

Obituary - Nachruf

Richard Marx Held (1922–2016)



Photo: Massachusetts Institute of Technology, Cambridge, MA, USA

Richard (Dick) Held, born in New York City, received his Bachelor of Arts in Engineering in 1943 and his Bachelor of Science in Liberal Arts in 1944 from Columbia University, before becoming research assistant to Wolfgang Köhler at Swarthmore College in 1946. There he obtained his Master of Arts in Psychology in 1948. He was a research fellow at the New York Zoological Society in 1948 and, afterward, enrolled in the Graduate Program in Psychology at Harvard University. Faculty members at that time included Georg von Békésy, S.S. Stevens, J.G. Beebe-Center, B. Verplanck, and B.F. Skinner. Held also attended talks and colloquia by Karl Lashley. He received his PhD in Experimental Psychology from Harvard in 1952 with a thesis on adaptation of auditory localization. Thereafter, he became an instructor and, later, Professor and Department Chair at Brandeis University between 1952 and 1963, conducting research on visual and visuomotor adaptation to various kinds of optical rearrangement. From 1955 to 1956, he was a member at the Institute for Advanced Study, Princeton, NJ, USA.

From 1962 to 1963, Held was *National Science Foundation* Senior Research Fellow and Visiting Professor at the Department of Psychology, Massachusetts Institute of Technology (MIT), USA. In 1963, he moved to MIT as Full Professor, where he continued his studies of visual rearrangement and visuomotor development in both humans and monkeys. This was at the time when Hans-Lukas Teuber was about to create a new department at MIT with emphasis on brain and behavior [<https://www.nap.edu/read/1000/chapter/18#468> (p.468)]. “What we want to know,” Teuber exclaimed, “is nothing less than what goes on within ourselves (and by that we mean within our central nervous system) when we perceive, when we move, when we feel (or express emotions), and when we learn or remember.” Those years were a profoundly important scientific period and, in many ways, the beginning of contemporary neuroscience as a discipline.

Following the tragic death of Teuber in January 1977, Held took over as Head of the Department of Psychology from 1977 to 1986 and helped shape the emerging discipline of brain and cognitive sciences. Thus, he became one of the founding fathers of the Department of Brain and Cognitive Sciences at MIT, serving as Professor from 1986 to 1994 and, then, as Professor Emeritus.

When I came to MIT in 1964 as a postdoctoral researcher from Freiburg, the name of Richard Held was well known to me. I knew of the classic experiments in which he had collaborated with Wolfgang Köhler at Swarthmore, recording electrical potentials from the back of the head to find evidence for brain satiation preceding figural aftereffects. A weak electrical shock was administered via a scalp electrode to the occipital region, to determine whether this might result in a distortion of a perceived test distance comparable to the one induced by prolonged inspection of a normal satiation figure. I also was fascinated by Held's (unpublished) demonstration of the aftereffect of adaptation to simple geometrical

patterns in Teuber's chapter in the *Handbook of the American Physiological Society*, which preceded Colin Blakemore's demonstration of spatial frequency adaptation by some 20 years. Lastly, I knew of his wonderful experiment using a kitten carousel. One kitten was active and the other passive, and only the active kitten could perform the paw-placing test, while the passive kitten could not. Evidently, self-produced movement and proprioceptive feedback during adaptation were crucial for coordinated motor behavior. Held repeated this experiment with two MIT students, one of whom pushed a wheelchair, while the other was sitting inside. Both students wore prism goggles displacing the visual scene, but only the active student showed adaptation. This was interpreted as evidence for cortical remapping and plasticity. These early observations deserve to be respected in this age when functional magnetic resonance imaging (MRI) could test this conclusion directly.

I was interested in this kind of research, which also involved Alan Hein and Joe Bauer, and so I signed up for a seminar jointly organized by Richard Held and Stuart Sutherland. Held had a warm and informal – but somewhat reserved – manner, an always-ready smile, and a wry but gentle sense of humor. Sutherland was just the opposite, gregarious and sometimes intimidating. Evening seminars lasted 3 hours with a break in between, when Held smoked a cigar and Sutherland a cigarette. We were handed long reading lists and learnt the fundamentals of visual psychophysics, which was later to become my field of specialization.

