and a "them" – or people of my side ≈ people of the other side. Accordingly, a unit is defined as the union of 2 fundamental parts, and numerical place value assumes the significance of reciprocal social relationships. The dialectical association of beings, human or not, material or symbolic, within the dynamism of Xavante dualism synthesizes these and other key ideas about the philosophy of Gê mathematical thought.

Kurzreferat: *Leute meiner Seite ≈ Leute der anderen Seite. Sozionumerische Systeme in Zentralbrasilien.* Bei dieser philosophischen Erkundung der Grundlagen des mathematischen Denkens des Volkes der Xavante tauchen Zahlen auf als Kategorien, die durch soziale Gegebenheiten in Zentralbrasilien strukturiert sind. Clans, Teile, Altersgruppen, spezifische Verwandtschaftsbeziehungen können als konventionelle Symbole oder Zahlzeichen angesehen werden, die die wesentlichen Bestandteile des sozionumerischen Systems der Xavante repräsentieren. Wie in anderen Gê-sprechenden Gesellschaften des brasilianischen Amazonasgebiets dienen die Zahlen der Xavante sozusagen als Katalysator für Voraussetzungen dialektischer mathematischer Systeme, deren Rationalität durch den Dualismus begründet ist, der die soziale Interaktion der heute auf ca. 8000 geschätzten Xavante beherrscht. Die binäre Natur dieses numerischen Systems ist das Ergebnis einer allgegenwärtigen dialektischen Weltsicht, die laufend zwischen "uns" und "ihnen" hin- und herschwingt – oder: Leute meiner Seite ≈ Leute der anderen Seite. Entsprechend wird eine Einheit definiert als Vereinigung von zwei fundamentalen Teilen, und dem numerischen Stellenwert liegt die Bedeutung der reziproken sozialen Beziehung zugrunde. Die dialektische Assoziation von menschlichen und nichtmenschlichen, materiellen und symbolischen Wesen im Rahmen des Dynamismus im Dualismus der Xavante synthetisiert diese und andere Schlüsselideen zur Philosophie des Gê mathematischen Denkens.

1. A Xavante history of creation

In the beginning of times, two powerful young warriors wandered around a vast territory in Central Brazil, creating all kinds of beings that now inhabit the Xavante natural world. The two wapté – adolescent boys being prepared for initiation rites – had the power of choosing what they wanted to create "just by thinking of it". So the two brought into being all kinds of delicious nuts and fruits the people were delighted to savor, but also gave birth to specimens of the animal world – such as dogs, jaguars and hornets – that frightened Xavante children and adults alike.

The pair of *ti'aimomé* – the creators – fulfilled their fantasies of populating the Xavante cosmos with ferocious, menacing beings, by transforming themselves into the very animals they dedicated themselves to create. Disguised as ants, mosquitoes and other kinds of nasty beasts, they wandered among the people biting, stinging and creating havoc among the once peaceful nation.

Because the youngsters' powers got out of control, they would have to be killed. This was not an easy task, however, because the transformative powers of the creators lured everyone. They'd transform themselves into birds and fly away, or else into underground animals, and bury themselves into safety. Adults from both clans, both married and unmarried, young and old, were involved in devising a plan to kill the *ti'aimomé*. Because the youngsters terribly frightened the community, they became "people of the other side", as opposed to "people of this side" – the broader Xavante population.

Well aware of the danger they faced, the two young warriors nevertheless took part of the tribe´s everyday activities – their energy stemmed from social life. Tragedy was soon to follow: immediately after the two boys trespassed the expected distance between initiated and non-initiated men, approaching a group of male elders on a hunting expedition, they were clubbed to death. While the people danced around their motionless bodies, the *ti'aimomé*'s blood fertilized the earth and gave birth to two trees of power: *watépare*, from the blood of the Owawé clan, and *wawa* from the Poreza'ono blood. The first payback killings among the Xavante then took place: the *ti'aimomé* created *pi'u*, a deadly kind of black bee, which stung and killed everyone (adapted from Serebura et al. 1997).

Articulating "people of my side", "people of the other side" (*waniwihã, wasi're'wa*) is an underlying feature of the Xavante way of being in the world today. It is a cosmological principle that has actually been strengthened, rather than weakened, after half a century of colonial exploitation and missionary proselytizing. The definition of "us" and "them" changes across space and time, and acquires special meanings according to the political context. The recently published book *Wamreme Za'ra – Our Word. Myth and History of the Xavante People* (Serebura et. al 1997), narrated by five Xavante elders of the Pimentel Barbosa Village in the state of Mato Grosso, central Brazil features several ancestral narratives, including the above, about the origins of the Xavante people and of their cultural elements, that are valued today as the core of Xavante knowledge.

