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Human Visual Orientation *Perceiving in Depth, Volume 2 Characterization of Orientation Sensitivity in the Human Visual System* **Orientation Anisotropies in Human Visual Cortex** *Stimulus Orientation Biases of the Human Visual System Human Visual Perception of Spatial Structure Perceiving in Depth, Volume 3: Other Mechanisms of Depth Perception* **Orientation Selectivity in the Human Visual System On the Existence of Orientation-contingent Contrast Detectors in the Human Visual System** The Induction of an Orientation Anisotropy to Transient Stimulation in the Human Visual System **Designing an Orientation Finding Algorithm Using Human Visual Data Perceiving in Depth, Volume 3** *Modeling Human Perception of Visual Orientation with Resource-limited Bayesian Inference Model* **Digital Images and Human Vision Human Spatial Orientation** Effects of Alcohol on Inhibition in the Human Visual System An Electrophysiological and Psychophysical Study on the Processing of Contour Orientation in the Human Visual System **Functional Organisation of the Human Visual Cortex Orientation Tuning in Human Color Vision** *Human Visual Processing of Orientation in Broadband Stimuli* **Spatial Variation of Object Representation in Human Visual System Perceiving in Depth, Volume 1** *Interaction of Cues in Human Visual Perception* **Emergent Techniques for Assessment of Visual Performance**

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Visual illusions are compelling phenomena that draw attention to the brain's capacity to

construct our perceptual world. The Compendium is a collection of over 100 chapters on visual illusions, written by the illusion creators or by vision scientists who have investigated mechanisms underlying the phenomena. -- Psychological experiments carried out over a period of nearly forty years led Georg von Bekesy to realize that inhibition interconnects, at least in one respect, the fields of vision, hearing, skin sensations, taste, and smell. This book indeed almost creates the field of sensory inhibition as a significant one for study, bringing understanding to many observations that formerly seemed uncertain or unrelated and raising many problems still to be solved. Originally published in 1967. The Princeton Legacy Library uses the latest print-on-demand technology to again make available previously out-of-print books from the distinguished backlist of Princeton University Press. These editions preserve the original texts of these important books while presenting them in durable paperback and hardcover editions. The goal of the Princeton Legacy Library is to vastly increase access to the rich scholarly heritage found in the thousands of books published by Princeton University Press since its founding in 1905. Visual perception can be understood as an inferential process that combines noisy sensory information with internalized knowledge drawn from previous experience. In statistical Bayesian terms, internal representations of the visual environment can be understood as posterior estimates obtained by weighting imperfect sensory information (a likelihood) by internalized biases (a prior). Given limited perceptual resources, it is advantageous for the visual system to capitalize on predictable regularities of the visual world, and internalize them in the form of priors. This dissertation presents novel findings in the

domain of spatial vision and visual memory, as well as some new work on memory for the 3D orientation of objects. In all cases, an unprecedented signal-to-noise ratio, achieved by employing serial reproduction chains (a ``telephone game'' procedure) combined with non-parametric kernel density estimation techniques, reveals a number of stunning intricacies in the prior for the first time. Methodological implications, as well as implications for amending prior empirical findings and revisiting past theoretical explanations are discussed. Recent vision research has led to the emergence of new techniques that offer exciting potential for a more complete assessment of vision in clinical, industrial, and military settings. Emergent Techniques for Assessment of Visual Performance examines four areas of vision testing that offer potential for improved assessment of visual capability including: contrast sensitivity function, dark-focus of accommodation, dynamic visual acuity and dynamic depth tracking, and ambient and focal vision. In contrast to studies of accepted practices, this report focuses on emerging techniques that could help determine whether people have the vision necessary to do their jobs. In addition to examining some of these emerging techniques, the report identifies their usefulness in predicting performance on other visual and visual-motor tasks, and makes recommendations for future research. Emergent Techniques for Assessment of Visual Performance provides summary recommendations for research that will have significant value and policy implications for the next 5 to 10 years. The content and conclusions of this report can serve as a useful resource for those responsible for screening industrial and military visual function. Volume 3 addresses depth-perception mechanisms other than stereopsis. It starts by reviewing monocular cues to depth, including accommodation, vergence,