I remember two conferences that were organized at MIT at that time. In 1965, Anton Hajos from Innsbruck presented the pioneering experiments by Ivo Kohler on prism adaptation, and Celeste McCollough showed her color contingent aftereffect. Both seminars complemented Held's series of papers on prism adaptation with Aglaia Efstathiou, combining rearrangement with temporal delay.

In 1967, Gerald Schneider presented his data on brain lesions in the hamster and proposed a dual system for navigation and recognition. This was the beginning of the famous "Where versus What" dichotomy, which describes two modes of visual processing, position vs. shape. These results were first presented at a symposium at the Eastern Psychological Association. David Ingle reported on the goldfish, Gerald Schneider on the hamster, Colwyn Trevarthen on the monkey, and Richard Held on human observers. The title of Held's talk read "Dissociations of visual functions and deprivation and rearrangement" and referred to a high degree of plasticity of visually guided behavior, but only limited modifiability in the perception of shape.

Between 1972 and 1976, Held edited three volumes of selected articles on perception in the *Scientific American*. Whitman Richards was a coeditor. These were valuable resources of research by the pioneers of brain and perception, cherished by students and faculty alike.

In 1973, Held was elected to the National Academy of Sciences. It was also in 1973 that Pöppel and Held published their paper on blindsight, demonstrating that patients who were cortically blind had residual vision, presumably by using the colliculopulvinar pathway. Five years later, *Perception* – the eighth volume of the *Handbook of Sensory Physiology* – appeared, with Held, Leibowitz, and Teuber as editors.

In 1979, Held received the Glenn A. Fry Award from the American Academy of Optometry, and in 1984, he was awarded an honorary doctoral degree from the Free University of Brussels. In 1985, Cambridge University bestowed upon him the prestigious Kenneth Craik Award.

Thereafter, Held switched to the study of developmental vision. Jane Gwiazda, Anne Moskowitz, Frank Thorn, and Eileen Birch studied a number of ocular mechanisms in young children, and soon, the Held Laboratory became one of the foremost addresses for the study of accommodation, astigmatism, myopia, strabismus, stereoacuity, and optokinetic nystagmus in infants.

It was at this time that Shinsuke Shimojo and Jeremy Wolfe began their studies in Held's laboratory, which took them to highly successful scientific careers: Shin to the study of surface perception (with Ken Nakayama), and Jeremy to attention.

In 1987, Held visited Freiburg to participate in the International Badenweiler Conference, which produced our book "*The Neurophysiological Foundations of Visual Perception*" (L. Spillmann, J.S. Werner, eds., Academic Press, 1990). He returned to Freiburg in 1992 on his way to Frank Schäffel in Tübingen to learn about his research on myopia. Handing him over to Frank on a foggy morning at a road turnout in the Black Forest was reminiscent of the exchange of a spy in the Cold War. Schäffel had demonstrated in chickens that placing lenses in front of their eyes could change the axial growth, thus rendering them myopic or hyperopic. Myopia is a major problem in Asia, where 85 percent of children are affected.

In the mid-nineties, Held went to the New England College of Optometry (NECO) as Adjunct Professor of Vision Science and Director of Research. In 2003, he invited me to give a talk on fading and filling-in. I will never forget the introduction he gave me by placing the Freiburg research by Richard Jung and coworkers in line with the work of the eminent Czech physiologist Jan Evangelista Purkyně. When I retired in the same year (mandatory at age 65 in Germany) and was cut off from my grant support, Held wrote a strong letter of endorsement to the Freiburg University authorities, cosigned by Peter Schiller, Whitman Richards, and Ken Nakayama. This letter helped me to continue working, although in a different capacity.

Held supported us also in other ways. He had published an article entitled “Dissociations between perceptual and oculomotor effects induced by rotating visual displays” in the *Festschrift* for the famous Innsbruck psychologist Ivo Kohler and also endorsed our translation in 2006 of *Laws of Seeing* by Wolfgang Metzger. He likewise encouraged us to undertake the 2012 translation of Max Wertheimer’s 1912 and 1923 papers on perceived motion and figural organization. Both of these volumes were published by MIT Press.

