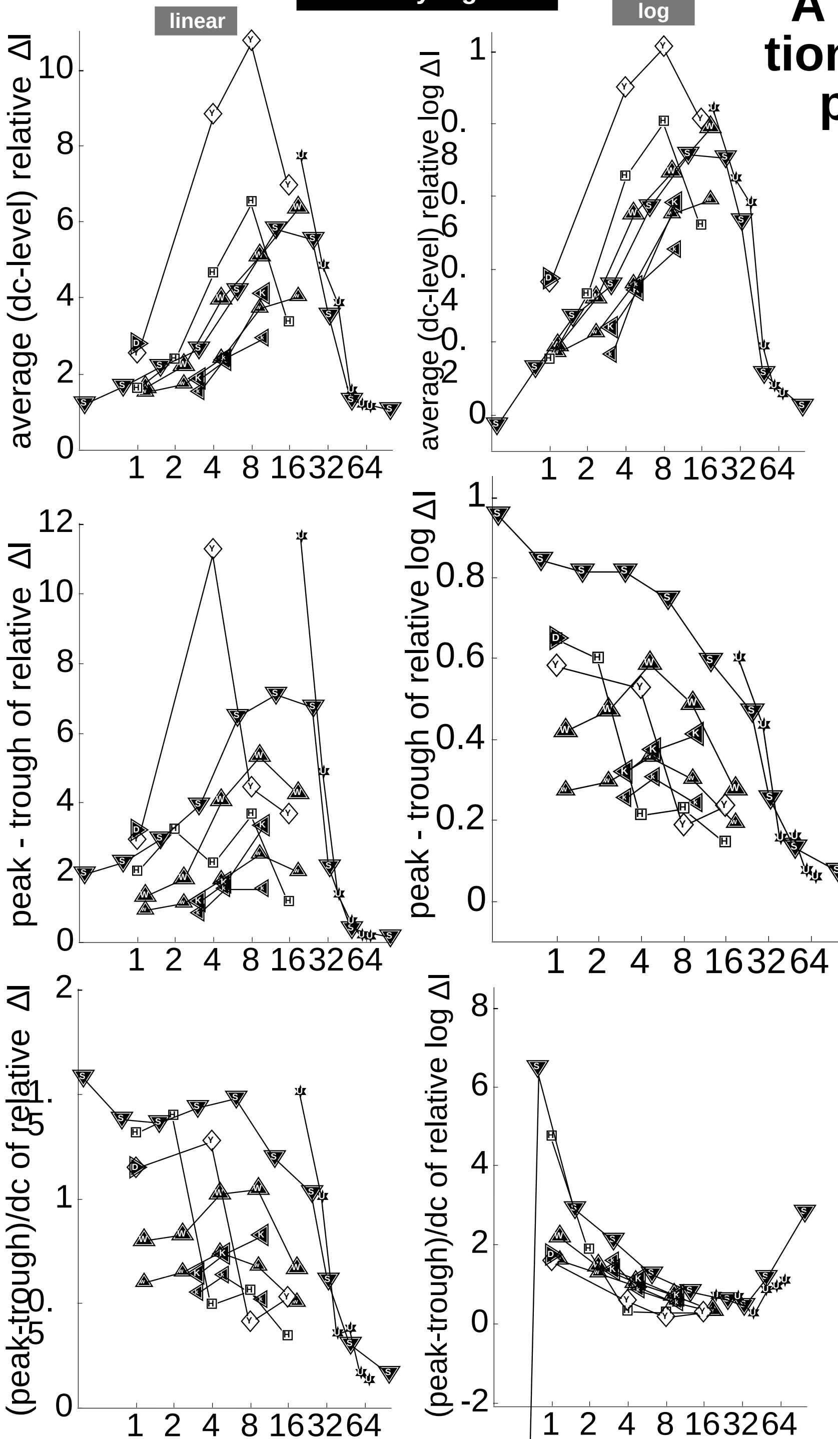
Summary Figures



A comparison of light adaptation results from 40 years of the probed-sinewave paradigm

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METHODS AND PROCEDURES

In the probed-sinewave paradigm, detection threshold is measured for a probe superimposed at various times (phases) on a sinusoidally flickering background. We compared all published studies known to us that used sinusoidally flickering backgrounds at photopic luminances. These studies were conducted under widely varying conditions. (See table below for conditions shown in figures here. An even wider set of conditions can be found in the original studies.)