perspective, interposition, shading, and motion parallax. Constancies, such as the ability to perceive the sizes and shapes of objects as they move are reviewed. The ways in which different depth cues interact are discussed. One chapter reviews information used to perceive motion in depth. Pathologies of depth perception, including stereoanomalies and albanism are reviewed. Visual depth-perception mechanisms through the animal kingdom are reviewed together with a discussion of the evolution of stereoscopic vision. The next chapter describes how visual depth perception guides movements of the hand and body. The next three chapters review non-visual mechanisms of depth perception, including auditory localization, echolocation in bats and marine mammals, the lateral-line system of fish, electrolocation, and heat-sensitive sense organs. The volume ends with a discussion of mechanisms used by animals to navigate. Human and Machine Vision provides information pertinent to an interdisciplinary program of research in visual perception. This book presents a psychophysical study of the human visual system, which provides insights on how to model the flexibility required by a general-purpose visual system. Organized into 17 chapters, this book begins with an overview of how a visual display is segmented into components on the basis of textual differences. This text then proposes three criteria for judging representations of shape. Other chapters consider an increased use of machine vision programs as models of human vision and of data from human vision in developing programs for machine vision. This book discusses as well the diversity and flexibility of systems for representing visual information. The final chapter deals with dot patterns and discusses the process of interring orientation information from collections of them. This book is a valuable resource for psychologists,

neurophysiologists, and computer scientists. "Orientation processing is fundamental to the encoding of form. While it was once thought that form and color were entirely segregated, there is now evidence for both orientation tuned and untuned color mechanisms. A previous psychophysical experiment found a monocular color vision mechanism, revealed at low spatial frequencies, that lacks orientation tuning and may act as a surface color or 'blob' detector. However, monocular color vision at mid spatial frequencies and achromatic vision both displayed orientation tuning, and are therefore capable of form processing. This research thesis tests the limitations and extent of the proposed untuned mechanism in color vision in three investigations of related visual behaviors with both color and achromatic stimuli at different spatial frequencies. First, we asked if binocular vision also has mechanisms that are not tuned for orientation. Using the technique of subthreshold summation, we measured binocular summation of dichoptic plaids over a range of component orientation differences. An orientation tuned model provided a good fit to all conditions with similar bandwidth estimates. Binocular summation in color vision is orientation tuned. Next, we examined the perception of high contrast stimuli to see if an untuned color mechanism influences vision above threshold. We employed a contrast matching paradigm in which high contrast orthogonal monocular plaids were perceptually matched with their component gratings. Summation was calculated as a ratio of contrast of the plaid to its perceptually matched grating. High summation could indicate an influence of untuned mechanisms. While low spatial frequency color plaids had the highest average summation of perceived contrast, it was statistically indistinguishable from achromatic stimuli. In the final experiment, we used the

assumption of labelled lines to test for isotropic mechanisms in identification. We asked if identification of oriented gratings is possible at detection threshold and so concurrently measured identification and detection thresholds. While orientation discrimination was worse for low spatial frequency color stimuli, orthogonal gratings could be distinguished at threshold. Identification at threshold in monocular color vision is orientation tuned. We find no direct evidence of an untuned color mechanism beyond monocular detection. When any potentially untuned signals go through the additional processing inherent to these tasks, orientation tuning is imposed. Form and color appear intertwined beyond early vision." -- "Object processing is an essential task of the human visual system that is thought to beaccomplished through hierarchical processing of objects attributes in the ventral occipitotemporal cortex. An object can primarily be delineated by its shape and surface information,including its color and texture. A shape can initially be defined as a set of oriented elementsdefined in luminance or color contrast. It is now thought that red-green color vision can detectcolor-defined edges almost as well as luminance vision can detect luminance-defined edges. Thisis supported by evidence from both psychophysical experiments and single cell recordings.However, it is not yet well understood how color contrast is used by the visual system in formprocessing. Color vision can have an important additional role to luminance vision in objectperception, by processing the surface color of an object. Evidence from single cell recordings inprimates have shown the presence of a neurons population of about 10% in V1 that respondexclusively to full field color stimuli and are not tuned to spatial frequency or orientation,making them candidates for surface color processing. Psychophysical