Held did not stay long on the other side of the Charles River. He returned to MIT to become Pawan Sinha’s “senior postdoc”, where he continued collaborating on the research of *Project Prakash* (“light” in Sanskrit), a project aimed at restoring eyesight in patients blind from birth, as well as studying recovery of vision after surgery. Together, they went to India to study people who had become blind early in life due to river blindness and congenital cataracts. Held presented the results of their experiment at the 2007 Meeting of the Visual Science Society (VSS) in Florida, when he was 84. The room was packed and everybody was excited to see the sage of our field addressing the question William Molyneux had famously asked John Locke in 1688:

Consider a man born blind and taught by his touch to distinguish between a cube and a sphere. Suppose the blind man now be made to see. Our query then is, whether by his sight, before he touched them, could he distinguish and state which is the sphere, which is the cube?

Held started his talk citing previous work by scholars who had concerned themselves with this question in the 18th and 19th centuries, among them Leibniz, Berkeley, Voltaire, La Mettrie, Diderot, and Müller. Would patients after receiving a corneal transplant or lens implant be able to distinguish between shapes such as spheres and cubes by sight alone, without recourse to touch? Tests after surgery revealed postoperative visual acuities sufficient to distinguish between the objects used for touch discrimination. Despite their restored visual acuity, patients could not immediately assign visual percepts to tactile percepts, but did so after only one week. Held and Sinha concluded as follows: “Based on the results from the three subjects we have studied, it appears that Molyneux’s query is likely to have a negative answer; the newly sighted show little transfer from touch to vision immediately after sight onset. But, the ability to transfer is acquired rapidly, via mechanisms that are currently unknown.” There was thunderous applause. (See more recently, Jie Chen et al. in *Current Biology*, 26, 8, 1069–1074, 2016.)

Sadly, during all my visits, I rarely spoke with Held much about his relationship with Wolfgang Köhler and the other European psychologists who had emigrated from Germany to the United States. Too great was the respect, too great the sense of loss.

In his autobiographical note in Larry Squire's series on *The History of Neuroscience in Autobiography* (Vol. 6), Held relates a funny story. He writes: "Previously, Köhler had always addressed me as Mr. Held, while I addressed him as Prof. Köhler. One day Köhler approached me, 'Mr. Held', he greeted me, 'we have worked together for more than a year. From now on, you can call me Dr. Köhler; and I will call you Held'. Calling me Held was a big step toward informality." Held's son Lucas told me that his father had great respect for Köhler and had a photo of the master in his study for all his life.

Although I never collaborated with Held, I very much wish I had. I could have learned so much from him. His house was not far from where I lived (at Lakewood Avenue). He was a role model for me from the very beginning and I am grateful for his enduring support, encouragement, and inspiration over a period of nearly 50 years.

At the beginning of this year, he told me that he needed to "downsize". Could I help him find a home for his complete collection of "*Psychologische Forschung*", autographed by E. Boring? I did, the volumes are now at the Institute for the History of Psychology in Würzburg, back in Germany, from where they originally came.

The farewell dinner organized by Pawan Sinha at MIT in June of this year was a fitting tribute to a man whom all of us greatly admired and who had greatly influenced and enriched our lives. We wished him a happy retirement, good health, continued inspiration, and satisfaction for many years to come. It was not to be.

When Held left Boston for Northampton, MA, the college town of Kurt Koffka, it was as if we had lost a fatherly friend. In his new surroundings, he was active and involved to the last hour of his life. He was a great scientist, a mentor, as well as a beacon of modesty, fairness, and honesty. His passing leaves a tremendous void in the field. To those of us who knew him, he will always be in our hearts and lovingly so.

Selected Bibliography

Taken from the Professional Biography of R. Held. In: The History of Neuroscience in Autobiography, Volume 6 (2009), edited by L. Squire, Academic Press, Elsevier.

- Bauer, J. A., & Held, R. (1975). Comparison of visually-guided reaching in normal and deprived infant monkeys. *Journal of Experimental Psychology: Animal Behavior Processes*, 4, 298–308.
- Birch, E. E., Gwiazda, J., & Held, R. (1982). Stereoaquity development for crossed and uncrossed disparities in human infants. *Vision Research*, 22, 507–513.
- Dichgans, J., Held, R., Young, L. R., & Brandt, T. (1972). Moving visual scenes influence the apparent direction of gravity. *Science*, 178, 1217–1219.
- Efstathiou, A., Bauer, J. A., Greene, M., & Held, R. (1967). Altered reaching following adaptation to optical displacement of the hand. *Journal of Experimental Psychology*, 73, 113–120.
- Finke, R., & Held, R. (1978). State reversals of optically induced tilt and torsional eye movements. *Perception & Psychophysics*, 23, 337–340.

