References

Ahmad-Taylor, T., and Montesino, D. (1992, December 6). In my backyard? (accompanying map). *New York Times*, p. 54.

Allis, S. (1979, August 5). Underground artistry in New York: When the city changes its subway map, art critics and cartographers crashed head-on. *Washington Post*, p. G3.

Anderson, J. R. (1982). Acquisition of cognitive skill. *Psychological Review*, 89, 369–406.

Andrews, S. K., Otis-Wilborn, A., and Messenheimer-Young, T. (1991). *Beyond Seeing and Hearing: Teaching Geography to Sensory Impaired Children. An Integrated Base Curriculum Approach*. Indiana, PA: NCGE.

Antes, J. R., and Mann, S. W. (1984). Global–local precedence in picture processing. *Psychological Research*, 46, 247–259.

Antonietti, A. (1991). Why does mental visualization facilitate problem-solving? In R. H. Logie and M. Denis (Eds.), *Mental Images in Human Cognition* (pp. 211–227). Amsterdam: Elsevier.

Armstrong, S. L., Gleitman, L. R., and Gleitman, H. (1983). What some concepts might not be. *Cognition*, 13, 263–308.

Arnheim, R. (1974). *Art and Visual Perception*. Berkeley and Los Angeles: University of California Press.

Arnheim, R. (1985). The double-edged mind: Intuition and the intellect. In E. Eisner (Ed.), *Learning and Teaching the Ways of Knowing: Eighty-fifth Yearbook of the National Society for the Study of Education* (pp. 77–96). Chicago: National Society for the Study of Education.

Axelsen, B., and Jones, M. (1987). Are all maps mental maps? *GeoJournal*, 14, 447–464.

Baddeley, A. (1988). Imagery and working memory. In M. Denis, J. Engelkamp, and J. T. E. Richardson (Eds.), *Cognitive and Neuropsychological Approaches to Mental Imagery* (pp. 169–180). Dordrecht: Martinus Nijhoff.

Baddeley, A. D., and Hitch, G. (1974). Working memory. In G. Bower (Ed.), *The*

Psychology of Learning and Motivation, Volume VIII (pp. 47–89). New York: Academic Press.

Balchin, W. G. V. (1988). The media watch in the United Kingdom. In M. Gauthier (Ed.), *Cartographie dans les Médias* (pp. 33–48). Quebec: Presses de l'Université Québec.

Barlow, H. (1990). What does the brain see? How does it understand? In C. B. H. Barlow and M. Weston-Smith (Eds.), *Images and Understanding* (pp. 5–25). Cambridge: Cambridge University Press.

Barsalou, L. W. (1983). Ad hoc categories. *Memory and Cognition, 11*, 211–227.

Barsalou, L. W. (1985). Ideals, central tendency, and frequency of instantiation as determinants of graded structure in categories. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 11*, 629–654.

Barthes, R. (1967). *Elements of Semiology*. London: Cape.

Barthes, R. (1977). *Image—Music—Text*. New York: Hill & Wang.

Bastide, F. (1985, June). Iconographie des textes scientifiques: Principes d'analyse. In B. Latour and J. d. Noblet (Eds.), *Les "Vues" de l'Esprit. Culture Technique, 14* [Special Issue].

Beck, J. (1966). Perceptual grouping produced by changes in orientation and shape. *Science, 154*, 538–540.

Becker, R. A., and Cleveland, W. S. (1987). Brushing scatterplots. *Technometrics, 29*, 127–142.

Bemis, D., and Bates, K. (1989). *Color on Temperature Maps: A Second Look*. Unpublished manuscript, Department of Geography, Pennsylvania State University.

Berlin, B. (1972). Speculations on the growth of ethno-botanical nomenclature. *Language in Society, 1*, 51–86.

Berlin, B., and Kay, P. (1969). *Basic Color Terms: Their Universality and Evolution*. Berkeley and Los Angeles: University of California Press.

Bertin, J. (1981). *Graphics and Graphic Information Processing*. Berlin: Walter de Gruyter. (French edition, 1977)

Bertin, J. (1983). *Semiology of Graphics: Diagrams, Networks, Maps*. Madison: University of Wisconsin Press. (French edition, 1967)

Berton, J. A. J. (1990). Strategies for scientific visualization: Analysis and comparison of current techniques. *Proceedings, Extracting Meaning from Complex Data: Processing, Display, Interaction*, February 14–16, Santa Clara, CA, SPIE—The International Society for Optical Engineering, pp. 110–121.

Beshers, C., and Feiner, S. (1992). Automated design of virtual worlds for visualizing multivariate relations. *Proceedings, Visualization '92*, October 19–23, Boston, IEEE Computer Society Technical Committee on Computer Graphics, pp. 283–290.

Beveridge, M., and Parkins, E. (1987). Visual representation in analogical problem solving. *Memory and Cognition, 15*(3), 230–237.

Beyls, P. (1991). Discovery through interaction: A cognitive approach to computer media in visual arts. *Leonardo, 24*(3), 311–315.

Biederman, I. (1987). Recognition-by-components: A theory of human image understanding. *Psychological Review, 94*(2), 115–147.

Bishop, I. D. (1992). *The Role of Visual Realism in Communicating and Understand-*

ing Spatial Change and Process. Working paper for the AGI Visualization Workshop, July 12–14, Loughborough University of Technology.

Bjorklund, E. M. (1991). Culture as input and output of the cognitive–linguistic processes. In D. M. Mark and A. U. Frank (Eds.), *Cognitive and Linguistic Aspects of Geographic Space* (pp. 65–70). Amsterdam: Kluwer Academic.

Board, C. (1967). Maps as models. In R. J. Chorley and P. Haggett (Eds.), *Models in Geography* (pp. 671–725). London: Methuen.

Board, C. (1973). Cartographic communication and standardization. *International Yearbook of Cartography, 13*, 229–236.

Bowman, W. J. (1968). *Graphic Communication*. New York: Wiley.

Brachman, R. J. (1985). On the epistemological status of semantic networks. In R. Brachman and H. Levesque (Eds.), *Readings in Knowledge Representation* (pp. 191–215). San Mateo, CA: Morgan Kaufmann.

Brewer, C. A. (1989). The development of process-printed Munsell charts for selecting map colors. *American Cartographer, 16*(4), 269–278.

Brewer, C. A. (1991). *The Prediction of Surround-Induced Changes in Map Color Appearance*. Unpublished Ph.D. dissertation, Michigan State University.

Brewer, C. A. (1992). *Color Selection for Geographic Data Analysis and Visualization*. Paper presented at GIS/LIS, November, 12, San Jose, CA.

Brewer, C. A. (1993). *Color Selection for Maps: Interactive Tutorial*. Unpublished hypermedia document, Department of Geography, San Diego State University.

Brewer, C. A. (1994). Color use guidelines for mapping and visualization. In A. M. MacEachren and D. R. F. Taylor (Eds.), *Visualization in Modern Cartography* (pp. 123–147). Oxford, UK: Elsevier.

Brewer, C. A., and Marlow, K. A. (1993). Color representation of aspect and slope simultaneously. *Proceedings, Auto-Carto 11*, October 30–November 1, Minneapolis, MN, ASPRS & ACSM, pp. 328–337.

Brown, A., and van Elzakker, C. P. J. M. (1993). The use of colour in the cartographic representation of information quality generated by a GIS. *Proceedings, 16th Conference of the International Cartographic Association*, May 3–9, Cologne, Germany, pp. 707–720.

Brown, M. H., and Hershberger, J. (1992, December). Color and sound in algorithm animation. *Computer*, pp. 52–63.

Brown, R. (1958). How shall a thing be called? *Psychological Review, 65*, 14–21.

Bruce, V., and Green, P. R. (1990). *Visual Perception: Physiology, Psychology, and Ecology* (2nd ed.). Hove, UK: Erlbaum.

Buja, A., McDonald, J. A., Michalak, J., and Stuetzle, W. (1991). Interactive data visualization using focusing and linking. *Proceedings, Visualization '91, IEEE Conference on Visualization*, October 22–25, San Diego, CA, pp. 156–163.

Bunn, J. H. (1981). *The Dimensionality of Signs, Tools, and Models*. Bloomington: Indiana University Press.

Buttenfield, B. (Ed.). (1993). *Mapping Data Quality. Cartographica, 30*(2 & 3) [Special Content Issue].

Buttenfield, B., and Beard, K. (1994). Graphical and geographical components of

data quality. In H. Hearnshaw and D. Unwin (Eds.), *Visualization in Geographical Information Systems* (pp. 150–157). London: Wiley.

Buxton, B. (1990). Using our ears: An introduction to the use of nonspeech audio cues. *Proceedings, Extracting Meaning from Complex Data: Processing, Display, Interaction*, February 14–16, Santa Clara, CA, SPIE—The International Society for Optical Engineering, pp. 124–127.

Caivano, J. L. (1990). Visual texture as a semiotic system. *Semiotica*, 80(3/4), 239–252).

Campbell, J., and Davis, J. (1979). *The Northern Part of the Wakarusa Quadrangle, Kansas Atlas*. Kansas Geological Survey, University of Kansas, Lawrence, KS, and the experimental Cartography Unit, Natural Environmental Research Council, London, UK.

Carr, D. B., Olsen, A. R., and White, D. (1992). Hexagon mosaic maps for display of univariate and bivariate geographical data. *Cartography and Geographic Information Systems*, 19(4), 228–236.

Carswell, C. M., and Wickens, C. D. (1990). The perceptual interaction of graphical attributes: Configurality, stimulus homogeneity, and object integration. *Perception and Psychophysics*, 47, 157–168.

Carswell, C. M., Frankenberger, S., and Bernhard, D. (1991). Graphing in depth: Perspectives on the use of three-dimensional graphs to represent lower-dimensional data. *Behavior and Information Technology*, 10(6), 459–474.

Castner, H. W. (1983). Tactual maps and graphics: Some implications for our study of visual cartographic communication. *Cartographica*, 20(3), 1–16.

Castner, H. W. (1990). *Seeking New Horisons: A Perceptual Approach to Geographic Education*. Montreal: McGill–Queen's University Press.

Castner, H. W., and Eastman, J. R. (1985). Eye-movement parameters and perceived map complexity—II. *American Cartographer*, 12(1), 29–40.

Castner, H. W., and Robinson, A. (1969). *Dot Area Symbols in Cartography: The Influence of Pattern on Their Perception*. Washington, DC: American Congress on Surveying and Mapping.

Cave, K. R., and Wolfe, J. M. (1990). Modeling the role of parallel processing in visual search. *Cognitive Psychology*, 22, 225–271.

