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Sumerian Numeric System Comparison

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Chapter 19
Sumerian Numeric System Comparison

Similar to the 260-day calendar discussion, since the Nephite gold/silver metrological system and some of the reformed Egyptian numerals originate from or have some commonality with the early Sumerian system, the question comes to mind whether there may be some indication of Sumerian/Elamite influence on other Mesoamerican numeric systems. In trying to make this comparison, one has to keep in mind that there are always some chance associations that will be present. Considering that the Jaredite migration occurred around 2600 BC and consisted of a very small group of people entering a populated area with a long cultural history of its own, in comparing it with Mesoamerican systems occurring 2,000 to 4,500 years later, one would not necessarily expect much, if anything, to be present.

However, numerals and number systems do have a way of exhibiting some continuity over long timespans. Since Mesoamerica appears to have had a much more limited exchange with other cultures than those in the Middle East, perhaps there may be some evidence of connection present.

Summary of the Early Sumerian Number System

Numerical notation first developed in Mesopotamia around 3500 BC. However, Mesopotamian numeration has been described as a “dead end.” The numerals did not spread geographically far beyond their point of origin and did not survive when placed under pressure from numerical notation systems of later inhabitants of the region. As discussed earlier, the Sumerian proto-cuneiform consists of multiple numeric systems, and some identical signs appear to have different values in different systems (Chrisomalis 2010). All of the Sumerian systems appear to be cumulative-additive, although some individual signs are formed multiplicatively, that is, 600 = 60 x 10 (see figure 82).

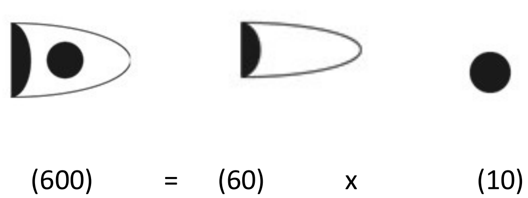

Figure 82. Example of a numeric sign formed multiplicatively in Sumerian proto-cuneiform.

Cumulative additive means that there are many signs per power of the base and that the sum of those values is taken to obtain the total value. An example of this type of system would be classical Roman numerals: CCCXXIIII means 100 + 100 + 100 + 10 + 10 + 1 + 1 + 1 + 1, or 324 in our system. The recovered proto-cuneiform texts are primarily accounting documents. While some of the proto-cuneiform systems don’t have systematic classifications, there are sexagesimal systems (consisting of numeric signs that alternate between factors of 6 and 10), bisexagesimal systems (consisting of numeric signs that alternate between factors of 6 and 10 but have some intermediate signs arrived at by using a factor of 2), systems to calculate area, and the U_4 system, which was used to record time and calendrical units.

The number system of the area adjacent to Sumer known as Elam is represented by Proto-Elamite number signs, was very similar to the Sumerian proto-cuneiform system.

In addition to the written number system, it is also important to look at the verbal number system to determine the utilization of base or subbases within the system. While we don't know with any certainty the verbal nomenclature of the early Sumerian proto-cuneiform number systems, looking at what we know of the verbal names for Sumerian numbers helps us see that verbal Sumerian numeric notation consisted of different bases depending on where one is in the number system. A decimal-sexagesimal system, with elements of a subbase 10 and a base 60, describes the system with numbers above 60. Below 60 the number system is quinary-vigesimal with traces of decimal counting, meaning it is a subbase 5 and a base 20 system, with some traces of counting by 10s (Seidenberg 1965). More precisely, it is a cross between a quinary-vigesimal system and a decimal system, with the vigesimal dominating up to the base 60.

At the beginning of the Early Dynastic period (2900–2350 BC) significant changes were made to the script in the region. The older ideographic proto-cuneiform system slowly transformed into a writing system that used wedge-shaped (cuneiform) signs. However, despite the change to the script, the proto-cuneiform numeral signs remained identical to the archaic proto-cuneiform symbols. Around the 27th century BC, the numerals, along with the rest of the script, were rotated and written horizontally.

A positional number system was eventually adopted in Mesopotamia. The earliest assertion of this development is during the Early Dynastic IIIb period as part of a metrological (measurement) text (2500–2350 BC) (Whiting 1984). The system had a zero concept but essentially used a blank space for zero instead of a specific character.