- Finke, R. A., Pankratov, M., & Held, R. (1984). Dissociations between perceptual and oculomotor effects induced by rotating visual displays. In B. Wooten & L. Spillmann (Eds.), *Festschrift for Ivo Kohler: Sensory Experience. Adaptation and Perception* (pp. 303–316). Hillsdale, NJ: Erlbaum Associates.
- Gwiazda, J., Bauer, J., Thorn, F., & Held, R. (1995). A dynamic relationship between myopia and blur-driven accommodation in school-aged children. *Vision Research*, *35*, 1299–1304.
- Gwiazda, J., Brill, S., Mohindra, I., & Held, R. (1978). Infant visual acuity and its meridional variation. *Vision Research*, *18*, 1557–1564.
- Gwiazda, J., Grice, K., Held, R., McLellan, J., & Thorn, F. (2000). Astigmatism and the development of myopia in children. *Vision Research*, *40*, 1019–1026.
- Gwiazda, J., Thorn, F., Bauer, J., & Held, R. (1993). Emmetropization and the progression of manifest refraction in children followed from infancy to puberty. *Clinical Vision Sciences*, *8*, 337–344.
- Hardt, M. E., Held, R., & Steinbach, M. J. (1971). Adaptation to displaced vision: a change in the central control of sensorimotor coordination. *Journal of Experimental Psychology*, *89*, 229–239.
- Hein, A., & Held, R. (1967). Dissociation of the visual placing response into elicited and guided components. *Science*, *158*, 390–392.
- Hein, A., Held, R., & Gower, E. C. (1970). Development and segmentation of visually controlled movement by selective exposure during rearing. *Journal of Comparative and Physiological Psychology*, *22*, 181–187.
- Held, R. (1955). Shifts in binaural localization after prolonged exposures to atypical combinations of stimuli. *American Journal of Psychology*, *68*, 526–548.
- Held, R. (1960). Perception and representation. E. H. Gombrich's Art and Illusion. *Yale Review*.
- Held, R. (1962). Adaptation to rearrangement and visual spatial aftereffects. *Psychologische Beiträge*, Reprint from Volume VI(3/4), 439–450.
- Held, R. (1965). Plasticity in sensory-motor systems. *Scientific American*, *213*, 89–94.
- Held, R. (1968). Dissociation of visual functions by deprivation and rearrangement. *Psychologische Forschung*, *31*, 338–348. (As part of a symposium, Locating and Identifying: Two Modes of Visual Processing.)
- Held, R. (1970). Two modes of processing spatially distributed visual stimuli. In F. O. Schmitt (Ed.), *The Neurosciences: Second Study Program* (pp. 317–324). New York, NY: The Rockefeller Press.
- Held, R. (1980). The rediscovery of adaptability in the visual system. In C. S. Harris (Ed.), *Visual Coding and Adaptability* (pp. 69–94). Hillsdale, NJ: Lawrence Erlbaum Associates.
- Held, R., & Bauer, J. A. (1967). Visually guided reaching in infant monkeys after restricted reaching. *Science*, *155*, 718–720.
- Held, R., & Bauer, J. A. (1974). Development of sensorially-guided reaching in infant monkeys. *Brain Research*, *71*, 265–271.
- Held, R., Birch, E. E., & Gwiazda, J. (1980). Stereoacuity of human infants. *Proceedings of the National Academy of Science of the USA*, *21*, 5572–5574.
- Held, R., & Bossom, J. (1961). Neonatal deprivation and adult rearrangement: complementary techniques for analyzing plastic sensory-motor coordination. *Journal of Comparative and Physiological Psychology*, *21*, 33–37.
- Held, R., Dichgans, J., & Bauer, J. A. (1975). Characteristics of moving visual scenes influencing spatial orientation. *Vision Research*, *15*, 357–365.
- Held, R., Efstathiou, A., & Greene, M. (1966). Adaptation to displaced and delayed visual feedback from the hand. *Journal of Experimental Psychology*, *72*, 887891.
- Held, R., & Freedman, S. J. (1963). Plasticity in human sensorimotor control. *Science*, *142*, 455–462.
- Held, R., & Hein, A. (1958). Adaptation of disarranged hand-eye coordination contingent upon reafferent stimulation. *Perceptual and Motor Skills*, *8*, 87–90.
- Held, R., & Hein, A. (1963). Movement-produced stimulation in the development of visually guided behavior. *Journal of Comparative and Physiological Psychology*, *56*, 872–876.
- Held, R., & Rekohs, J. (1963). Motor-sensory feedback and the geometry of visual space. *Science*, *141*, 722–723.
- Held, R., & Schlank, M. (1959). Adaptation to disarranged eye-hand coordination in the distance dimension. *The American Journal of Psychology*, *12*, 603–605.
- Held, R., & Shattuck, S. R. (1971). Color- and edge-sensitive channels in the human visual system: Tuning for orientation. *Science*, *174*, 314–315.
- Jacobson, S. G., Mohindra, I., & Held, R. (1981). Age of onset of amblyopia in infants with esotropia. *Documenta Ophthalmologica, Proceedings Series*, *30*, 210–216.
- Köhler, W., & Held, R. (1949). The cortical correlate of pattern vision. *Science*, *110*, 412–419.