Cavenagh, P. (1987). Reconstructing the third dimension: Interactions between color, texture, motion, binocular disparity and shape. *Computer Vision, Graphics and Image Processing*, 37, 171–195.

Cavenagh, P. (1988). Pathways in early vision. In Z. Pylyshyn (Ed.), *Computational Processes in Human Vision* (pp. 239–261). Norwood, NJ: Ablex.

Chang, K.-T., Antes, J., and Lenzen, T. (1985). The effect of experience on reading topographic relief information: Analysis of performance and eye movements. *Cartographic Journal*, 22(2), 88–94.

Chase, W. G., and Simon, H. A. (1973). The mind's eye in chess. In W. Chase (Ed.), *Visual Information Processing* (pp. 215–281). New York: Academic Press.

Cheal, M., and Lyon, D. R. (1992). Attention in visual search: Multiple search classes. *Perception and Psychophysics*, 52(2), 113–138.

Cheng, P. W., and Holyoak, K. J. (1985). Pragmatic reasoning schemas. *Cognitive Psychology*, 17, 391–416.

Cheng, P. W., and Pachella, R. G. (1984). A psychological approach to dimensional separability. *Cognitive Psychology, 16,* 279–304.

Cleveland, W. S. (1991). *A Model for Studying Display Methods of Statistical Graphics.* Unpublished manuscript, AT&T Bell Laboratories.

Cleveland, W. S. (1993). A model for studying display methods of statistical graphics. *Journal of Computational and Graphical Statistics, 2*(4), 323–343.

Cleveland, W. S., and McGill, R. (1984). Graphical perception: Theory, experimentation, and application to the development of graphical methods. *Journal of the American Statistical Association, 79,* 531–554.

Coulson, M. R. C. (1987). In the matter of class intervals for choropleth maps: With particular attention to the work of George F. Jenks. *Studies in Cartography, Monograph 37, Cartographica, 24*(2), 16–39.

Coulson, M. R. C. (1991). Progress in creating tactile maps from geographic information systems (G.I.S.) output. *Proceedings, 15th Conference of the International Cartographic Association,* September 23–October 1, Bournemouth, UK, pp. 167–174.

Cox, C. W. (1976). Anchor effects and the estimation of graduated circles and squares. *American Cartographer, 3,* 65–74.

Crampton, J. (1992a). A cognitive analysis of wayfinding expertise. *Cartographica, 29*(3/4), 46–65.

Crampton, J. (1992b). New directions in the information era—a reply to Taylor (1991). *Cartographic Journal, 29*(2), 145–150.

Crampton, J. (1994). *Alternative Cartographies: New Frontiers of Human Issues.* Unpublished Ph.D. dissertation, Department of Geography, Pennsylvania State University.

Crawford, P. V., and Marks, R. A. (1973). The visual effects of geometric relationships on three-dimensional maps. *Professional Geographer, 25*(3), 233–238.

Cuff, D. J. (1973). Colour on temperature maps. *Cartographic Journal, 10,* 17–21.

Dacey, M. (1970). Linguistic aspects of maps and geographic information. *Ontario Geography, 5,* 71–80.

Darius, J. (1990). Scientific images: Perception and deception. In C. B. H. Barlow and M. Weston-Smith (Eds.), *Images and Understanding* (pp. 333–357). Cambridge: Cambridge University Press.

DeLucia, A. A., and Hiller, D. W. (1982). Natural legend design for thematic maps. *Cartographic Journal, 19,* 46–52.

DeMey, M. (1992). *The Cognitive Paradigm.* Chicago: University of Chicago Press.

Dennett, D. (1990). Thinking with a computer. In C. B. H. Barlow and M. Weston-Smith (Eds.), *Images and Understanding* (pp. 297–309). Cambridge: Cambridge University Press.

Dent, B. D. (1970). *Perceptual Organization and Thematic Map Communication: Some Principles for Effective Map Design with Special Emphasis on the Figure–Ground Relationship.* Worcester, MA: Department of Geography, Clark University.

Dent, B. D. (1972). Visual organization and thematic map communication. *Annals of the Association of American Geographers*, 62(1), 79–93.

Dent, B. D. (1993). *Cartography: Thematic Map Design* (3rd ed.). Dubuque, IA: Wm. C. Brown.

DeValois, R. L., and Jacobs, G. H. (1968). Primate color vision. *Science, 162*, 533–540.

DeYoe, E., Knierem, J., Sagi, S., Julesa, B., and van Essen, D. (1986). Single unit responses to static and dynamic texture patterns in macaque V2 and V1 cortex. *Investigative Ophthalmology and Visual Science, 27*, 18.

DiBiase, D. (1990). Visualization in the earth sciences. *Earth and Mineral Sciences, Bulletin of the College of Earth and Mineral Sciences, Pennsylvania State University, 59*(2), 13–18.

DiBiase, D., Krygier, J., Reeves, C., MacEachren, A. M., and Brenner, A. (1991a). Animated cartographic visualization in earth system science. *Proceedings, 15th Conference of the International Cartographic Association*, Bournemouth, UK, September 23–October 1, pp. 223–232.

DiBiase, D., Krygier, J., Reeves, C., MacEachren, A. M., and Brenner, A. (1991b). *An Elementary Approach to Cartographic Animation*. University Park, PA: Deasy GeoGraphics Laboratory, Department of Geography, Pennsylvania State University [video].

DiBiase, D., MacEachren, A. M., Krygier, J. B., and Reeves, C. (1992). Animation and the role of map design in scientific visualization. *Cartography and Geographic Information Systems, 19*(4), 201–214.

DiBiase, D., Paradis, T., and Sloan, J. L. I. (1994a). Weighted isolines: An alternative method of isoline symbolization. *Professional Geographer, 46*(2), 218–228.

DiBiase, D., Reeves, C., Krygier, J., MacEachren, A. M., von Wyss, M., Sloan, J., et al. (1994b). In A. M. MacEachren and D. R. F. Taylor (Eds.), *Visualization in Modern Cartography* (pp. 287–312). Oxford, UK: Elsevier.

DiBiase, D., Reeves, C., MacEachren, A. M., Krygier, J., von Wyss, M., Sloan, J., et al. (1993). A map interface for exploring multivariate paleoclimate data. *Proceedings, Auto-Carto 11*, Minneapolis, MN, October 30–November 1, ASPRS & ACSM, pp. 43–52.

Dobson, M. W. (1973). Choropleth maps without class intervals? A comment. *Geographical Analysis, 5*, 262–265.

Dobson, M. W. (1979a). The influence of map information on fixation localization. *American Cartographer, 6*, 51–65.

Dobson, M. W. (1979b). Visual information processing during cartographic communication. *Cartographic Journal, 16*, 14–20.

Dobson, M. W. (1983). Visual information processing and cartographic communication: The utility of redundant stimulus dimensions. In D. R. F. Taylor (Ed.), *Graphic Communication and Design in Contemporary Cartography, Volume 2, Progress in Contemporary Cartography* (pp. 149–175). New York: Wiley.

Dobson, M. W. (1985). The future of perceptual cartography. *Cartographica, 22*(2), 27–43.

Dorling, D. (1992a). *Persuading Older Research Workers of the Wonders of Car-*

tograms. Paper presented at the IBG Annual Conference, January 6, Royal Holloway, London.

Dorling, D. (1992b). Stretching space and splicing time: From cartographic animation to interactive visualization. *Cartography and Geographic Information Systems*, 19(4), 215–227.

Dorling, D. (1992c). Visualizing people in time and space. *Environment and Planning B: Planning and Design*, 19, 613–637.

Dorling, D., and Openshaw, S. (1992). Using computer animation to visualize space–time patterns. *Environment and Planning B: Planning and Design*, 19, 639–650.

Downing, C. J., and Pinker, S. (1985). The spatial structure of visual attention. In M. I. Posner and O. S. M. Martin (Eds.), *Attention and Performance, Volume XI* (pp. 171–188). Hillsdale, NJ: Erlbaum.

Downs, R. M., and Liben, L. S. (1987). Children's understanding of maps. In P. Ellen and C. Thinus-Blanc (Eds.), *Cognitive Processes and Spatial Orientation in Animal and Man, Volume II, Neurophysiology and Development Aspects* (pp. 202–219). Dordrecht: Martinus Nijhoff.

Downs, R. M., Liben, L. S., and Daggs, D. G. (1988). On education and geographers: The role of cognitive development theory in geographic education. *Annals of the Association of American Geographers*, 78, 680–700.

Duncan, J. (1984). Selective attention and the organization of visual information. In M. I. Posner and O. S. M. Marin (Eds.), *Attention and Performance, Volume XI* (pp. 85–106). Hillsdale, NJ: Erlbaum.

Duncan, J., and Humphreys, G. W. (1987). Visual search and stimulus similarity. *Psychological Review*, 96, 433–448.

Eastman, J. R. (1981). The perception of scale change in small-scale map series. *American Cartographer*, 8(1), 5–21.

Eastman, J. R. (1985a). Cognitive models and cartographic design research. *Cartographic Journal*, 22(2), 95–101.

Eastman, J. R. (1985b). Graphic organization and memory structures for map learning. *American Cartographer*, 22, 1–20.

Eastman, J. R. (1986). Opponent process theory and syntax for qualitative relationships in quantitative series. *American Cartographer*, 13(4), 324–333.

Eastman, J. R. (1987). Graphic syntax and expert systems for map design. *Technical Papers, ACSM & ASPRS*, 4, 87–96.

Eastman, J. R., and Castner, H. W. (1983). The meaning of experience in task-specific map reading. In D. R. F. Taylor (Ed.), *Graphic Communication and Design in Contemporary Cartography, Volume 2, Progress in Contemporary Cartography* (pp. 115–148). New York: Wiley.

Eco, U. (1972). *Einführung in die Semiotik*. Munich: Fink.

Eco, U. (1976). *A Theory of Semiotics*. Bloomington: Indiana University Press.

Eco, U. (1977). *Zeichen: Einführung in einen Begriff und seine Geshichte*. Frankfurt: Suhrkamp. (Italian edition, 1973)

Eco, U. (1985a). How culture conditions the colors we see. In M. Blonsky (Ed.), *On Signs* (pp. 157–175). Baltimore: Johns Hopkins University Press.

Eco, U. (1985b). Producing signs. In M. Blonsky (Ed.), *On Signs* (pp. 176–183). Baltimore: Johns Hopkins University Press.

Edney, M. H. (1993). Cartography without progress: Reinterpreting the nature of historical development of mapmaking. *Cartographica, 30*(1), 54–68.

