Perception, 2005, volume 34, pages 241 – 244

DOI:10.1068/p3402ob

Obituary

Professor C R Cavonius (1932 – 2003)

Perception has a long-standing link with the European Conference on Visual Perception (ECVP) and so it is appropriate to remember here the death of Carl Richard Cavonius in January 2003. Dick Cavonius, as he liked to be known, was one of the group of four who founded ECVP in 1978. He was the organiser of the 1986 Bad Nauheim meeting, he wrote a statistical history of ECVP (Cavonius 1999), and he secured ECVP's most consistent source of funding.

Dick Cavonius was born in Santa Barbara, California, in 1932. His parents had independently come to the United States from Finland and had met in New York City. His father, Carl Volmar Cavonius, was Swedish-speaking, while his mother, Lillie Vertti, was Finnish-speaking and came from the Karelian village of Anttrea, now in Russia. Dick was raised largely in New England and in Florida. He took his BA in Physics at Wesleyan University in 1953, and then served as an officer in the US Navy. At a time when the Cold War was at its coldest, he trained as a naval pilot and flew long-distance reconnaissance patrols over the Arctic and North Atlantic. He continued to fly for the Navy while he was a graduate student at Brown University, and remained a Lieutenant Commander in the naval reserve until the retirement age. He was buried at sea, after a ceremony on the USS Winston S Churchill.

Figure 1. Carl Richard Cavonius, in the uniform of a US Navy officer.

Dick Cavonius was one of the distinguished group of visual scientists who were trained in Lorrin Riggs' laboratory at Brown. He received his PhD in 1962. From 1967 to 1971 he was Director of the Eye Research Foundation in Bethesda, Maryland. After holding research positions in Munich, Cambridge, and Amsterdam, he was appointed a Director of the Institut für Arbeitsphysiologie at the University of Dortmund in 1977. There he led an active group of sensory scientists until his retirement in 1997. He married Rita Euerle in 1980, and their daughter Lillie was born the following year.

Dick Cavonius contributed to many areas of visual science. One of his most notable papers, published jointly with Oscar Estévez in 1975, describes the spatial contrast sensitivity functions (CSFs) for individual classes of cone. The different cone classes were elegantly isolated with a silent-substitution method. The CSFs for the long-wave and middle-wave cones proved to be very similar to one another, whereas the function for the short-wave cones was reduced in sensitivity and its peak lay at a lower spatial frequency (figure 2). The long-wave and middle-wave functions were bandpass, Cavonius and Estévez argued, when detection depended on a non-opponent post-receptoral channel, but were low-pass when detection depended on a chromatic channel. These were landmark measurements.

