

## Mary Hegarty

### Personal:

Born 1958, Dublin Ireland  
US Permanent Resident

### Address:

Department of Psychology  
University of California, Santa Barbara  
Santa Barbara, CA 93106-9660  
(805) 893-3570  
mary.hegarty@psych.ucsb.edu

### Education:

Ph.D. 1988 Carnegie Mellon University (Psychology)  
M.A. 1983 University College Dublin (Psychology)  
B.A. 1980 University College Dublin (Psychology)

### Professional Experience:

2015 – date Associate Dean, Graduate Division, UC Santa Barbara  
2000 – date Professor, Department of Psychology, UC Santa Barbara  
(Affiliate, Department of Geography since 2008)  
1999 - 2000 Visiting Associate Professor, Department of Education and  
Department of Engineering and Computer Science, UC Berkeley  
1995 – 2000 Associate Professor, Department of Psychology, UC Santa Barbara  
1995 Visiting Associate Professor, Department of Psychology and Human  
Development, Vanderbilt University  
1988 - 1995 Assistant Professor, Department of Psychology, UC Santa Barbara  
1981 - 1984 Research Assistant, Educational Research Centre, St Patrick's College,  
Dublin

### Awards and Honors:

2001 Fellow of the American Psychological Society  
1992 National Academy of Education Spencer Fellow  
1989-1990 University of California Faculty Career Development Award  
1984-1985 R. K. Mellon Doctoral Fellowship  
1984 Fulbright Program Travel Grant

**Professional Affiliations:**

American Educational Research Association, Association for Psychological Science, Cognitive Science Society, Psychonomic Society, Women in Cognitive Science.

**Service****Editorial Positions:**

Associate Editor, *TopiCS in Cognitive Science* (2008-date)  
*Journal of Experimental Psychology: Applied* (2013-date)

**Editorial Boards:**

*Spatial Cognition and Computation* (2008 – date),  
*Learning and Individual differences* (2012- date)  
*Journal of Experimental Psychology: Learning, Memory & Cognition* (2007 – 2012)  
*Journal of Educational Psychology* (1993 – 1996, 2010 to 2012)

**Ad Hoc Reviewer:**

*Cognition & Instruction; Cognition; Cognitive Science; Cognitive Psychology; Current Directions in Psychological Science; European Journal of Cognitive Psychology; International Journal of Human-Computer Studies; Journal of Educational Psychology; Journal of Experimental Psychology: Applied; Journal of Experimental Psychology: General; Journal of Experimental Psychology: Perception and Performance; Learning and Individual Differences; Learning and Instruction, Memory and Cognition, National Science Foundation Proceedings of the National Academies of Sciences, Psychological Bulletin; Psychological Review, Psychological Science, Science.*

**Conference Reviewing:**

Annual Meeting of the Cognitive Science Society, Conference on Spatial Information Theory (COSIT); Diagrams Conference Series; International Conference on Geographic Information Science (GIScience), Spatial Cognition Conference series; Artificial Intelligence in Design conference series.

**Service to Professional Organizations:**

Chair, Cognitive Science Society (2010-2011). Executive Committee (2009-2012)  
Governing Board, Cognitive Science Society (2006 – 2012)  
Fellows Committee, Cognitive Science Society (2006 – 2009, 2012)  
Conference Co-Chair, Spatial Cognition, 2016  
Conference Co-Chair, Spatial Cognition 2014  
Conference Co-Chair, AAAI Spring Symposium, March 2005  
Conference Co-Chair, Diagrams 2002

Steering Committee, Diagrams Conference series, 2002 – 2008  
Conference Chair, Mind III, Conference, Cognitive Science Society of Ireland,  
1998.

### **Departmental Service**

Vice Chair, 2009 - 2011, 2006 – 2008, 2003 - 2004  
Executive Committee, 2009 - 2010, 2006 – 2008, 2004 - 2005  
Chair, Graduate Affairs Committee, 2012-2015  
Chair, Graduate Admissions Committee  
Chair, Graduate Affairs Committee 2004 – 2006, 2012-date  
Undergraduate Affairs Committee  
Colloquium Committee, 2006 - 2008

### **UCSB Campus and University Service**

Associate Director, Center for Spatial Studies, 2013 – 2016  
Director, Center for Spatial Studies, 2012 – 2013  
Committee on Privilege and Tenure, 2011 - 2015  
Chair, Cognitive Science Steering Committee (2009 – 2015)  
Academic Assembly, University of California, 2005 – 2007  
Academic Senate Executive Committee, 2005 - 2007  
Committee on Educational Policy and Academic Planning, 2000 – 2002  
Council on Budget and Planning, 2002 - 2003  
Privilege and Tenure Ad-Hoc Committee, 2002 – 2003.  
Ad-Hoc Personnel Committees, 2005, 2003,

### **Courses Taught**

Advanced Research Methods  
Introduction to Cognitive Psychology  
Psychology of Language  
Human Learning  
Human Memory  
Human Reasoning and Problem Solving  
Memory and Cognitive Processes  
Laboratory in Cognitive Psychology  
Freshman/Sophomore Honors Seminar  
Graduate Seminars on Comprehension of Text and Graphics, Eye Fixations and  
Visual Cognition, Embodied Cognition, Individual Differences in Spatial  
Cognition, Mental Imagery, Working Memory, Spatial Cognition.

## **External Funding:**

Fostering Representational Competence with Virtual Models in Chemistry. National Science Foundation, \$656,432, 2013-2017, Co-PI, PI Andrew T. Stull)

Modeling, Display and Understanding Uncertainty in simulations for Policy Decision Making. National Science Foundation. \$599,797, 2012 - 2017 (PI, Co-PI Michael Goodchild)

Investigating the Neural Basis of Individual Differences in Navigational Abilities, Institute for Collaborative Biotechnologies, \$100,000, 2013-2014.

Representation Translation with Concrete and Virtual Models in Chemistry. National Science Foundation, \$667,559, 2010-2014 (PI, Co-PIs Mike Stieff, Bonnie Dixon)

Alternative Strategies for problem solving in science. National Science Foundation. 2007-2011. \$296,257 (PI, Co-PIs Mike Stieff, Bonnie Dixon)

Assessing the relationship between spatial abilities and participation in college science. 2007-2010. \$59,142. (PI, Co-PIs Mike Stieff, Bonnie Dixon)

Comprehension of weather maps: Towards principled design of METOC displays. Office of Naval Research. 2005-2009. \$266,977 (PI, Co-PI Harvey Smallman)

3-D Visualizations for medical education. National Science Foundation (ITR). 2003 – 2006, \$463,794. (PI, Co-PI D. R. Montello)

Internal and external visualizations in complex cognition. Office of Naval Research. 2003 – 2006, \$321,130. (PI)

Virtual Environments to Elucidate Strategies in Complex Spatial Problem Solving. National Science Foundation (KDI) 1999- 2002, \$1,000,000. (Co-PI, with F. Tendick, D. R. Montello, S. Sastry, L. Way)

Analysis and Synthesis of Hypermedia Information Visualizations. Office of Naval Research, 1999 – 2001, \$198,727. (PI, Co-PI N. Hari Narayanan)

Spatial Cognition of the Environment: Processes and Structures, National Science Foundation, 1999 – 2001, \$26,057. (Co-PI, with D.R. Montello, B. Tversky, C. Freksa, C. Habel, C. Eschenbach)

Virtual Environments and Behavior. National Science Foundation, 1998 – 2001, \$1,800,000. (Senior Personnel, PIs J. Loomis & J. Blascovich)

Individual Differences in Interacting with Hypermedia Manuals" Office of Naval Research (AASERT) 1997-2000, \$99,633. (PI).

Individual Differences in Spatial Communication Abilities. Army Research Institute (AASERT) 1997-98, \$36,907. (Co-PI with D. R. Montello)

Building Hypermedia Manuals for Optimal Comprehension of Complex Machines. Office of Naval Research, 1996-1999, \$435,000. (PI, Co-PI N. H. Narayanan)

Individual differences in Environmental Spatial Cognition. Army Research Institute 1995-1998, \$306,873. (Co-PI with D. R. Montello)

Computer-based laboratory instruction in human information processing. National Science Foundation Instrumentation and Laboratory Improvement Grant, 1993, \$32,809. (Co-PI, with D. H. Brainard & R. K. Klatzky)

Inferring Motion from Static Diagrams. National Academy of Education Spencer Fellowship, 1992-93, \$35,000. (PI).

Individual Differences in Mental Animation of Static Displays. Spencer Foundation, 1991, 7,500. (PI).

## **Publications**

### **Articles and Chapters:**

Liu, L., Boone, A., Ruginski, I., Padilla, L., Hegarty, M.; Creem-Regehr, S H., Thompson, W. B., Yuksel, C., & House, D. (in press). Uncertainty visualization by representative sampling from prediction ensembles. *Transactions on Visualization and Computer Graphics*.

