FIRE: Exploring Visual Cueing to Facilitate Problem Solving in Physics

REFERENCES CITED

Antes, J. R., & Kristjanson, A. F. (1991). Discriminating artists from nonartists by their eye-fixation patterns. *Perceptual and Motor Skills, 73*(3), 893-894.

Bennett, A., Moore, T., & Nguyen, X. (2011). *A Longitudinal Study on Students' Development and Transfer of the Concept of Integration.* Paper presented at the 2011 Annual Conference and Exposition, , Vancouver, British Columbia, Canada.

Boucheix, J., & Lowe, R. K. (2010). An eye tracking comparison of external pointing cues and internal continuous cues in learning with complex animations. *Learning and Instruction, 20*(2), 123-135.

Canham, M., & Hegarty, M. (2010). Effects of knowledge and display design on comprehension of complex graphics. *Learning and Instruction, 20*(2), 155-166.

Carmichael, A., Larson, A., Gire, E., Loschky, L., & Rebello, N. S. (2010). How does visual attention differ between experts and novices on physics problems? *AIP Conference Proceedings, 1289*(1), 93-96.

Charness, N., Reingold, E.M., Pomplun, M. & Stampe, D.M. (2001). *The perceptual aspect of skilled performance in chess: Evidence from eye movements.* Memory & Cognition, *29,* 1146-1152.

Chen, J., & Warren, S. (2011). *Work in Progress: Higher-Level-Learning Enhancements to Online Assignments in an Electrical Engineering Linear Systems Course* Paper presented at the Frontiers in Education Conference, Rapid City, SD.

Chen, J., Warren, S., Nguyen, D., Rebello, N. S., & Bennett, A. (2011). *Teaching-Learning Interviews to Understand and Remediate Student Difficulties with Fourier Series Concepts.* Paper presented at the 2011 Annual Conference and Exposition, American Society for Engineering Education, Vancouver, British Columbia, Canada.

Craig, S. D., Gholson, B., & Driscoll, D. M. (2002). Animated pedagogical agents in multimedia educational environments: Effects of agent properties, picture features, and redundancy. J*ournal of Educational Psychology*, 94, 428–434

de Koning, B. B., Tabbers, H. K., Rikers, R. M. J. P., & Paas, F. (2009). Towards a Framework for Attention Cueing in Instructional Animations: Guidelines for Research, and Design. *Educational Psychological Review, 21*, 113–140.

de Koning, B. B., Tabbers, H. K., Rikers, R. M. J. P., & Paas, F. (2007). Attention cueing as a means to enhance learning from an animation. *Applied Cognitive Psychology*, 21, 731–746.

de Koning, B. B., Tabbers, H. K., Rikers, R. M. J. P., & Paas, F. (2010). Attention guidance in learning from a complex animation: Seeing is understanding? *Learning and Instruction, 20*(2), 111-122.

Desimone, R., & Duncan, J. (1995). Neural mechanisms of selective visual attention. *Annual Review of Neuroscience, 18*(1), 193-222.

Dubinsky, E., & Harel, G. (1992). The nature of the process conception of function. In E. Dubinsky & G. Harel (Eds.), *The concept of function: Aspects of epistemology and pedagogy* (pp. 85-106).Duncker, K. (1945). On problem solving. *Psychological Monographs, 58*(270).

Feil, A., & Mestre, J. P. (2007). ExpertNovice Differences on a Recognition Memory Test of Physics Diagrams. *2007 Proceedings of the Physics Education Research Conference*.

Foulsham, T., & Underwood, G. (2008). What can saliency models predict about eye movements? spatial and sequential aspects of fixations during encoding and recognition. *Journal of Vision, 8*(2)

Gick, M. L., and Holyoak, K. J. (1983). Analogical Problem Solving. *Cognitive Psychology, 12*, 306-355.

Gire, E., Nguyen, D., & Rebello, N. S. (2011). *Characterizing Students' Use of Graphs in Introductory Physics with a Graphical Analysis Epistemic Game.* Paper presented at the 2011 National Association for Research in Science Teaching Annual Meeting Orlando, FL.

Grant, E. R., & Spivey, M. J. (2003). Eye Movements and Problem Solving: Guiding Attention Guides Thought. *Psychological Science, 14*(5), 462-466.

Hegarty, M. (1992). Mental animation: Inferring motion from static displays of mechanical systems. *Journal of Experimental Psychology. Learning, Memory, and Cognition*, 18, 1084–1102.

Hestenes, D., Wells, M., & Swackhammer, G. (1992). Force Concept Inventory. *The Physics Teacher, 30*, 141-151.

Irwin, D. E., & Gordon, R. D. (1998). Eye movements, attention and trans-saccadic memory. *Visual Cognition, 5*(1-2), 127-155.

Itti, L., & Koch, C. (2000). A saliency-based search mechanism for overt and covert shifts of visual attention. *Vision Research, 40*(10-12), 1489-1506.

Jamet, E., Gavota, M., & Quaireau, C. (2008). Attention guiding in multimedia learning. *Learning and Instruction*, 18, 135–145.

Johnson-Laird, P. N. (1983). *Mental Models: Towards a cognitive science of language, inference, and consciousness*. Cambridge, MA: Harvard University Press.