experiments, however,have not revealed any direct evidence for non-oriented color mechanisms.In this thesis I use the psychophysical method of subthreshold summation to determine theorientation tuning of the red-green color mechanisms in human vision, and for luminancecontrast under equivalent conditions. Psychophysical models, based on the presence of multipletuned detectors or a single, non-oriented mechanism, are used to determine tuning properties ofthe neural detectors underlying the psychophysical responses.The first set of experiments revealed evidence for two types of red-green color mechanism: 1)non-oriented revealed monocularly at low spatial frequencies (0.25-0.375 cycles/degree), and 2)oriented that appeared binocularly or at higher spatial frequencies (1.5 cycles/degree). Inluminance vision, evidence supported the presence of orientation tuning at all spatial scales andviewing conditions. Based on these findings, further experiments were done to measure the fullmonocular orientation tuning responses of color vision, in comparison to luminance vision, atdifferent spatial scales. At mid spatial frequencies, similar orientation tuning responses andneural detector bandwidth estimates were found for color and luminance vision (16 and 13 degsrespectively). At low spatial frequencies, tuning curves for color contrast were extremely broadand fitted reasonably by a model involving isotropic detectors. For luminance vision, orientationtuning is preserved with no change in detector bandwidth. Finally, binocular responses weremeasured using dichoptic chromatic stimuli that revealed orientation tuning at both low and midspatial frequencies. In summary, the results of this thesis have revealed the presence of twodistinct pathways in color vision at the behavioral level that are best equipped, respectively forthe representation of an object's surface-color and form, and

have provided estimates of theorientation bandwidth of their underlying neural detectors." -- Eye movements are a vital part of our interaction with the world. They play a pivotal role in perception, cognition, and education. Research in this field is now proceeding at a considerable pace and casting new light on how the eyes move and what information we can derive during the frequentand brief periods of fixation. However, the origins of this work are less well known, even though much of our knowledge was derived from this research with far more primitive equipment. This book is unique in tracing the history of eye movement research. It shows how great strides were made in this area before modern recording devices were available, especially in the measurement of nystagmus. When photographic techniques were adapted to measure discontinuous eye movements, fromabout 1900, many of the issues that are now basic to modern research were then investigated. One of the earliest cognitive tasks examined was reading, and it remains in the vanguard of contemporary research. Modern researchers in this field will be astonished at the subtleties of these early experimental studies and the ingenuity of interpretations that were advanced one and even two centuries ago. Though physicians often carried out the original eye movement research, later on it was pursued bypsychologists - it is within contemporary neuroscience that we find these two strands reunited. Anyone interested in the origins of psychology and neuroscience will find much to stimulate and surprise them in this valuable new work. The three-volume work Perceiving in Depth is a sequel to Binocular Vision and Stereopsis and to Seeing in Depth, both by Ian P. Howard and Brian J. Rogers. This work is much broader in scope than the previous books and includes mechanisms of depth

perception by all senses, including aural, electrosensory organs, and the somatosensory system. Volume 1 reviews sensory coding, psychophysical and analytic procedures, and basic visual mechanisms. Volume 2 reviews stereoscopic vision. Volume 3 reviews all mechanisms of depth perception other than stereoscopic vision. The three volumes are extensively illustrated and referenced and provide the most detailed review of all aspects of perceiving the three-dimensional world.Volume 1 starts with a review of the history of visual science from the ancient Greeks to the early 20th century with special attention devoted to the discovery of the principles of perspective and stereoscopic vision. The first chapter also contains an account of early visual display systems, such as panoramas and peepshows, and the development of stereoscopes and stereophotography. A chapter on the psychophysical and analytic procedures used in investigations of depth perception is followed by a chapter on sensory coding and the geometry of visual space. An account of the structure and physiology of the primate visual system proceeds from the eye through the LGN to the visual cortex and higher visual centers. This is followed by a review of the evolution of visual systems and of the development of the mammalian visual system in the embryonic and post-natal periods, with an emphasis on experience-dependent neural plasticity. An account of the development of perceptual functions, especially depth perception, is followed by a review of the effects of early visual deprivation during the critical period of neural plasticity on amblyopia and other defects in depth perception. Volume 1 ends with accounts of the accommodation mechanism of the human eye and vergence eye movements. Volume 2 addresses stereoscopic vision. It starts with the physiology of stereoscopic mechanisms. It then deals with binocular