Edwards, G. (1991). Spatial knowledge for image understanding. In D. M. Mark and A. U. Frank (Eds.), *Cognitive and Linguistic Aspects of Geographic Space* (pp. 295–307). Amsterdam: Kluwer Academic.

Ellis, W. (1955). *Sourcebook of Gestalt Psychology.* London: Routledge & Kegan Paul.

Engel, F. (1977). Visual conspicuousness, visual search and fixation tendencies of the eye. *Vision Research, 17,* 95–108.

Eriksen, C. W. (1952). Location of objects in a visual display as a function of the number of dimensions on which the objects differ. *Journal of Experimental Psychology, 44,* 126–132.

Eriksen, C. W., and Murphy, T. D. (1987). Movement of attentional focus across the visual field: A critical look at the evidence. *Perception and Psychophysics, 42,* 299–305.

Eyton, J. R. (1990). Color stereoscopic effect cartography. *Cartographica, 27*(1), 20–29.

Familant, M. E., and Detweiler, M. C. (1993). Iconic reference: Evolving perspectives and an organizing framework. *International Journal of Man–Machine Studies, 39,* 705–728.

Ferreia, J., and Wiggins, L. (1990). The density dial: A visualization tool for thematic mapping. *GeoInfo Systems, 1,* 69–71.

Finke, R. (1980). Levels of equivalence in imagery and perception. *Psychological Review, 87,* 113–132.

Fisher, P. (1993). Visualizing uncertainty in soil maps by animation. *Cartographica, 30*(2 & 3), 20–27.

Fisher, P. (1994). Randomization and sound for the visualization of uncertain spatial information. In D. Unwin and H. Hearnshaw (Eds.), *Visualization in Geographic Information Systems* (pp. 181–185). London: Wiley.

Ford, K. L. (1985). Map reading, divided attention, and limited viewing area (abstract). *Conference Program and Abstracts, 5th Annual Meeting of the North American Cartographic Information Society,* November 10–13, Chicago, p. 10.

Forrest, D., and Castner, H. W. (1985). The design and perception of point symbols for tourist maps. *Cartographic Journal, 22,* 11–19.

Friedhoff, R. M., and Benzon, W. (1989). *Visualization: The Second Computer Revolution.* New York: Harry Abrams.

Frutiger, A. (1989). *Signs and Symbols: Their Design and Meaning.* New York: Van Nostrand Reinhold.

Ganter, J. H., and MacEachren, A. M. (1989). *Cognition and the Design of Scientific Visualization Systems.* Unpublished manuscript, Department of Geography, Pennsylvania State University.

Garling, T., Lindberg, E., and Mantyla, T. (1983). Orientation in buildings: Effects of familiarity, visual access, and orientation aids. *Journal of Applied Psychology, 68,* 177–186.

Garner, W. R. (1976). Interaction of stimulus dimensions in concept and choice processes. *Cognitive Psychology, 8,* 98–123.

Gerber, R. V. (1981). Competence and performance in cartographic language. *Cartographic Journal*, 18(2), 104–111.

Gerber, R., Burden, P., and Stanton, G. (1990). Development of public information symbols for tourism and recreation mapping. *Cartographic Journal*, 27(2), 92–103.

Gershon, N. D. (1992). Visualization of fuzzy data using generalized animation. *Proceedings, Visualization '92*, October 19–23, Boston, IEEE Computer Society Technical Committee on Computer Graphics, pp. 268–273.

Gersmehl, P. J. (1977). Soil taxonomy and mapping. *Annals of the Association of American Geographers*, 67(3), 419–428.

Gersmehl, P. J. (1990, Spring). Choosing tools: Nine metaphors of four-dimensional cartography. *Carographic Perspectives*, No. 5, 3–17.

Gibson, A. E. (1987). A model describing options for parallel color/data structuring. *Technical Papers, ACSM & ASPRS*, 4, 97–106.

Gibson, J. J. (1950). *Perception of the Visual World*. New York: Houghton Mifflin.

Gibson, J. J. (1979). *An Ecological Approach to Visual Perception*. Boston: Houghton Mifflin.

Giere, R. N. (1988). *Explaining Science: A Cognitive Approach*. Chicago: University of Chicago Press.

Gilmartin, P. P. (1978). Evaluation of thematic maps using the semantic differential test. *American Cartographer*, 5, 133–139.

Gilmartin, P. P. (1981). Influence of map content on circle perception. *Annals of the Association of American Geographers*, 71, 253–258.

Gilmartin, P. P. (1988). The design of choropleth shadings for maps on 2- and 4-bit color graphics monitors. *Cartographica*, 25(4), 1–10.

Gilmartin, P. P., and Shelton, E. (1989). Choropleth maps on high resolution CRTs: The effects of number of classes and hue on communication. *Cartographica*, 26(2), 40–52.

Goldberg, J. H., MacEachren, A. M., and Kotval, X. P. (1992). Mental image transformations in terrain map comparison. *Cartographica*, 29(2), 46–59.

Goldhamer, H. (1934). The influence of area, position, and brightness in the visual perception of a reversible configuration. *American Journal of Psychology*, 46(2), 189–206.

Golledge, R. G., Gale, N., Pellegrino, J. W., and Doherty, S. (1992). Spatial knowledge acquisition by children: Route learning and relational distances. *Annals of the Association of American Geographers*, 82(2), 223–244.

Golledge, R. G., and Stimson, R. J. (1987). Spatial cognition. In *Analytical Behavioral Geography* (pp. 52–83). New York: Croom Helm.

Gombrich, E. (1990). Pictorial instructions. In C. B. H. Barlow and M. Weston-Smith (Eds.), *Images and Understanding* (pp. 26–45). Cambridge: Cambridge University Press.

Goodman, N. (1976). *Languages of Art: An Approach to a Theory of Symbols* (2nd ed.). Indianapolis: Hackett.

Gould, P., Kabel, J., Gorr, W., and Golub, A. (1991). AIDS: Predicting the next map. *Interfaces*, 21(3), 80–92.

Gratzer, M. A., and McDowell, R. D. (1971). *Adaptation of an Eye Movement*

Recorder to Aesthetic Environment Mensuration. Storrs, CT: Storrs Agricultural Station, University of Connecticut.

Gregory, R. (1990). How do we interpret images? In C. M. H. Barlow and M. Weston-Smith (Eds.), *Images and Understanding* (pp. 310–330). Cambridge: Cambridge University Press.

Griffin, T. L. C. (1985). Group and individual variations in judgment and their relevance to the scaling of graduated circles. *Cartographica*, 22(1), 21–37.

Grinstein, G., Sieg, J. C. J., Smith, S., and Williams, M. G. (1992). Visualization for knowledge discovery. *International Journal of Intelligent Systems*, 7, 637–648.

Groop, R. E., and Cole, D. (1978). Overlapping graduated circles: Magnitude estimation and method of portrayal. *Canadian Cartographer*, 15, 114–122.

Guiraud, P. (1975). *Semiology*. London: Routledge & Kegan Paul.

Hadamard, J. (1945). *An Essay on the Psychology of Invention in the Mathematical Field*. New York: Dover.

Haining, R. P. (1978). A spatial model for high plains agriculture. *Annals of the Association of American Geographers*, 68, 493–504.

Hall, S. S. (1992). *Mapping the Next Millenium: The Discovery of New Geographies*. New York: Random House.

Handel, S., Imai, S., and Spottswood, P. (1980). Dimensional similarity and configural classification of integral and separable stimuli. *Perception and Psychophysics*, 28, 205–212.

Hannah, M. (1993). *Foucault Deinstitutionalized: Spatial Prerequisites for Modern Social Control*. Unpublished Ph.D. dissertation, Department of Geography, Pennsylvania State University.

Harley, J. B. (1988). Maps, knowledge, and power. In D. Cosgrove and S. Daniels (Eds.), *The Iconography of Landscape: Essays on the Symbolic Representation, Design and Use of Past Environments* (pp. 277–311). Cambridge: Cambridge University Press.

Harley, J. B. (1989). Deconstructing the map. *Cartographica*, 26(2), 1–20.

Harley, J. B. (1990). Cartography, ethics, and social theory. *Cartographica*, 27(2), 1–23.

Harrower, M. (1936). Some factors determining figure–ground articulation. *British Journal of Psychology*, 4, 407–424.

Hartshorne, C., and Weiss, P. (Eds.). (1931). *The Collected Papers of Charles Sanders Peirce, Volumes I and II*. Cambridge, MA: Belknap Press of Harvard University Press.

Harvey, D. (1969). *Explanation in Geography*. London: Edward Arnold.

Harwood, K. (1989). Cognitive perspectives on map displays for helicopter flight. *Proceedings, 33rd Annual Meeting of the Human Factors Society*, October 16–18, Denver, CO, pp. 13–17.

Head, C. G. (1984). The map as natural language: A paradigm for understanding. *Cartographica*, 21(1), 1–31.

Hervey, S. (1982). *Semiotic Perspectives*. London: Allen & Unwin.

Hochberg, J. (1980). Pictorial functions and perceptual structures. In M. A. Hagen (Eds.), *The Perception of Pictures* (pp. 47–93). New York: Academic Press.

Hoffman, D. D., and Richards, W. A. (1984). Parts of recognition. *Cognition*, *18*, 65–96.

Hoffman, H. S. (1989). *Vision and the Art of Drawing*. Englewood Cliffs, NJ: Prentice-Hall.

Hoffman, R. R., Detweiler, M., Conway, J. A., and Lipton, K. S. (1993). Some considerations in using color in meteorological displays. *Weather and Forecasting*, *8*, 505–518.

Holyoak, K. J., and Nisbett, R. E. (1988). Induction. In R. J. Sternberg and E. E. Smith (Eds.), *The Psychology of Human Thought* (pp. 50–91). Cambridge: Cambridge University Press.

Howard, V. A. (1980). Theory of representation: Three questions. In P. A. Kolers, M. E. Wrolstad, and H. Bouma (Eds.), *Processing of Visible Language, Volume 2* (pp. 501–515). New York: Plenum Press.

Hsu, M.-L. (1979). The cartographer's conceptual process and thematic symbolization. *American Cartographer*, *6*, 117–127.

Hubel, D. H. (1988). *Eye, Brain and Vision*. New York: Scientific American Library.

Humphreys, G. W., and Bruce, V. (1989). *Visual Cognition: Computational, Experimental and Neuropsychological Perspectives*. London: Erlbaum.