Mesoamerican Systems

Bar-and-Dot System

The bar-and-dot numerals were the most commonly used system in lowland Mesoamerica, both on stone monuments (400 BC–910 AD) and in the four surviving Maya codices (1000–1500 AD). The numbers from 1 to 19 in this system are written by combining a dot sign for one and a bar sign for five additively (see figure 83).

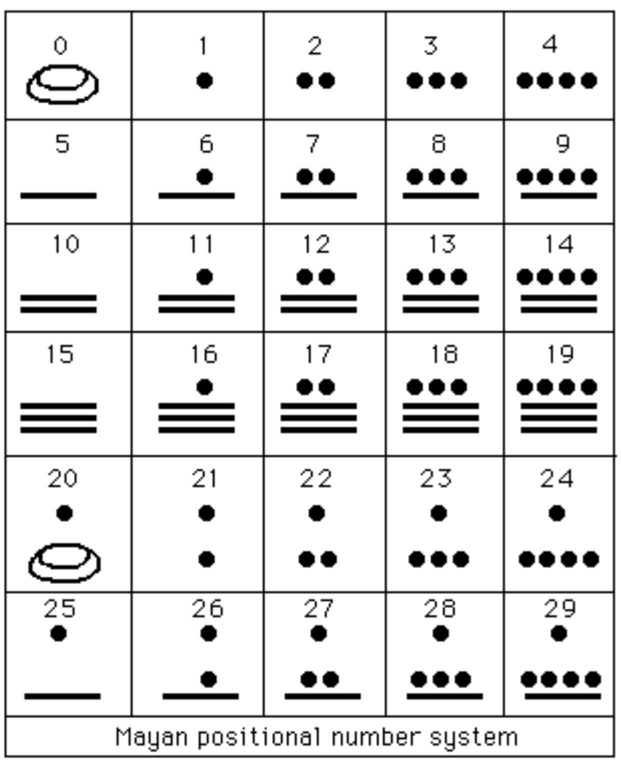

Figure 83. Maya positional number system

Also, in Maya monumental inscriptions (see figure 84) and in Maya codices (see figure 85), the number 20 takes different forms.

Figure 84. Monumental Maya forms of the number 20. (Morley 1915)

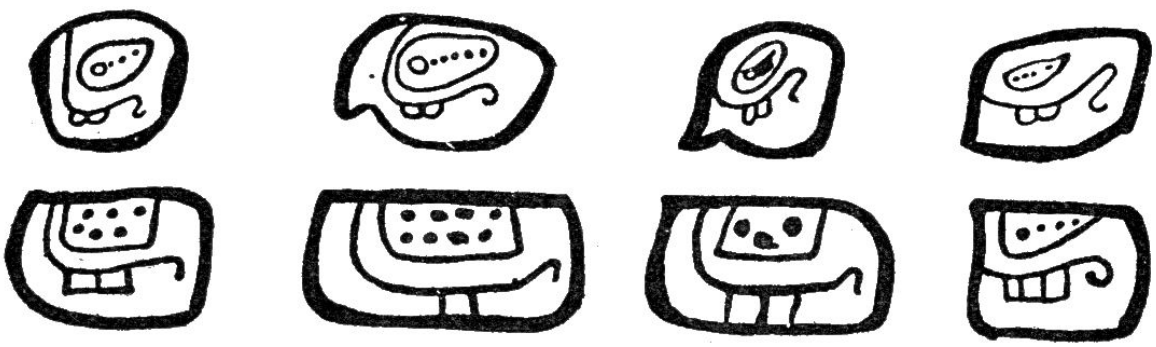

Figure 85. Codex Maya forms of the number 20. (Morley 1915)

The Maya/Mesoamerican Long Count calendar required the use of zero as a placeholder within its vigesimal positional numeral system. A shell glyph was used as a zero symbol for these Long Count dates (see figures 86 and 87). These values of zero were not really used as a zero in the Western sense; normally, it served as a placeholder within dates, with the rough meaning of "completion of a given cycle of time."