Beginning with the first narrative – "Au'we Uptabi" (The Real People) –, Xavante culture is presented and characterized as "traditional knowledge", as opposed to the white man's lack of knowledge and of respect towards "real people". Not only is the distinction us/them obvious throughout the original narrative; other pairs of

complementary relationships are used as basic structuring resources by the narrators. As the narratives about the beginning of the world and its creators unfold towards the conflicts and tensions of the contact situation between Indians and non-Indians, classical cosmological oppositions – human/animal, male/female, day/night, high/low, raw/cooked, and so on – are dialectically redefined in terms of power relations between "us" and "them": before/after, white/Indian, primitive/civilized, savage/pacified, weak/strong, health/disease, confinement/freedom, and so forth. The general dynamic properties of the moiety structure of Xavante society are nevertheless present in all of these newly formed paired relationships, an idea that is summoned up in the very last saying of the book: "Tradition must remain. It came before us and will follow ahead" (Serebura et. al 1997).

Different worldviews – the socially constituted world and its cosmological foundations – and the everyday experience of active individuals account for the diversity of strategies of mathematical reasoning (Ferreira 1997, Lave 1988). In other words, different cultures, and individuals within any given culture, proceed differently in their logical schemes in the way they manage quantities and, consequently, numbers, geometrical shapes and relations, measurements, classifications and so forth (D'Ambrosio 1990, 1999). It is thus important to comprehend the fundamental principles of a dialectical society, as expressed in the above history of creation, in order to understand more fully some ideas and principles of Xavante mathematical philosophy. Let us now look at some recent contingencies of Indian-white relations that both express and help shape aspects of Gê mathematical thought.

2. Contact history: before and after the "whites"

The Xavante Indians of Mato Grosso, central Brazil, were first encroached upon by Salesian missionaries, and by timber and mining companies in the early 1920s. While the missionaries set out to "save the savages' lost souls", the loggers and miners "domesticated the wilderness," opening the way for the Brazilian colonizing enterprise to take over the economic and demographic "void" of the country's heart. The occupation of the traditional territories of the Xavante and of several other native populations thus became one of the principal fronts of the nationalist program of Brazil's president Getúlio Vargas in the 1930s and 40s, and in the next decades by the geopolitics of national security (Lopes da Silva 2000). In the late 1950s, the Xavante realized the political advantages of "peaceful contact" with the broader Brazilian society, if not only to guarantee the tribe's physical survival. This meant, among other things, embracing some fundamentals of economic development, such as sedentary agricultural production and missionary schooling. The Summer Institute of Linguistics (SIL) became an official partner of the Brazilian government in 1958, the very year the Xavante were finally deemed "pacified" Indians (Maybury-Lewis 1967).

The divide between "us" and "them", or "people separated from us," thus assumed an additional contrastive significance after contact was established with the broader Brazilian society, as to include the separation between Indians and whites. This important cosmic distinction neatly and poetically represents a series of binary oppositions which are the very warp of what being in the world means for the Xavante, and that express social relationships between men and women, children and adults of one's own, or of the other's, house, lineage, clan, village, age-set, name-group, substance-group, etc. Each individual is thus necessarily assigned to one or the other of every two groupings – either male or female, married or unmarried, young or old, initiated or not, and so on, according to culturally and historically specific recruitment principles. Each of every two groupings formed is structurally symmetrical in terms of its normative composition, but the relationship between each of them tends to be expressed symbolically in an asymmetrical way (Lévi-Strauss 1952, 1956), adding do the dynamism of the moiety system.

The dynamic properties of the system constantly call for the reproduction of the collective institutions, while trying to guarantee room for transformations to take place. In other words, the moiety system of dialectical societies can be considered a self-regulating system of transformations, just like any system capable of institutionalizing cyclical or repetitive reproductive processes (Turner 1979). The moiety system reflects a fundamental and contemporary structuring principle of Xavante cosmology, through which the tribe constructs its universe and thinks of itself as opposed to other beings.

Dualism is also an important structuring resource of the tribe's daily practices and activities, as expressed in the tribe's bimodal economic pattern. This pattern is characterized by an alternation between the practice of slash-and-burn agriculture around a large base village, supplemented by hunting and gathering done on a predominantly individual basis. The village can also disperse into hunting and trekking bands for part or every year. The treks are always organized on the basis of collective male groups, according to the composition of each household, age-set membership, etc. (Maybury-Lewis 1979).