Kalyuga, S., Chandler, P., & Sweller, J. (1999). Managing split-attention and redundancy in multimedia instruction. *Applied Cognitive Psychology*, *13*, 351–371

Lorch, R. F., & Lorch, E. P. (1995). Effects of organizational signals on text-processing strategies. *Journal of Educational Psychology*, *87*, 537–544.

Lorch, R. F., & Lorch, E. P. (1996). Effects of organizational signals on free recall of expository text. *Journal of Educational Psychology*, 88, 38–48.

Lowe, R. (1999). Extracting information from an animation during complex visual learning. *European Journal of Psychology of Education, 14*(2), 225-244.

Lowe, R. K. (1989). Search strategies and inference in the exploration of scientific diagrams. *Educational Psychology*, 9, 27–44

Lowe, R. K. (2003). Animation and learning: Selective processing of information in dynamic graphics. *Learning and Instruction, 13*(2), 157-176.

Mautone, P. D., & Mayer, R. E. (2007). Cognitive aids for guiding graph comprehension. *Journal of Educational Psychology*, 99, 640–652

Mayer, R. E. (2001). *Multimedia learning*. New York: Cambridge University Press.

Mayer, R. E. (2010). Unique contributions of eye-tracking research to the study of learning with graphics. *Learning and Instruction, 20*(2), 167-171.

Nguyen, D., & Rebello, N. S. (2011). Students' Difficulties with Integration in Electricity. *Physical Review Special Topics - Physics Education Research, under review*.

Nguyen, D., & Rebello, N. S. (2011). Students' Understanding and Application of the Area Under the Curve Concept in Physics Problems. *Physical Review Special Topics - Physics Education Research, under review*.

Nguyen, D., Gire, E., & Rebello, N. S. (2010). Facilitating Students' Problem Solving Across Multiple Representations in Introductory Mechanics. *Proceedings of the 2010 Physics Education Research Conference*.

Rayner, K. (1998). Eye movements in reading and information processing: 20 years of research. *Psychological Bulletin, 124*(3), 372-422.

Rebello, N. S., Cui, L., Bennett, A. G., Zollman, D. A., & Ozimek, D. J. (2007). Transfer of learning in problem solving in the context of mathematics and physics. In D. H. Jonassen (Ed.), *Learning to solve complex, scientific problems*. Mahwah, NJ: Lawrence Earlbaum Associates.

Rebello, N. S., Zollman, D. A., Allbaugh, A. R., Engelhardt, P. V., Gray, K. E., Hrepic, Z., et al. (2005). Dynamic Transfer: A Perspective from Physics Education Research. In J. P. Mestre (Ed.), *Transfer of Learning from a Modern Multidisciplinary Perspective* (pp. 217-250). Greenwich, CT: Information Age Publishing Inc.

Rosengrant, D., Thomson, C., & Mzoughi, T. (2009). Comparing experts and novices in solving electrical circuit problems with the help of eye-tracking. *2009 Proceedings of the Physics Education Research Conference*.

Schnotz, W., & Lowe, R. K. (2008). A unified view of learning from animated and static graphics. In R. K. Lowe & W. Schnotz (Eds.), *Learning with animation: Research and design implications*. New York: Cambridge University Press.

Shah, P., Mayer, R. E., & Hegarty, M. (1999). Graphs as aids to knowledge construction. *Journal of Educational Psychology*, 91, 690–702

Simons, D. J., & Chabris, C. F. (1999). Gorillas in our midst: sustained inattentional blindness for dynamic events. *Perception, 28*, 1059 – 1074.

Singh, C., & Rosengrant, D. (2003). Multiple-choice test of energy and momentum concepts. *American Journal of Physics, 71*(6), 607-617.

Smith, A. D., Mestre, J. P., & Ross, B. H. (2010). Eye-gaze patterns as students study worked-out examples in mechanics. *Physical Review Special Topics - Physics Education Research, 6*, 020118.

Stevens, T., Carmichael, A., Larson, A., Gire, E., Loschky, L., & Rebello, N. S. (2011). *Effects of Visual Attentional Cueing on Beginner Problem Solvers in Physics*. Paper presented at the Annual Meeting of the National Association for Research in Science Teaching.

Tai, R. H., Loehr, J. F., & Brigham, F. J. (2006). An exploration of the use of eye-gaze tracking to study problem-solving on standardized science assessments. *International Journal of Research & Method in Education, 29*(2), 185-208.

Thomas, L. E. & Lleras, A. (2007). Moving eyes and moving thought: On the spatial compatibility between eye movements and cognition. *Psychonomic Bulletin Review, 14*(4), 663.

Thomas, L. E., & Lleras, A. (2009). Covert shifts of attention function as an implicit aid to insight. *Cognition*, 111(2), 168-174.

Triesman, A., & Gelade, G. (1980). A feature integration theory of attention. *Cognitive Psychology, 12*, 97-136.

Tversky, B., Heiser, J., Lozano, S., MacKenzie, R., & Morrison, J. (2008). Enriching animations. In R. K. Lowe & W. Schnotz (Eds.), *Learning with animation: Research and design implications*. New York: Cambridge University Press

Tversky, B., Morrison, J., & Bétrancourt, M. (2002). Animation: Can it facilitate? *International Journal of Human-Computer Studies*, 57, 247–262.

Van Gog, T. (2005). Uncovering expertise-related differences in troubleshooting performance: Combining eye movement and concurrent verbal protocol data. *Applied Cognitive Psychology, 19*(2), 205-221.