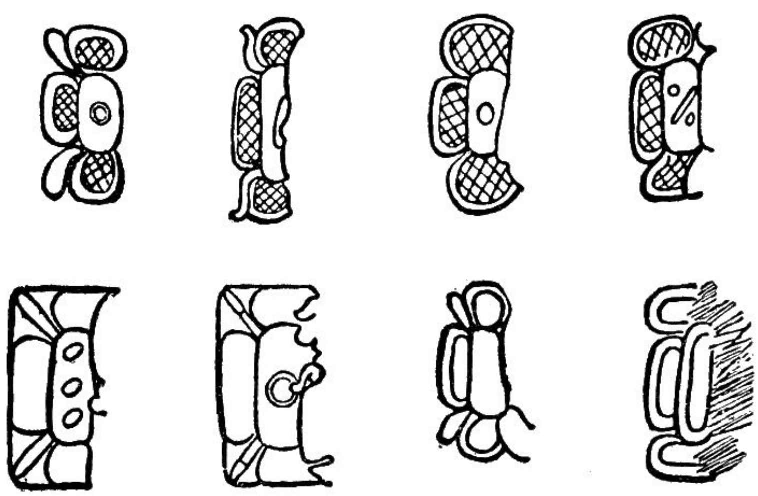

Figure 86. Monumental Maya forms of the number zero. (Morley 1915)

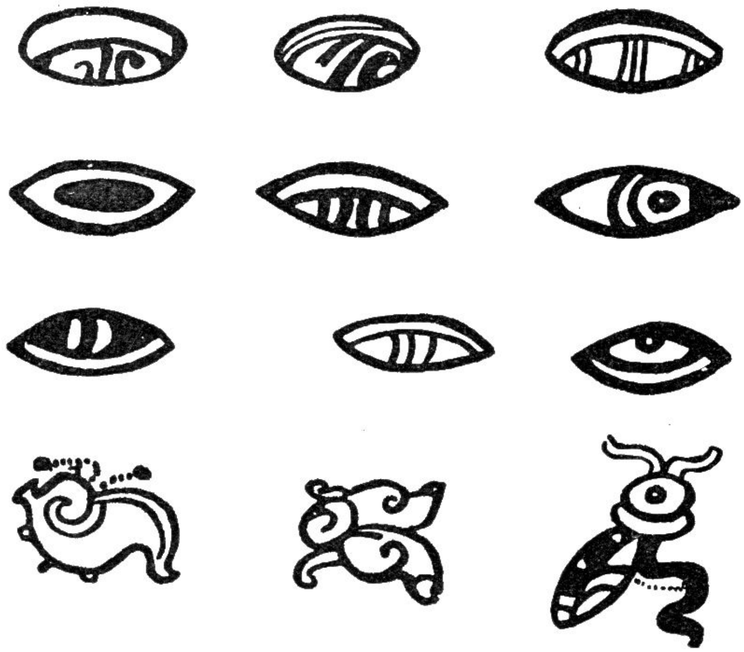

Figure 87. Codex Maya forms of the number zero. (Morley 1915)

The bar-and-dot system occurred in all three of the major Formative period (1000–400 BC) Mesoamerican script traditions: Isthmian (Epi-Olmec), Zapotec, and Maya. The written Maya system is considered to have a quinary-vigesimal structure (subbase 5, base 20). The verbal Maya system, which is known at a much later date, is a vigesimal structure (base 20) with a decimal subbase (base 10) for numbers less than 20.

Aztec Number System

The Aztec possessed a vigesimal numerical notation system, with multiple signs for the same numeral (see figures 88 to 91). The signs were combined in a cumulative-additive system, written in horizontal rows with the highest powers on the left. Unlike the Maya, the Aztecs did not always use a separate sign for five but would instead make groups of identical signs into groups of five.