Humphreys, G. W., and Quinlan, P. T. (1987). Normal and pathological processes in visual object constancy. In G. W. Humphreys and M. J. Riddoch (Eds.), *Visual Object Processing: A Cognitive Neurological Approach* (pp. 43–105). London: Erlbaum.

Hurvich, L. M., and Jameson, D. (1957). Opponent-process theory of color vision. *Psychological Review*, *64*(6), 384–404.

Imhof, E. (1982). *Cartographic Relief Presentation*. Berlin: Walter de Gruyter. (German edition, 1965)

Innis, R. E. (Ed.). (1985). *Semiotics: An Introductory Anthology*. Bloomington: Indiana University Press.

Jakobson, R. (1960). Linguistics and poetics. In T. A. Sebeok (Ed.), *Style in Language* (pp. 350–377). Cambridge, MA: MIT Press.

James, W. (1950). *The Principles of Psychology, Volume 1*. New York: Dover. (Original work published 1890)

Japan Cartographers Association. (1980). Examples of methods used for oceanic cartography in Japan. *The Dynamics of Oceanic Cartography, Monograph 25, Cartographica*, *17*(2), 157–181.

Jenks, G. F. (1963). Generalization in statistical mapping. *Annals of the Association of American Geographers*, *53*(1), 15–26.

Jenks, G. F. (1967). The data model concept in statistical mapping. *International Yearbook of Cartography*, *7*, 186–190.

Jenks, G. F. (1973). Visual integration in thematic mapping: Fact or fiction? *International Yearbook of Cartography*, *13*, 27–34.

Jenks, G. F. (1975). The evaluation and prediction of visual clustering in maps symbolized with proportional circles. In J. Davis and M. McCullaugh (Eds.), *Display and Analysis of Spatial Data* (pp. 311–327). New York: Wiley.

Jenks, G. F. (1977). *Optimal Data Classification for Choropleth Maps*. Lawrence: Department of Geography, University of Kansas.

Jenks, G. F., and Brown, D. A. (1966). Three-dimensional map construction. *Science, 154,* 857–864.

Jenks, G. F., and Caspall, F. C. (1971). Error on choroplethic maps: Definition, measurement, reduction. *Annals of the Association of American Geographers, 61,* 217–244.

Johnson, G. (1983). *Qualitative Symbology: An Evaluation of the Pictorial Signs of the National Park Service as Cartographic Symbols.* Unpublished master's thesis, Virginia Polytechnic Institute and State University.

Johnson, M. (1987). *The Body in the Mind: The Bodily Basis of Meaning, Imagination, and Reason.* Chicago: University of Chicago Press.

Judson, H. F. (1987). *The Search for Solutions.* Baltimore: Johns Hopkins University Press.

Julesz, B. (1965). Texture and visual perception. *Scientific American, 212,* 38–48.

Julesz, B. (1975). Experiments in the visual perception of texture. *Scientific American, 232,* 34–43.

Julesz, B. (1981). Textons, the elements of texture perception, and their interactions. *Nature, 290,* 91–97.

Kaiser, M. K., and Proffitt, D. R. (1992). Using the stereokinetic effect to convey depth: Computationally efficient depth-from-motion displays. *Human Factors, 34(5),* 571–581.

Kay, P., and McDaniel, C. (1978). The linguistic significance of the meanings of basic color terms. *Language, 54(3),* 610–646.

Keates, J. S. (1982). *Understanding Maps.* New York: Halsted Press.

Keates, J. S. (1984). The cartographic art. *New Insights in Cartographic Communication, Monograph 31, Cartographica, 23(1),* 37–43.

Kienker, P. K., and Sejnowski, T. J. (1986). Separating figure from ground with a parallel network. *Perception, 15,* 197–216.

Kimchi, R. (1988). Selective attention to global and local levels in the comparison of hierarchical patterns. *Perception and Psychophysics, 43,* 189–198.

Kimerling, A. J. (1985). The comparison of equal-value gray scales. *American Cartographer, 12,* 132–142.

Kinchla, R. A., and Wolfe, J. M. (1979). The order of visual processing: "Top-down," "bottom-up" or "middle-out." *Perception and Psychophysics, 25,* 225–231.

Kishto, B. N. (1965). The color stereoscopic effect. *Vision Research, 5,* 313–329.

Klymenko, V., and Weisstein, N. (1986). Spatial frequency differences can determine figure–ground organization. *Journal of Experimental Psychology: Human Perception and Performance, 12(3),* 324–330.

Klymenko, V., and Weisstein, N. (1989). Figure and ground in space and time: 1. Temporal response surfaces of perceptual organization. *Perception, 18(5),* 627–637.

Klymenko, V., Weisstein, N., Topolski, R., and Hsieh, C. (1989). Spatial and temporal frequency in figure–ground organization. *Perception and Psychophysics, 45,* 395–403.

Knowlton, J. Q. (1966). On the definition of "picture." *AV Communication Review, 14,* 157–183.

Koffka, K. (1935). *Principles of Gestalt Psychology*. New York: Harcourt, Brace & Co.

Kohler, W. (1947). *Gestalt Psychology*. New York: Liveright.

Koláčný, A. (1969). Cartographic information—a fundamental concept and term in modern cartography. *Cartographic Journal*, 6, 47–49.

Korac, N. (1988). Functional, cognitive and semiotic factors in the development of audiovisual comprehension. *ECTJ*, 36(2), 67–91.

Kosslyn, S. M. (1980). *Images and Mind*. Cambridge, MA: Harvard University Press.

Kosslyn, S. M. (1981). The medium and the message in mental imagery. *Psychological Review*, 88, 46–66.

Kosslyn, S. M. (1989). Understanding charts and graphs. *Applied Cognitive Psychology*, 3, 185–226.

Kosslyn, S. M., and Koenig, O. (1992). *Wet Mind: The New Cognitive Neuroscience*. New York: Free Press.

Kraak, M.-J. (1988). *Computer-Assisted Cartographical Three-Dimensional Imaging Techniques*. Delft: Delft University Press.

Kraak, M.-J. (1989). Computer-assisted cartographical 3D imaging techniques. In J. Raper (Ed.), *Three-Dimensional Applications in Geographic Information Systems* (pp. 99–113). London: Taylor & Francis.

Kraak, M.-J. (1993). Cartographic terrain modeling in a three-dimensional GIS environment. *Cartography and Geographic Information Systems*, 20(1), 13–18.

Krampen, M. (1965). Signs and symbols in graphic communication. *Design Quarterly*, 62, 1–31.

Kröse, B. (1987). Local structure analyzers as determinants of preattentive pattern discrimination. *Biological Cybernetics*, 55, 289–298.

Krygier, J. (1991). *An elemental approach to animation and sound in information graphics*. Electronically published on the INGRAPHX listserve.

Krygier, J. (1994). Sound and geographic visualization. In A. M. MacEachren and D. R. F. Taylor (Eds.), *Visualization in Modern Cartography* (pp. 149–166). Oxford, UK: Elsevier.

Krygier, J. (forthcoming). *Visualization, Geography, and Derelict Landscapes*. Unpublished Ph.D. dissertation, Pennsylvania State University.

Kubovy, M. (1981). Concurrent pitch segregation and the theory of indispensable attributes. In M. Kubovy and J. Pomerantz (Eds.), *Perceptual Organization* (pp. 55–98). Hillsdale, NJ: Erlbaum.

Kuhn, T. S. (1970). *The Structure of Scientific Revolutions* (2nd ed.). Chicago: University of Chicago Press.

Labov, W. (1973). The boundaries of words and their meanings. In J. Fishman (Ed.), *New Ways of Analyzing Variation in English* (pp. 340–373). Washington, DC: Georgetown University Press.

Lakoff, G. (1987). *Woman, Fire, and Dangerous Things: What Categories Reveal about the Mind*. Chicago: University of Chicago Press.

Lakoff, G., and Johnson, M. (1980). *Metaphors We Live By*. Chicago: University of Chicago Press.

Lamb, M., and Robertson, L. (1988). The processing of hierarchical stimuli: Ef-

fects of retinal locus, locational uncertainty, and stimulus identity. *Perception and Psychophysics, 44*(2), 172–181.

Land, E. H., and McCann, J. J. (1971). Lightness and retinex theory. *Journal of the Optical Society of America, 61*, 1–11.

Larkin, J., McDermott, J., Simon, D. P., and Simon, H. A. (1980). Expert and novice performance in solving physics problems. *Science, 208*, 1335–1342.

Larkin, J. H., and Simon, H. A. (1987). Why a diagram is (sometimes) worth ten thousand words. *Cognitive Science, 11*, 65–99.

Lavin, S. (1986). Mapping continuous geographical distributions using dot-density shading. *American Cartographer, 13*(2), 140–150.

Leach, E. (1964). Anthropological aspects of language: Animal categories and verbal abuse. In E. H. Lenneberg (Ed.), *New Directions in the Study of Language* (pp. 23–64). Cambridge, MA: MIT Press.

Leonard, J. J., and Buttenfield, B. P. (1989). An equal value gray scale for laser printer mapping. *American Cartographer, 16*(2), 97–107.

Levine, M., Jankovic, L., and Palij, M. (1982). Principles of spatial problem solving. *Journal of Experimental Psychology: General, 111*, 157–175.

Lewandowsky, S., and Spence, I. (1989). Discriminating strata in scatterplots. *Journal of the American Statistical Association, 84*(407), 682–688.

Lewis, P. (1992). Introducing a cartographic masterpiece: A review of the U.S. Geological Survey's digital terrain map of the United States, by Gail Thelin and Richard Pike. *Annals of the Association of American Geographers, 82*(2), 289–304.

Liben, L. S., and Downs, R. M. (1989). Understanding maps as symbols: The development of map concepts in children. *Advances in Child Development and Behavior, 22*, 145–201.

Lindauer, M., and Lindauer, J. (1970). Brightness differences and the perception of figure–ground. *Journal of Experimental Psychology, 84*(2), 291–295.

Liu, Y., and Wickens, C. D. (1992). Use of computer graphics and cluster analysis in aiding relational judgment. *Human Factors, 34*(2), 165–178.

Liverman, D. M., and O'Brian, K. L. (1991). Global warming and climate change in Mexico. *Global Environmental Change, 1*(4), 351–364.

Lloyd, R. (1982). A look at images. *Annals of the Association of American Geographers, 72*, 532–548.

Lloyd, R. (1988). Searching for map symbols: The cognitive processes. *American Cartographer, 15*(4), 363–377.

Lloyd, R. (1989). Cognitive maps: Encoding and decoding information. *Annals of the Association of American Geographers, 79*(1), 101–124.

