When do we need angular measures?

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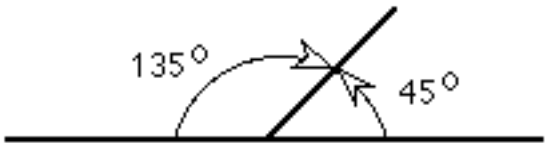
Category: Talking About
Subcategory: Basic Measures

Summary: Angular measures are frequently used to describe visual stimuli. Such measures may be as simple as describing the shape of a rectangle in terms of having four right-angles. One can, however, also use angular values in a different way to describe size. It is, for example, both common and useful to measure the "retinal or angular size" of a visual stimulus in a manner that simultaneously takes into account both the physical size and the physical distance of the target.

The use of *angular* measures is frequently required to describe visual stimuli. This use may be as simple as describing the angles of a square or rectangle as being right-angles or indicating the orientation of a line, with respect to the horizontal:

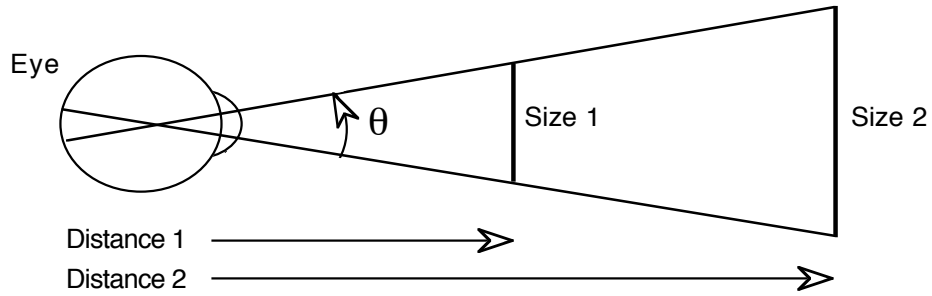


In using angular measurements, 1 degree is said to contain 60 minutes and each minute contains 60 seconds. Another measure of angular extent is the radian, where 1 rad = 57.29578 degrees.

One can, however, also use angular measurements in a less common manner, for describing the size of visual stimuli. Consider the diagram below that shows an eye, two alternative objects at which the eye might look, and some *lines-of-sight* between the eye and the two ends of the objects. For visual perception, the crucial stimulus is often the pattern of light as it falls on the eye.

Although one might describe that pattern by indicating both the size and distance of each object of interest, it is often more convenient to give an object's *angular size* (as

symbolized by the Greek letter theta --- θ). This measurement is also called the Visual Angle and is expressed in values such as degrees, minutes and/or seconds (see above). Any linear dimension of a visual stimulus (height, width, etc.) may be expressed in these angular terms, relative to the eye or some other observation point. Note below that size 1 at distance 1 and size 2 at distance 2 produce equal θ.



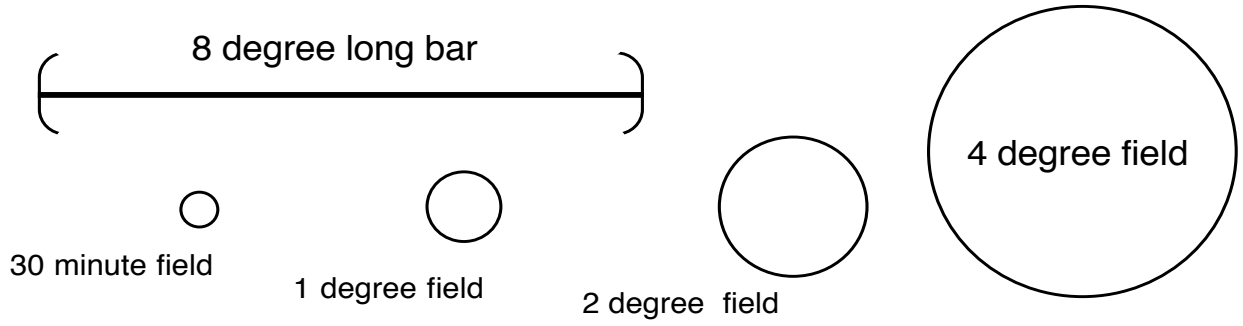
For situations in which **S** (size) is small, relative to **D** (distance), then:

$$\theta_{deg} = \arctan \frac{S}{D}$$

For some everyday comparisons, one can remember that, at an average arm's length of 57 cm, the horizontal width of the image of your hand is about 10 deg (10^o) wide.

At that same arm's length, a quarter coin (2.5 cm wide) *subtends* a visual angle of somewhat over 2 deg (2^o). The quarter viewed from 82.5 m, however, subtends only 1 min and, viewed from 4950 m (just over 3 miles), it subtends 1 sec.

The figure below may be used to provide a rough approximation of how different angular sizes appear. Ideally, try to adjust the sizes of the targets on your display, so that each one is physically about the same length *in cm* as its labeled size *in deg*. Then, position your head, so that your eyes are at what is nominally considered a reading distance (40 cm) from the display. The table below the figure will allow you to make a partial correction, if either of the above situations cannot be readily achieved.



Correction for Display Size and Display Distance to Eyes.

Directions: If the 8-degree bar is not equal to 8 cm long, then choose (from the left-most column) the closest value to the actual length of that target on your display. Similarly, if it isn't possible to view targets from the standard 40 cm distance, then choose the vertical column with the closest value to the actual eye-target distance. The value shown in the table is the correction factor for the angular size of each example target.

Just multiply any target's labeled size by its correction factor.

Actual Length		X =	Correction Factors if the eyes are positioned at distance X (in cm)				
			30	35	**40**	45	50
4	cm		0.67	0.57	0.500	0.44	0.40
5	cm		0.83	0.71	0.625	0.56	0.50
6	cm		1.00	0.86	0.750	0.67	0.60
7	cm		1.17	1.00	0.875	0.78	0.70
8	cm		1.33	1.14	**1.000**	0.89	0.80
9	cm		1.50	1.29	1.125	1.00	0.90
10	cm		1.67	1.43	1.250	1.11	1.00
11	cm		1.83	1.57	1.375	1.22	1.10
12	cm		2.00	1.71	1.500	1.33	1.20

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