Hegarty, M., Friedman, A., Boone, A. & Barrett, T. J. (in press). Where are you? The effect of uncertainty and its visual representation on location judgments in GPS-like displays. *Journal of Experimental Psychology: Applied*.

Tarampi, M. R., Heydari, N. & Hegarty, M. (in press). A tale of two types of perspective taking: Sex differences in spatial ability. *Psychological Science*.

Barrett, T. & Hegarty, M. (2016). Effects of interface and spatial ability on manipulation of virtual models in a STEM domain. *Computers in Human Behavior*, 65, 220-231.

Tarampi, M. R., Atit, K., Petcovic, H. L., Shipley, T. F. & Hegarty, M. (2016). Spatial skills in expert structural geologists. In B. Krantz, C. Ormand & B. Freeman (Eds.), *3D Structural Interpretation: Earth, Mind, and Machine* (pp. 65-73). AAPG Memoir 111.

- Stull, A. T., Gainer, M., Padalkar, S., & Hegarty, M. (2016). Promoting representational competence with molecular models in organic chemistry. *Journal of Chemical Education*, *93*, 994-1001.
- Shine, J. P., Valdés-Herrera, J. P., Hegarty, M., & Wolbers, T. (2016). The human retrosplenial cortex and thalamus code head direction in a global reference frame. *The Journal of Neuroscience*, *36*(24), 6371-6381.
- Stull, A. T. & Hegarty, M. (2016). Model manipulation and learning: Fostering representational competence with virtual and concrete models. *Journal of Educational Psychology*, *108*, 509- 527.
- Ruginski, I. T., Boone, A. P., Padilla, L. M., Liu, L., Heydari, N., Kramer, H. S., Hegarty, M., Thompson, W. B., House, D. H., & Creem-Regehr, S. H. (2016). Non-expert interpretations of hurricane forecast uncertainty visualizations. *Spatial Cognition & Computation*, *16*, 154-172.
- McKenzie, G., Hegarty, M., Barrett, T. J. & Goodchild, M. (2016). Assessing the effectiveness of different visualizations of positional uncertainty. *International Journal of Geographic Information Science*, *30*, 221-239.
- Xiao, C., Lian, Y., & Hegarty, M. (2015). Spatial updating of map-acquired representations. *Memory & Cognition*, *43*, 1032-1042.
- Condon, D. M., Wilt, J., Cohen, C. A., Revelle, W., Hegarty, M. & Uttal, D. H. (2015). Sense of direction: General factor saturation and association with the Big-Five traits. *Personality & Individual Differences*, *86*, 38-43.
- Padalkar, S. & Hegarty, M. (2015). Models as feedback: Developing representational competence in chemistry. *Journal of Educational Psychology*, *107*, 451-467.
- Hegarty, M., Stieff, M. & Dixon, B. L. (2015). Reasoning with Diagrams: Towards a broad ontology of spatial thinking strategies. In D. R. Montello, K. Grossner, K., & D. G. Janelle (Eds.), *Space in mind: Concepts for spatial learning and education*. Cambridge, MA: MIT Press (pp. 75-98).
- Davies, C., Fabrikant, S. & Hegarty, M. (2015). Towards empirically verified cartographic displays. In R. R. Hoffman et al. (Eds.) *Handbook of Applied Perception Research*. Cambridge, MA: Cambridge University Press.
- Barrett, T. J., Stull, A. T., Hsu, T. M., & Hegarty, M. (2015). Constrained interactivity for relating multiple representations in science: When virtual is better than real. *Computers & Education*, *81*, 69-81.

- Hegarty, M. (2014). Multimedia learning and the development of mental models. In R. E. Mayer (Ed.). *Handbook of Multimedia*, 2<sup>nd</sup> Edition. Cambridge, MA: Cambridge University Press (pp. 674-704).
- Adams, D. Stull, A. T. & Hegarty, M. (2014). Effects of mental and manual rotation training on mental and manual rotation performance. *Spatial Cognition and Computation*, 14, 169-198.
- Cohen, C. A. & Hegarty, M. (2014). Visualizing cross sections: Training spatial thinking using interactive animations and virtual objects. *Learning & Individual Differences*, 33, 63-71.
- Hegarty M. (2014). Spatial thinking in undergraduate science education. *Spatial Cognition and Computation*, 14, 142-167.
- Janelle, D. G., Hegarty, M. & Newcombe, N. S. (2014) Spatial thinking across the college curriculum: A report on a specialist meeting, *Spatial Cognition and Computation*, 14, 124-141.
- Zwick, R., Zapata, D. & Hegarty, M. (2014). Comparing graphical and verbal representations of measurement error in test scores. *Educational Assessment*, 19, 116-138.
- Labate, E., Pazzaglia, F. & Hegarty, M. (2014). What working memory subcomponents are needed in the acquisition of survey knowledge? Evidence from direction estimation and shortcut tasks. *Journal of Environmental Psychology*, 37, 73-79.
- Stieff, M. Dixon, B. L. Ryu, M., Kumi, B. & Hegarty, M. (2014). Strategy training eliminates sex differences in problem solving in a STEM domain. *Journal of Educational Psychology*. 106. 390-402.
- Stull, A. T., Barrett, T. & Hegarty, M. (2013). Usability of concrete and virtual models in chemistry instruction. *Computers in Human Behavior*, 29, 2546-2556.
- Khooshabeh, P., Hegarty, M. & Shipley, T. F. (2013). Individual differences in mental rotation: Piecemeal vs. holistic processing. *Experimental Psychology*, 60, 164-171.
- Hegarty, M., Stieff, M. & Dixon, B. L. (2013). Cognitive change in mental models with experience in the domain of organic chemistry. *Journal of Cognitive Psychology*, 25, 220-228.
- Hegarty (2013). Cognition, metacognition and the design of maps. *Current Directions in Psychological Science*, 22, 3-9.

- Stull, A. T., Hegarty, M., Dixon, B. L. & Stieff, M. (2012). Representational translation with concrete models in organic chemistry. *Cognition and Instruction, 30*, 404-434.
- Cohen, C. A. & Hegarty, M. (2012). Inferring Cross Sections of 3D Objects: A New Spatial Thinking Test. *Learning & Individual Differences, 22*, 868-874.
- Stieff, M., Ryu, M. Dixon, B. & Hegarty, M. (2012). The role of spatial ability & strategy preference during spatial problem solving in organic chemistry. *Journal of Chemical Education, 89*, 854-859
- Hegarty, M., Smallman, H. S. & Stull, A. T. (2012). Choosing and using geospatial displays: Effects of design on performance and metacognition. *Journal of Experimental Psychology: Applied, 18*, 1-17.
- Hegarty, M. & Stull, A. T. (2012). Visuospatial thinking. In K. Holyoak and R. Morrison. *Oxford Handbook of Thinking and Reasoning*. New York, NY: Oxford University Press (pp. 606-630).
- Hegarty, M. (2011). The cognitive science of visual-spatial displays; Implications for design. *Topics in Cognitive Science, 3*, 446-474.
- Stieff, M., Hegarty, M., & Deslongchamps, G. (2011). Identifying representational competence with multi-representational displays. *Cognition & Instruction, 29*, 123-145.
- Kooshabeh, P., & Hegarty, M. (2010). Inferring cross sections: When internal visualizations are more important than properties of external visualization. *Human Computer Interaction, 25*, 119-147.
- Hegarty, M. (2010). Components of spatial intelligence. In B. H. Ross (Ed.) *The Psychology of Learning and Motivation*. San Diego: Academic Press (pp. 265-297).
- Wolbers, T., & Hegarty, M. (2010). What determines our navigational abilities? *Trends in Cognitive Sciences, 14*, 138-146.
- Hegarty, M., Canham, M., & Fabrikant, S. I. (2010). Thinking about the weather: How display salience and knowledge affect performance in a graphic inference task. *Journal of Experimental Psychology: Learning, Memory and Cognition, 36*, 37-53.
- Fabrikant, S. I., Rebich-Hespanha, S., & Hegarty, M. (2010). Cognitively inspired and perceptually salient graphic displays for efficient inference making. *Annals of the Association of American Geographers, 100*, 13-29.