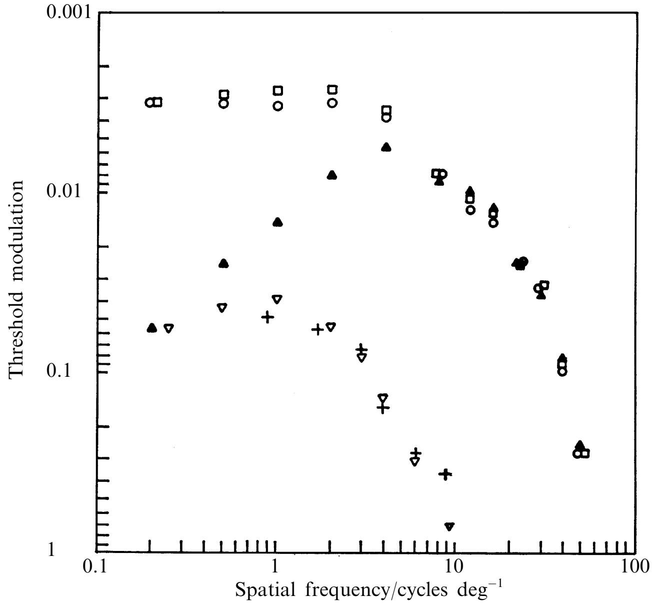

Figure 2. Spatial contrast-sensitivity functions obtained by Cavonius and Estévez (1975). The open squares represent conditions where only the long-wave cones are modulated and the open circles represent conditions where only the middle-wave cones are modulated. In both cases the function is low-pass, and Cavonius and Estévez suggested that this result was characteristic of detection by chromatic channels. If both types of cone are modulated together (solid triangles), and thus detection is by a non-opponent channel, then the function assumes a bandpass form. The lower symbols show the sensitivity for the short-wave cone systems of a normal observer (open triangle) and of a deuteranope (crosses). Reproduced with permission from *Journal of Physiology*, 1975, volume 248, page 654.

An important series of experiments by Hilz and Cavonius showed that chromatic discrimination could sometimes be improved by the introduction of a luminance difference between the stimulus fields (Hilz and Cavonius 1970; Hilz et al 1974). If the two colours formed alternate half-periods of a square-wave grating of approximately 4 cycles deg^{-1}, the hue discrimination threshold when adjacent bars differed in luminance by 0.045 log unit was five times lower than the threshold obtained at equiluminance. The luminance difference, it seems, introduces edge signals that assist the spatial segregation of the alternately coloured regions.

For one of his experiments, Dick Cavonius followed up some classical observations made by Charles Sherrington in 1904. Presenting a rapidly flickering light to one eye and a second light of the same frequency but adjustable phase to the other eye, Sherrington had claimed that flicker was equally detectable whether the two lights were in phase or out of phase, and he had therefore concluded that there was no common neural pathway in which the two monocular signals reinforced or cancelled one other.

Sherrington's measurements were all made in the region of the critical flicker frequency, where a small change of frequency corresponds to a large change in contrast sensitivity. Cavonius (1979) extended the measurements to cover the entire temporal CSF and showed that the data do reveal an interaction of the binocular signals if the threshold for detecting flicker is expressed in terms of the depth of modulation of the light rather than in terms of its frequency. This effect is clearest at lower frequencies. A later paper by Cavonius, Estévez, and van der Tweel (1992) examined the residual flicker that is seen when two lights of the same frequency but opposite phase are combined binocularly: the binocular flicker has an apparent frequency twice that of the monocular signals. A particularly curious result is obtained if the luminance of the modulated light is attenuated in one of the two eyes and if the observer is asked to adjust its phase so as to minimise the perceived flicker. For any given attenuation of the weaker stimulus, the observer advances this stimulus by a constant phase shift (48° per log unit of attenuation), not by a constant time. This result holds for frequencies ranging from 16 Hz to as low as 2 Hz (Cavonius and Estévez 1980). Conventional wisdom predicts a fixed delay when luminance is reduced, rather than a constant shift in phase. Cavonius and Estévez's strange finding has remained unexplained for 25 years and deserves further investigation.

Widely cited on the internet is an applied study by Bauer and Cavonius (1980), showing that dark text on a light field is more accurately read than text in the opposite contrast. This paper has probably influenced the design of many of the web pages that we read today. Among the many other topics on which Dick Cavonius published were the alpha rhythm, visual evoked potentials, the relationship of luminance and brightness, and the temporal CSF of chromatic channels. Over a number of years, Dick and I collaborated in a project to reconstruct observers' colour spaces from a performance measure: as the input to a multidimensional scaling program, we used choice reaction times rather than the usual subjective ratings (Mollon and Cavonius 1986). The same preference for performance measures brought us together to measure wavelength discrimination by two-alternative temporal forced choice (Mollon et al 1992). In a later study, Paramei and Cavonius (1999) compared colour spaces reconstructed from performance and phenomenal measures. A full bibliography of papers by Dick Cavonius is given by Bauer, Ehrenstein, and Paramei (2003) and an electronic copy is available at http://www.ifado.de/downloads/news/2003/C.R.CAVONIUS.pdf.