RESULTS AND DISCUSSION

Shape of Probe-Threshold-versus-Phase curves

The shapes of the probe-threshold-versus-phase curves at low flicker frequencies (e.g. the 1Hz - 1.9 Hz figure here) are quite similar in all the studies, showing a distinct drop in threshold near 270 deg, the phase at which the flickering background's intensity is lowest.

The shapes of the probe-threshold-versus-phase curves at middle frequencies (e.g. the 7Hz -13 Hz figure here) are quite variable. For example, the curves indicated by the symbols Y, H, and m have primary or secondary maxima near 270 deg, while the other curves continue to show minima at 270 deg.

The shapes of the probe-threshold-versus-phase curves at high frequencies (>=30 Hz) are quite similar in the few studies measuring that high. They are generally sinusoidal and in phase with the stimulus near 30 Hz but shift phase at higher frequencies.

dc-level, peak-trough distance, and "modulation"

The dc-levels of the probe-threshold-versus-phase curves (thresholds averaged over phase) show a dramatic maximum at middle frequencies. (See the top left and right panels of the Summary Figures.) This is true whether linear (top left) or logarithmic (top right) probe thresholds are averaged. The maximum dc-level occurs at about 8 Hz in the studies indicated by Y and H and closer to 20 Hz in the other studies. (The dc-level is unknown for the study indicated by m.)

The peak-trough distances in the probe-threshold-versus-phase curves act differently in different studies and for linear vs. logarithmic thresholds. (See the variability within and between the middle panels of the Summary Figures.)

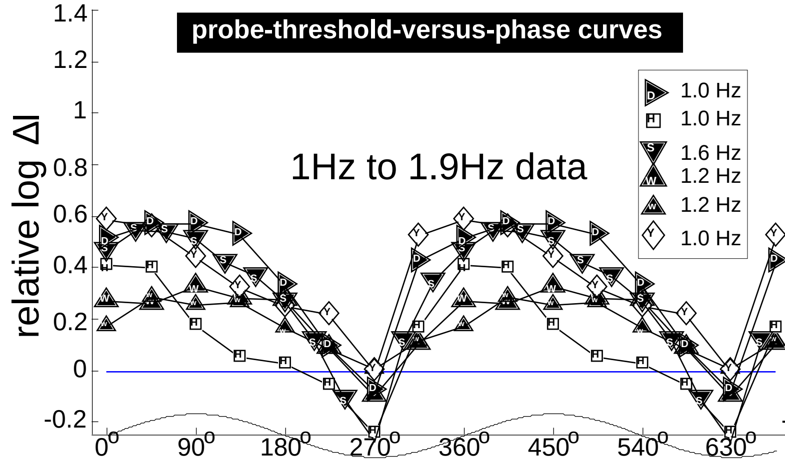
The "percent modulation" in the probe-threshold-versus-phase curves (the peak-trough distance divided by the dc-level) acts very differently for linear versus logarithmic thresholds (lower left vs. right panels of Summary Figures). For reasons we do not (yet?) understand, the "percent modulation" for logarithmic thresholds is very similar in all the studies: thus the curves juxtapose better in the lower right panel of the Summary figures than in any other panel.