3. The contributions of sociocultural anthropology

My interest in the philosophy of mathematics springs from insights the field of social sciences has brought to my experience in teaching mathematics on indigenous reservations in central Brazil in the 1970s and 1980s (Ferreira 1981, 1994, 1997, 1998). Sociocultural anthropology can be particularly thought provoking in the field of mathematical philosophy because it recognizes knowledge as a major modality of culture. Here, knowledge is understood as the ways in which different peoples experience the world and act upon it, including "feelings as well as thoughts, embodied skills as well as taxonomies and other verbal models" (Barth 1995).

Using knowledge as a prototype for culture allows us to look back at the logical foundations of certain concepts and principles that we are inclined to take for granted in mathematics – such as the concept of what constitutes a unit, as well as the concept of number itself. A journey

into the cosmological underpinnings of dialectical societies, which emphasize a binary division of the world experienced, allow us to acquire fresh insight and new logical powers into the structures of mathematical thought. This, in turn, can hopefully enhance our ability to strengthen one of the basic objectives of Ethnomathematics, according to D'Ambrosio (1990, 1999): a critical analysis of the production, transmission and institutionalization of knowledges and practices across time.

A journey into general ideas and principles of Xavante mathematics can, in turn, enlighten basic notions of arithmetic, such as what is meant by "number", "1", "2", "adding 1", and so on. Once considered too simple and primitive to be defined, these notions became hotly debated topics among various mathematicians during the 20th century. An assessment of the philosophy of number of dialectical societies has rarely, if ever, been brought into question.

The philosophical underpinnings of Xavante mathematics can challenge, in turn, some of the traditional assumptions of traditional pure mathematics, which may be regarded as consisting wholly of propositions about the natural numbers (Russell 1963).

4. Key ideas of Xavante mathematical thought

4.1 The Xavante concept of unit

By turning our attention to the mathematical philosophy of dialectical societies, what we learn, from the very beginning, is that unlike the Euclidian definition of a unit as "that by virtue of which each of the things that exist is called one", among dialectical societies I would suggest the following: each of the things that exist is called two – *maparané* – a couple because it is necessarily formed by a pair of ones – *mitsi* – a lonely self. Man/woman, house/patio, village/forest, and human/spirit are only a few of the paired moieties that form, each one of them, a *unit*. Without the woman, the man is nothing but *half* of a unit, because man and woman together form the fundamental unitary value.

4.2 The Xavante definition of number

4.2.1 Counting

When asked to count something, or asked a "how many/much" question, a Xavante individual will first proceed to group the objects in pairs – if at hand, like bullets or arrows – or else express the same mental procedure by grouping his/her fingers in pairs. How many fingers are actually involved in the operation is less important than the number of pairs he/she comes up with. This means that a two-one relation is being established. If the individual has to resort to his toes after pairing up all of his fingers, the word for many – *ahodi* – is inevitably used at some point of the procedure, indicating that anything above 5 or 6 pairs can or should be considered "a large amount".

However, counting "is only available, as a means of discovering how many terms a collection has, when the collection is finite" (Russell 1963). A brief consideration

of the composition of Xavante moieties indicates that each one is composed of an indefinite number of terms. Social relationships, as mentioned above, are fundamental structuring resources of Xavante moieties. If we consider the pair of moieties composed of "married men" and "married women" in Xavante society, for example, we would not have, in each one of the groups, the same number of terms as we would expect to have in most Western countries, where polygamy is rare. A Xavante man may well have more than one wife at the same time, a situation which characterizes polygyny. Rather than a one-one relation, the relation of husband and wife in Xavante society could be, instead, one-two, one three ... one-many, *but not exclusively one-one*.

The father to son/daughter relation is also distinct from the one we would expect to find in societies which define fatherhood exclusively in biological terms. In such societies, the relation of father to son/daughter ranges from one-one to one-many, while that of son to father is usually many-one. Among the Xavante and other dialectical society, the mother's brother and all the males of his descent group are like father (Maybury-Lewis 1979). Therefore, the father to son relation would hardly ever range from one-one to one-many. It would very frequently encompass, instead, a many-many relation. The same could be said about the mother-son/daughter relation.

Accordingly, in each of the age-set moieties – composed, each one of them, of four alternating age-set groups – the number of terms is unpredictable because of two reasons: 1) birth and death rates within any given five-year period of time are highly variable; and 2) since the age-set class reproduces itself every 40 years, during two generations (life-expectancy is approximately 55 years of age) there will be, at any given time, members of a same age-set group whose birth dates are approximately 40 years apart.

Therefore, there is no way of determining how many individuals there are in each one of the age-sets, the moieties composed of alternating age-sets or the class of age-sets itself.