Lloyd, R., and Steinke, T. (1976). The decision-making process for judging the similarity of choropleth maps. *American Cartographer, 3*, 177–184.

Lloyd, R., and Steinke, T. (1985). Comparison of qualitative point symbols: The cognitive process. *American Cartographer, 12*, 156–168.

Lobeck, A. K. (1958). *Block Diagrams* (2nd ed.). Amherst, MA: Emerson–Trussel.

Lockhead, G. R. (1970). Identification and the form of multidimensional discrimination space. *Journal of Experimental Psychology, 85*, 1–10.

Luckiesh, M. (1918). On "retiring" and "advancing" colors. *American Journal of Psychology, 29*, 182–186.

Luria, S. M., Neri, D. F., and Jacobsen, A. R. (1986). The effects of set size on color matching using CRT displays. *Human Factors*, 28(1), 49–61.

Lynch, K. (1960). *The Image of the City*. Cambridge, MA: MIT Press.

Lyutyy, A. A. (1985). On the essence of the language of the map. *Mapping Sciences and Remote Sensing*, 23, 127–139.

MacDougall, E. B. (1992). Exploratory analysis, dynamic statistical visualization, and geographic information systems. *Cartography and Geographic Information Systems*, 19(4), 237–246.

MacEachren, A. M. (1979). *Communication Effectiveness of Choropleth and Isopleth Maps: The Influence of Visual Complexity*. Unpublished Ph.D. dissertation, University of Kansas.

MacEachren, A. M. (1982). The role of complexity and symbolization method in thematic map effectiveness. *Annals of the Association of American Geographers*, 72, 495–513.

MacEachren, A. M. (1989, March). Review of [Yamahira, T., Kasahara, Yutaka, and Tsurutani, Tateyuki (1985). How map designers can represent their ideas in thematic maps. *The Visual Computer*, 1, 174–184.] *Cartographic Perspectives*, No. 11, 5–16.

MacEachren, A. M. (1991a). The role of maps in spatial knowledge acquisition. *Cartographic Journal*, 28, 152–162.

MacEachren, A. M. (1991b). *Visualization Quality and the Representation of Uncertainty*. Orono, ME: National Center for Geographic Information and Analysis.

MacEachren, A. M. (1992a). Application of environmental learning theory to spatial knowledge acquisition from maps. *Annals of the Association of American Geographers*, 82(2), 245–274.

MacEachren, A. M. (1992b, Fall). Visualizing uncertain information. *Cartographic Perspectives*, No. 13, 10–19.

MacEachren, A. M. (1994a). *Some Truth with Maps: A Primer on Design and Symbolization*. Washington, DC: Association of American Geographers.

MacEachren, A. M. (1994b). Viewing time as a cartographic variable. In H. Hearnshaw and D. Unwin (Eds.), *Visualization in GIS* (pp. 115–130). London: Wiley.

MacEachren, A. M. (1994c). Visualization in modern cartography: Setting the agenda. In A. M. MacEachren and D. R. F. Taylor (Eds.), *Visualization in Modern Cartography* (pp. 1–12). Oxford, UK: Elsevier.

MacEachren, A. M. (in collaboration with Buttenfield, B., Campbell, J., DiBiase, D., and Monmonier, M.) (1992). Visualization. In R. Abler, M. Marcus, and J. Olson (Eds.), *Geography's Inner Worlds: Pervasive Themes in Contemporary American Geography* (pp. 99–137). New Brunswick, NJ: Rutgers University Press.

MacEachren, A. M., and DiBiase, D. W. (1991). Animated maps of aggregate data: Conceptual and practical problems. *Cartography and Geographic Information Systems*, 18(4), 221–229.

MacEachren, A. M., and Ganter, J. H. (1990). A pattern identification approach to cartographic visualization. *Cartographica*, 27(2), 64–81.

MacEachren, A. M., Howard, D., von Wyss, M., Askov, D., and Taormino, T. (1993). Visualizing the health of Chesapeake Bay: An uncertain endeavor.

Proceedings, GIS/LIS '93, Minneapolis, MN, November 2–4, ACSM & ASPRS, pp. 449–458.

MacEachren, A. M., and Mistrick, T. A. (1992). The role of brightness differences in figure–ground: Is darker figure? Cartographic Journal, 29(2), 91–100.

Mackworth, N. H., and Morandi, A. J. (1967). The gaze selects the information details within pictures. Perception and Psychophysics, 2, 547–552.

Maclean, A. L., D'Avello, T. P., and Shetron, S. G. (1993). The use of variability diagrams to improve the interpretation of digital soil maps in a GIS. Photogrammetric Engineering and Remote Sensing, 59(2), 223–228.

Makkonen, K., and Sainio, R. (1991). Computer assisted cartographic communication. Proceedings, 15th Conference of the International Cartographic Association, September 23–October 1, Bournemouth, UK, pp. 211–222.

Malik, J., and Perona, P. (1990). Preattentive texture discrimination with early vision mechanisms. Journal of the Optical Society of America, A7, 923–932.

Margolis, H. (1987). Patterns, Thinking, and Cognition: A Theory of Judgment. Chicago: University of Chicago Press.

Mark, D., and Frank, A. (Eds.). (1991). Cognitive and Linguistic Aspects of Geographic Space, NATO ASI Series D: Behavioral and Social Sciences, Volume 63. Dordrecht: Kluwer Academic.

Mark, D. M., and Gold, M. D. (1991). Interacting with geographic information: A commentary. Photogrammetric Engineering and Remote Sensing, 57(11), 1427–1430.

Marr, D. (1982). Vision: A Computational Investigation into the Human Representation and Processing of Visual Information. San Francisco: W. H. Freeman.

Marr, D. (1985). Vision: The philosophy and the approach. In A. M. Aitkenhead and J. M. Slack (Eds.), Issues in Cognitive Modeling (pp. 103–126). London: Erlbaum.

Marr, D., and Nishihara, H. K. (1978). Representation and recognition of the spatial organization of three-dimensional shapes. Proceedings of the Royal Society, 200, 269–294.

Marshall, R., Kempf, J., and Dyer, S. (1990). Visualization methods and simulation steering for a 3D turbulence model of Lake Erie. Computer Graphics, 24(2), 89–97.

Martinet, J. (1973). Clefs pour la Sémiologie. Paris: Editions Seghers.

Martinet, J. (1990). The semiotics of Luis Prieto. In T. A. Sebeok and Umiker-Sebeok (Eds.), The Semiotic Web 1989 (pp. 89–108). Berlin: Mouton de Gruyter.

McCleary, G. F. (1970). Beyond simple psychophysics: Approaches to the understanding of map perception. Technical Papers, ACSM, 189–209.

McCleary, G. F. (1975). In pursuit of the map user. Proceedings, Auto-Carto II, September 21–25, Washington, DC, U.S. Bureau of the Census & ACSM, pp. 238–250.

McCleary, G. F. (1981). How to design an effective graphics presentation. Harvard Library of Computer Graphics 1981 Mapping Collection, 17, 15–64.

McGranaghan, M. (1989). Ordering choropleth map symbols: The effect of background. American Cartographer, 16(4), 279–285.

McGranaghan, M., Mark, D., and Gould, M. D. (1987). Automated provision of navigation assistance to drivers. *American Cartographer, 14*(2), 121–138.

McGuigan, F. J. (1957). An investigation of several methods of teaching contour interpretation. *Journal of Applied Psychology, 41*, 53–57.

McGuinness, C., van Wersch, A., and Stringer, P. (1993). User differences in a GIS environment: A protocol study. *Proceedings, 16th Conference of the International Cartographic Association*, May 3–9, Cologne, Germany, pp. 478–485.

McLay, W. J. (1987). *Two-Variable Mapping: A Practical Case for the Soil Map*. Unpublished master's thesis, Pennsylvania State University.

Medyckyj-Scott, D., and Board, C. (1991). Cognitive cartography: A new heart for a lost soul. In J.-C. Muller (Ed.), *Advances in Cartography* (pp. 201–230). London: Elsevier.

Mersey, J. E. (1990). *Colour and Thematic Map Design: The Role of Colour Scheme and Map Complexity in Choropleth Map Communication, Monograph 41, Cartographica, 27*(3).

Metz, C. (1974). *Film Language: A Semiotics of the Cinema*. New York: Oxford University Press. (French edition, 1968)

Metzger, P. (1992). *Perspective without Pain*. Cincinnati: North Light Books.

Meyers, G. (1988). Every picture tells a story: Illustrations in E. O. Wilson's *Sociobiology*. In M. Lynch and S. Woolgar (Eds.), *Representation in Scientific Practice* (pp. 231–265). Cambridge, MA: MIT Press.

Mistrick, T. (1990). *The Effects of Brightness Contrast on Figure–Ground Discrimination for Black and White Maps*. Unpublished master's thesis, Pennsylvania State University.

Moellering, H. (1976). The potential uses of a computer animated film in the analysis of geographical patterns of traffic crashes. *Accident Analysis and Prevention, 8*, 215–227.

Moellering, H. (1980a). The real-time animation of three dimensional maps. *American Cartographer, 7*, 67–75.

Moellering, H. (1980b). Strategies of real-time cartography. *Cartographic Journal, 17*, 12–15.

Moellering, H. (1993). MKS-Aspect™—a new way of rendering cartographic Z surfaces. *Proceedings, 16th Conference of the International Cartographic Association*, May 3–9, Cologne, Germany, pp. 675–681.

Moellering, H., and Kimerling, J. (1990). A new digital slope–aspect display process. *Cartography and Geographic Information Systems, 17*(2), 151–159.

Mollon, J. (1990). The tricks of colour. In C. B. H. Barlow and M. Weston-Smith (Eds.), *Images and Understanding* (pp. 61–78). Cambridge: Cambridge University Press.

Monmonier, M. (1972). Contiguity-biased class-interval selection: A method for simplifying patterns on statistical maps. *Geographical Review, 62*, 203–228.

Monmonier, M. (1989a). Geographic brushing: Enhancing exploratory analysis of the scatterplot matrix. *Geographical Analysis, 21*(1), 81–84.

Monmonier, M. (1989b). Graphic scripts for the sequenced visualization of geographic data. *Proceedings, GIS/LIS '89, ASPRS & ACSM*, pp. 381–389.

Monmonier, M. (1990). Strategies for the visualization of geographic time-series data. *Cartographica*, *27*(1), 30–45.

Monmonier, M. (1991a). *How to Lie with Maps*. Chicago: University of Chicago Press.

Monmonier, M. (1991b). On the design and application of biplots in geographic visualization. *Journal of the Pennsylvania Academy of Science*, *65*(1), 40–47.

