Christopher R. Bennett

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The University of Maine
Spatial Informatics Program
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Education

2006-2009 Villanova University, Philadelphia, PA
Bachelor of Arts in Psychology
Minor in Cognitive Science

2010-2016 The University of Maine, Orono, ME
Ph.D. Student: Spatial Information Science and Engineering
Minor in Research Methods and Statistics
Cumulative GPA = 3.7

Graduate Research Assistant

2010-present Virtual Environments and Multimodal Interaction Lab (VEMI)

Joined the VEMI lab during the summer of 2010 under director and advisor Dr. Nicholas Giudice. Research interests began with Multiple Sensory Modalities and Functional Equivalence, but have expanded to also include Individual Differences (most notably aging and low vision populations) and Virtual Simulations. Activities involve all aspects of design, facilitation, and analysis of human subjects' research studies, programming for said studies as well as various Virtual Reality Demonstrations used by the lab. Above and beyond research activities, I have developed a leadership role for graduate and undergraduate students.

Related Research Awards

Graduate Exposition Oral Presentation 2nd place award for talk titled, "Do Cognitive Maps Decay with Age?" Received prize and award April, 2016.

University of Maine Graduate Student Government Grant funding received for Fall 2015.

Graduate Exposition Oral Presentation 1st place award for talk titled, "Improving Spatial Aging through the Use of Compensatory Augmentations." Received prize and award April, 2015.

International Spatial Cognition Summer Institute (ISCSI). Awarded acceptance with two weeks room and board included. Santa Barbara, CA. Summer, 2013.

Graduate Exposition Poster Presentation 2nd place award for poster titled, "Non-Visual Graphical Accessibility" Received prize and award April, 2013.

Chase Distinguished Research Assistantship Recipient. Received award at Graduate Student and Faculty Recognition Ceremony May 4, 2012. Assistantship includes tuition and stipend coverage for the academic year (2012-2013)

Graduate Exposition Poster Presentation 3rd place award for poster titled, "The Effects of Life Span Development on Spatial Updating of Haptic Arrays." Received prize and award April, 2012.

Graduate Exposition Oral Presentation 3rd place award for talk titled, "Life Span Development and the Spatial Image." Received prize and award April, 2012.

Bennett C.R. Best Doctoral Colloquium Award. Conference on Spatial Information Theory (COSIT 2011). Belfast, ME

Peer reviewed Journal Publications

Bennett C.R., Giudice N.A., Klatzky R.L., & Loomis J.M. (submitted) Spatial Updating of Multiple Targets across the Lifespan. *Attention, Perception, & Psychophysics.*

Giudice N.A., Bennett C.R., Klatzky R.L., & Loomis J.M. (accepted for 2017 edition) Spatial Updating of Haptic Arrays Across the Lifespan. *Experimental Aging Research. 43 (2).*

Bennett, C. R., Corey, R. R., Giudice, U., & Giudice, N. A. (2016) Immersive Virtual Reality Simulation as a Tool for Aging and Driving Research. *HCI International 2016.*

Klatzky, R. L., Giudice, N.A., Bennett, C. R., & Loomis, J. M. (2014). Touch-Screen Technology for the Dynamic Display of 2D Spatial Information without Vision: Promise and Progress. *Multisensory Research*. 0, 1-20.

Giudice N.A., Klatzky R.L., Bennett C.R., & Loomis J.M. (2013) Combining Locations from Working Memory and Long-Term Memory into a Common Spatial Image. *Spatial Cognition and Computation.* 13:2, 103-128

Giudice N.A., Bennett C.R., Klatzky R.L., & Loomis J.M. (2012). Perception of 3-D Location Based on Vision, Touch, and Extended Touch. *Experimental Brain Research*, 224, 141 – 153.

Conference Presentations

Kaplan, T.M., Bennett, C.R., Giudice, N.A. (2016) Virtual Reality Simulation as Supplemental Treatment in Cases of Seasonal Affective and Anxiety Disorders. 57th Annual Psychonomics Society Meeting. November, Boston, MA. (Poster)

Richards, S.M., Bennett, C.R., Giudice, N.A. (2016) Virtual Reality Exposure Therapy for Veterans with PTSD. 57th Annual Psychonomics Society Meeting. November, Boston, MA. (Poster)

Bennett, C.R., Giudice, N.A. (2016) Cognitive Map Decay in Older Adults: Evaluations using Virtual Reality Driving Simulation. Spatial Cognition 2016. August. Philadelphia, PA. (Poster)

Bennett, C.R., Corey, R.R., Giudice, U., Giudice, N.A. (2016) Immersive Virtual Reality Simulation as a Tool for Aging and Driving Research. 18th International Conference on Human-Computer Interaction. July, Toronto, Canada. (Talk)

Bennett, C.R., Giudice, N.A. (2016). Do Cognitive Maps Decay with Age? Graduate Exposition at The University of Maine. Orono, ME. (Talk)

Bennett, C.R., Giudice, N.A. (2015). Developing Compensatory Augmentations for Aging and Navigation. 6th International Conference on Spatial Cognition: "Space and Situated Cognition". September. Rome, Italy. (Poster)