- Köhler, W., O'Connell, D., & Held, R. (1952). An investigation of cortical currents. *Proceedings of the American Philosophical Society*, *96*, 290–330.
- Leehey, S. C., Moskowitz-Cook, A., Brill, S., & Held, R. (1975). Orientational anisotropy in infant vision. *Science*, *190*(4217), 900–902.
- Merker, B., & Held, R. (1981). Eye torsion and the apparent horizon under head tilt and visual field rotation. *Vision Research*, *21*, 543–547.
- Mikaelian, H., & Held, R. (1964). Two types of adaptation to an optically-rotated visual field. *American Journal of Psychology*, *22*, 257–263.
- Mohindra, I., Held, R., Gwiazda, J., & Brill, S. (1978). Astigmatism in infants. *Science*, *202*, 329331.
- Mohindra, I., Jacobson, S. G., Thomas, J., & Held, R. (1979). Development of amblyopia in infants. *Transactions of the Ophthalmological Society U.K.*, *99*, 344–346.
- Nägele, J. R., & Held, R. (1982). The postnatal development of monocular optokinetic nystagmus in infants. *Vision Research*, *22*, 341–346.
- Pöppel, E., Held, R., & Frost, D. (1973). Residual visual functions after brain wound involving the central visual pathways in man. *Nature*, *243*, 295–296.
- Shattuck, S., & Held, R. (1975). Color and edge sensitive channels converge on stereo-depth analyzers. *Vision Research*, *12*(2), 309–311.
- Shimojo, S., Birch, E. E., Gwiazda, J., & Held, R. (1984). Development of vernier acuity in infants. *Vision Research*, *2i*, 721–728.
- White, B. L., Castle, P., & Held, R. (1964). Observations on the development of visually-directed reaching. *Child Development*, *22*, 349–364.
- Wolfe, J., & Held, R. (1979). Eye torsion and visual tilt are mediated by different binocular processes. *Vision Research*, *12*, 917–920.

Original query of William Molyneux:

“A Man, being born blind, and having a Globe and a Cube, nigh of the same bignes, Committed into his Hands, and being taught or Told, which is Called the Globe, and which the Cube, so as easily to distinguish them by his Touch or Feeling; Then both being taken from Him, and Laid on a Table, Let us Suppose his Sight Restored to Him; Whether he Could, by his Sight, and before he touch them, know which is the Globe and which the Cube? Or Whether he Could know by his Sight, before he stretch'd out his Hand, whether he Could not Reach them, tho they were Removed 20 or 1000 feet from Him?”

Lothar Spillmann

Address: Department of Psychology, National Taiwan University, Roosevelt Road, Taipei 10617, Taiwan
Email: Lothar.Spillmann@zfn-brain.uni-freiburg.de