rivalry, binocular summation, and interocular transfer. A review of how images are brought into binocular register is followed by a review of stimulus tokens used to detect disparities. Cyclopean effects, such as cyclopean illusions, cyclopean motion, texture segregation, and binocular direction are reviewed. Factors that influence stereoacuity are discussed. Two chapters describe how stimuli in distinct depth planes produce contrast effects, and affect motion perception and whiteness perception. The Pulfrich stereomotion effect and perception of motion in depth are reviewed. The volume ends with a review of applications of stereoscopy. Addresses the problems that arise when we attempt to convey information with visual displays such as graphs by presenting psychological principles for constructing effective graphs. This work is useful for those who use visual displays to convey information in the sciences, humanities, and business such as finance, marketing, and advertising. Includes social cognition in birds and nonhuman primates as well as various aspects of social cognition in human children This book discusses the design of the new mobility assistive information and communication technologies (ICT) devices for the visually impaired. The book begins with a definition of the space concept, followed by the concept of interaction with a space during mobility and this interaction characteristics. The contributors will then examine the neuro-cognitive basis of space perception for mobility and different theories of space perception. The text presents the existing technologies for space perception (sense recovery with stem and iPS cells, implants, brain plasticity, sensory substitution devices, multi modal technologies, etc.), the newest technologies for mobility assistance design, the way the feedback on environment is conveyed to the end-user. Methods for formative and summative evaluations of the mobility

devices will also be discussed. The book concludes with a look to the future trends in research and technology development for mobility assistive information and communication technologies. Functional Organisation of the Human Visual Cortex In experiments reported here, visual and vestibular stimuli were manipulated independently. Observers made judgments about body orientation or self-motion. Results show that visual and vestibular senses are highly complimentary, in that they provide very similar types of information. Results also show that self-motion stimuli influence body orientation perception, and body orientation stimuli influence self-motion perception. The three-volume work Perceiving in Depth is a sequel to Binocular Vision and Stereopsis and to Seeing in Depth, both by Ian P. Howard and Brian J. Rogers. This work is much broader in scope than the previous books and includes mechanisms of depth perception by all senses, including aural, electrosensory organs, and the somatosensory system. Volume 1 reviews sensory coding, psychophysical and analytic procedures, and basic visual mechanisms. Volume 2 reviews stereoscopic vision. Volume 3 reviews all mechanisms of depth perception other than stereoscopic vision. The three volumes are extensively illustrated and referenced and provide the most detailed review of all aspects of perceiving the three-dimensional world. Volume 3 addresses all depth-perception mechanisms other than stereopsis. The book starts with an account of monocular cues to depth, including accommodation, vergence eye movements, perspective, interposition, shading, and motion parallax. A chapter on constancies in depth perception, such as the ability to perceive the sizes and shapes of objects as they move or rotate in depth, is followed by a chapter on the ways in which depth cues interact. The

next chapter reviews sources of information, such as changing disparity, image looming, and vergence eye movements, used in the perception of objects moving in depth. Various pathologies of depth perception, including visual neglect, stereoanomalies, and albanism are reviewed. Visual depth-perception mechanisms through the animal kingdom are described, starting with insects and progressing through crustaceans, fish, amphibians, reptiles, birds, and mammals. The chapter includes a discussion of how stereoscopic vision may have evolved. The next chapter describes how visual depth perception is used to guide reaching movements of the hand, avoiding obstacles, and walking to a distant object. The next three chapters review non-visual mechanisms of depth perception. Auditory mechanisms include auditory localization, echolocation in bats and marine mammals, and the lateral-line system of fish. Some fish emit electric discharges and then use electric sense organs to detect distortions of the electric field produced by nearby objects. Some beetles and snakes use heat-sensitive sense organs to detect sources of heat. The volume ends with a discussion of mechanisms used by animals to navigate to a distant site. Ants find their way back to the nest by using landmarks and by integrating their walking movements. Several animals navigate by the stars or by polarized sunlight. It seems that animals in several phyla navigate by detecting the Earths magnetic field. These fifteen contributions by distinguished vision and imaging scientists explore the role of human vision in the design of modem image communication systems. A dominant theme in the book is image compression—how compression algorithms can be designed to make best use of what we know about human vision. Electronic image communications, which encompass television, high-definition television, teleconferencing, multimedia,

