

MEASUREMENT

Yolŋu most frequently measure by a process of comparison or reference rather than by enumeration in units of measurement. However this not exclusively so - I have heard Yolŋu quantify the distance between one place and another in terms of the number of jerry cans needed as boat fuel to get there. It is quite common to express distances between places in terms of the number of nights spent camping whilst travelling between them.

There is a rich variety of terms for comparing physical attributes (although many attributes are not named as such):

weyin	long
wajarr	tall
dhumbul', gurriri	short
yindi (plural: gilkurr)	big
nyumukuginy (pl. yumurrku)	small
dhamburru*	fat
bārka, binydjitj	thin, narrow
bondi	fast
bulnha	slow
ŋonuy	heavy, dense
damba*	light (also hollow)
däl	rigid (also strong)
yaljgi	lax (also weak)
djaka*	length, height
djaka-ŋupan	measure (lit. follow length)

*Makassan loanwords

The terms above are elaborated by the use of qualifying adverbs such as **märr** (fairly) and **märr gannga** (a little). E.g. **yindi märr** - fairly big/a fair bit bigger.

Linear dimensions of height, width, length and distance are specified by means of reference to an equivalent. So one person might delineate the distance at which a wallaby was shot by nominating a reference point at an equivalent distance (e.g. "from here to that tree").

When Yolŋu are making ceremonial armbands or headbands they may first measure the circumference of the arm or head by using a leaf from the frond of a Fan Palm (**dhalpi**) which is wound around and cut so that two ends meet each other exactly. This is then kept as a measurement of the circumference.

Similarly a spearthrower (**galpu**) is tailor made for the user by making its length equal to the distance measured from his armpit and along his outstretched arm to the palm of his hand (Munyarryun, 1990).

SPACE

Aboriginal skills in orienteering are well known, as is the ability for Aboriginal children to outperform European children in tests of spatial concepts (Kearins, 1977). Yolŋu, even when sitting in an unfamiliar, closed room, will gesture in the true direction of places as they come up in conversation. In the same circumstances Europeans are generally unable to even nominate a compass point unless they can see the sun, and even then it takes some time to take a bearing. In my experience when Yolŋu are shown a map of familiar country they frequently take the time to turn the map around so that it is oriented correctly in true terms.

There is a group of directional terms in Djambarrpuyŋu which derive from specific seasonal wind names. They are:

lungurrma	(northeast wind)	north
djalathaŋ*	(south wind)	south
dhimurru*	(east wind)	east
bärra**	(northwest wind)	west

* These names are Makassan loan words: *sallataŋ* (south), *timoro'* (east wind), *bara'* (west wind).

These terms can be combined to express medial directions. Thus for example, **dhimurru-makarr-lungurrma** (lit. east-thigh-north), northeast (Zorc, 1986).

Yolŋu also express location by relating to nominated referents:

dhunupa'ŋu	right
wiŋ'ku	left
gumurrŋur	in front (lit. at or on the chest)
dhudŋur	behind (lit. at or on the buttocks)

Yolŋu space concepts are also reflected in their art and craftwork (particularly paintings and woven mats and baskets) which exhibit mathematical design including symmetry (bilateral, quadrilateral and radial), seriation and recursion (these same features are developed at a further level of abstraction in the Yolŋu kinship system).

With respect to regular shapes I have seen in various Yolŋu paintings circles, concentric circles, right angle triangles, isosceles triangles, equilateral triangles, squares, parallelograms, rectangles and trapezia. In conversations with working artists I have heard them use terms such as **gulkmaram** (lit. cut, extension bisect), **rrambaŋi** (equal, referring to area, or congruency of shapes), **gumurr'yun** (meet, referring to cross-hatched sections being set in symmetry to one another), **malthun** (follow, referring to parallel or following lines), **napuŋga** (middle), **yarrata** (line), **maŋutji** (lit. eye, extension circle), and **likan** (lit. elbow, extension corner).

On one occasion (June, 1990) I was visiting with an artist (in his mid sixties) who had a 1.3 metre square canvas upon which he wished to lay a fine painting. He expressly asked me to help him bisect the canvas into two equal portions with a line, using a blackboard ruler he had seen me with earlier. On smaller areas he could gauge it by reckoning (he never used a straight edge himself), but a large one was difficult and he wanted it perfect. (Is this then aesthetic thinking or mathematical thinking?)

A number of Yolŋu words have a group of additional meanings (apart from the principal or literal meaning) which extend into conceptual domains which Westerners would categorise as mathematical. The word **maŋutji** (lit. eye) which carries the concept of roundness is one of these. Some of the meanings I am familiar with are seed, bullet (remembering that the first bullets Yolŋu saw were the spherical bullets fired from the guns of Makassans two or three centuries ago), waterhole, hole, the centre of a flower, and headlight.

Another word, **barrku** (lit. far away), is remarkable in that it uses traverse mathematical dimensions of time and space. It is also applied to notions of intelligence, spirituality and kinship, yet all the while maintaining the concept of distance in a somewhat similar way as the English word 'distant'. Yolŋu uses of this word demonstrate Yolŋu languages' capacities to generalise and to abstract mathematical qualities

into a variety of conceptual domains. I have heard Yolŋu express the following ideas through this word **barrku**:

- a place far away from this one or a person who is far away from here;
- a distant relative;
- a point of time in the future;
- a person whose wisdom or spirituality is highly developed or admired;
- two very different accounts of the same event.