It could be argued, however, that it would be possible to define how many individuals compose the whole class of (two generations of) eight age-sets, because it would amount to the entire amount of the Xavante population. Theoretically, it would be a possibility. However, the Xavante, as well as other Gê populations, have been characterized as semi-nomadic societies, which depart from a base-village on two to three-month hunting and collecting expeditions. The geographic mobility is further enhanced by the Gê's exogamous marriage system, which requires individuals to marry outside of their clan, and there are two clans per village. This elementary principle of kinship relations might require a woman to find a husband in a village far from her own, if there are no available spouses from the other clan in her own village. Thus, social mobility also characterizes Xavante life, which means that it would be highly unlikely that the demographics of any particular Xavante village would remain steady or predictable at any given period of time. The migratory pattern is additionally intensified due to various factors: the need to rotate agricultural fields; the

encroachment of non-indigenous settlers; the splitting of villages due to political and/or demographic reasons, among many other reasons.

Last but not least, let us briefly examine the relation between the human/Xavante domain and the animal domain, which form one of the most powerful pair of moieties of Gê societies. While the number of terms that forms the human class is highly irregular, as seen above, the same unpredictability can be found in the animal world. According to modern science, the number of animal species in the world is finite, and increasingly declining, because of human predatory practices – and Gê populations are well aware of this.

The problem, here, is one of classification, that is, what Gê societies consider to be an "animal". "Supernatural" beings that evade the scientific classificatory scheme are included by Gê populations as part of the (natural) animal kingdom, as is the case of the underwater "supernatural" beings enumerated by the Suyá of the Xingu Park (Ferreira 1997, 2000). To complicate the situation a bit more, such supernatural beings can transform themselves into human beings, and vice-versa, or take the form of any other being, material or symbolic, of the universe. Here, too, it is highly unlikely, or downright impossible, to establish a one-one correspondence between any of the elements of any given class or category of the basic constituent moieties of dialectical societies.

Why, then, would the Xavante, the Suyá, the Kayapó, the Xikrin or any other Gê society have developed a linear and ordered – at first, second, third, etc. – counting system if 1) most, if not all, of their significant collections or classes are not finite; and 2) the one-one correlation between the set of objects counted and a so-called series of natural numbers is absent?

We are so used to counting, that we take for granted that anything is supposed to be counted. This could also hold true for other South American societies that have not developed a counting system that reaches beyond five, six or seven, but that always include ways of expressing a large amount or quantity, through words, intonation or gestures that indicate "many" or "beyond reach", for instance.

4.2.2 Numerical place value as social relationships
Let us now turn our attention to the semantics of place value among dialectical societies. We have seen that an individual's position in society is largely informed by dual or binary relationships established between him/herself and other relations of his sex, age-set, clan, lineage, etc. If the numerical system also expresses (and is constitutive of) this normative model, it could be expected that the "numerical" place value would also be determined by social relationships.

Xavante number names follow the dualistic organizing principle outlined above, expressing a fundamental difference between odd and even numbers. The number 1, *mitsi*, means that the element is "alone" or "on its own". *Maparané*, the number 2, is the unitary base for counting, because it is the union of the "lonely halves", which form a pair. *Tsi'umdatõ*, the number 3, starts with the prefix *tsi*, which implies that it is an odd number (*tsi* alone, on its own). *Maparané tsiuiwanã*, the number 4,

represents 2 groups of 2. *Imrotõ*, the number 5, means "without a mate" (*imro* husband, mate; *tõ* without), also an odd number. *Imropo*, the number 6, stands for "the one who has found his mate".

The semantic meaning of Xavante numerals has been used to interpret the magnitude of Indo-Arabic numbers in classroom situations and economic transactions. Take, for instance, the reasoning behind Lino Tsere'a's explanation, when I asked him to compare 185 and 900: "185 is less than 900 because I am alone [*mitsi* 1] in 185 and without a mate [*imroto* 5]. In 900 *tomai'ã tomai'ã* is strong because it is *wanena* [the two of us together]". Here, Lino expressed value in terms of social relations. *Wanena* – "the two [of us] together", is an important value of the Xavante's dualistic social organization and the basic unitary value of the tribe's traditional numerical system. [1]

4.3 Xavante cyclical laws of numerical succession
The philosophy of Xavante mathematics challenges the basic set of ideas that informs the series of "natural" numbers, according to which the successor of 0 is 1, the successor of 1 is 2, and so on. If, according to Xavante thought, the basic unit is two, the number one can be considered to have a contrastive identity, that is, to be defined in relation, or in opposition, to two. That being the case, the "natural order" for the Xavante numerical sequence would not be 0, 1, 2, 3 ... n, n + 1, ... but could possibly be:

$$2, 1, 4, 3, 6, 5, 8, 7 ... n, n - 1, n + 3 ...$$
if n is an even number and
$$2, 1, 4, 3, 6, 5, 8, 7 ... m, m + 3, m + 2 ...$$
if m is an odd number.