Monmonier, M. (1992). Authoring graphics scripts: Experiences and principles. *Cartography and Geographic Information Systems*, *19*(4), 247–260.

Monmonier, M., and Gluck, M. (1994). Focus groups for design improvement in dynamic cartography. *Cartography and Geographic Information Systems*, *21*(1), 37–47.

Morita, T. (1991). *The Measurement of Eye Movements for Map Design Evaluation: Legibility of Quantitative Symbols*. Paper presented at the 15th Meeting of the International Cartographic Association, September 23–October 1, Bournemouth, UK.

Morris, C. W. (1938). *Foundations of the Unity of Science: Towards an International Encyclopedia of Unified Science, Volumes 1 and 2*. Chicago: University of Chicago Press.

Morris, C. W. (1971). Esthetics and the theory of signs. In C. W. Morris (Ed.), *Writings on the General Theory of Signs* (pp. 415–433). The Hague: Mouton. (Original paper published 1939)

Morris, C. W. (1971). Signs, language, and behavior. In C. Morris (Ed.), *Writings on the General Theory of Signs* (pp. 73–398). The Hague: Mouton. (Original paper published 1946)

Morris, C. W. (1964). *Signification and Significance*. Cambridge, MA: MIT Press.

Morrison, J. L. (1974). A theoretical framework for cartographic generalization with the emphasis on the process of symbolization. *International Yearbook of Cartography*, *14*, 115–127.

Morrison, J. L. (1984). Applied cartographic communication: Map symbolization for atlases. *New Insights in Cartographic Communication, Monograph 31, Cartographica*, *21*, 44–84.

Movshon, A. (1990). Visual processing of moving images. In C. B. H. Barlow and M. Weston-Smith (Eds.), *Images and Understanding* (pp. 122–137). Cambridge: Cambridge University Press.

Mowafy, L., Blake, R., and Lappin, J. S. (1990). Detection and discrimination of coherent motion. *Perception and Psychophysics*, *48*(6), 583–592.

Muehrcke, P. (1973). Visual pattern comparison in map reading. *Proceedings, Association of American Geographers*, April 14–18, Atlanta, GA, pp. 190–194.

Muehrcke, P. (1974). Beyond abstract map symbols. *Journal of Geography*, *73*(8), 35–52.

Muehrcke, P. (1990). Cartography and geographic information systems. *Cartography and Geographic Information Systems*, *17*(1), 7–15.

Muehrcke, P., and Muehrcke, J. O. (1974). Maps in literature. *Geographical Review*, *64*, 317–338.

Muehrcke, P., and Muehrcke, J. O. (1978). *Map Use: Reading, Analysis, and Interpretation*. Madison, WI: JP Publications.

Mulder, J., and Hervey, S. (1990). *The Strategy of Linguistics*. Edinburgh: Scotish Academic Press.

Muller, J.-C. (1979). Perception of continuously shaded maps. *Annals of the Association of American Geographers*, 69, 240–249.

Murphy, G. L., and Medin, D. L. (1985). The role of theories in conceptual coherence. *Psychological Review*, 92(3), 289–316.

Nakayama, K., and Silverman, G. H. (1986). Serial and parallel processes of visual feature conjunctions. *Nature*, 320, 264–265.

Navon, D. (1977). Forest before trees: The precedence of global features in visual perception. *Cognitive Psychology*, 9, 353–383.

Neisser, U. (1976). *Cognition and Reality: Principles and Implications of Cognitive Psychology*. San Francisco: W. H. Freeman.

Neisser, U. (1987). A sense of where you are: Functions of the spatial module. In *Proceedings of the NATO Advanced Study Institute on Cognitive Processes and Spatial Orientation in Animal and Man, 1985* (pp. 293–311). La-Baume-les-Aix, France: Martinus Nijhoff.

Nöth, W. (1990). *Handbook of Semiotics*. Bloomington: Indiana University Press.

Nothdurft, H.-C. (1992). Feature analysis and the role of similarity in preattentive vision. *Perception and Psychophysics*, 52(4), 355–375.

Nyerges, T. L. (1991a). Geographic information abstractions: Conceptual clarity for geographic modeling. *Environment and Planning A*, 23, 1483–1499.

Nyerges, T. L. (1991b). Representing geographical meaning. In B. P. Buttenfield and R. B. McMaster (Eds.), *Map Generalization: Making Rules for Knowledge Representation* (pp. 59–85). Essex, UK: Longman.

Ogden, C. K., and Richards, I. A. (1923). *The Meaning of Meaning*. New York: Harcourt, Brace & Co.

Olson, J. M. (1972). Class interval system on maps of observed correlation distribution. *Canadian Cartographer*, 9, 122–131.

Olson, J. M. (1976). A coordinated approach to map communication improvement. *American Cartographer*, 3, 151–159.

Olson, J. M. (1979). Cognitive cartographic experimentation. *Canadian Cartographer*, 16, 34–44.

Olson, J. M. (1981). Spectrally encoded two-variable maps. *Annals of the Association of American Geographers*, 71(2), 259–276.

Olson, J. M. (1983). Future research directions in cartographic communication and design. In D. R. F. Taylor (Ed.), *Graphic Communication and Design in Contemporary Cartography, Volume 2, Progress in Contemporary Cartography* (pp. 257–284). New York: Wiley.

Olson, J. M. (1989, February). *Maps for People with Defective Color Vision: Experimental Results*. Paper presented at the Pennsylvania State University Department of Geography Coffee Hour.

Olson, J. M. (1994). Problems and uses of color in cartography: Examples from Michigan State University. In J. Bares (Chair/Ed.), *Color Hardcopy and Graphic Arts III, Proceedings, SPIE—The International Society for Optical Engineering, Volume 2171*, pp. 46–53.

Olson, R. K., and Attneave, F. (1970). What variables produce similarity grouping? *American Journal of Psychology*, 83, 1–21.

Oyama, T. (1960). Figure–ground dominance as a function of sector angle, brightness, hue, and orientation. *Journal of Experimental Psychology*, 60(5), 299–305.

Paivio, A. (1969). Mental imagery in associative learning and memory. *Psychological Review*, 76, 241–263.

Palmer, S. E. (1975). Visual perception and world knowledge: Notes on a model of sensory-cognitive interaction. In D. A. Norman and D. E. Rumelhart (Eds.), *Explorations in Cognition* (pp. 279–307). San Francisco: W. H. Freeman.

Palmer, S. E. (1977). Hierarchical structure in perceptual representation. *Cognitive Psychology*, 9, 441–474.

Papathomas, T. V., and Julesz, B. (1988). The application of depth separation to the display of large data sets. In W. S. Cleveland and M. E. McGill (Eds.), *Dynamic Graphics for Statistics* (pp. 353–377). Belmont, CA: Wadsworth.

Paquet, L., and Merikle, P. (1988). Global precedence in attended and nonattended objects. *Journal of Experimental Psychology: Human Perception and Performance*, 14(1), 89–100.

Patton, J. C., and Crawford, P. V. (1978). The perception of hyposometric colours. *Cartographic Journal*, 15, 115–127.

Peirce, C. S. (1985). Logic as semiotic: The theory of signs. In R. E. Innis (Ed.), *Semiotics: An Introductory Anthology* (pp. 4–23). Bloomington: Indiana University Press.

Penn, A. (1993). Intelligent analysis of urban space patterns: Graphical interfaces to precedent databases for urban design. *Proceedings, Auto-Carto 11*, October 30–November 1, Minneapolis, MN, ASPRS & ACSM, pp. 53–62.

Pentland, A. P. (1985). The focal gradient: Optics ecologically salient (abstract). *Ophthalmology and Visual Science, Supplement*, 26(3), 243.

Perkins, D. N. (1981). *The Mind's Best Work*. Cambridge, MA: Harvard University Press.

Perkins, D. N. (1988). Creativity and the quest for mechanism. In R. J. Sternberg and E. E. Smith (Eds.), *The Psychology of Human Thought* (pp. 309–336). Cambridge: Cambridge University Press.

Petchenik, B. B. (1975). Cognition in cartography. *Proceedings, Auto-Carto II*, September 21–25, Washington, DC, U.S. Bureau of the Census & ACSM, pp. 183–193.

Peterson, M. A., and Gibson, B. S. (1991). The initial identification of figure–ground relationships: Contributions from shape recognition processes. *Journal of Experimental Psychology: Human Learning and Memory*, 29(3), 199–202.

Peterson, M. A., Harvey, E. M., and Weidenbacher, H. J. (1991). Shape recognition contributions to figure–ground reversal: Which route counts? *Journal of Experimental Psychology: Human Perception and Performance*, 17(4), 1075–1089.

Peterson, M. J., and Graham, S. E. (1974). Visual detection and visual imagery. *Journal of Experimental Psychology*, 103(3), 509–514.

Peterson, M. P. (1979). An evaluation of unclassed crossed-line choropleth mapping. *American Cartographer*, 6(1), 21–37.

Peterson, M. P. (1985). Evaluating a map's image. *American Cartographer, 12,* 41–55.

Peterson, M. P. (1987). The mental image in cartographic communication. *Cartographic Journal, 24*(1), 35–41.

Peuquet, D. J. (1988). Representations of geographic space: Toward a conceptual synthesis. *Annals of the Association of American Geographers, 78*(3), 373–394.

Peuquet, D. J. (1994). It's about time: A conceptual framework for the representation of temporal dynamics in geographic information systems. *Annals of the Association of American Geographers, 84*(3), 441–461.

Phillips, R. J. (1984). Experimental method in cartographic communication: Research on relief maps. *New Insights in Cartographic Communication, Monograph 31, Cartographica, 21*(4), 120–128.

Phillips, R. J., and Noyes, L. (1977). Searching for names in two city street maps. *Applied Ergonomics, 8*(2), 73–77.

Phillips, R. J., Noyes, L., and Audley, R. J. (1978). Searching for names on maps. *Cartographic Journal, 15,* 72–77.

Phillips, W. A. (1974). On the distinction between sensory storage and short-term visual memory. *Perception and Psychophysics, 16,* 283–290.

Phillips, W. A. (1983). Short-term visual memory. *Philosophical Transactions of the Royal Society of London, B302,* 295–309.

Pike, R. J., and Thelin, G. P. (1989). Shaded relief map of U.S. topography from digital elevations. *Eos, 70*(38), cover, 843, 853.

Pinker, S. (1984). Visual cognition: An introduction. *Cognition, 18,* 1–63.