- Canham, M., & Hegarty, M. (2010). Effects of knowledge and display design on comprehension of complex graphics. *Learning and Instruction, 20*, 155-166.
- Hegarty, M. (2009). Visual Imagery. In Goldstein, B. (Ed). *Sage Encyclopedia of Perception*. Thousand Oaks, CA: Sage Publications.
- Stull, A. T., Hegarty, M., & Mayer, R. E. (2009). Orientation references: Getting a handle on spatial learning. *Journal of Educational Psychology, 101*, 803-816.
- Hegarty, M. Smallman, H. S., Stull, A. T., & Canham, M. (2009). Naïve cartography: How intuitions about display configuration can hurt performance. *Cartographica, 44*, 171-187.
- Hegarty, M., Keehner, M., Khooshabeh, P., & Montello, D. R. (2009). How spatial ability enhances, and is enhanced by, dental education. *Learning and Individual Differences, 19*, 61-70.
- Wolbers, T., Hegarty, M. Büchel, C., & Loomis, J. (2008). How the brain keeps track of changing object locations during observer motion. *Nature Neuroscience, 11*, 1223-1230.
- Keehner, M. Hegarty, M., Cohen, C. A., Khooshabeh, P., & Montello, D. R. (2008). Spatial reasoning with external visualizations: What matters is what you see, not whether you interact. *Cognitive Science, 32*, 1099-1132.
- Keehner, M., Khooshabeh, P., & Hegarty, M. (2008). Interactive visualizations and individual differences among users. In F. Dong, G. Ghinea, & S. Y. Chen (Eds.) *User Centered Design for Medical Visualization*. Hershey, PA: Idea Group Inc (pp. 1-24).
- Hegarty, M., & Kriz, S. (2007). Effects of knowledge and spatial ability on learning from animation. In R. Lowe & W. Schnotz. *Learning from Animation*. Cambridge University Press (pp. 3-29).
- Kriz, S., & M. Hegarty (2007). Top-down and bottom-up influences on learning from animation. *International Journal of Human-Computer Studies, 65*, 911-930.
- Cohen, C. A., & Hegarty, M. (2007). Individual differences in use of an external visualization while performing an internal visualization task. *Applied Cognitive Psychology, 21*, 701-711.
- Kozhevnikov, M., Motes, M., & Hegarty, M. (2007). Spatial visualization in physics problem solving. *Cognitive Science, 31*, 549-579.

- Hegarty, M., Keehner, M., Cohen, C., Montello, D. R., & Lippa, Y. (2007). The role of spatial cognition in medicine: Applications for selecting and training professionals. In G. Allen (Ed.) *Applied Spatial Cognition*. Mahwah, NJ: Lawrence Erlbaum Associates.
- Keehner, M., Guerin, S., Miller, M., Turk, D., & Hegarty, M. (2006). Modulation of neural activity by angle of rotation during imagined spatial transformations. *Neuroimage*, *33*, 391-398.
- Keehner, M., Lippa, Y., Montello, D. R., Tendick, F., & Hegarty, M. (2006). Learning a spatial skill for surgery: How the contributions of abilities change with practice. *Applied Cognitive Psychology*, *20*, 487-503.
- Hegarty, M., Montello, D. R., Richardson, A. E., Ishikawa, T., & Lovelace, K. (2006). Spatial abilities at different scales: Individual differences in aptitude-test performance and spatial-layout learning. *Intelligence*, *34*, 151-176.
- Hegarty, M., Mayer, S., Kriz, S., & Keehner, M. (2005). The role of gestures in mental animation. *Spatial Cognition and Computation*, *5*, 333-356.
- Mayer, R.E., Hegarty, M., Mayer, S. Y., & Campbell, J. (2005). When passive media promote active learning: Static diagrams versus animation in multimedia instruction. *Journal of Experimental Psychology: Applied*, *11*, 256-265.
- Hegarty, M. (2005). Multimedia learning about physical systems. In R. E. Mayer (Ed). *The Cambridge Handbook of Multimedia Learning*. Cambridge University Press (pp. 447-465).
- Hegarty, M., & Waller, D. (2005). Individual differences in spatial abilities. In P. Shah & A. Miyake (Eds.). *The Cambridge Handbook of Visuospatial Thinking*. Cambridge University Press (pp. 121-169).
- Hegarty, M. (2004). Commentary: Dynamic visualizations and learning: Getting to the difficult questions. *Learning and Instruction*, *14*, 343-351.
- Hegarty, M. (2004). Mechanical reasoning as mental simulation. *Trends in Cognitive Sciences*, *8*, 280-285.
- Keehner, M. M., Tendick, F., Meng, M.V., Anwar, H.P., Hegarty, M., Stoller, M.L., & Duh. Q. Y. (2004). Spatial ability, experience, and skill in laparoscopic surgery, *American Journal of Surgery*, *188*, 71-75.
- Hegarty, M., & Waller, D. (2004). A dissociation between mental rotation and perspective-taking spatial abilities. *Intelligence*, *32*, 175-191.

- Montello, D. R., Waller, D., Hegarty, M., & Richardson, A. E. (2004). Spatial memory of real environments, virtual environments, and maps. In G. Allen (Ed.). *Human Spatial Memory: Remembering Where* (pp. 251-285). Mahwah, NJ: Lawrence Erlbaum Associates.
- Hegarty, M., Kriz, S., & Cate, C. (2003). The roles of mental animations and external animations in understanding mechanical systems. *Cognition & Instruction, 21*, 325-360.
- Hegarty, M., Haarslev, V., & Narayanan, N. H. (2002). Diagrammatic reasoning. *Kuntsclische Intelligenz, 4*, 38-39.
- Waller, D., Montello, D. R., Richardson, A. E., & Hegarty, M. (2002). Orientation specificity and spatial updating of memories for layouts. *Journal of Experimental Psychology, Learning, Memory & Cognition, 28*, 1051-1063.
- Narayanan, N. H., & Hegarty, M. (2002). Multimedia design for communication of dynamic information. *International Journal of Human-Computer Studies, 57*, 279-315.
- Hegarty, M., Richardson, A. E., Montello, D. R., Lovelace, K., & Subbiah, I. (2002). Development of a self-report measure of environmental spatial ability. *Intelligence, 30*, 425-447.
- Hegarty, M., Narayanan, N. H., & Freitas, P. (2002). Understanding machines from multimedia and hypermedia presentations. In J. Otero, A. C. Graesser & J. Leon (Eds.). *The Psychology of Science Text Comprehension*. Mahwah, NJ: Lawrence Erlbaum Associates.
- Kozhevnikov, M., Hegarty, M., & Mayer, R. E. (2002). Revising the visualizer/verbalizer dimension: Evidence for two types of visualizers. *Cognition and Instruction, 20*, 47-77.
- Miyake, A., Rettinger, D. A., Friedman, N. P., Shah, P., & Hegarty, M. (2001). Visuospatial working memory, executive functioning and spatial abilities. How are they related? *Journal of Experimental Psychology: General, 130*, 621-640.
- Kozhevnikov, M., & Hegarty, M. A. (2001). Impetus beliefs as default heuristics: Dissociation between explicit and implicit knowledge about motion. *Psychonomic Bulletin & Review, 8*, 439-453.
- Kozhevnikov, M., & Hegarty, M. (2001). A dissociation between object-manipulation and perspective-taking spatial abilities. *Memory & Cognition, 29*, 745-756.

- Hegarty, M., Shah, P., & Miyake, A. (2000). Constraints on using the dual-task methodology to specify the degree of central executive involvement in cognitive tasks. *Memory & Cognition*, *28*, 376-385.
- Tendick, F., Downes, M., Gogtekin, T., Cavusoglu, M.C., Feygin, D., Wu, X., Eyal, R., Hegarty, M., & Way, L.W. (2000). A virtual testbed for training laparoscopic surgical skills. *Presence*, *9*, 236-255.
- Hegarty, M. & Kozhevnikov, M. (1999). Types of visual-spatial representations and mathematical problem solving. *Journal of Educational Psychology*, *91*, 684-689.
- Shah, P., Mayer, R. E. & Hegarty, M. (1999). Graphs as aids to knowledge construction. *Journal of Educational Psychology*, *91*, 690-702.
- Montello, D. R., Richardson, A. E., Hegarty, M & Provenza, M. (1999). A comparison of methods for estimating directions in egocentric space. *Perception*, *28*, 981-1000.
- Richardson, A. E., Montello, D. & Hegarty, M. (1999). Spatial knowledge acquisition from maps, and from navigation in real and virtual environments. *Memory & Cognition*, *27*, 741-750.
- Hegarty, M., Quillici, J., Narayanan, N. H., Holmquist, S., & Moreno, R. (1999). Multimedia instruction: Lessons from evaluation of a theory-based design. *Journal of Educational Multimedia and Hypermedia*, *8*, 119-150.
- Kintsch, W., Healy, A., Hegarty, M., Pennington, B., & Salthouse, T. (1999). Models of working memory: Eight questions and some general answers. In A. Miyake & P. Shah, (Eds.). *Models of Working Memory*. Cambridge University Press.
- Revlín, R., & Hegarty, M. (1999). Resolving signals to cohesion: Two models of bridging inferences. *Discourse Processes*, *27*, 77-102.
- Narayanan, N. H., & Hegarty, M. (1998). On designing comprehensible hypermedia manuals. *International Journal of Human-Computer Studies*, *48*, 267-301.
- Hegarty, M., & Steinhoff, K. (1997). Use of diagrams as external memory in a mechanical reasoning task. *Learning and Individual Differences*, *9*, 19-42.
- Sims, V. K., & Hegarty, M. (1997). Mental animation in the visual-spatial sketchpad: Evidence from dual-task studies. *Memory & Cognition*, *25*, 321-332.
- Mayer, R. E., & Hegarty, M. (1996). The process of understanding mathematical problems. In R.J. Sternberg & T. Ben-Zeev (Eds.) *The nature of mathematical thinking*. Hillsdale, NJ: Erlbaum.