digital photography, desktop publishing, and digital movies, is a rapidly growing segment of technology and business. Because these products and technologies are designed for human viewing, knowledge of human perception is essential to optimal design. This book provides a timely compendium of important ideas and perspectives on such subjects as the key aspects of human visual sensitivity that are relevant to image communications and, conversely, the major problems in image communications that vision science can address; the mathematical models of human vision that are useful in the design of image comunications systems; reliable and efficient methods of evaluating visual quality; and aspects of human vision that can be exploited to provide substantial improvements in coding efficiency. Andrew B. Watson is Senior Scientist for Vision Research at NASA. Contributors: Albert J. Ahumada, Jr. E. Barth. V. Michael Bove, Jr. Gershon Buchsbaum. Phillipe Cassereau. Pamela C. Cosman. Scott J. Daly. Michael Eckert. Bernd Girod. William E. Glenn. Robert M. Gray. Paul J. Hearty. Bradley Horowitz. Stanley Klein. Jeffrey Lubin, Cynthia Null. Karen L. Oehler. Alex Pentland. Todd Reed. Andrew B. Watson. B. Wegmann. Christof Zetsche. Recently our lab has shown that with broadband stimuli (either visual noise or natural scenes), performance for detecting oriented content is worst at horizontal, best at the obliques, and intermediate at vertical orientations-an anisotropy (termed the "horizontal effect") quite different from the well-known "oblique effect" (worst performance at obliques) obtained with simple line or grating stimuli. This horizontal effect can be explained by a proposed anisotropic normalization model that operates at the level of striate cortex by implementing the known numerical biases of striate neurons preferring different orientations as well as the strength of those responses

from neurons tuned to similar orientations and spatial frequencies (with that strength being dependent on the spatial relationships between different scales and orientations present in the stimuli). To assess how the proposed striate normalization mechanism might operate when the visual system is presented with broadband stimuli containing different amounts of spatial frequency and orientation content, two suprathreshold matching experiments were conducted. Additionally, to provide an estimate of how broadband stimuli might modulate the weights of the proposed model, a series of neural response simulations were carried out on different types of broadband natural scene imagery. The stimuli for the psychophysical experiments were generated by making broadband isotropic visual noise patterns and filtering their amplitude spectra to contain a test increment across a specified range of orientations and spatial frequencies. The extent of the test increment's orientation and frequency bandwidth was systematically varied. A standard psychophysical matching paradigm was used to assess the perceived strength of the oriented structure in a test pattern relative to the oriented structure in a comparison pattern. The results yielded the traditional oblique effect when a fairly small range of orientations and high spatial frequencies were incremented and the horizontal effect was observed for broadband increments of about 20° and 1-octave in frequency and larger. A blend of the two anisotropies was observed at intermediate increment bandwidth. The results of the psychophysical experiments were discussed in the context of the proposed striate normalization model with added insight from the results of the neural response simulations. In this book a leading researcher and artist explores how we see pictures and how they can communicate messages to us, both directly and indirectly by making

allusions to objects in space or to stored images in our minds. Originally published in 1990, Dr Wade provides fascinating examples of pictures that communicate hidden messages, either by implying something else, or by a shape or portrait which is carried covertly within another design. He analyses image processing stages in vision, demonstrating that the various stages may be related to styles in representational art. He shows how the way we have been taught to look at and recognise objects, affects the way we see them. The book lavishly illustrates with original examples of visual allusions and includes detailed practical advice on how photographers and designers can create them. Essential reading for photographers, designers, artists, people in film and television, and anyone involved in visual science , visual communication and advertising.

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