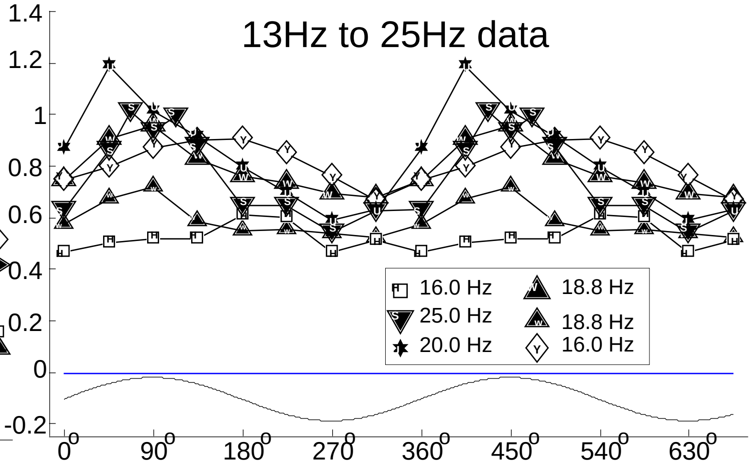
TWO QUESTIONS

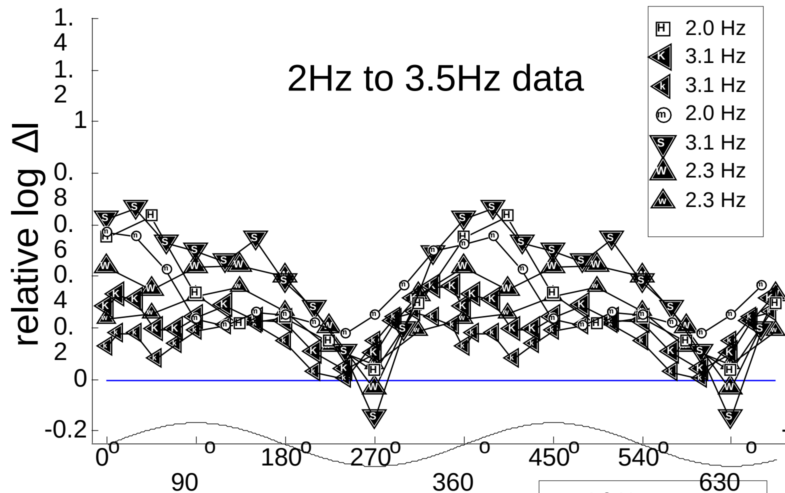
What do the studies Y, H, (and probably m) have in common that leads their results at middle frequencies to differ from those of the other studies?

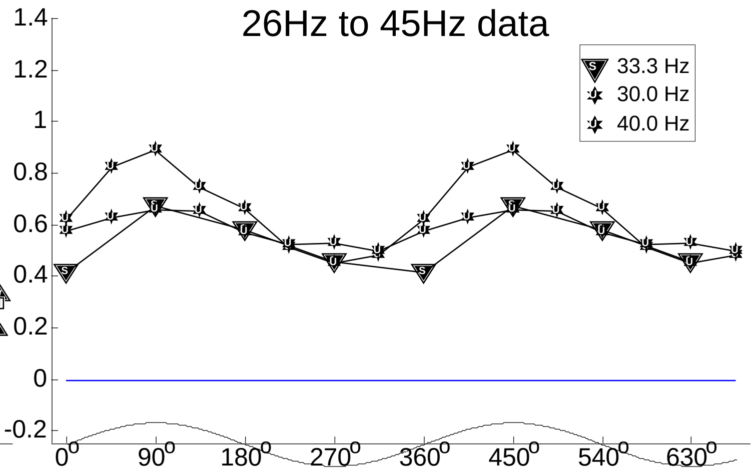
Why does "percent modulation" in the probe-threshold-versus-phase curves from different studies agree so well (when the other summary measures do not)?