- Hegarty, M., Mayer, R. E., & Monk, C. (1995). Comprehension of arithmetic word problems: A comparison of successful and unsuccessful problem solvers. *Journal of Educational Psychology, 87*, 18-32.
- Ferguson, E. L., & Hegarty, M. (1995). Learning with real machines or diagrams: Application of knowledge to real-world problems. *Cognition and Instruction, 13*(1), 129-160.
- Hegarty, M., & Sims, V. K. (1994). Individual differences in mental animation during mechanical reasoning. *Memory & Cognition, 22*, 411-430.
- Ferguson, E. L., & Hegarty, M. (1994). Properties of cognitive maps constructed from text. *Memory & Cognition, 22*, 455-473.
- Hegarty, M., & Just, M.A. (1993). Constructing mental models of machines from text and diagrams. *Journal of Memory and Language, 32*, 717-742.
- Hegarty, M., Mayer, R. E., & Green, C. E. (1992). Comprehension of arithmetic word problems: Evidence from students' eye fixations. *Journal of Educational Psychology, 84*, 76-84.
- Hegarty, M. (1992). The mechanics of comprehension and comprehension of mechanics. In K. Rayner (Ed.) *Eye movements and visual cognition: Scene perception and reading*. New York: Springer Verlag.
- Hegarty, M. (1992). Mental animation: Inferring motion from static diagrams of mechanical systems. *Journal of Experimental Psychology: Learning, Memory and Cognition, 18*(5) 1084-1102. [Reprinted in J. Glasgow, H. Narayanan & Chandrasekaran (Eds) (1995). *Diagrammatic Reasoning: Computational and Cognitive Perspectives*. Cambridge, MA: MIT Press.]
- Mayer, R., Lewis, A. B., & Hegarty, M. (1992). Mathematical misunderstandings: Qualitative reasoning about quantitative problems. In Campbell, J. I. D. (Ed.) *The Nature and Origins of Mathematical Skills*. Amsterdam: Elsevier Science Publishers.
- Hegarty, M. (1991). Knowledge and processes in mechanical problem solving. In R. J. Sternberg & P. A. Frensch (Eds.) *Complex problem solving: Principles and mechanisms*. Hillsdale NJ: Lawrence Erlbaum Associates.
- Hegarty, M., Carpenter, P. A., & Just, M. A. (1990). Diagrams in the comprehension of scientific text. In R. Barr, M. L. Kamil, P. Mosenthal, & P. D. Pearson (Eds.) *Handbook of reading research*. New York: Longman.

Hegarty, M., & Just, M. A. (1989). Understanding machines from text and diagrams. In H. Mandl & J. Levin (Eds.). *Knowledge acquisition from text and picture*. Amsterdam: North Holland (Elsevier Science Publishers).

Hegarty, M., Just, M. A., & Morrison, I. R. (1988). Mental models of mechanical systems: Individual differences in qualitative and quantitative reasoning. *Cognitive Psychology*, 20, 191

Greaney, V., & Hegarty, M. (1987). Correlates of leisure time reading. *Journal of Research in Reading*, 10(1), 3- 20.

Kellaghan, T., & Hegarty, M. (1984). Participation in the leaving certificate examination 1961- 1980. *The Irish Journal of Education*, 18 (2), 71-106.

### **Edited Volumes:**

Freksa, C., Nebel, B., Hegarty, M., & Barkowsky, T. (2014). *Spatial Cognition IX: Lecture Notes in Artificial Intelligence, 8684*, Berlin: Springer

Hegarty, M. (2011). The cognitive science of visual-spatial displays; Implications for design. *Topics in Cognitive Science*, 3, 3.

Hegarty, M., Meyer, B., & Narayanan, N. H. (Eds.) (2002). *Diagrammatic representation and inference*. Berlin: Springer-Verlag.

Barkowsky, T., Freksa, C., Hegarty, M., & Lowe, R. (Eds.) (2005). *Reasoning with mental and external diagrams: Computational modeling and spatial assistance. Papers from the AAAI Spring symposium*. Menlo Park, CA: AAAI Press.

### **Proceedings Papers:**

Barrett, T., & Hegarty, M., (2014) Interaction design and the role of spatial ability in moderating virtual molecule manipulation performance. In P. Bello, M. Guarini, M. McShane, & B. Scassellati (Eds.), *Proceedings of the 36th Annual Conference of the Cognitive Science Society*. Austin, TX: Cognitive Science Society.

Burte, H. M., & Hegarty, M. (2014). Alignment effects and allocentric headings within a relative heading task. In C. Freksa, B. Nebel, B., M. Hegarty, M., & T. Barkowsky, (Eds). *Spatial Cognition IX: Lecture Notes in Artificial Intelligence, 8684*, Berlin: Springer (pp. 46-61).

- Barrett, T. & Hegarty, M. (2013). Interface design and spatial cognition: A case of virtual molecule manipulation. In M. Knauff, M. Pauen, N. Sebanz, & I. Wachsmuth (Eds.), *Proceedings of the 35th Annual Conference of the Cognitive Science Society* (pp. 157-162). Austin, TX: Cognitive Science Society.
- Burte, & Hegarty (2013). Individual and Strategy Differences in an Allocentric-Heading Recall Task. In M. Knauff, M. Pauen, N. Sebanz, & I. Wachsmuth (Eds.), *Proceedings of the 35th Annual Conference of the Cognitive Science Society* (pp. 1958-1963). Austin, TX: Cognitive Science Society.
- Padalkar, S. & Hegarty, M. (2013). Undergraduate students' understanding about representations in chemistry. In Nagarjuna, G., Jamakhandi, A. & Sam, E. B. (Eds.) *Proceedings of Conference Episteme-5*, (pp. 288-294).
- Padalkar, S. & Hegarty, M (2012). Improving representational competence in chemistry with model-based feedback In N. Miyake, D. Peebles, & R. P. Cooper (Eds.), *Proceedings of the 34th Annual Conference of the Cognitive Science Society* (pp. 2162-2167). Austin, TX: Cognitive Science Society.
- Burte & Hegarty (2012). Revisiting the relationship between allocentric-heading recall and self-reported sense of direction. In N. Miyake, D. Peebles, & R. P. Cooper (Eds.), *Proceedings of the 34th Annual Conference of the Cognitive Science Society* (pp. 162-167). Austin, TX: Cognitive Science Society.
- Stull, A. T., Barrett, T. & Hegarty, M., (2012). Design of a virtual reality system for the study of diagram use in organic chemistry. *Proceedings of the workshop on technology enhanced diagrams. Diagrams 2012. CEUR Conference Proceedings, ISSN 1613-0073.*
- Stieff, M., Hegarty, M. & Dixon, B. (2010). Alternative strategies for spatial reasoning with diagrams. In A. K. Goel, M. Jamnik & N. H. Narayanan (Eds.). *Diagrammatic Representation and Inference. Proceedings of 6<sup>th</sup> International Conference, Diagrams 2010.* Berlin: Springer.
- Stull, A. T., Hegarty, M., Stieff, M. (2010). & Dixon, B. (2010). Does manipulating molecular models promote representation translation in chemistry? In A. K. Goel, M. Jamnik & N. H. Narayanan (Eds.). *Diagrammatic Representation and Inference. Proceedings of 6<sup>th</sup> International Conference, Diagrams 2010.* Berlin: Springer.
- Hegarty, M., Crookes, R., Dara-Abrams, D., & Shipley, T. F. (2010). Do all science disciplines rely on spatial abilities? Preliminary evidence from self-report questionnaires. In T. F. Shipley., C. Holscher, J. Bateman, N. S. Newcombe, & M. Olivetti (Eds). *Spatial Cognition VII.* Berlin: Springer.