Pinker, S. (1990). A theory of graph comprehension. In R. Friedle (Ed.), *Artificial Intelligence and the Future of Testing* (pp. 73–126). Norwood, NJ: Ablex.

Pittman, K. (1992). A laboratory for the visualization of virtual environments. *Landscape and Urban Planning, 21,* 327–331.

Plumb, G. A. (1988). Displaying GIS data sets using cartographic classification techniques. *Proceedings, GIS/LIS '88: Assessing the World, Volume 1,* November 30–December 2, San Antonio, TX, pp. 340–349.

Pomerantz, J. R. (1985). Perceptual organization in information processing. In A. M. Aitkenhead and J. M. Slack (Eds.), *Issues in Cognitive Modelling.* London: Erlbaum.

Pomerantz, J. R., and Garner, W. R. (1973). Stimulus configuration in selective attention tasks. *Perception and Psychophysics, 14,* 565–569.

Pomerantz, J. R., and Schwaitzberg, S. D. (1975). Grouping by proximity: Selective attention measures. *Perception and Psychophysics, 18,* 335–361.

Pomerantz, S. (1983). Global and local precedence: Selective attention in form and motion perception. *Journal of Experimental Psychology: General, 112*(4), 516–540.

Posner, M. I. (1980). Orienting attention. *Quarterly Journal of Experimental Psychology, 32,* 3–25.

Pylyshyn, Z. W. (1981). The imagery debate: Analogue media versus tacit knowledge. *Psychological Review, 88,* 16–45.

Quinlan, P. T., and Humphreys, G. W. (1987). Visual search for targets defined by combinations of color, shape, and size: An examination of the task con-

straints on feature and conjunction searches. *Perception and Psychophysics,* *41*(5), 455–472.

Rabenhorst, D. A., Farrell, E. J., Jameson, D. H., Linton, T. D., and Mandelman, J. A. (1990). Complementary visualization and sonification of multi-dimensional data. *Proceedings, Extracting Meaning from Complex Data: Processing, Display, Interaction,* February 14–16, Santa Clara, CA, SPIE—The International Society for Optical Engineering, pp. 147–153.

Rader, C. P. (1989). *A Functional Model of Color in Cartographic Design.* Unpublished master's thesis, University of Washington.

Raichle, M. (1991). Plate 3.1: Computerized PET images showing the changes in local blood flow in the brain, associated with local changes in neuronal activity, that occur during different states of information processing. In C. M. Pechura and J. B. Martin (Eds.), *Mapping the Brain and Its Functions: Integrating Enabling Technologies into Neuroscience Research.* Washington, DC: National Academy Press.

Ramachandran, V. S., and Anstis, S. M. (1986). The perception of apparent motion. *Scientific American, 254*(6), 102–109.

Raper, J. (Ed.). (1989). *Three-Dimensional Applications in Geographic Information Systems.* London: Taylor & Francis.

Ratajski, L. (1971). The methodical basis of the standardization of signs on economic maps. *International Yearbook of Cartography, 11,* 137–159.

Ratner, C. (1989). A sociohistorical critique of naturalistic theories of color perception. *Journal of Mind and Behavior, 10,* 361–372.

Rheingans, P. (1992). Color, change, and control of quantitative data display. *Proceedings, Visualization '92,* October 19–23, Boston, IEEE Computer Society Technical Committee on Computer Graphics, pp. 252–259.

Rheingans, P., and Tebbs, B. (1990). A tool for dynamic explorations of color mappings. *Computer Graphics, 24*(2), 145–146.

Rhind, D. (1993). Mapping for the new millenium. *Proceedings, 16th Conference of the International Cartographic Association,* May 3–9, Cologne, Germany, pp. 3–14.

Rice, K. (1990). Disoriented prism maps: A recognition experiment (abstract). *Cartographic Perspectives, 4,* 32.

Robinson, A. H. (1952). *The Look of Maps.* Madison: University of Wisconsin Press.

Robinson, A. H. (1953). *Elements of Cartography.* New York: Wiley.

Robinson, A. H. (1960). Symbolization and processing map data. In *Elements of Cartography* (2nd ed, pp. 136–145). New York: Wiley.

Robinson, A. H. (1967). Psychological aspects of color in cartography. *International Yearbook of Cartography, 7,* 50–61.

Robinson, A. H. (1973). An international standard symbolism for thematic maps: Approaches and problems. *International Yearbook of Cartography, 13,* 19–26.

Robinson, A. H., and Petchenik, B. B. (1976). *The Nature of Maps.* Chicago: University of Chicago Press.

Robinson, A. H., Sale, R. D., Morrison, J. L., and Muehrcke, P. C. (1984). *Elements of Cartography* (5th ed.). New York: Wiley.

Rogers, J. E., and Groop, R. E. (1981). Regional portrayal with multi-pattern color dot maps. *Cartographica*, 18(4), 51–64.

Rollins, M. (1989). *Mental Imagery: On the Limits of Cognitive Science*. New Haven: Yale University Press.

Rosch, E. (1973). Natural categories. *Cognitive Psychology*, 4, 328–350.

Rosch, E. (1975a). Cognitive reference points. *Cognitive Psychology*, 7, 532–547.

Rosch, E. (1975b). Cognitive representations of semantic concepts. *Journal of Experimental Psychology: General*, 104(3), 192–233.

Rosch, E. (1977). Human categorization. In N. Warren (Ed.), *Studies in Cross-Cultural Psychology* (pp. 27–48). London: Academic Press.

Rosch, E. (1978). Principles of categorization. In E. Rosch and B. B. Lloyd (Eds.), *Cognition and Categorization* (pp. 27–48). Hillsdale, NJ: Erlbaum.

Rosch, E., and Lloyd, B. B. (Eds.). (1975). *Cognition and Categorization*. Hillsdale, NJ: Erlbaum.

Rosch, E., Mervis, C., Gray, W., Johnson, D., and Boyes-Braem, P. (1976). Basic objects in natural categories. *Cognitive Psychology*, 8, 382–439.

Roth, I., and Frisby, J. P. (1986). *Perception and Representation: A Cognitive Approach*. Philadelphia: Open University Press.

Rowles, R. A. (1978). Perception of perspective block diagrams. *American Cartographer*, 5, 331–344.

Rumelhart, D. E., and Norman, D. A. (1985). Representation of knowledge. In A. M. Aitkenhead and J. M. Slack (Eds.), *Issues in Cognitive Modeling* (pp. 15–62). London: Erlbaum.

Rumelhart, D. E., and Ortony, A. (1977). The representation of knowledge in memory. In R. C. Anderson, R. J. Spiro, and W. E. Montague (Eds.), *Schooling and the Acquisition of Knowledge* (pp. 99–135). Hillsdale, NJ: Erlbaum.

Rundstrom, R. (1993). The role of ethics, mapping, and the meaning of place in relations between Indians and whites in the United States. *Introducing Cultural and Social Cartography, Monograph 44, Cartographica*, 30(1), 21–28.

Saint-Martin, F. (1989). From visible to visual language: Artificial intelligence and visual semiology. *Semiotica*, 77(1/3), 303–316.

Salichtchev, K. A. (1983). Cartographic communication: A theoretical survey. In D. R. F. Taylor (Ed.), *Graphic Communication and Design in Contemporary Cartography, Volume 2, Progress in Contemporary Cartography* (pp. 11–36). New York: Wiley.

Saushkin, Y. G., and Il'yina, L. N. (1985). Conversations in the language of maps. *Soviet Geography*, 26, 1–10.

Saussure, F. de. (1986). *Cours de Linguistique Générale*, 25th ed. (C. Bally and A. Sechehaye, Eds.). Paris: Payot. (Original work published 1916)

Schank, R. C., and Abelson, R. P. (1977). *Scripts, Plans, Goals and Understanding: An Inquiry into Human Knowledge Structures*. Hillsdale, NJ: Erlbaum.

Schlichtmann, H. (1979). Codes in map communication. *Canadian Cartographer*, 16, 81–97.

Schlichtmann, H. (1984). Discussion of C. Grant Head, "The map as natural language: A paradigm for understanding." *Cartographica*, 21, 33–36.

Schlichtmann, H. (1985). Characteristic traits of the semiotic system "map symposium." *Cartographic Journal*, 22, 23–30.

Schlichtmann, H. (1991). Plan information and its retrieval in map interpretation: The view from semiotics. In D. M. Mark and A. U. Frank (Eds.), *Cognitive and Linguistic Aspects of Geographic Space* (pp. 263–284). Amsterdam: Kluwer Academic.

Schneider, W., and Shiffrin, R. M. (1977). Controlled and automatic human information processing: 1. Detection, search, and attention. *Psychological Review*, 84, 1–66.

Schustack, M. W. (1988). Thinking about causality. In R. J. Sternberg and E. E. Smith (Eds.), *The Psychology of Human Thought* (pp. 92–115). Cambridge: Cambridge University Press.

Schweizer, D. M., and Goodchild, M. F. (1992). Data quality and choropleth maps: An experiment with the use of color. *Proceedings, GIS/LIS '92*, November 10–12, San Jose, CA, ACSM & ASPRS, pp. 686–699.

Sebeok, T. A. (1976). Problems in the classification of signs. In T. Sebeok (Ed.), *Contributions to the Doctrine of Signs, Volume 5, Studies in Semiotics* (pp. 71–143). Bloomington: Indiana University Press.

Shannon, C., and Weaver, W. (1949). *The Mathematical Theory of Communication*. Urbana: University of Illinois Press.

Shapley, R., Caelli, T., Grossberg, S., Morgan, M., and Rentschler, I. (1990). Computational theories of visual perception. In L. Spillmann and J. S. Werner (Eds.), *Visual Perception: The Neurophysiological Foundations* (pp. 417–447). New York: Academic Press.

Shepard, R. N. (1978). The mental image. *American Psychologist*, 33, 125–137.

Shepard, R. N., and Cooper, L. (1982). *Mental Images and Their Transformations*. Cambridge, MA: MIT Press.

Shortridge, B. G. (1979). Map reader discrimination of lettering size. *American Cartographer*, 6, 13–20.

Shortridge, B. G. (1982). Stimulus processing models from psychology: Can we use them in cartography? *American Cartographer*, 9, 155–167.

Shortridge, B. G., and Welch, R. B. (1980). Are we asking the right questions? Comments on instructions in cartographic psychophysical studies. *American Cartographer*, 7, 19–23.

Shortridge, B. G., and Welch, R. B. (1982). The effect of stimulus redundancy on the discrimination of town size on maps. *American Cartographer*, 9, 69–80.