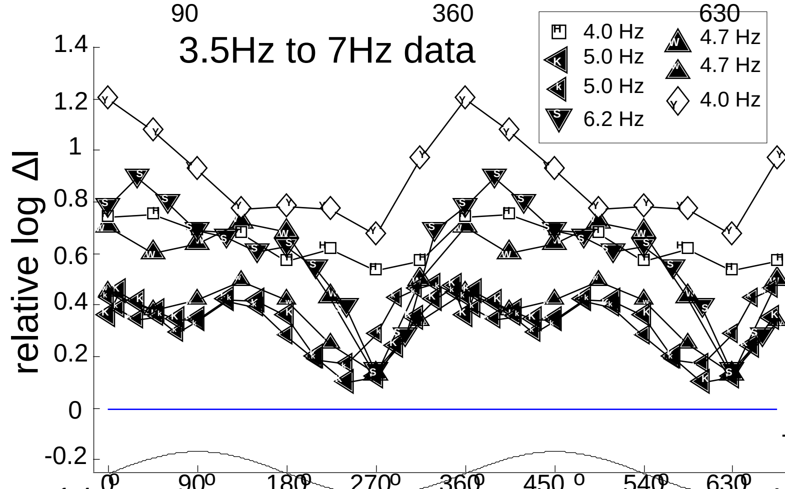
SYMBOL:	D	H	K	*k*	M	S	U	W	*w*	Y
Equipment	optical (Max. view)	optical (Max. view)	optical (Max. view)		optical (Max. view)	optical (Max. view)	optical (Max. view)	computer monitor (free viewing)		optical (Max.view)
Light source ("Color")	570 nm filter & xenon arc lamp	627 nm LEDs "red"	Bkd.= tungsten Probe = glow-mod.		glow-mod. "white"	563nm LEDs "green"	594 nm He-Ne laser	CRT "gray"		660nm LEDs "red"
Mean luminance	741 td	250 td	1280 td	2560 td	31.4 td	7500 td	2300 td	52 cd/m2 (~ 250 td)		250 td
Contrast of background flicker	63%	57%	50%	25%	28.6%	80%	100% peak in Gaussian W=5.5 cyc	57%	28.5%	57%
Cycles of background flicker before probe	continuous	continuous	continuous		continuous	continuous	several cycles	>2.5sec		continuous
Time between probes	1 sec	S response inbetween	>= 1 sec		1 sec	S response inbetween	S response inbetween	S response inbetween		S response inbetween
Probe duration	100 ms	10 ms	2 ms		1 ms	7.5 ms	2 ms	13 ms		10 ms
Polarity of probe	increment	increment	increment		increment	increment	increment	decrement		increment
Probe diameter	same as background	1 deg (2 deg total)	2 deg		0.86 deg	46 min	1.6 deg	1 deg (1.5 deg total)		1 deg (2 deg total)
Edge of probe	sharp	gradual 0.5 deg	sharp		sharp	sharp	sharp	gradual 0.25 deg		gradual 0.5 deg
Background diameter	2 deg in dark surround	18 deg in dark surround	22 deg in dark surround		1.72 deg in dark surround	17 deg in dark surround	9.5 deg	7 deg (10 deg total) in Lo surround		15 deg
Edge of background	sharp	sharp	sharp		sharp	sharp	sharp	gradual 1.5 deg		sharp
Psychophysical method	adjustment	YN staircase	adjustment		adjustment	YN	2AFC staircase	YN staircase		YN staircase
No. of phases tested	8	8	17		many	4-12	9	8		8
Phases intermixed?	no	no	no		no	no	yes	yes		no
Steady-state thresholds measured?	Yes	Yes	Yes		No	Yes	"Control" between flicker bursts	Yes		Yes
# of S's averaged here	3	2	2		2	1-3	2	3	5	3
Fig. # in paper showing data plotted here	6	4	5&6		4&9	1	3	2		9
Authors	DeMarco, Hughes, & Purkiss (2000)	Hood,Graham, von Wiegand, &Chase(1997)	Shickman (1970)		Maruyama & Takahashi (1977)	Snippe, Poot & van Hateren (2000)	Wu, Burns, Elsner, Eskew & He (1997)	Wolfson & Graham (2001)		Shady (2000)