There are distinct ordering possibilities and layouts, though, other than this linear, increasing succession. Given the fact that several instances of Xavante social
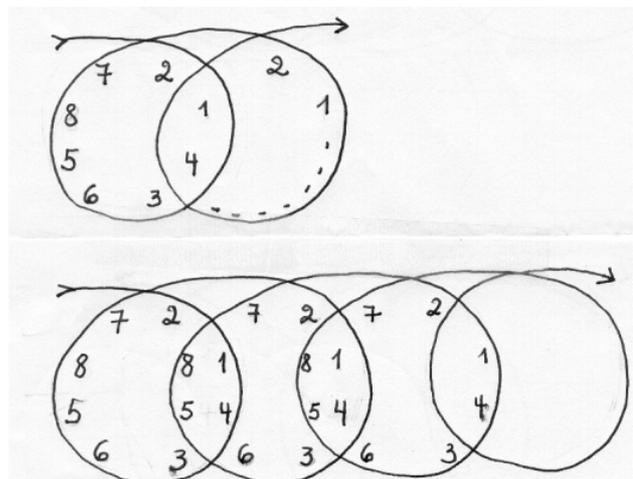

Figure 1: Cyclical configuration of Xavante numerical system

[1] Elsewhere I have discussed in detail the influences of the Salesian missionaries on Xavante numerals, especially the conflicts the Xavante experienced with the numerical system invented by Salesian missionaries and introduced in Xavante schools in the 1960s and 1970s (Ferreira 1994, 1998, in print). For lack of space, important aspects of the discussion are not included here.

life, including their notion of time, the body and relation to the environment are expressed in cycles (Ferreira 1994, 1998; Lopes da Silva 1986; Maybury-Lewis 1979; Turner 1979), perhaps it would be more appropriate to represent their number system in a cyclical order, which reproduces itself in spiral form, such as in Figure 1.

The dynamic properties of a cyclical model, as noted above, allow for the reproduction of the collective institutions, as well as for transformations in the socionumerical order. The spiraling nature of the curve moves simultaneously away from, and towards, the basic organizing principles of Xavante social structure. Structural transformations in Xavante kinship, encompassing recent changes in marriage arrangements and delayed birth of offspring, for example, have had the potential of elongating the spiral, because it delays the offset of a new cycle. However, because moiety systems of dialectical societies are self-regulating systems of transformations, they are capable of institutionalizing cyclical or repetitive reproductive processes by incorporating change without changing the basic composition of the system.

The numerals that represent each socionumerical cycle have been limited to eight because there is evidence that the Xavante traditional counting system extended itself up to eight (Ferreira 1998). This ties in perfectly with the tribe's age-set system, another institution that complements their moiety system. One of the cycles of Xavante social life is marked by the successive incorporation of individuals into age-sets. There is a total of eight age-sets, formed every five years, totaling a cycle of forty years, when the system reenacts itself. Every five years, therefore, boys and girls undergoing initiation are assigned to one of the following age-sets: *Tsada'ro, Ai'rere, Hotorã, Tirowa, Etepá, Abareú, Nodzou,* and *Anorowa*. Alternated age-sets (distinguished in bold font), in turn, form two separate moieties, according to the pervasive dualism.

The age-set system could be considered a (finite and cyclic) progression, composed of moments of time and social relations that qualify the system as a socionumerical one. In the Xavante age-set system there is a first term, and a successor to each term. Although the system repeats itself every 40 years, the individuals that compose each of the recurrent age-groups are separated by two generations of 20 years each and relate to each other dialectically, observing instances of proximity and of avoidance, depending on specific social contexts. Social relations function as place values, because the individual's position within the system – and therefore his/her status or (social) value – can only be determined in relation to the class it is part of (the alternating age-group moiety, which, in turn, relates dialectically to the other set of alternating age-groups).

Xavante numbers are, therefore, representations of social categories that stand for a way of bringing together a group or collection of individuals, which, in turn, embody the Xavante nation as a whole. I would therefore suggest a basic set of ideas and propositions that could be central to the philosophy of Xavante mathematics: the basic unit is two; a unit is formed by the union of 2 fundamental parts; the Xavante concept of number is an expression of the society's dialectical worldview; and place value is accordingly defined by social relationships.

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