- Khooshabeh, P., & Hegarty, M. (2010). Representation of shape during mental rotation. In T. Barkowsky., S. Bertel., C. Hölsher & T. F. Shipley (Eds.). *Cognitive Shape Processing: Papers from the AAAI Spring symposium*. Menlo Park, CA: AAAI Press.
- Stull, A., Hegarty, M., & Mayer, R. E. (2010). Anatomy learning with virtual objects. In T. Barkowsky., S. Bertel., C. Hölsher & T. F. Shipley (Eds.). *Cognitive Shape Processing: Papers from the AAAI Spring symposium*. Menlo Park, CA: AAAI Press.
- DeLeeuw, K., & Hegarty, M. (2008). What diagrams reveal about representations in linear reasoning, and how they help. In G. Stapleton, J. Howse & J. Lee (Eds.). *Proceedings of Diagrams 2008, Lecture Notes in Artificial Intelligence, Number 5223 (pp.89-102)*. Berlin: Springer. [Best Student Paper Award]
- Hegarty, M., Smallman, H. S., & Stull, A. T. (2008). Decoupling intuitions and performance in the use of complex visual displays. In B. C. Love, K. McRae & V. M. Sloutsky (Eds.), *Proceedings of the 30<sup>th</sup> Annual Conference of the Cognitive Science Society (pp .881-886 )* Austin, TX: Cognitive Science Society.
- Khooshabeh, P., & Hegarty, M. (2008). How visual information affects a spatial task. In B. C. Love, K. McRae & V. M. Sloutsky (Eds.), *Proceedings of the 30<sup>th</sup> Annual Conference of the Cognitive Science Society*.
- Cohen, C. A., & Hegarty, M. (2007). Sources of difficulty in imagining cross sections of 3D objects. In D. McNamara & G. Trafton (Eds.). *Proceedings of the 29<sup>th</sup> Annual Conference of the Cognitive Science Society*.
- Canham, M., Hegarty, M., & Smallman, H. S. (2007). Using complex visual displays: When users want more than is good for them. In K. Mosier & U. Fischer (Eds.) *Proceedings of the Eight Annual Conference on Naturalistic Decision Making, Pacific Grove, CA*.
- Smallman, H. S., & Hegarty, M. (2007). Expertise, spatial ability and intuition in the use of complex displays. *Proceedings of the annual meeting of the Human Factors and Ergonomics Society*.
- Kriz, S., & Hegarty, M. (2005) Spatial perspective in spoken descriptions of real-world environments at different scales. In B. Bara, L. Barsalou & M. Bucciarelli (Eds.) *Proceedings of the 27<sup>th</sup> Annual Conference of the Cognitive Science Society* Mahwah, NJ: Erlbaum.
- Kriz, S., & Hegarty, M. (2004). Constructing and revising mental models of a mechanical system: The role of domain knowledge in understanding external visualizations. In K. Forbus, D. Gentner & T. Regier (Eds.) *Proceedings of the 26<sup>th</sup> Annual Conference of the Cognitive Science Society*. Mahwah, NJ: Lawrence Erlbaum Associates.



- Hegarty, M. (2004). Diagrams in the mind and in the world: Relations between internal and external animations. In A Blackwell, K. Mariott and A. Shimojima (Eds). *Diagrammatic Representation and Inference*. Lecture Notes in Artificial Intelligence (pp. 1-13). Berlin: Springer.
- Kozhevnikov, M., Hegarty, M., & Mayer, R. E. (2002). Spatial abilities in kinematics problem solving. In M. Anderson, B. Meyer & P. Olivier (Eds). *Diagrammatic Representation and Reasoning* (pp.155 – 171). Berlin: Springer-Verlag.
- Hegarty, M. (2000). Capacity limits in diagrammatic reasoning. In M. Anderson, P. Cheng & V. Harslev (Eds.) *Theory and Application of Diagrams. Lecture Notes in Artificial Intelligence 1889*. Berlin: Springer.
- Narayanan, N. H., & Hegarty, M. (2000). Communicating dynamic behaviors: Are interactive multimedia presentations better than static mixed-mode presentations? In M. Anderson, P. Cheng & V. Harslev (Eds.) *Theory and Application of Diagrams. Lecture Notes in Artificial Intelligence 1889*. Berlin: Springer.
- Hegarty, M., & Kozhevnikov, M. (1999) Spatial abilities, working memory and mechanical reasoning. In J. Gero & B. Tversky (Eds.) *Visual and Spatial Reasoning in Design*. Key Centre of Design and Cognition, Sydney, Australia.
- Kozhevnikov, M., & Hegarty M. (1999, June). Representational momentum or representational impetus. In J. Gero & B. Tversky (Eds.) *Visual and Spatial Reasoning in Design*. Key Centre of Design and Cognition, Sydney, Australia.
- Lovelace, K.L., Hegarty, M., & Montello, D. R. (1999) Elements of good route directions in familiar and unfamiliar environments. In Freksa, C., & Mark, D. M. (eds.). *Spatial information theory: Cognitive and computational foundations of geographic information science. Lecture Notes in Computer Science 1661*. Berlin: Springer.
- Schwartz, D. L., & Hegarty, M. (1996). Coordinating multiple representations for reasoning about mechanical devices. *Proceedings of the AAAI Spring Symposium on Cognitive and Computational Models of Spatial Representation*. Menlo Park, CA: AAAI Press.
- Hegarty, M., & Narayanan, N. H. (1994). Visual reasoning in problem solving. *Proceedings of the 16th Annual Conference of the Cognitive Science Society* (pp. 982-984). Hillsdale, NJ: Lawrence Erlbaum Associates.

## Presentations

### Invited:

Hegarty, M. (2016, August). Balancing work and home. Presentation in women and cognitive science symposium, Annual Conferences of the Cognitive Science society, Philadelphia, PA.

Hegarty, M. (2016, August). The power of diagrams in science and challenges of diagrams in science education. Keynote Lecture Diagrams 2016, Philadelphia, PA.

Hegarty, M. (2015, April). Individual differences in spatial thinking: Implications for education. Invited lecture, Temple Institute for Learning and Education Sciences, Temple University, Philadelphia, PA.

Hegarty, M. (2015, April). The power of diagrams in science and challenges of diagrams in science education. Keynote Lecture, Diagrams as Vehicles of Scientific Reasoning, Center for Philosophy of Science, University of Pittsburgh, Pittsburgh, PA.

Hegarty, M. (2014, August). Designing Media for Learning: The Case of Understanding Physical Systems, Keynote Lecture, EARLI SIG 2 Comprehension of Text and Graphics Conference, Rotterdam, The Netherlands.

Hegarty, M. Padalkar, S., Stull, A. T. & Cohen, C. (2014, May), Developing representational competence with drawings and models. Presented in the Spatial Intelligence and Learning Center (SILC) workshop on Sketching and Education. Chicago, IL.

Hegarty M. (2013, June). The cognitive science of spatial thinking. Hedberg research conference on 3D Structural Geologic Interpretation: Earth, Mind, and Machine, Reno, Nevada.

Hegarty, M. (2013, March) Spatial thinking. Colloquium presented to the Cognitive Science program, University of California, Berkeley.

Hegarty, M. (2012, May). Broadening the study of spatial intelligence. Talk presented to the Pittsburgh Science of Learning Center, Pittsburgh, PA.

Hegarty, M. (2011, November). The cognitive science of visual displays: Implications for design. Colloquium presented to the Department of Geography, University of Zurich, Switzerland.

- Hegarty, M. (2011, May). The cognitive science of visual displays: Implications for design. Talk given to the Statistics Department, University of California, Santa Barbara.
- Hegarty M. (2011, April). Broadening the study of spatial intelligence. Colloquium presented to the cognitive science program, University of Arizona, Tucson, AZ.
- Hegarty, M. (2010, December). The role of spatial thinking in undergraduate science education. Paper presented at a meeting of the National Research Council Committee on the status, contributions, and future directions of discipline-based education research, Irvine CA.
- Hegarty, M. (2010, November). Representations in the mind and in the world: How cognitive science can inform the design of visualizations. Keynote presentation, IEEE:Visualization conference, Salt Lake City, UT.
- Hegarty, M. (2010, May). Varieties of spatial intelligence and their relevance for STEM disciplines. Spatial Learning Conference, Cambridge, MA.
- Hegarty, M. (2009, July). Identifying the components of spatial intelligence. Keynote Lecture. DFG-NSF Workshop on Integrating Spatial Cognition. New York, NY.
- Hegarty, M. (2009, January). Aspects of spatial intelligence. Colloquium presented to the Cognitive Group, Department of Psychology, University of California, Los Angeles.
- Hegarty, M. (2008, November). The role of spatial cognition in medicine: Applications for selection and training. Colloquium presented to the Cognitive Science Research Seminar, University of California, Merced.
- Hegarty, M. (2007, March). The role of spatial cognition in medicine: applications for selection and training. Grand Rounds Presentation, Department of Surgery, University of Sherbrooke, Canada.
- Hegarty, M (2006, September). Relations between external and internal representations in spatial thinking. Keynote Lecture, Spatial cognition conference, Bremen, Germany.
- Hegarty, M. (2005, July). Visualizations in the mind and in the world: Relations between internal and external representations. Keynote lecture. Gordon conference on visualization in science and education. Oxford, UK.
- Hegarty, M. (2005, March). The role of spatial abilities in medicine: Applications for selection and training. Invited talk to Stanford University Medical Media and Information Technology (SUMMIT) group, School of Medicine, Stanford University.