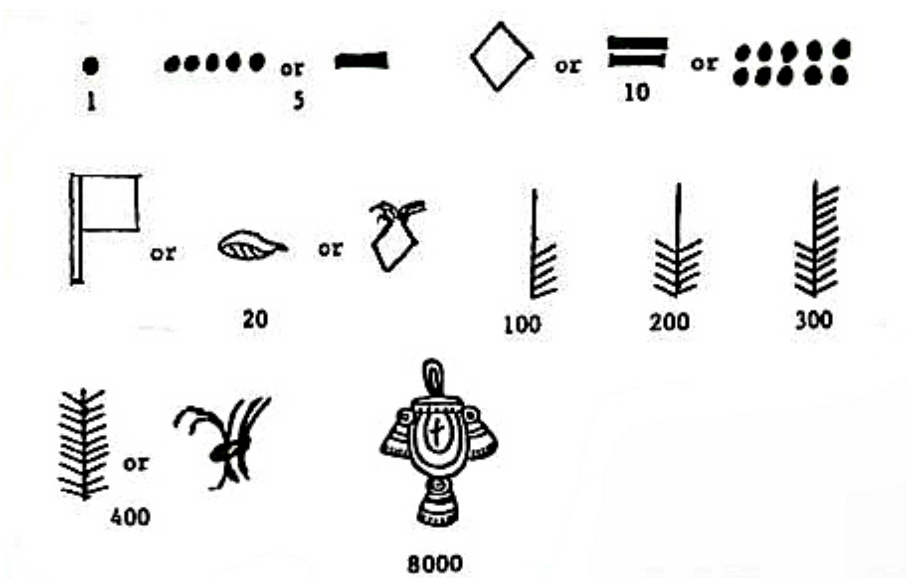

Figure 88. Aztec numbers set one. (Ortiz-Franco 2002, 239)

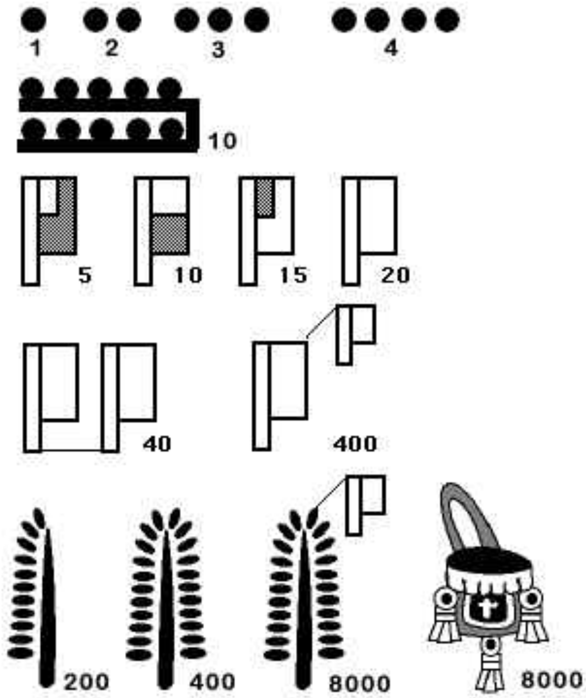

Figure 89. Aztec numbers set two. (Learning Connection 2015)

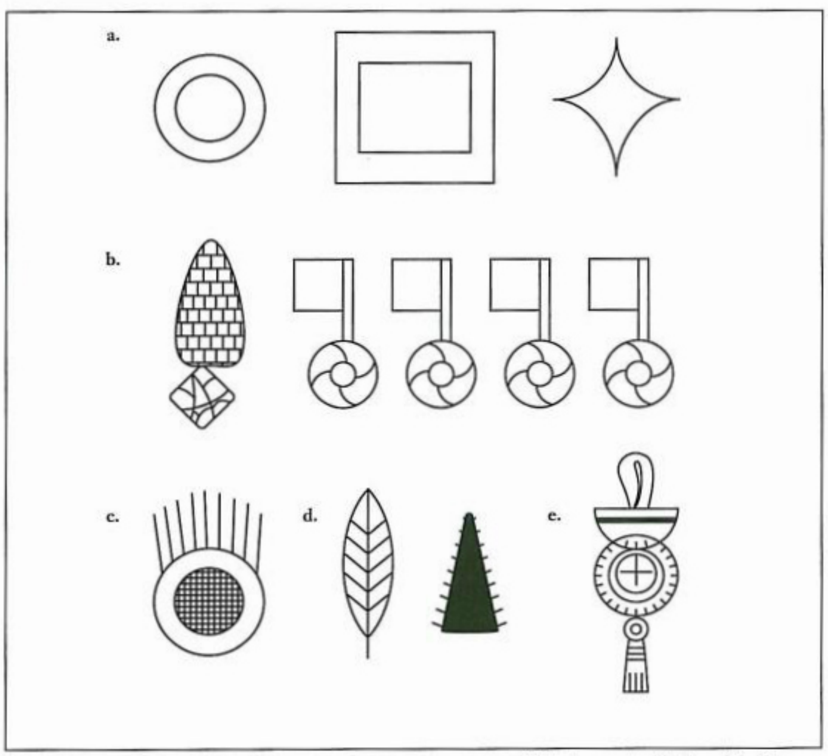

Figure 90. Aztec number glyphs set three: a) symbols for the number 10; b) symbols for the number 20; c) symbol for the number 80; d) symbols for the number 400; e) symbol for the number 8,000. (Aguilar-Moreno 2006, 313)

