Lecture 2 (advanced): Colour & Stereopsis

Colour - Elementary colour theory

– The 4 primary colours red, green, blue &yellow transcend language and culture [1,2]
– The 4 primary colours are so called 'unique hues' (Hering)
– A 'retinogeniculate' theory of colour perception seems to explain (most) basic phenomena:
  - The parvo L-M and M-L channels explain red-green opponency
  - The konio S-(L+M) and (L+M)-S channels explain blue-yellow opponency
  - Orange cyan magenta & chartreuse are blends of primary colours
  - Other shades (brown, ochre) are caused by darkness induction
  - Pastel hues (e.g. pink) are due to desaturation (increasing white content)
  - BUT - the redness at the shortwave end of the spectrum (indigo & violet) is not accounted for.

Cardinal colours are not unique hues

– Disaster strikes! The axes in colour space that correspond to retinal L/M and S/L+M mechanisms are not the unique hues
  - These axes are referred to as cardinal axes, and may be identified psychophysically [3,4]
  - And shown to selectively activate the two retinogeniculate colour channels [5] [6]
– Unlike LGN, where colour sensitivity clusters around the 2 cardinal axes, V1 colour sensitivities are broadly distributed [6-8]
  - V2 is similar [9]
– Colour selectivity in IT cortex also shows no sign of clustering around unique hues [10,11]
  - The IT colour studies use CIE colour space (x, y, z coordinate system)
– Use fMRI to chart colour pathways in monkeys – find colour 'globs' in V4 and posterior IT cortex, and larger colour patches in anterior IT cortex [12,13]
  - Recordings from globs do, *possibly*, show colour selectivities clustered around unique hues [14]
  - ... Implies a 2nd stage of interaction between cardinal channels to generate the 'perceptual' primaries (R G B &Y)
  - Where and how this interaction takes place is poorly understood.

Stereo

– Random dot stereograms & cyclopean perception
– Absolute v relative disparity
  - Optical & psychophysical differences
  - Dorsal pathway emphasizes absolute disparity; stereoscopic vision of agnosic patient DF[15]
  - Selectivity for absolute & relative disparity in area V1, V2, V3 & V3A, V5 and V4 [16-20]
    - Testing absolute disparity tuning under anaesthesia reveals stereo properties primarily in magno dominated modules/compartments (i.e. layer 4b of V1, thick stripes of V2, area V3);
  - BUT – patient DF *is* proficient at discriminating transparent depth planes [15]
  - AND V5 has recently been demonstrated to have some neurons selective for relative disparity[21]
– Selectivity for curved surfaces ('disparity curvature') in IT cortex [22]
  - Implies use of relative disparity by ventral pathway

General Reading: Colour

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