- Hegarty, M. (2004, June). Individual differences in spatial perception and cognition. Keynote lecture presented to NSF sponsored workshop on Geoscience education, Smith College, Springfield, MA.
- Hegarty, M. (2004, January). Internal and external visualizations. Colloquium presented to the Department of Psychology, Rutgers University, Newark, NJ.
- Hegarty, M. (2002, May). Spatial thinking in complex cognition. Colloquium presented to the Department of Psychology, University of California, Santa Cruz.
- Hegarty, M. (2002, March). Spatial thinking in higher-level cognition. Presentation to National Research Council Committee "Support for Thinking Spatially". Santa Fe, New Mexico.
- Hegarty, M. (1999, October) Mental Animation. Colloquium given to the Cognitive Science group, University of California, Berkeley. Also presented at Department of Computer Science, Monash University, Melbourne November 1999, Department of Architecture, University of Sydney, December 1999 and Department of Psychology, Stanford University, Jan 2000, University of Massachusetts, Amherst, June 2000.
- Hegarty, M. (1999, April) Discussion of papers on geometric, spatial and arithmetic learning in elementary school students. Annual conference of the American Educational Research Association, Montreal, Canada.
- Hegarty, M. (1999, March). Understanding how machines work: Implications for multimedia design. Colloquium presented to the Department of Education, University of California, Berkeley.
- Hegarty, M. (1997, November). Commentary on "Bars and lines: A study of graphic communication" by Jeff Zacks and Barbara Tversky. AAAI Fall Symposium on Reasoning with Diagrammatic Representations. MIT, Cambridge, MA
- Hegarty, M. (1997, November). Panel Member: Diagrammatic reasoning and representations: Future directions. AAAI Fall Symposium on Reasoning with Diagrammatic Representations. MIT. Cambridge, MA
- Hegarty, M. (1997, July). Discussion of the unitary/non-unitary nature of working memory and the role of working memory in complex cognition. ONR-sponsored conference on Theories of Working Memory, University of Colorado, Boulder, CO.
- Hegarty, M. (1997, April). Comprehension of text and diagrams: Implications for multimedia design. Talk presented to the Writing Program and IEEE Technical Communication Group, University of California, Santa Barbara.

- Hegarty, M. (1997, April). Comprehension of text and diagrams: Implications for multimedia design. Colloquium presented to the Department of Psychology, University of Colorado, Boulder, CO.
- Hegarty, M. (1997, January). Understanding how machines work: Implications for multimedia design. Colloquium presented to the Cognitive Science Interdisciplinary Program, University of California, San Diego, CA.
- Hegarty, M. & Narayanan, N. H. (1996, November) Designing hypermedia manuals to explain how machines work. Fourth ACM International Multimedia Conference, Boston, MA.
- Hegarty, M., & Narayanan, N. H. (1996, February) Building hypermedia manuals for optimal comprehension of complex machines. Paper presented at the Office of Naval Research Workshop on Issues in Interactive Multimedia, New Mexico State University, Las Cruces, February, 1996.
- Hegarty, M. Mental animation: Strategies and limitations. Talk presented to the Department of Psychology and Human Development, Vanderbilt University, October 1995, Cognitive Science Program, Georgia Institute of Technology, November 1995, 1995 and Department of Psychology, Texas Institute of Technology, November 1995.
- Hegarty, M. (1995, May) Comprehension of text and graphics. Colloquium presented to the Department of Linguistics, University of California.
- Hegarty, M. (1995, March) Mental animation. Colloquium presented to the Department of Psychology, University of California, Irvine and to the Department of Cognitive and Linguistic Sciences, Brown University.
- Hegarty, M. (1994, April). Mental animation and mechanical reasoning. Paper presented in the Spencer Fellows Forum, National Academy of Education Spring Meeting.
- Hegarty, M. (1994, March). Mental animation: Inferring motion from static diagrams. Invited talk to the Knowledge systems group, Stanford University.
- Hegarty, M. (1994, March). Mental animation: Inferring motion from static diagrams. Colloquium presented to the EMST/Sesame group, Department of Education, University of California, Berkeley.
- Hegarty, M. (1993, April). Mental animation of static diagrams. Invited talk to the Department of Psychology, Stanford University.

Hegarty, M. (1990, August). The mechanics of understanding and understanding mechanics. Paper presented at the Eye Movements and Visual Cognition Conference, Amherst, MA.

Hegarty, M. (1998). The mechanics of understanding and understanding mechanics. Colloquium presented at Georgia Institute of Technology, University of South Florida, University of Texas, Louisiana State University, California State University, Fullerton, University of California, Santa Barbara, University of Delaware, State University of New York at Stony Brook, January to March 1988.

Hegarty, M., and Just, M. A. (1986, July). Understanding Machines Explained in Text and Diagrams. Paper presented at the symposium on knowledge acquisition from text and pictures. Deutsches Institut fur Fernstudien (DIFF), Tübingen, Germany.

### **Conference Presentations:**

Hegarty, M., Stull, A. T., & Stieff, M. (2016, August) Fostering spatial intelligence in Organic Chemistry. Talk presented at the Annual Meeting of the Cognitive Science Society.

Boone, A. P., Gong, X., Sañosa, D. & Hegarty, M. (2016, August). Individual differences in navigation efficiency and strategy using the dual solution paradigm. Talk presented at Spatial Cognition Conference, Philadelphia, PA.

Boone, A. P., Gunalp, P., Heydari, N., & Hegarty, M. (2016, August). Effects of verbal instructions on non-expert interpretations of hurricane forecast uncertainty visualizations. Poster presented at Spatial Cognition Conference, Philadelphia, PA.

Tarampi, M. R., & Hegarty, M. (2016, August). Comparing Performance on Paper-and-Pencil and Computer-based Assessments of Spatial Ability. Poster to be presented at Spatial Cognition 2016, Philadelphia, PA.

Friedman, A., Hegarty, M., Boone, A. P., & Barrett, T. J. (2016, August). Where are you? The effect of uncertainty & its visual representation on location judgments in GPS-like displays. Poster presented at Spatial Cognition Conference, Philadelphia, PA.

Stull, A. T., Gainer, M., Padalkar, S., & Hegarty, M. (2016, July). Promoting Representational Competence with Molecular Models in Organic Chemistry. Talk presented at the 2016 Biennial Conference on Chemical Education, University of Northern Colorado, CO.

- Hegarty, M., Burte, H., Boone, A., Heydari, N & Tarampi, M. (2015, September). Individual Differences in Spatial Abilities across Different Scales of Space. Presented at the 6<sup>th</sup> International Conference on Spatial Cognition, Rome, Italy.
- Heydari, N., Hegarty, M., & Tarampi, M. R. (2015, July). Social Influences on the Spatial Perspective-Taking Abilities of Males and Females. Poster presented at CogSci 2015: The Annual Meeting of the Cognitive Science Society, Pasadena, CA.
- Boone, A. P. & Hegarty, M. (July 2015). Strategy differences do not account for gender difference in mental rotation. Poster presented at Cognitive Sciences Society, Pasadena, CA.
- Ruginski, I. T., Boone, A. P., Padilla, L., Hegarty, M., Thompson, W. B., & Creem-Regehr, S. H. (July 2015). Understanding the Cone of Uncertainty: Non-expert interpretations of hurricane forecast uncertainty visualizations. Poster presented at Cognitive Sciences Society, Pasadena, CA.
- Stull, A. T., Barrett, T., & Hegarty, M. (2015, April). Concrete and Virtual Manipulatives in Chemistry. Talk presented at the Annual Conference of the American Educational Research Association. Chicago, IL.
- Stull, A. T., & Hegarty, M. (2015, July). Developing Representational Competence with Concrete and Virtual Manipulatives in Chemistry. Poster presentation at the Annual meeting of the Cognitive Science Society. Pasadena, CA.
- Hegarty, M., Barrett, T. J., McKenzie, G. & Goodchild, M. (2014, November). Interpreting visualizations of uncertainty on smartphone displays. Poster presented at the 55th Annual Meeting of the Psychonomic Society, Long Beach, CA.
- Tarampi, M. R., Atit, K., Petcovic, H.L., Shipley, T.F. & Hegarty, M. (2014, November). Spatial Ability in Expert Geoscientists. Poster presented at the 55th Annual Meeting of the Psychonomic Society, Long Beach, CA.
- Burte, H., Hegarty, M., Turner, B. O., & Miller, M. B. (2014, November). *Neural basis of individual differences in a relative heading task*. Poster session presented at the 2014 Psychonomic Society Annual Meeting, Long Beach, CA.
- Burte, H., Hegarty, M., Turner, B. O., & Miller, M. B. (2014, November). *Neural basis of individual differences in a relative heading task*. Poster session presented at the 2014 Society for Neuroscience Conference, Washington, DC.
- Boone, A. P., & Hegarty, M. (2014, September). Twelve years later: The Santa Barbara Sense of Direction scale. Poster presented at Spatial Cognition, Bremen, Germany.

