3-D paintings on a flat canvas

Novel techniques developed by painters John Jupe and Dorle Wolf, and their significance for human stereopsis

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John Jupe (Bristol) discovered that in the peripheric visual field *double images* can be perceived even when looking only with a single eye In a simple test 42% out of 64 subjects verified this surprising observation after their attention had been drawn to it.

Experiment:
Close one eye and stare at the fixation point F from a distance of about 30 cm. Hold the pencil straight up and move it from outside into the field of peripheric vision. You may perceive - from the corner of your eye! - kind of a *double image* with apparently two pencils lying closely side by side, separated by an angle of approximately 2-3°. Note that both edges of the pencil appear sharp. When you move it towards your line of sight, the distance between the two images decreases to zero - one more example of the curious fact that there are percepts that most of us have seen, but, as physicist Ernst Mach put it: Only especially gifted people are able to discover them.

F

a Fig. 1 John Jupe: Image pair *"Bathers"* © b

Jupe guides the viewer`s gaze to a well-defined fixation point close to the image center (to the elbow of the woman in the background in **Fig.1a**, and the glass in **b**) and provides peripheric objects with double contours which are not perceived, however, due to the fuzziness caused by the low cortex magnification.

The photo of a still life manipulated in a similar way (**Fig.2a**) provides considerable spatial depth when compared with the half images of the stereo pair **c** and **d**, and their superposition **b**. However, it does not reach the genuine spatial depth of the fused stereo pair.

a b c (© John Jupe, Bristol d

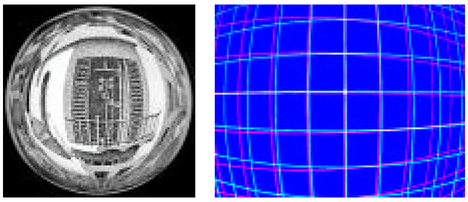
Fig. 2 Artificial double contours of objects in the visual periphery (**a**) enhance perceived depth when you gaze at the image center with both eyes, whereas the half images (**c** and **d**) as well as their superposition (**b**) appear flat. However, spatial depth of the stereo pair, fused by crossing one`s eyes, proves to be superior.

How does spatial depth come off in Jupe`s paintings? We hypothesise that the normally unavoidable 3-D information *"flat canvas"* is suppressed by *simulating normal stereopsis, i.e., by offering double images which do not contain disparities with true stereoptic information*. Double contours in the visual periphery thus make the 3-D information of the flatness of the canvas obsolete, and therefore the abundance of monocular depth cues like intersections, shading etc. can take over.

***The presence of double contours seen with a single eye* indicates that, in addition to the original retinal image, a *visual afference copy* seems to be projected from the retina with its image details shifted towards the periphery.**

What might be the purpose of such a visual afference copy? In the retinotopic cortex projection the image is extremely distorted (Fig. **3a**). As a consequence, the images sent from both eyes cannot be fused even when there is a flat surface (Fig. **3b**). *To determine tiny disparities in the peripheric visual field, it might be appropriate to project afference copies to those sites of the cortex where the similarly distorted information from the other eye is expected to arrive* (8).

Our **afference copy hypothesis** predicts that a punctiform luminous stimulus moved across the visual field may cause a double image in V1 when seen with a single eye. Single-cell excitations showing two subsequent peaks are indicative of such a double projection (D Perrett 2002, pers. comm.). If this should prove true, it might become necessary to reconsider the concept of Panum`s area (2) in the peripheric visual field.



a b

Fig. 3 A model of image distortion in V1. (**a**) In Escher`s lithography *"Balcony"* the cortex magnification factor is 3:1. With the aid of a fish-eye lens this factor was artificially increased to 20:1, a value considered realistic for the human brain.
(**b**) An anaglyphic stereo pair of a flat pattern of quadriform tiles taken through a fish-eye lens shows the problem of binocular fusion arising from a near visual object: In the peripheric regions of the visual field the left image (red) does not fit to the right image (blue), although here the virtual cortex magnification factor does not exceed 2:1.

Dorle Wolf (Würzburg) is the first painter who made use of **enhanced "chromostereopsis"** (1) in art. When passing the blazed diffraction gratings of the colorless "ChromaDepth"-3-D glasses, light is dispersed according to the colors of the rainbow (3, 6-10). The different colors, from which white light is composed, thus enter the eye from different directions. As a consequence, colored surfaces stand out from the canvas, seem to hover in the air, become colored spatial objects which change before our eyes, for it is only gradually that there is an opening up of the full depth (5, 6, 9; **Figs 4,5**).

When the lateral borders of homogeneously stained plains which adjoin areas of a different color indicate different positions-in-depth, they are generally perceived as *skew*, and so are plains containing continually gliding colors (**Fig. 6**). When reflecting several discrete wavelengths, an area may lead to the impression of several transparent plains being staggered in depth.

Most pigments reflect polychromatic light, thus contours may look blurred due to color dispersion. If the 3-D glasses are held a little off straight, so that one eye looks past the glasses, or if they contain only one diffraction grating film, then the perceived depth is decreased by 75%, but the picture on the whole appears very sharp.

Fig. 4 Dorle Wolf: Hour of shelter (3-D, acryl on hardboard, 90x90cm)

Fig. 5 Dorle Wolf: Dawn in the garden(3-D, acryl on hardboard, 45x53cm)

If the 3-D glasses are moved sideways until the left eye looks through the right "lens", the colored surfaces seem to be arranged in reverse order: foreground and background are transposed.

As the angle of chromatic aberration of the ChromaDepth glasses is constant, perceived depth is seen to increase with the viewing distance - even more than is the case in normal 3-D projection. Thus, the further you step back, the more sculptural the pictures seem, and as you pass by, the structures seem to turn, too.

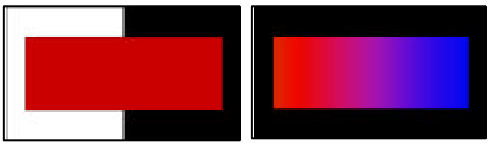


Fig. 6

ChromaDepth 3-Dglasses for enhancement of chromostereopsis (Fig 4-6)
Anaglyphic glasses for binocular fusion of the stereo pair (Fig. 3b) =>

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ChromaDepth 3-D glasses 2,50 €
Catalog *"der farbe leben"* (with 3-D glasses) 23,00 €