ADDITIONAL INFORMATION

Number Words in Many Languages

ABOUT FULFULDE

A Conversation with a Linguist from Niger

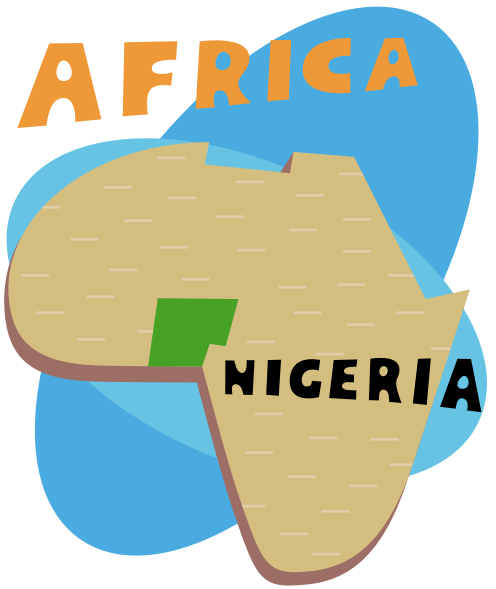
Fulfulde is a language spoken in parts of northern Africa. The version included in the lesson is the version spoken in northern Nigeria. A similar version with some variation is spoken in the country of Niger, bordering on the north of Nigeria.

The Mathematics Behind the Number Words

Fulfulde has several significant numbers, or building blocks. Since the number words reflect primarily a base 10 system, powers of 10 are significant building blocks. Unlike English, however, Fulfulde uses the word for 5 as a significant building block to make the words for 6, 7, 8, and 9, and other words that include the names for 6–9.

Sappo means "ten." *Chappan* is actually the plural of the word *sappo,* so *chappan* is literally "tens" or "groups of ten." *E* means "and." Sometimes it indicates addition, and sometimes it indicates multiplication. It can have both meanings within the same word, as in the word for 60: *chappan e joyi e go'o* = $10 \times (5 + 1)$.

Upon closer examination, the reader may notice that the word for 60 *(chappan e joyi e go'o)* appears to be the same as the word for 51. The difference is found in the pronunciation. The word for 51 is indeed *chappan e joyi e go'o,* "tens and five and one." The word for 60, on the other hand, is also *chappan e joyi e go'o* but is spoken using a contraction of the words *joyi e go'o* that sounds like *jeego'o.* So the word for 51 tells you to think $(10 \times 5) + 1$, and the word for 60 tells you to think $10 \times (5 + 1)$. This same kind of contraction is used in 70 *(jeeɗiɗi),* 80 *(jeetati),* and 90 *(jeenayi).*



ADDITIONAL INFORMATION

How to Pronounce the Words in Fulfulde

There are a number of phonetic sounds in Fulfulde for which there are no equivalents in English. The apostrophe in *go'o* is one such sound. It indicates what linguists call a glottal stop—a break in the air stream that separates the word into different syllables. It is like trying to say *g-oh,* stopping the sound of "go" by tightening the throat.

The *ɗ* found in the word for 2 is another such sound. It can be very roughly approximated by placing the tip of the tongue behind the upper front teeth and trying to say *gee-gee* with a hard *g.* However, the sound is formed deeper in the throat than is usual for English speakers, and can be difficult to reproduce.

The vowels in Fulfulde words are often pronounced as separate sounds. Thus *joyi* is more closely approximated by thinking of the word as *jo-yee* rather than with an *oy* diphthong, as in *joy-ee.* However, the *y* in *joyi* is not pronounced as strongly as in *yet.* It is closer to the *y* sound in the word *Maya.*

The word for 20 *(noogas)* has a long *o* sound, not an *oo* sound as in *moon.* Think of saying *no-oh-gahs* without pausing between *no* and *oh.* In Fulfulde, the length of the vowel sound can completely change the meaning of the word. According to Ms. Salamatou Sow (pronounced *So*), our linguist from Niger, a Fulfulde person would not understand that a person saying *nogas* meant 20. The difference in meaning between *noogas* and *nogas* would be akin to the difference between *cat* and *cot* in English.

Analysis of Number Words in Many Languages

The authors of this unit are not linguists, and thus cannot speak definitively about all languages. However, we can say that the languages presented in this lesson can be grouped into several kinds of mathematical categories. There are languages whose number words are:

- a straightforward base 10 system (like English)
- mostly base 10, with a few exceptions in some of the words
- a straightforward base 20 system
- a mix of base 10 and base 20

CATEGORY 1

The first category includes languages whose number words use a straightforward base 10 system. Most of the languages presented in Lesson 3 fall in this category.

Arabic, Chinese, English, Gikuyu (Kenya), Hawaiian, Hebrew, Indonesian, Japanese, Lakota, Latvian, Nipmuc*, Swedish

*From the number words that are available, this language appears to reflect a base 10 system. However, some of the words are not known. (See Curriculum Links, page 8.)