- Burte, H. & Hegarty, M. (2013, November), Individual differences and strategies in the allocentric recall task. Talk presented at the Annual Conference of the Psychonomic Society, Toronto, Canada.
- Hegarty M. (2013, July). Cognition and metacognition in learning and reasoning with diagrams. Talk presented in the workshop on Diagrammatic Cognition: Discovery and Design. Cognitive Science Conference, Berlin.
- Hegarty M. (2013, May). Broadening the study of spatial thinking in science. The case of organic chemistry. Talk presented at the annual meeting of the American Educational Research Association, San Francisco, CA.
- Hegarty M. (2013, April). Spatial thinking across the college curriculum. Report of an interdisciplinary specialist meeting. Annual meeting of the Association of American Geographers, Los Angeles, CA.
- Hegarty, M. (2012, August). Metarepresentational competence as an aspect of spatial intelligence. Annual meeting of the Cognitive Science Society, Sapporo, Japan.
- Stull, A. T., Barrett, T. & Hegarty, M. (2012, July). Design of a virtual reality system for the study of diagram use in organic chemistry. Presented at the Workshop on Technology-Enhanced Diagrams Research (TEDR-2012), Canterbury, UK.
- Hegarty, M. (2012, April). Spatial abilities and chemistry achievement. Contributions and limitations of correlational studies. Talk presented at the annual meeting of the American Educational Research Association, Vancouver, Canada.
- Hegarty, M. (2011, November) Wayfinding in the Seattle public library: Discussion. Talk presented at the Annual Meeting of the Psychonomic Society, Seattle, WA.
- Stull, A. T., Barrett, T. & Hegarty, M. (2011, August). Directional bias induced error patterns when translating structural representations. Poster presented at the 33<sup>rd</sup> Annual Conference of the Cognitive Science Society, Boston, MA.
- Stull, A. T. & Hegarty, M. (2011, April). Chemistry models: Facilitating cognition through external manipulatives. Poster presented at the Annual Conference of the American Educational Research Association, New Orleans, LA.
- Hegarty, M. (2010, February) Introduction to symposium: Visualizations in the mind and in the world: Implications for STEM education. Annual meeting of the American Association for the Advancement of Science, San Diego, CA.
- Hegarty, M. (2009, August) Thinking processes in diagrammatic reasoning. Annual meeting of the Cognitive Science Society. Amsterdam, The Netherlands.



- Hegarty, M., Stull, A. T., & Smallman, H. S. (2009, March). Naïve cartography: How users' intuitions about map design can hurt performance. Annual Meeting of the Association of American Geographers, Las Vegas, NV.
- Stull, A. T., Hegarty, M., & Mayer, R. E. (2008, July). The seduction of symmetry. Bias in the manual rotation of a virtual object. Annual meeting of the Cognitive Science Society. Washington, DC.
- Cohen, C. A., & Hegarty, M. (2007, November) Inferring cross sections: Benefits of spatial visualization training. Poster presented at the 48<sup>th</sup> Annual Meeting of the Psychonomics Society Meeting, Long Beach, CA.
- Stull, A., Hegarty, M., & Mayer, R. E. (2007, November) Mitigating effects of spatial ability on mental and manual rotation. Poster presented at the 48<sup>th</sup> Annual Meeting of the Psychonomics Society Meeting, Long Beach, CA.
- Kriz, S., & Hegarty, M. (2007, November). Perspective in spatial memory and descriptions: Transforming representations for communication. Poster presented at the 48<sup>th</sup> Annual Meeting of the Psychonomics Society Meeting, Long Beach, CA.
- Dara-Abrams, D., & Hegarty, M. (2007, November) Learning the layout of a new building: A longitudinal, real-world study. Poster presented at the 48<sup>th</sup> Annual Meeting of the Psychonomics Society Meeting, Long Beach, CA.
- Wolbers, T., Hegarty, M. Buechel, C., & Loomis, J. (2007, November) Path integration and spatial updating in humans: Behavioral principles and underlying neural mechanisms. Poster presented at the 48<sup>th</sup> Annual Meeting of the Psychonomics Society Meeting, Long Beach, CA.
- Cohen, C. A., & Hegarty, M. (2007, August). Sources of difficulty in imagining cross sections of 3D objects. Paper presented at the annual meeting of the Cognitive Science Society, Nashville, TN.
- Hegarty, M. (2007; August) Discussant: Symposium on eyetracking as a means for detailed analysis of multimedia learning processes. 12<sup>th</sup> Biannual conference of the European Association for Research on Learning and Instruction, Budapest, Hungary.
- Hegarty, M., Keehner, M. Cohen, C. A., Khooshabeh, P. & Montello, D. R. (2007, August) Spatial thinking with external visualizations: The role of individual differences. Paper presented at the 12<sup>th</sup> Biannual conference of the European Association for Research on Learning and Instruction, Budapest, Hungary.

- Keehner, M., Hegarty, M., Cohen, C. A., & Khooshabeh, P. (2007, August) Reasoning with interactive visualizations: The importance of individual differences among users. Paper presented at the 12<sup>th</sup> Biannual conference of the European Association for Research on Learning and Instruction, Budapest, Hungary.
- Hegarty, M., Canham, M. S., & Kriz, S. (2007). Interactions between knowledge and display design in interpretation of complex graphics. Presented at the annual meeting of the Psychonomic Society. Houston, TX.
- Cohen, C. A., and Hegarty, M. (2005, July) Individual differences in the use of external visualization during an internal visualization task. Presented at the Cognitive Science Society Annual Conference, Stresa, Italy.
- Mayer, R. E., Hegarty, M., & Mayer, S. (2005, April). Does animation improve learning? Presented at the annual convention of the American Educational Research Association, Montreal, Canada.
- Keehner, M., Lippa, Y., Hegarty, M., Montello, D. R., & Tendick, F. (2005, January) Learning to use a simulated angled laparoscope: How practice moderates individual differences. Paper presented at the Medicine Meets Virtual Reality conference, Long Beach, CA.
- Hegarty, M., Mayer, S., & Kriz, S. (2004, July). Use of gestures in communicating and thinking about machines. Presented at the annual meeting of the Cognitive Science Society, Chicago, IL.
- Keehner, M., Montello, D. R., Hegarty, M., & Cohen, C. (2004, July). Effects of interactivity and spatial ability on the comprehension of spatial relations in a 3D computer visualization. Presented at the annual meeting of the Cognitive Science Society, Chicago, IL.
- Canham, M., & Hegarty, M (2004, July). Influences of knowledge on eye fixations while interpreting weather maps. Paper presented at the annual meeting of the Cognitive Science Society, Chicago, IL.
- Keehner, M., & Hegarty M. (2004, April). Neural correlates of object-based versus egocentric spatial transformations Presented at the annual meeting of the Cognitive Neuroscience Society, San Francisco, CA.
- Hegarty, M. (2004, April). Internal and external visualizations. Paper presented at the annual meeting of the American Educational Research Association, San Diego, CA.

- Cohen, C. A., Hegarty, M., Montello, D. R., & Keehner, M. (2004, April) The effects of spatial abilities and animated instruction on representing cross sections. Paper presented at the annual meeting of the American Educational Research Association, San Diego, CA.
- Keehner, M., Cohen, C. A., Hegarty, M., & Montello, D. R. (2004, January). Cognitive factors and interactivity: Implications for the design and implementation of 3D computer visualizations for medical education. Poster presented at the Medicine Meets Virtual Reality, conference, Long Beach, CA.
- Hegarty, M., Montello, D. R., & Richardson, A. E. (2003, November). Sex differences in spatial abilities, sense of direction and spatial layout learning. Paper presented at the annual meeting of the Psychonomics Society, Vancouver.
- Hegarty, M., Canham, M., & Shimozawa, N, (2003, August) Inferences from weather maps: Do you need a weatherman to know which way the wind blows? Paper presented at the annual meeting of the Cognitive Science Society, Boston, MA.
- Cohen, C., Hegarty, M., Keehner, M., & Montello, D. R. (2003, August). Spatial ability in the representation of cross sections. Paper presented at the annual meeting of the Cognitive Science Society, Boston, MA.
- Lippa Y., Hegarty M., Montello D. R., & Tendick, F. (2002, November). Exploiting individual differences to study processes of perceptual-motor learning. Paper presented at the annual meeting of the Psychonomics Society, Kansas City.
- Waller, D., & Hegarty, M. (2002, November). Further evidence that mental rotation and perspective taking are separable factors. Paper presented at the annual meeting of the Psychonomics Society, Kansas City.
- Hegarty, M. (2002, August). Internal and external visualization. Paper presented at the Annual Meeting of the Cognitive Science Society, Fairfax, VA.
- Hegarty, M. (2002, August). Discussant: Symposium on cognition of complex visualizations. Annual Meeting of the Cognitive Science Society, Fairfax, Virginia.
- Waller, D., Montello, D. R., Hegarty, M., & Richardson, A. E. (2001, November). Alignment effects in room space: Attenuating, eliminating, reversing. Paper presented at the 42<sup>nd</sup> Annual Meeting of the Psychonomics Society, Orlando FL.
- Kozhevnikov, M., & Hegarty, M. (2001, November). The role of spatial imagery in physics problem solving. Paper presented at the 42<sup>nd</sup> Annual Meeting of the Psychonomics Society, Orlando FL.
- Hegarty, M. (2001, May). Capacity limits in mechanical reasoning. Paper presented at AAAI conference on Qualitative Reasoning, San Antonio.