Bennett, C.R., Giudice, N.A. (2015). Improving Spatial Aging through the Use of Compensatory Augmentations. Graduate Exposition at The University of Maine. Orono, ME. (Talk)

Bennett, C.R., Giudice, N.A. (2014). Research Topics in Spatial Navigation and Aging. 5th Annual Mainely Data, Some Theory Conference. April, The University of Maine, Orono, ME. (Talk)

Bennett, C.R., Giudice, N.A. (2014). Exploring Effects of Age on Diving through Virtual Simulation. Graduate Exposition at The University of Maine. Orono, ME. (Poster)

Bennett, C.R., Loomis, J.M., Klatzky, R.L., and Giudice, N.A. (2013). Spatial Aging and Memory Load on the Updating of Multiple Target Arrays. 54th Annual Psychonomics Society Meeting. November. Toronto, Canada. (Poster)

Bennett, C.R., Giudice, N.A. (2013). Spatial Updating and Aging. International Spatial Cognition Summer Institute. Santa Barbara, CA. (Talk)

Bennett, C.R., Giudice, N.A. (2013). Non-Visual Graphical Accessibility. Graduate Exposition at The University of Maine. Orono, ME. (Poster)

Bennett, C.R., Loomis, J.M., Klatzky, R.L., and Giudice, N.A. (2012).Minimal Effects of Memory Load on the Updating of Multiple Target Arrays. 53rd Annual Psychonomics Society Meeting. November, Minneapolis, MN. (Poster)

Giudice, N.A., Bennett, C.R., Klatzky, R.L., and Loomis, J.M. (2012). Haptic Spatial Updating Across the Lifespan. 53rd Annual Psychonomics Society Meeting. November, Minneapolis, MN. (Poster)

Bennett, C.R., Giudice, N.A. (2012). The Effects of Life Span Development on Spatial Updating of Haptic Arrays. Spatial Cognition Conference. September, Bavaria, Germany. (Poster)

Bennett, C.R., Giudice, N.A. (2012). The Spatial Image: Multiple Research Studies. 3rd Annual Mainely Data, Some Theory Conference. May, Colby College, Waterville, ME. (Talk)

Bennett, C.R., Giudice, N.A. (2012). Life Span Development and the Spatial Image. Graduate Exposition at The University of Maine. Orono, ME. (Talk)

Bennett, C.R., Giudice, N.A. (2012). The Effects of Life Span Development on Spatial Updating of Haptic Arrays. Graduate Exposition at The University of Maine. Orono, ME. (Poster)

Bennett, C.R., Giudice, N.A., Klatzky, R.L., & Loomis, J.M. (2011). Spatial Images Developed through Extended Touch: Comparing Updating Performance between Haptic and Visual Learning. 52nd Annual Psychonomics Society Meeting. November, Seattle, WA. (Poster)

Bennett, C.R., Giudice, N.A. (2011). Spatial Images Developed through Touch and Vision: Effects of Age on Updating Performance. Conference on Spatial Information Theory (COSIT 2011). Belfast, ME (Won Best Presentation) (Talk)

Bennett, C.R., Giudice, N.A. (2011). Development of Spatial Images through Extended Touch: Comparing Updating Performance against Haptic Inspection and Vision. Graduate Exposition, The University of Maine. Orono, ME. (Poster)

Naylor-Emlen, S.J., Haney, K., Bennett, C.R. (2009). Transforming and Reconstruction Space: Multiple Tasks Elucidate Skills and Strategy. Psychonomics Society 50th Annual Meeting . November, Boston, MA. (Poster)

Bennett, C.R., Shadowen, N.L., Scherer, K., Markey, P.M., & Markey, C.N. (2009). Geometric Models and Violent Video Games: A New Application of "Interpersonal Statistics". Villanova, PA. (Poster)

Invited Talks

Bennett, C.R. (2014). Lifespan Navigation and Compensatory Augmentations. Symposium Titled: Merging Neuroplasticity, Education, and Rehabilitation Studies in the Blind. Radcliffe Institute, Harvard University, Boston, MA.

Bennett, C.R. (2012). The Spatial Image Continued: Capacity and Aging. Psychology Department Graduate Colloquium, University of Maine. Orono, ME.

Bennett, C.R. (2011). The Spatial Image: A Look through Multiple Sensory Modalities. Psychology Department Graduate Colloquium, University of Maine. Orono, ME.

Research Projects

Fall 2010 Combining locations between Long Term memory and Working Memory

This research dealt with characterizing the 'spatial image' (3D working memory representations of objects in space) and whether long term memory representations of object layouts could be instantiated with spatial images in working memory within one coordinate system. Participants performed multiple walking and pointing tasks which were focused on examining the spatial images in relation to both the long-term and working memory representation of object sets.

Spring 2011 Development of Spatial Images through Extended Touch

This research focused on the spatial images created from extended touch which is important for understanding how we build up a representation of space when using tools, such as a rod/pole, to learn objects as an extension of the body. Representations from extended touch were then compared with those formed from vision and physical touch. Participants performed a blind-folded walking task in order to test the accuracy of the spatial images created through each condition.