Dick Cavonius was a very private man, and to some people he seemed the Finn of stereotype, but he extended a warm and generous friendship to those who knew him well. As a child, he was impressed by the great museums of New York, and throughout his life he was an insightful amateur of exhibitions and galleries. It is no surprise that he was a particularly firm friend of Henk van der Tweel, print connoisseur and head of the Medical Physics Laboratory in Amsterdam.

Dick's friends were astonished by his repertoire of practical skills: without hesitation, and sometimes to the alarm of onlookers, he would dismantle cars, houses, pianos, clocks, antique furniture, and laboratory instruments, and restore them to health. By his own account, a critical turning point in his life came in his junior year at Wesleyan, when a friend, majoring in psychology, asked him to repair a kymograph. A psychology professor, Morton Applebaum—later President of Clark University—recognised the young physicist's talent, engaged him to spend a summer restoring a range of instruments, and encouraged him to take courses in psychology. It was this experience that led Dick to enrol for graduate study in psychology at Brown.

Dick Cavonius brought a dry sense of humour to the laboratory, and had no time for pretension or pomposity. He collected parodies and spoofs. He was fond of elaborate academic jokes and once conspired successfully to secure the election of a fictitious candidate to a learned society that had grown lax in its admission procedures.

And yet there was another side to him: from his Navy experience, he knew how to interact with authorities and managers and how to work within a bureaucratic system. And this quality proved critical to sustaining ECVP: as a result of Dick's contacts, the conference enjoyed support from US Government agencies throughout most of its history, support that was given generously and without restrictions.

John D Mollon
Department of Experimental Psychology, University of Cambridge, Downing Street, Cambridge CB2 3EB, UK

References

Bauer D, Cavonius C R, 1980 "Improving the legibility of visual displays through contrast reversal", in *Ergonomic Aspects of Visual Display Terminals* Eds E Grandjean, E Vigiliani (London: Taylor & Francis) pp 137 – 142

Bauer D, Ehrenstein W H, Paramei G V, 2003 "Nachruf—Professor Carl Richard Cavonius" *Die Farbe* **46** 125 – 128

Cavonius C R, 1979 "Binocular interactions in flicker" *Quarterly Journal of Experimental Psychology* **31** 273 – 280

Cavonius C R, 1999 "Trends in European visual science: 1978 – 1997" *Perception* **28** 1435 – 144

Cavonius C R, Estévez O, 1975 "Contrast sensitivity of individual colour mechanisms of human vision" *Journal of Physiology* **65** 966 – 968

Cavonius C R, Estévez O, 1980 "Applications of signal-processing methods in visual psychophysics", in *Signal Processing: Theories and Applications* Eds M Kunt, F de Coulon (Amsterdam: North-Holland) pp 343 – 349

Cavonius C R, Estévez O, Tweel L H van der, 1992 "Counterphase dichoptic flicker is seen as its own second harmonic" *Ophthalmic and Physiological Optics* **12** 153 – 156

Hilz R, Cavonius C R, 1970 "Wavelength discrimination measured with square-wave gratings" *Journal of the Optical Society of America* **60** 273 – 277

Hilz R L, Huppmann G, Cavonius C R, 1974 "Influence of luminance contrast on hue discrimination" *Journal of the Optical Society of America* **64** 763 – 766

Mollon J D, Astell S, Cavonius C R, 1992 "A reduction in stimulus duration can improve wavelength discriminations mediated by short-wave cones" *Vision Research* **32** 745 – 755

Mollon J D, Cavonius C R, 1986 "The discriminability of colours on c.r.t. displays" *Journal of the Institution of Electronic and Radio Engineers* **56** 107 – 110

Paramei G V, Cavonius C R, 1999 "Color spaces of color-normal and color-abnormal observers reconstructed from response times and dissimilarity ratings" *Perception & Psychophysics* **61** 1662 – 1674

Sherrington C S, 1904 "On binocular flicker and the correlation of activity of 'corresponding' retinal points" *British Journal of Psychology* **1** 26 – 60