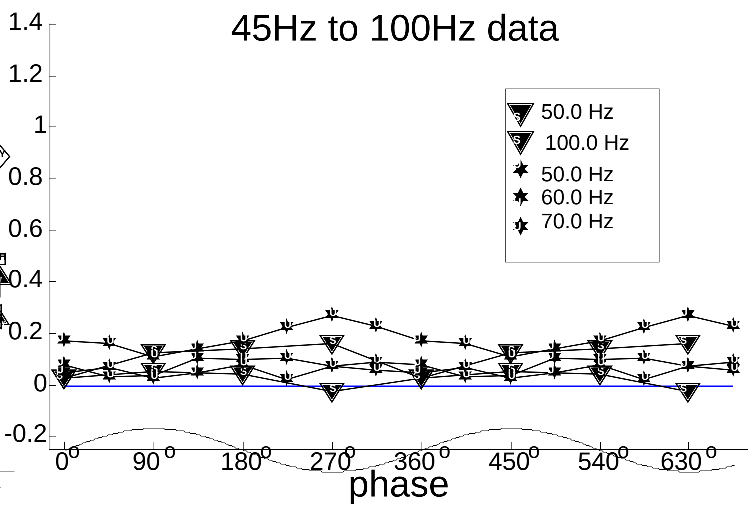


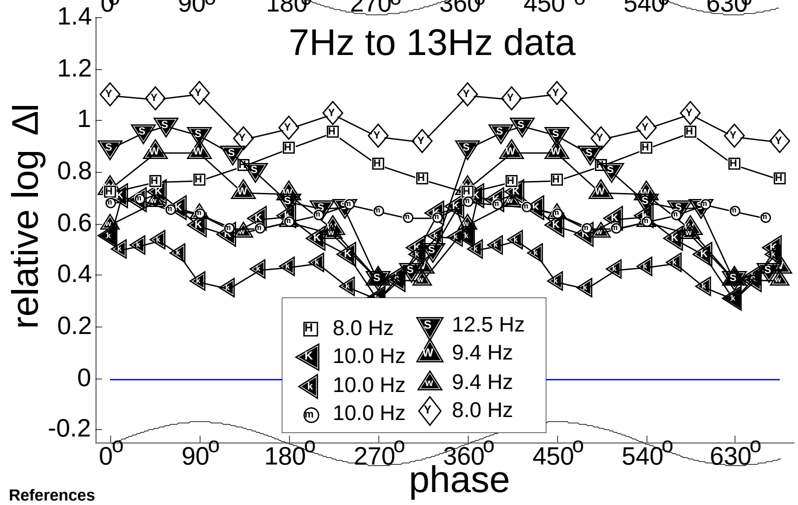












Notes About Data Selection

In the probe-threshold-versus-phase curves, each cycle of thresholds has been repeated twice for clarity.

For each study, the results shown here are the averaged log thresholds from 2 or more observers.

(1) The DeMarco, Hughes, and Purkiss (2000, symbol D) probe-threshold-versus-phase curve shown here at 1 Hz (their only frequency) is for a 100 ms probe because that is the only probe duration for which we could find the steady-state thresholds. They also used 12, 25, and 60 ms probes; the shapes of the curves at all probe durations are quite similar.

(2) The Maryuama & Takahashi (1977, symbol m) study is not included in the Summary Figures here because we could find no indication of the absolute level of their thresholds (nor of steady-state thresholds). In the Probe-Threshold-versus-Phase Figures here, the m curves were vertically shifted so that their thresholds measured at 180 deg equaled the average of all the other thresholds at 180 deg.

(3) The Wolfson and Graham (2001, symbols W and w) thresholds here are for decrement rather than increment probes because that data is more complete. As Wolfson and Graham, and also DeMarco et al show, there is a small systematic difference between increment and decrement thresholds. But it is too small to matter for the kinds of conclusions being drawn in this poster.

(4) The Wu, Burns, Elsner, and Eskew (1997, symbol U) study did not measure thresholds on a steady-state uniform background but instead measured "control" thresholds on a uniform background inbetween bursts of flicker. These control thresholds varied with background flicker frequency, being greatest at the lowest frequency they measured (20 Hz) and quite low at the highest frequencies (60 and 70 Hz). For our purposes here, we took the minimum control threshold as an estimate of the true steady-state threshold.

SUPPORT

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