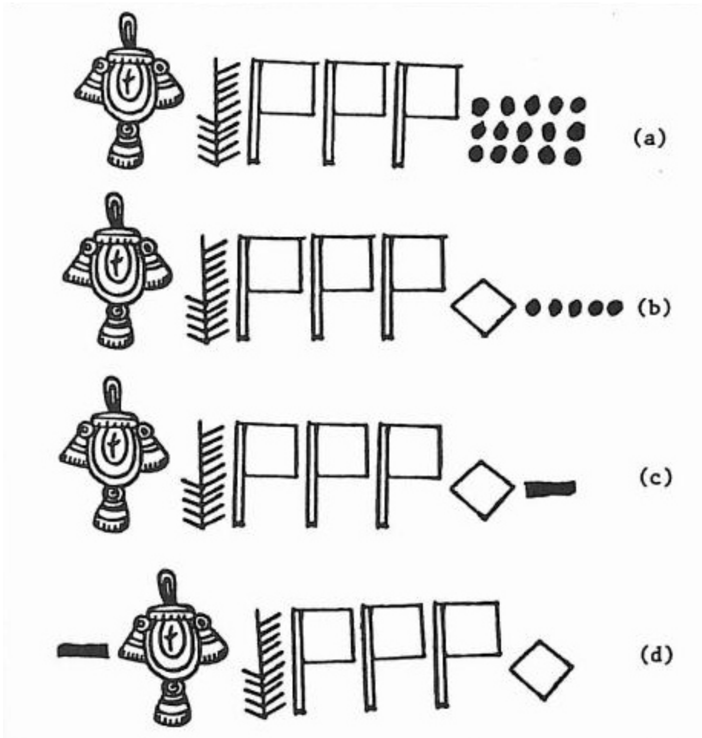

Figure 91. Four ways of writing 8,375 with Aztec number symbols. (Ortiz-Franco 2002, 241)

In addition to the Aztec script, we know how the Aztecs identified their numbers in the spoken language (Nahuatl). Since people still speak Nahuatl today, this provides a useful comparative tool. For the numbers up to 100, the system operates verbally as a base 20 system operates, with a subbase of 5 and 10. From 20 to 100 it is base 20, with a subbase of 5 between the factors of 20, with separate stratum steps (words) using the words for 5, 10, and 15. Its classification would be considered quinary-vigesimal with traces of decimal counting.

Texcocan Line-and-Dot System

The city of Texcoco in the province of Tepetlaoztoc was located in the valley of Mexico. It was a regional power before and after the Spanish conquest. Documents from the city indicate a number system that was a base 20 with a subbase of 5. The sign for 5 was a comb-like symbol with five lines. A grouping of a set of five dots was sometimes used to make 100 (see figure 92). It was a cumulative-additive system. Numeral phrases were written in a variety of directions but were always arranged from the highest to lowest sign (Harvey 1982, 191; see figure 93). Higher numbers used Aztec type symbols such as a bag or sack for 8,000 and the bush or tree for 400.

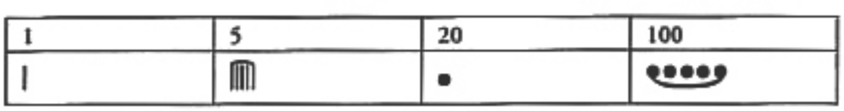

Figure 92. Texcocan line-and-dot numerals. (Chrisomalis 2010, 304)