Fall 2011 Age Effects on Spatial Images Developed from Touch

This research confronted the important issue of age and its relation to the development of spatial images through physical touch. Participants (ranging from 20 to 80 years of age) learned table-top size arrays of objects and performed multiple pointing and recreation tasks. Results show a marked decline in spatial ability as a function of age. This study is particularly important given the rapid aging of our population in Maine and nationwide.

Summer 2012 Online Updating for Varying Levels of Working Memory Loads

This research looked at "on the fly" updating within an environment, a task which is important for accurate spatial learning and navigation. Participants learned various numbers of targets and

performed a walking task from multiple unknown updating positions. Results showed that individuals were able to update 1, 3, and even 6 object locations with equal effectiveness, with the various updating locations having no further effect on performance.

Spring 2013 Non-Visual Graphical Accessibility

This research project looked at the ability for graphical information to be provided non-visually on a common tablet device. Participants learned various graph types through audio, vibration, or a combination of feedbacks from their finger movements. Results show personal preference for conditions with audio feedback, but finger tracking results showed no significant differences between the conditions. These results provide important data for the development of non-visual graphical interfaces.

Fall 2013 Online Updating under Increased Memory Load and Aging

A re-visit of the summer 2012 online updating study including an older adult age group. Participants ranged from 60 to 80 years of age and performed the same visual learning task (1 to 6 targets) followed by blind folded walking to 1 target location. This elderly age group showed effects of number of targets, performing worse on 6 targets than 3 and 1. Interestingly enough, the spatial updating imposed no increased effort or error on performance. When compared to the younger adult age group, older adults maintained a similar pattern of updating.

Spring and Summer 2014 Aging and Driving through Virtual Simulation

The aging process brings various physical and cognitive changes that begin to affect daily life tasks, such as driving. Driving is key to the independence of the elderly community and safety is of course the biggest concern. Virtual reality has a strong foothold in real-world relevance for research but has not been extensively used to look at older adults. This research combined a fully functional driving simulator (built specifically with the purpose of use with older adults) with immersive head mount displayed virtual reality to explore age effects on driving. This study in particular focused on the usability and key driving events that are known problems for the elderly (speed maintenance, obstacle avoidance, and intersection decision making). Results show that the older driver's performance at each even is not as good as the younger drivers, and in particular intersections and lane drifting were problem areas for the older adult group.

Summer and Fall 2014 Thermal Identification of Persons for Blind/Low-Vision Users

This work involved a company out of Minnesota called MOAI. The goal was to use their thermal imaging hardware and human detecting software to identify people in view of the camera and display that information to a blind user. While the hardware and software for the thermal imaging was done by MOAI, the design for the haptic/audio display of information and any human subjects experimentation was done at the VEMI lab. After running a short study, results showed that the device allowed for significantly faster identification of people than traditional methods (White cane).

Summer and Fall 2015 Aging and Outdoor Cognitive Map Decay

This project extends off the previous with continued use of the immersive virtual reality driving simulator. In this case the focus of the work looks at mental representations of space (cognitive maps) of older adults that are developed while driving through an unfamiliar area. Testing of cognitive maps took place immediately after learning, 1 day after learning, and 1 week after learning. This was done in order to explore the decay over time of these representations. Results were also compared to younger adults to examine the age differences in decay and cognitive map maintenance. The outcome showed decay for both age groups over time, but significantly more decay for older adults.

Lectures and Tutorials

Bennett C.R., (2012). **Matlab and SPSS Graphical Data Management:**

Explorations into SPSS software and beginner introduction to Matlab as a graphical tool for data representations. Lecture was given to graduate students within the SIE department at The University of Maine.

Bennett C.R., (2011). **SPSS Data Analysis:**

Instructed on methods for proper analysis of data sets derived from human subjects research. Worked heavily with SPSS developing proper thought processes into how to proceed with data analysis. Lecture was given to graduate students within the SIE department at The University of Maine.

Bennett C.R., (2011). **Data Structure and Organization:**

Instructed on useful techniques for managing large data sets derived from human subjects research. Efficient and safe ways to handle data in programs such as Microsoft Excel were demonstrated. Lecture was given to graduate students within the SIE department at The University of Maine.

Skills and Technical Expertise

Research Methods, Statistics Software, and Virtual Programming:
Microsoft Office, IBM Statistics software (SPSS), R, S+, Matlab, ArcGis, Gardony Map Drawing Analyzer (GMDA), Unity 3D, Unreal Engine, Google SketchUp, Blender, Audacity, and MakerBot 3D printing

Programming Languages:
C++, Java, Python, and C-sharp

Professional and Extra Curricular Activities

Reviewer for Assistive Technology Journal (2014-present)
Golden Key Member (2012 – present)
Volunteer for Special Olympics Basketball Hosted at Bangor CYCC (2012 – present)
Member of Virtual Environments and Multimodal Interaction lab Development Team (2010 - present)
Affiliate of American Psychology Association (2008 – present)
Volunteer for Special Olympics Hosted at Villanova University (2006 – 2009)

Reference

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