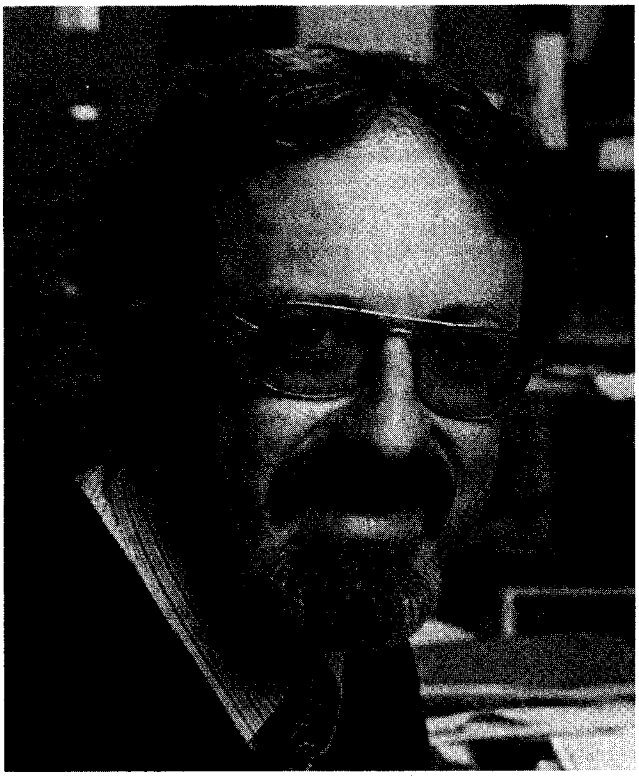

George Sperling
Note. Photo courtesy of New York University/Phillip Gallo Photo.

Biography

George Sperling regards his life as blissfully uneventful—devoted to intellectual pursuits and insulated from cataclysmic world events. Educated in the public schools of New York City, Sperling went to the University of Michigan to study science, majoring simultaneously in biology, chemistry, physics, and mathematics, receiving a BS in 1955. After an MA in psychology from Columbia University in 1956, he went on to Harvard. During the summer of 1957, George Miller arranged for Sperling to borrow a tachistoscope in order to carry out an experiment he had proposed in a student report. Sperling used a method of partial report to measure the time course of visual persistence (sensory memory). Subsequently, Neisser renamed it "iconic memory." With S. S. Steven's help, the summer experiments became Sperling's doctoral thesis in 1959.

The summer of 1958 was spent at Bell Laboratories. The previous summer's experiments were repeated, and Sperling first used post-stimulus visual masking to measure the rate of information extraction from visual materials, uncontaminated by visual persistence. (His post-stimulus mask was a stimulus consisting of visual noise that overwrote the persistence.) Sperling mailed photographic copies of his masking stimulus to numerous colleagues but enticed only Averbach and Coriell across the hall. Now, of course, post-stimulus masking by visual noise is universally used.

After graduation, Sperling returned to the Bell Laboratories with interruptions to teach at New York University (NYU), Duke University, Columbia University, University of California: Los Angeles, University of London, University of Western Australia, University of Washington, and Stanford University. In 1970 he joined NYU, continuing jointly at Bell Labs until 1987. In the early 1960s, Sperling proposed the auditory synchronization method of measuring visual persistence duration. This method requires the subject to judge the synchrony of a click and the onset or termination of a light flash. Many years later, with Erich Weichselgartner, the method was extended to measure not just the moment at which visual persistence ceased but also the entire rise and fall of the temporal brightness function.

What had attracted Sperling to psychology originally was the prospect that the quantitative methods and formal theories used by physicists to probe and describe the nature of matter could be adapted to yield equally quantitative measurements and theories of mental microprocesses. Although the specific content of this early work was important—for example, in initiating the study of what is now called sensory memory—the style of more atomic theoretical conceptualizations had a much greater influence. Some measure of the impact of Sperling's 1960s work can be garnered from citations to the three articles (1960, 1963, and 1967) that introduced partial report, visual noise masking, and the auditory synchronization method. All were among the 99 most cited articles in psychology according to a 1970s survey.

Sperling's first publication in visual psychophysics was "Negative Afterimages Without Prior Positive Images," an explanation of Bidwell's top. Subsequently, he published mathematical models for adaptation and flicker (in 1968 with M. M. Sondhi), contrast detection, binocular vision, and motion perception. The binocular model of 1970 was cast in the form of a physical and a neural theory. The physical theory predates Thom's catastrophe theory and probably was the first application of potential theory in psychology to describe the phenomena of path dependence and multiple stable states. The neural model embodied several important innovations (a winner-take-all network, cooperation–competition interaction, and different levels of spatial resolution) that were adopted by subsequent modelers (Julesz, Grossberg, Nelson, Marr, and others).

Van Santen and Sperling (1984, 1985) proposed a mathematical theory of human motion detection. Their detectors were elaborations of Reichardt detectors that extracted Fourier components in dynamic motion stimuli. Chubb and Sperling (1988) then discovered a whole gamut of moving stimuli that were invisible to Reichardt detectors and required rectification to expose latent motion. Ultimately, they showed that both motion and texture perception were served by two parallel computational systems: a Fourier and a rectifying system.