Simcox, W. A. (1983). *A Perceptual Analysis of Graphic Information Processing*. Unpublished Ph.D. dissertation, Tufts University, Medford, MA.

Singh, G., and Chignell, M. H. (1992). Components of the visual computer: A review of relevant technologies. *Visual Computer*, 9, 115–142.

Slocum, T. A. (1983). Predicting visual clusters on graduated circle maps. *American Cartographer*, 10, 59–72.

Slocum, T. A., and McMaster, R. B. (1986). Gray tone versus line plotter area symbols: A matching experiment. *American Cartographer*, 13(2), 151–164.

Slocum, T. A., Roberson, S. H., and Egbert, S. L. (1990). Traditional versus sequenced choropleth maps: An experimental investigation. *Cartographica*, 27(1), 67–88.

Smith, E. E., and Medin, D. L. (1981). *Categories and Conceps*. Cambridge, MA: Harvard University Press.

Smith, S., Grinstein, G., and Pickett, R. (1991). Global geometric, sound, and color controls for iconographic displays of scientific data. *Proceedings, Extracting Meaning from Complex Data: Processing, Display, Interaction II*, February 26–28, Santa Clara, CA, SPIE—The International Society for Optical Engineering, pp. 192–206.

Speeth, S. D. (1961). Seismometer sounds. *Journal of the Acoustical Society of America, 33*, 909–916.

Spiess, E. (1978). *Some Graphic Means to Establish Visual Levels in Map Design*. Paper presented at the 9th International Conference on Cartography, July 26–August 2, College Park.

Spiess, E. (1988). Map compilation. In R. W. Anson (Ed.), *Basic Cartography for Students and Technicians, Volume 2* (pp. 35–69). London: International Cartographic Association.

Steinke, T. R. (1987). Eye movement studies in cartography and related fields. *Studies in Cartography, Monograph 37, Cartographica, 24*(2), 40–73.

Steinke, T. R., and Lloyd, R. E. (1983a). Images of maps: A rotation experiment. *Professional Geographer, 35*(4), 455–461.

Steinke, T. R., and Lloyd, R. E. (1983b). Judging the similarity of choropleth map images. *Cartographica, 20*, 35–42.

Suchan, T. (1991). *Useful Categories: A Cognitive Approach to Land Use Categorization Systems*. Unpublished master's thesis, University of Washington.

Szegö, J. (1987). *Human Cartography: Mapping the World of Man*. Stockholm: Swedish Council for Building Research.

Tanaka, K. (1932). The orthographical relief method of representing hill features on a topographical map. *Geographical Journal, 79*, 213–219.

Tatham, A. F. (1991). The design of tactile maps: Theoretical and practical considerations. *Proceedings, 15th Conference of the International Cartographic Association*, September 23–October 1, Bournemouth, UK, pp. 157–166.

Tatham, A. F., and Dodds, A. G. (Eds.). (1988). *Proceedings of the Second International Symposium on Maps and Graphics for Visually Handicapped People*. London: University of Nottingham.

Taylor, D. R. F. (1991). Geographic information systems: The microcomputer and modern cartography. In D. R. F. Taylor (Ed.), *Geographic Information Systems: The Microcomputer and Modern Cartography* (pp. 1–20). Oxford, UK: Elsevier.

Thomas, E. L., and Lansdown, E. L. (1963). Visual search patterns of radiologists in training. *Radiology, 81*, 288–292.

Tobler, W. R. (1981). Depicting federal fiscal transfers. *Professional Geographer, 33*(4), 419–422.

Travis, D. S. (1990). Applying visual psychophysics to user interface design. *Behaviour and Information Technology, 9*(5), 425–438.

Treinish, L. (1993). Visualization techniques for correlative data analysis in the earth and space sciences. In R. A. Earnshaw and D. Watson (Eds.), *Animation and Scientific Visualization: Tools and Applications* (pp. 193–204). New York: Academic Press.

Treisman, A. (1988). Features and objects: The fourteenth Bartlett Memorial Lecture. *Quarterly Journal of Experimental Psychology, 40A,* 201–237.

Treisman, A., Cavenagh, P., Fischer, B., Ramachandran, V. S., and von der Heydt, R. (1990). Form, perception, and attention. In L. Spillmann and J. S. Werner (Eds.), *Visual Perception: The Neurophysiological Foundations* (pp. 273–316). New York: Academic Press.

Treisman, M. (1985). The magical number seven and some other features of category scaling: Properties of a model for absolute judgement. *Journal of Mathematical Psychology, 29,* 175–230.

Tsal, Y., and Kolbert, L. (1985). Disambiguating ambiguous figures by selective attention. *Quarterly Journal of Experimental Psychology, 37A,* 25–37.

Tsal, Y., and Lavie, N. (1988). Attending to color and shape: The special role of location in selective visual processing. *Perception and Psychophysics, 44,* 15–21.

Tufte, E. (1983). *The Visual Display of Quantitative Information.* Cheshire, CT: Graphics Press.

Tufte, E. (1990). *Envisioning Information.* Cheshire, CT: Graphics Press.

Tukey, J. W. (1977). *Exploratory Data Analysis.* Reading, MA: Addison-Wesley.

Tversky, B., and Hemenway, K. (1984). Objects, parts, and categories. *Journal of Experimental Psychology: General, 113*(2), 169–191.

Tyner, J. A. (1974). *Persuasive Cartography.* Unpublished Ph.D. dissertation, University of California at Los Angeles.

Ucar, D. (1993). A semiological approach to typology of the map signs. *Proceedings, 16th Conference of the International Cartographic Association,* May 3–9, Cologne, Germany, pp. 768–781.

Ullman, S. (1984). Visual routines. *Cognition, 18,* 97–159.

U.S. Environmental Protection Agency. (1990). *Region 6 Comparative Risk Project, Appendix A: Ecological Report.* EPA Region 6 Office of Planning and Analysis, Dallas, TX.

Usery, L. (1993). Category theory and the structure of features in geographic information systems. *Cartography and Geographic Information Systems, 20*(1), 5–12.

Uttal, W. R. (1988). *On Seeing Forms.* Hillsdale, NJ: Erlbaum.

van der Wel, F. J. M. (1993). Visualization of quality information as an indispensable part of optimal information extraction from a GIS. *Proceedings, 16th Conference of the International Cartographic Association,* May 3–9, Cologne, Germany, pp. 881–897.

Vasconcellos, R. (1992). Knowing the Amazon through tactual graphics. *Proceedings, 15th Conference of the International Cartographic Association,* September 23–October 1, Bournemouth, UK, pp. 206–210.

Vasilev, I., Freundschuh, S., Mark, D. M., Theisen, G. D., and McAvoy, J. (1990). What is a map? *Cartographic Journal, 27*(2), 119–123.

Vernon, M. D. (1962). *The Psychology of Perception.* Baltimore: Penguin Books.

Wade, N. J., and Swanston, M. (1991). *Visual Perception.* New York: Routledge.

Wanger, L. R., Ferwerda, J. A., and Greenburg, D. P. (1992, May). Perceiving spatial relationships in computer-generated images. *IEEE Computer Graphics and Applications,* pp. 44–55.

Watt, R. J. (1988). *Visual Processing: Computational, Psychological and Cognitive Research*. London: Erlbaum.

Wever, E. (1927). Figure and ground in the visual perception of form. *American Journal of Psychology, 38*, 194–226.

Wiedel, J. (Ed.). (1983). *Proceedings of the First International Symposium on Maps and Graphics for the Visually Handicapped*, International Cartographic Association.

Williams, L. G. (1967). The effects of target specification on objects fixated during visual search. *Acta Psychologica, 27*, 355–360.

Wilson, H. R., Levi, D., Maffei, L., Rovamo, J., and DeValois, R. (1990). The perception of form. In L. Spillmann and J. S. Werner (Eds.), *Visual Perception: The Neurophysiological Foundations* (pp. 231–272). New York: Academic Press.

Wolodtschenko, A., and Pravda, J. (1993). Cartosemiotics—ideas and inducements. *Proceedings, 16th Conference of the International Cartographic Association*, May 3–9, Cologne, Germany, pp. 1235–1237.

Wong, E., and Weisstein, N. (1983). Sharp targets are detected better against a figure, and blurred targets are detected better against a ground. *Journal of Experimental Psychology: Human Learning and Memory, 9*, 194–202.

Wong, E., and Weisstein, N. (1984). Flicker induces depth: Spatial and temporal factors in the perceptual segregation of flickering and nonflickering regions in depth. *Perception and Psychophysics, 35*, 229–236.

Wood, C. H. (1976). Brightness gradients operant in the cartographic context of figure–ground relationship. *Proceedings, American Congress on Surveying and Mapping*, pp. 5–34.

Wood, D. (1977). Now and then: Comparisons of ordinary American's symbol conventions with those of past cartographers. *Prologue, 9*, 151–161.

Wood, D. (1978). *Cultured Symbols: Thoughts on the Cultural Context of Cartographic Symbols*. Unpublished manuscript, Department of Landscape Architecture, University of North Carolina at Chapel Hill.

Wood, D. (1992). *The Power of Maps*. New York: Guilford Press.

Wood, D., and Fels, J. (1986). Designs on signs: Myth and meaning in maps. *Cartographica, 23*(3), 54–103.

Wood, M. (1968). Visual perception and map design. *Cartographic Journal, 5*, 54–64.

Wood, M. (1972). Human factors in cartographic communication. *Cartographic Journal, 9*, 123–132.

Woods Hole Oceanographic Institute. (1982). *Georges Bank* (map). Cambridge, MA: MIT Press.

Woodsworth, R. S. (1938). *Experimental Psychology*. New York: Holt.

Woodward, D. (1985). Reality, symbolism, time, and space in medieval world maps. *Annals of the Association of American Geographers, 75*(4), 510–521.

Wright, J. K. (1942). Map makers are human: Comments on the subjective in maps. *Geographical Review, 32*(4), 527–544.

Wright, J. K. (1944). The terminology of certain map symbols. *Geographical Review, 34*, 653–654.

Yamahira, T., Kasahara, Y., and Tsurutani, T. (1985). How map designers can represent their ideas in thematic maps. *Visual Computing, 1*, 174–184.

Yapa, L. S. (1992). Why do they map GNP per capita? In S. K. Majumdar, G. S. Forbes, E. W. Miller, and R. F. Schmalz (Eds.), *Natural and Technological Disasters: Causes, Effects and Preventative Measures* (pp. 494–510). Easton: Pennsylvania Academy of Science.

Zadeh, L. (1965). Fuzzy sets. *Information and Control, 8*, 338–353.