MONEY

Money as an item and a concept was introduced to Yolŋu by the Makassans. There is a range of Yolŋu words for money, the most common being **rrupiya** (from Makassan *rupia* which is in turn borrowed from India). Another word is **doy'** (from the Makassan *doe'* which originally referred to a Dutch coin).

The following is a list of Yolŋu words (compiled from Walker, 1987), borrowed from Makassans, which carry concepts relating to money, trade and exchange. Their roots lie in the prolonged and extensive contact with Makassans which was terminated by the South Australian Government in 1906.

<u>Yolŋu</u>	<u>Meaning</u>	<u>Makassan</u>	<u>Meaning</u>
balala	greedy	<i>balala</i>	greedy
bäyarra	pay, pay back	<i>bayara'</i>	pay
bothurru	count	<i>botoro</i>	gamble
bulay	jewelry, gold	<i>bulaeng</i>	gold
dharrima	buy	<i>tarima</i>	receive
djaka	size, length	<i>jakka'</i>	measure unit
djäma	work, build, do	<i>jama</i>	work, build, do
djambi	change, exchange	<i>sambe</i>	money-changer
dopulu	gamble	<i>dobolo'</i>	gamble
doy'	money	<i>doe'</i>	Dutch coin
gätjala	highly valued	<i>ka'djala</i>	expensive
gätjkatji	poor	<i>kasi-asi</i>	poor, needy
girri'	clothes, things	<i>kiring</i>	export
gorraj	few, not much	<i>kurang</i>	too little
labina	few, some	<i>la'binna</i>	remainder
lamurru	cheap (price)	<i>lammoro</i>	cheap (price)
rräpi	sufficient	<i>rapi</i>	sufficient
rrambaŋi	equal, together	<i>rambangi</i>	equal
rringgi	expensive	<i>ringgi'</i>	Dutch coin
rrupiya	money	<i>rupia</i>	money unit

These borrowings provide evidence of the exposure of Yolŋu to a market economy and their participation in it. Linguistic evidence and Yolŋu oral history show that this participation was sustained for many generations prior to Yolŋu contact with the Europeans. The Yolŋu participated from a strong position. They provided access to an annual trepang harvest which across the coast from Port Essington to Groote, totalled up to 350

tons (sic) dry weight (MacKnight, 1976). They also permitted seasonal camps to be set up in their region for the processing and drying of trepang. Yolŋu men sold their labour and were also able to barter turtle shell and mother of pearl. Yolŋu were interested in the axes, knives, tobacco, sugar etc. that the Makassans carried to trade with them. There were also Yolŋu who actually travelled to Makassar and who were able to participate directly in a cash economy (Cooke, 1987) and bring back stories of money home to Arnhemland.

Historically the growth of cash economies and trading centres, where the value of goods and services could be measured in quantities of monetary units, was enabled by the development of a suitably sophisticated number system. Though only a small number of Yolŋu would have had the opportunity to directly experience the use of money, there was a great deal of bartering and exchanging of goods and services (where their values are assessed in terms of quality and quantity). It is interesting though that Makassan counting numbers do not exist as loanwords in Yolŋu languages. Given the usual importance of quantification in barter and trade, and the ease with which Makassan words have been accepted into the Yolŋu lexicon (and have remained there), it seems worth hypothesizing that the Yolŋu system for enumeration may have undergone development during the long period of contact.

Nowadays of course, Yolŋu participate in a cash economy. Money is obtained from gambling, salaries, commercial contracts, pensions, royalties, sale of goods and artifacts, relatives, taxation returns, etc. Money is spent on a large range of goods and services. The extent though to which Yolŋu share our understanding of the base ten counting system and of numerical operations as they operate in the context of money, is sometimes debated by teachers and other educators, with some people maintaining that Yolŋu mainly learn to recognise various combinations and permutations for equivalent quantities (i.e. \$10 can be 10x\$1, 5x\$2, 2x\$5, etc), rather than determining equivalence through the performance of numerical operations.

It is a debate I cannot resolve. However I will make two observations. One is that in Yolŋu gambling rings the pace of play and the rate of recombination and exchange of money is such that I can barely follow the game let alone play in it. In putting money into the ring (especially when playing with silver and smaller notes) Yolŋu demonstrate through the appropriate and speedy selection of coins for the required amount, competency and efficiency in the manipulation of cash. The other is to mention **buta**, a card game which is based on the subtraction of multiples of ten from the sum of numbers in the player's hand. The total hand of five cards is dealt in two stages. At first three cards are dealt to each player and the score is assessed. Then another two are dealt to each player and the score assessed again in relation to the result from the

first hand. The status of the first deal is determined by the presence of multiples of ten and the value of the units digit in the sum. Upon dealing an additional two cards the status is assessed in terms of the closeness of the total score to being a multiple of ten.

This game has been played at Galiwin'ku since the sixties (and possibly earlier), when the cards were home made (there are no picture cards used in this game). I suspect that people initially learn the game through computation. Then after several thousand hands computation is hardly necessary. (The woman who explained the rules to me said that she had been confused by the game in the early stages herself and it was only when she realised that one was required to add up numbers that she understood it.)

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“Seeing Yolngu, seeing mathematics” page 13 to 18 (m0069594_v_p13to18_a.pdf)

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