Patterns to Note

1–10

There are unique words for 1–10, unlike Fulfulde, for example, in which the word for *six* is made up of the words *five* and *one*.

Teens

The number words for 11–19 reflect addition: $10 + (1, 2, \ldots, 9)$.

Powers

There are unique words for powers of 10; for example, English has the word *hundred* instead of continuing the pattern to say *tenty*. These words, or some close variation of them, are then used to build other number words. For example, in English, variations of the word *ten* are used in the teens (thirteen, fourteen, etc.) and in multiples of ten (twenty, thirty, etc.).

Multiples of Ten

The number words for multiples of ten reflect multiplication: $10 \times (1, 2, \ldots, 9)$. The occasional exception, 20, is sometimes named by a different word that bears no apparent relation to "two tens," sometimes due to the cultural origins of the word.

ADDITIONAL INFORMATION

CATEGORY 2

In the second category are languages whose number words use mostly base 10, with a few exceptions in some of the words.

This is the second largest category for the languages presented in Lesson 3. For the most part, it can be presumed that these languages reflect a base 10 number system. However, some of the words may not follow the apparent numeric pattern. This is due in some cases to the linguistic history of the language; for example, many cultures' languages were influenced by the languages of neighboring cultures or of conquering cultures.

French, Fulfulde, Hindi, Portuguese, Russian, Spanish, Swahili

Patterns to Note

The same properties hold true as for Category 1, for the most part.

Exceptions

Language	Exceptions to Notice
Fulfulde	The word for 5 is used as a significant building block. (This feature will also appear on the Chinese abacus in the next section.) Number words are composed of ones, fives, tens, and hundreds.
French	Two notable exceptions exist: 1. In the teens, 11–16 have the *-ze* ending. Then, suddenly, 17–19 include the word for 10, added to 7, 8, or 9. 2. 70, 80, and 90 break the pattern. 70 is literally 60 + 10, rather than 7 tens. The words for 80 and 90 reflect a base 20 system; 80 is "four twenties," and 90 is "four twenties and a ten."
Hindi	This language seems to reflect a base 10 structure, though the linguistic relations between words are tenuous.
Portuguese	Similar structure to French, in that an exception appears in the teens. 11–15 have a similar *-ze* ending, but 16–19 use the word for 10 in the number word.
Russian	The word for 40 does not appear to follow the pattern.
Spanish	Similar structure to French and Portuguese, in that the exception appears in the teens again. 11–15 have a *-ce* ending, but 16–19 use the word for 10 in the number word.
Swahili	The words for 30, 40, 50, and 80 do not appear to follow the linguistic pattern. Compare Swahili to Arabic and you will find some interesting parallels. These multiples of 10 resemble the Arabic words, because of the Arabic influence in parts of Africa. (There are similarities to the Arabic words for 6, 7, 9, and 20 as well.)

CATEGORY 3

Category 3 includes languages whose number words mirror a base 20 system.

Mayan

Patterns to Note

1–10: There are unique words for 1–10 and 11.

Teens: The words for 12–19 reflect addition: $10 + (2, 3, \ldots, 9)$.

Powers: There is a unique word for 20, and for powers of 20. The word for 20 uses the word for 1 and a prefix *(kal)* for "twenties."

Multiples of Ten: The number words for multiples of 10 reflect multiplication and subtraction! The even multiples of ten (20, 40, 60, 80, 100) are composed of 1, 2, 3, 4, or 5 twenties. The odd multiples of 10 (30, 50, 70, 90) have the word for 10 preceding the word for the next multiple of 10. For example, 30 is "ten, two twenties," or presumably "ten less than two twenties," or $2(20) - 10$. 50 is "ten, three twenties," or $3(20) - 10$.

Note that there is no unique word for 100, as it is not a significant building-block number in base 20. 100 is simply 5 twenties.

CATEGORY 4

The fourth category includes languages whose number words reflect a mix of base 10 and base 20.

Danish, Gaelic (Irish dialect of Gaelic)

Patterns to Note

1–10: There are unique words for 1–10.

Teens: The number words for 11–19 reflect addition: $10 + (1, 2, \ldots, 9)$.

Powers: As with words for a base 10 system, there are unique words for powers of 10. However, as with the words for a base 20 system, there is also a unique word for 20.

Multiples of Ten: The number words for multiples of 10 reflect multiplication and addition. The even multiples of 10 (40, 60, 80) are composed of 2, 3, or 4 twenties. However, there is a unique word for 100. The odd multiples of 10 (30, 70, 90) have the word for 10 after the word for the previous multiple of 10. For example, 30 is "one twenty and ten"; 70 is "three twenties and ten." Fifty is an odd exception for which there are two different words. One of them appears to be a unique word, while the other suggests "half a hundred," which suggests a base 10 structure.