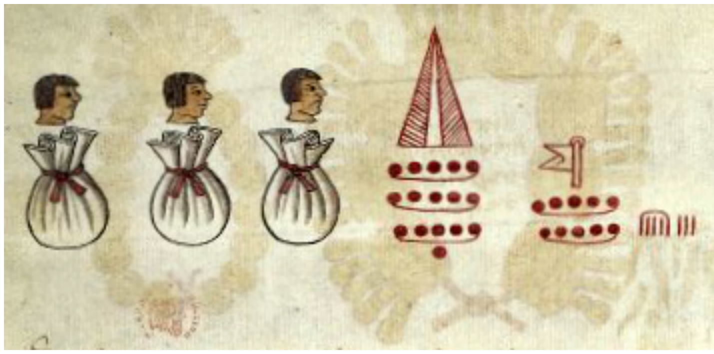

Figure 93. Numerical phrase from the Codex Kingsborough, circa AD 1550, enumerating the population of Tepetlaoztoc at 27,765 ([3 x 8,000] + [9 x 400] + [8 x 20] + 5). (Chrisomalis 2010, 305)

Various modifications of this system have been found. The Códice de Santa María Asunción contains this number system that expresses the numbers positionally rather than additively, meaning the number value is changed based on its position. These different positions were made relative to a land registry. In this system, in one position dots and lines were used to indicate numbers up to 19. In a second, lower position, units and groups of five indicated multiples of 20 units, but no dots were used in this position. When dots were found, they occurred above the base second position; this upper position also counted multiples of 20, and in this upper position a line is equal to 20 and a dot is equal to 400.

In this system, the position of the dot changes the value. This system also has a zero-type glyph called the *cintli* (corn) glyph.

Comparison of the Archaic Sumerian Numerical System to Mesoamerican Systems

Attempting to compare the not fully understood Sumerian proto-cuneiform numerical system that would have come with a small group of travelers around 2600 BC to the Mesoamerican systems of the Formative Maya, Zapotec, Epi-Olmec, and later Aztec thousands of years later is no easy task. It is quite apparent that there has been significant fragmentation as well as unique invention in the later Mesoamerican numeric systems from what the Olmec may have been using. Nevertheless, even though there has been indisputable early trade contact in the New World from various parts of the world (Sorenson et al. 2013), one would not expect the kind of diffusion and borrowing that has occurred elsewhere in the world with numeric systems in Mesoamerica because it was significantly more isolated. As a result, one might be able to identify traces of the Sumerian system that were incorporated into these later Mesoamerican systems.

When evaluating connections between neighboring or ancestral numerical systems, Stephen Chrisomalis (2010) has proposed the following criteria for borrowing to differentiate those that may have been independently invented versus those that have borrowed or significantly utilized other systems:

1. Use of the two systems at the same point in time
2. Similarity in structural features
3. Similarity of forms and values of numeral signs
4. Known cultural contact between the regions where the two systems are used
5. Use of ancestor and descendant systems in similar contexts
6. Geographic proximity of the regions where two systems were used

Use of Two Systems at the Same Point in Time

This parameter is used to determine if direct borrowing or adoption has occurred. In the case of Sumerian, the time depth is much deeper than the Mesoamerican systems that we are looking at. The analysis here is an ancestral link, not a contemporary borrowing.

Similarity in Structural Features

Potential similarities in structural features between the systems are:

1. Both have combination vigesimal, quinary, and decimal structures.
2. Both have multiple signs for the same value (primarily Aztec).
3. Both have at least some positional numeric systems.
4. Both have the concept of zero, and in both it functions as a placeholder.
5. The Aztec and Sumerian systems are cumulative additive.

Similarity of Forms and Values of Numeral Signs

For purposes of this work, only a preliminary conceptual comparison is included. Additional research is required in order to describe and compare equivalent elements between the Sumerian and Mesoamerican systems.

Known Cultural Contact

The known cultural contact is based on a small group of immigrants coexisting or being incorporated into a native population. Since the point of the analysis is to see if there is an indication of this occurring, this parameter is assumed. Chrisomalis characterized this parameter as a “weak measure” and only to be used as a last resort in making these sorts of determinations.

Use in Similar Contexts

Generally speaking, from what we know of Sumerian and Mesoamerican use of numeric systems, they were used for religious, calendrical, and other trade uses, so the numeric system would generally be considered to have been used in similar contexts.

Geographic Proximity

The geographic proximity is based on a small group of immigrants coexisting or being incorporated into a native population. Since the point of the analysis is to see if there is an indication of this occurring, this parameter is assumed. Chrisomalis characterized this parameter as a “weak measure” and only to be used as a last resort in making these sorts of determinations.