Sperling's work on sensory memory evolved naturally to studies of visual search and attention. Using a computer to present stimuli for search at a rate of 25 displays per second, the eye-movement controlled search rate could be doubled (Sperling, Budiansky, Spivak, & Johnson, 1971). With M. J. Melchner, Sperling (1978) published the first empirical Attention Operating Characteristic. Sperling and A. Reeves (1980) developed a new paradigm with which they succeeded in describing the entire reaction-time distribution of an unobservable shift of visual attention. Weichselgartner and Sperling (1987) measured automatic and controlled attention shifts initiated consecutively by the same stimulus. In 1984, Sperling demonstrated the computational equivalence of signal detection theory and attentional resource theory, whereas Reeves and Sperling (1986) derived the time course of the temporal attention-gating function.

Deaf people who communicate by a manual sign language (such as American Sign Language, ASL) cannot use the telephone network to communicate dynamic images because its capacity is too small for ordinary television transmission. In 1980 Sperling made the first measurements of the minimum bandwidth needed to perceive ASL. Several laboratories jumped into the race to be first to develop image-processed ASL that could be sent over telephone lines. In 1985 Sperling, Landy, Cohen, and Pavel tested all of the then-available compression methods and demonstrated several feasible analog and digital methods, but so far they have failed to persuade any manufacturer to build a device.

In all, Sperling has enjoyed immensely his 30 years of uninterrupted research. Not completely satisfied with his accomplishments, he hopes to do better in the future.

Selected Bibliography

Burt, P., & Sperling, G. (1981). Time, distance, and feature trade-offs in visual apparent motion. *Psychological Review, 88,* 171–195.

Chubb, C., & Sperling, G. (1988). Drift-balanced random stimuli: A general basis for studying non-Fourier motion perception. *Journal of the Optical Society of America: A. Optics and Image Science, 5,* 1986–2006.

Reeves, A., & Sperling, G. (1986). Attention gating in short-term visual memory. *Psychological Review, 93,* 180–206.

Sperling, G. (1960). The information available in brief visual presentations. *Psychological Monographs, 74*(11, Whole No. 498).

Sperling, G. (1960). Negative afterimage without prior positive image. *Science, 131,* 1613–1614.

Sperling, G. (1963). A model for visual memory tasks. *Human Factors, 5,* 19–31.

Sperling, G. (1967). Successive approximations to a model for short-term memory. *Acta Psychologica, 27,* 285–292.

Sperling, G. (1970). Binocular vision: A physical and a neural theory. *American Journal of Psychology, 83,* 461–534.

Sperling, G. (1976). Movement perception in computer-driven visual displays. *Behavior Research Methods and Instrumentation, 8,* 144–151.

Sperling, G. (1980). Bandwidth requirements for video transmission of American Sign Language and finger spelling. *Science, 210,* 797–799.

Sperling, G., Budiansky, J., Spivak, J. G., & Johnson, M. C. (1971). Extremely rapid visual search: The maximum rate of scanning letters for the presence of a numeral. *Science, 174,* 307–311.

Sperling, G., & Dosher, B. A. (1986). Strategy and optimization in human information processing. In K. Boff, L. Kaufman, & J. Thomas (Eds.), *Handbook of perception and performance* (Vol. 1, pp. 1–65). New York: Wiley.

Sperling, G., Landy, M., Cohen, Y., & Pavel, M. (1985). Intelligible Encoding of ASL Image Sequences at Extremely Low Information Rates. *Computer Vision, Graphics, and Image Processing, 31,* 335–391.

Sperling, G., & Melchner, M. J. (1978). The attention operating characteristic: Some examples from visual search. *Science, 202,* 315–318.

Sperling, G., & Reeves, A. (1980). Measuring the reaction time of a shift of visual attention. In R. Nickerson (Ed.), *Attention and performance* (Vol. 8, pp. 347–360). Hillsdale, NJ: Erlbaum.

Sperling, G., & Sondhi, M. M. (1968). Model for visual luminance discrimination and flicker detection. *Journal of the Optical Society of America, 58,* 1133–1145.

Sperling, G., & Speelman, R. G. (1970). Acoustic similarity and auditory short-term memory: Experiments and a model. In D. A. Norman (Ed.), *Models of human memory* (pp. 149–202). New York: Academic Press.

van Santen, J. P. H., & Sperling, G. (1984). Temporal covariance model of human motion perception. *Journal of the Optical Society of America: A. Optics and Image Science, 1,* 451–473.

van Santen, J. P. H., & Sperling, G. (1985). Elaborated Reichardt detectors. *Journal of the Optical Society of America: A: Optics and Image Science, 2,* 300–321.

Weichselgartner, E., & Sperling, G. (1985). Continuous measurement of visible persistence. *Journal of Experimental Psychology: Human Perception and Performance, 11,* 711–725.

Weichselgartner, E., & Sperling, G. (1987). Dynamics of automatic and controlled visual attention. *Science, 238,* 778–780.

George Sperling

Citation

"For his ground-breaking contributions to visual information processing and attention. One of the leading visual scientists of our time, his fundamental contributions in both theory and empirical research span the breadth of visual science and related areas in cognition. His pioneering work includes the study of short-term visual persistence, the modeling of binocular vision, the mechanisms and limitations of high-speed visual search, and the nature of attentional limitations in visual perception. His research exhibits a tight bond between data collection, analysis, and mathematical modelling that has served as a role model for the field."

from AMERICAN PSYCHOLOGIST, April 1989
Vol. 44, No. 4, Pp. 626-628.

April 1989 • American Psychologist