- Hegarty, M., Montello, D. R. Richardson, A. E., & Ishikawa, T. (2000, November). Individual differences in spatial abilities in large- and small-scale space. Paper presented at the annual meeting of the Psychonomics Society, New Orleans.
- Hegarty, M. (2000, August). Capacity limits in diagrammatic reasoning. Paper presented at Diagrams 2000. Edinburgh, Scotland.
- Narayanan, N. H., & Hegarty, M. (2000, August). Communicating dynamic behaviors: Are interactive multimedia presentations better than static mixed-mode presentations? Paper presented at Diagrams 2000. Edinburgh, Scotland.
- Narayanan, N. H., & Hegarty, M. (2000, August). Communicating dynamic behaviors with mixed-mode presentations: Are interactive presentations better than static ones?" Presented at 1st international workshop on interactive graphical communication. London.
- Kozhevnikov, M., & Hegarty, M. (1999, November). Perspective-taking ability is distinct from mental-rotation ability. Paper presented at the annual meeting of the Psychonomics Society. Los Angeles.
- Hegarty, M., Narayanan, N.H., Cate, C., & Holmquist, S. (1999, July). Understanding machines from diagrams, text and hypermedia presentations. Presented at the annual conference of the Society for Applied Memory and Cognition. Boulder, Co.
- Hegarty, M. (1999, April). Understanding machines from interactive multimedia manuals. Presented at the annual meeting of the American Educational Research Association, Montreal, Canada.
- Kozhevnikov, M., Hegarty, M., & Mayer, R.E. (1999, April). The role of imagery in problem solving in physics. Presented at the annual meeting of the American Educational Research Association, Montreal, Canada.
- Hegarty, M., & Kozhevnikov, M. (1999, April). Types of visual-spatial representations and mathematical problem solving. Presented at the annual meeting of the American Educational Research Association, Montreal, Canada.
- Hegarty, M., Quilici, J., Narayanan, N. H., Holmquist, S., & Moreno, R. (1998, April). Designing hypermedia manuals to explain how machines work: Lessons from evaluation of a theory-based design. Hyped-Media to Hyper-Media: A Workshop at CHI'98: ACM SIGCHI Conference on Human Factors in Computing Systems, Los Angeles, CA.

- Shah, P, Hegarty, M., & Miyake, A. (1997, November). Working memory and spatial ability: Limitations of the dual-task methodology. Presented at the annual meeting of the Psychonomic Society, Philadelphia, PA.
- Richardson, A. E., Hegarty, M., & Montello, D. R. (1997, November) Spatial learning from maps and from navigation in real and virtual environments Presented at the annual meeting of the Psychonomic Society, Philadelphia, PA.
- Narayanan, N. H., & Hegarty, M. (1997, April). Model-based design of hypermedia presentations. ACM Human Factors in Computing Systems Conference (CHI).
- Shah, P., Mayer, R. E., & Hegarty, M. (1997, March). Which graphs are better? Textbook graphs as aids to knowledge construction. Presented at the annual meeting of the American Educational Research Association, Chicago, IL.
- Hegarty, M., Schwartz, D. L., & Rieser, J. J. (1996, November). Mechanical inference: When actions speak louder than words. Presented at the annual meeting of the Psychonomic Society, Chicago, IL.
- Miyake, A., Rettinger, D. Shah, P., & Hegarty, M. (1996, November). Reinterpreting psychometric visuospatial abilities with a multicomponent model of working memory. Presented at the annual meeting of the Psychonomic Society, Chicago, IL.
- Revlín, R., & Hegarty, M. (1996, July). Resolving anaphoric reference: Reading as enthymemic reasoning. Presented at the annual conference of the Cognitive Science Society, San Diego.
- Narayanan, N. H., & Hegarty, M. (1995, December). Understanding and reasoning with multi-modal representations. Presented at the Second International Symposium on Cognition and Education, Varanasi, India.
- Sims, V. K., & Hegarty, M. (1995, November). Understanding and reasoning with multi-modal representations. Presented at the annual meeting of the Psychonomics Society, Los Angeles.
- Hegarty, M., & Ferguson, E. L. (1995, April). Construction of mental models from text and graphics: Evidence from eye-fixation studies. Presented at the annual meeting of the American Educational Research Association, San Francisco.
- Mitchell, S., & Hegarty, M. (1995, April). Retrieval of analogous memories while solving physics motion problems. Presented at the annual meeting of the American Educational Research Association, San Francisco, April 1995.
- Hegarty, M., & Narayanan, N. H. (1994, August). Visual reasoning in problem solving. Presented at the annual conference of the Cognitive Science Society, Atlanta, GA.

- Hegarty, M., & Steinhoff, K. (1994, April). Use of diagrams as external memory in a mechanical reasoning task. Presented at the annual meeting of the American Educational Research Association, New Orleans, LA.
- Hegarty, M., Mayer, R. E., & Monk, C. A. (1994, April). Comprehension of arithmetic word problems: A comparison of successful and unsuccessful problem solvers. Presented at the annual meeting of the American Educational Research Association, New Orleans.
- Hegarty, M., & Ferguson, J. M. (1993, November). Strategy change with practice in a mental animation task. Presented at the annual meeting of the Psychonomic Society, Washington, DC.
- Hegarty, M. (1993, January). Understanding mechanical diagrams: Cognitive processes and abilities. Presented at the Fourth Annual Winter Text Conference, Jackson Hole, Wyoming, January 1993.
- Hegarty, M., & Sims, V. K. (1992, November). Individual differences in inferring motion from static diagrams. Presented at the annual meeting of the Psychonomic Society, St Louis.
- Ferguson, E. L., & Hegarty, M. (1992, June) Constructing hierarchical representations of text from different texts. Presented at the 4th annual convention of the American Psychological Society, San Diego.
- Hegarty, M., Mayer, R. E., & Monk, C. A. (1992, April). Comprehension strategies for arithmetic word problems. Presented at the annual meeting of the American Educational Research Association, San Francisco.
- Mayer, R. E., Hegarty, M., and Lewis, A. (1992, April). Mathematical Misunderstandings: Qualitative reasoning about quantitative problems. Presented at the annual meeting of the American Educational Research Association, San Francisco.
- Hegarty, M. (1992, January). Inferring motion from static diagrams. Presented at the Third Annual Winter Text Conference, Jackson Hole Wyoming.
- Hegarty, M., Mayer, R. E., & Green C. E. (1991, April). Comprehension of arithmetic word problems. Presented at the annual meeting of the American Educational Research Association, Chicago.
- Ferguson, E. L., & Hegarty, M. (1991, April). A hands on advantage for mechanical understanding? Effects of learning with real objects or diagrams. Presented at the annual meeting of the American Educational Research Association, Chicago.

- Hegarty, M. (1990, November). Inferring motion from static displays. Presented at the annual meeting of the Psychonomic Society, New Orleans.
- Hegarty, M. (1990, April). Text directed processing of diagrams in science instruction. Presented at the annual meeting of the American Educational Research Association, Boston.
- Hegarty, M. (1990, January). Constructing mental models from text and diagrams. Paper presented at the First Annual Winter Text Conference, Jackson Hole, Wyoming.
- Hegarty, M., & Just, M. A. (1989, November). Constructing mental models of mechanical systems from text and diagrams. Presented at the annual meeting of the Psychonomic Society, Atlanta, Georgia.
- Hegarty, M., Just, M. A., & Morrison, I. M. (1987, November). Individual differences in Mental Models of Mechanical Systems. Paper presented at the annual meeting of the Psychonomic Society, Seattle, Washington.
- Hegarty, M., Just, M. A. & Morrison, I. (1987, July). Individual differences in mechanical ability. Presented at the annual conference of the Cognitive Science Society, Seattle Washington, July 1987. Also published in the Proceedings of the Ninth Annual Conference of the Cognitive Science Society.
- Hegarty, M. (1983, July). Visual representation processes used by children in solving mathematical problems. Presented at the Special Conference on the Mathematical Education of Less Able Children and Youth, Dublin, Ireland.
- Greaney, V., & Hegarty, M. (1983). The influence of home environment on leisure reading. Presented at the annual conference of the International Reading Association, Anaheim, California.
- Greaney, V., & Hegarty, M. (1982). Factors related to mathematics attainment. Presented at the annual Conference of the Irish Mathematics Teachers Association, Ireland.

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