- Friday, April 17, 1998
  Layered Representations of Depth, Lightness, and Opacity

1.0 These are the minutes for the YORKVIS meeting on 17 April 1998. I am not going to minute the meetings on April 30th (ARVO practise talks) or May 5th (ARVO practise posters) except to record that they happened.

1.1 There will be occassional meetings over the summer. Possible visitors include Hugh Wilson and Harry Sperling. If anyone has any visitors over the summer or would themselves like to give a presentation either over the summer or in the fall, just let me know. We have nothing officially scheduled at this time.

2.0 Bart Anserson's talk was entitled: "Layered representations of depth, lightness, and opacity"

2.1 Bart started from the correspondence problem: Having two eyes, you have two views to work with, but only a single perception of the world. Given a point in one eye's image, how do you select the point in the other eye's image with which to pair it? 2.1.1 (possible solutions are (i) to make the image sparse by looking only at a particular scale thus limiting the choice of image points in the other eye; or (ii) to define features at a higher level so that it is easy to know which to choose -- eg, the corner of a table)

2.1.2 But the possible solutions to the correspondence problem, while not trivial, are not the point here because, even after matching the images, the pair of image points does not specify a unique depth structure to the stimulus!

2.1.3 For example let us say this matching pair of points is located on a vertical edge. There are many possible real-world configurations that could produce this edge, each with different three-dimensional structure:

variations in illuminations eg. shadows (the border between light and dark)
transparent surfaces
occluding surfaces (in which something is in front of something else: a discontinuity)
painted boundaries
folded edges 2.1.4 Knowing the disparity of a pair, or even all the points that make up the edge, does not distinguish between these possibilities: the information provided by the disparities of these points does not provide a full, three-dimensional description of the stimulus.
2.1.5 And in fact there is no definitive solution to most images defined only in terms of disparities. Any of the above factors could be responsible. And in fact more than one could be contributing at the same time.

2.2 One of the brain's problems is to divide the image up, attributing each feature to one or more of a range of possible sources. This process is known as "scission"(a standard dictionary word here given a technical definition).

2.2.1 Early work attempting to provide the rules of scission, did not predict how certain configurations are perceived. For example, what are the rules for seeing transparency? These can be deduced from the fact that looking at something through a transparent sheet can only alter the magnitude of a luminance edge and cannot change its sign. Edges with the same sign all along them (that is where the one side of the edge is consistently higher luminance than the other side) should be seen as belonging to a single object, even if that edge might be partially covered by a transparent surface.

2.2.2 Having deduced these rules, can they be applied to other situations such as the M nher-White illusion? 2.2.3 In this illusion, the top band is seen as lighter than the bottom band although simultaneous contrast should generate a perception the other way around. (Since the top bars of grey have long edges with white -- and should appear 'darker'-- and the lower ones have long edges with black-- and should appear 'lighter').

2.2.4 If we take the polarity of the various edges involved into account, then we can introduce a transparency explanation in which the lower band is seen as a transparent surface.

2.2.5 But this turns out, quantitatively, not to be quite enough... We also need to propose an assimilation (or averaging) across the various parts of our hypothetical transparent horizontal bar so that it is seen as a darkish surface lying over the background grid.

2.2.6 So is it the transparency (arrived at by scission) or the assimilation that creates the M nher-White brightness illusion?

2.3 We can create other illusions in which assimilation and scission are unconfounded. For example, viewing a sinewave through a diamond aperture in either a black or white surface.

2.3.1 Here, for the black background, assimilation should link the dark parts to a common surface and should therefore evoke a perception of white stripes on a black background. Similarly the white background should assimilate with the white parts and evoke a perception of black lines on a white background.

2.3.2 The scission process, on the other hand, making decisions based on the polarity of edges, predicts a white diamond in the foreground for the black-background diagram and a black diamond for the white background.

2.3.3 What is seen is predicted by the polarities of the boundaries (scission rules), not assimilation.

2.4 Since these illusions are unaffected by introducing disparities to the various edges, Bart concluded that scission rules are applied at an early stage, probably before the correspondence problem is even attempted.

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