

Collaborative Research: Explaining, Exploring, and Scientific Reasoning in Museum Settings

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Overview. This collaborative project is a middle-stage empirical research project seeking to advance the knowledge base in human STEM learning, STEM learning environments, and broadening participation in STEM. Our objective is to investigate how diverse samples of parents and children engage in explanation and exploration of scientific concepts in three children's museums across the U.S. In addition to uncovering patterns of family explanation and exploration, the proposed studies measure children's causal understanding, and build on this knowledge base to develop and test effective interventions. Children's museums are ideal environments for this research; they give us access to everyday activity and conversations of families, and they provide a natural laboratory for testing the effectiveness of targeted interventions.

Intellectual Merit. Given concerns about reduced numbers of students in STEM fields (President's Council of Advisors on Science & Technology, 2012), and public opinion diverging from scientists' views on issues like evolution and climate change (Pew Research Center, 2009), there is an urgent need to improve STEM learning. There is a fundamental tension between pedagogical goals for students' learning of STEM concepts through direct instruction or explanation (Dean & Kuhn, 2006; Klahr, Zimmerman, & Jirout, 2011) and goals for children to explore, discover, and develop interest in STEM in open-ended and authentic ways (Barton & Tan, 2010; Feinstein, 2011; Lehrer, Schauble, & Lucas, 2008). Children's museums struggle with this tension; they attempt to engage children's interest while acknowledging the difficulty of ensuring that they also learn STEM concepts (Allen, 2004). This tension parallels the interplay between *exploration* and *explanation* in research on science learning. We propose, rather than viewing pedagogical explanation and open-ended exploration as incompatible, that instead they are both essential parts of the practice of science. The challenge is to understand their distinct and complementary roles in children's scientific learning. This proposal seeks to uncover patterns and connections in how diverse families engage in these two important STEM-related practices, and how facilitation and intervention may affect families' engagement.

Broader Impacts. The proposed studies will advance both the basic research goal of improving our understanding of children's science learning, and the educational goal of developing new strategies for introducing STEM within meaningful educational activities. In this collaboration among developmental psychology researchers and children's museum practitioners from three parts of the U.S., each partner will bring their conceptual models to bear in developing and testing effectiveness of learning interventions, as suggested in Bell's (2004) views about pluralism in design-based research. The researchers span different theoretical and methodological approaches to the study of children's causal thinking – including experimental, computational, and sociocultural approaches. Bridging these areas, and working with diverse populations in three cities will provide opportunities to address issues of cultural diversity in parent-child conversation not possible in a single setting. Research in museums has primarily been either museum-prompted evaluation or researcher-focused experimentation. The proposed project takes the more unusual approach of a collaborative partnership, where research goals overlap with and support museum design goals (Callanan, 2012; Knutson & Crowley, 2005). We plan to disseminate findings broadly in venues that span developmental psychology, science education, and museum learning, including open access online journals, and informal science learning websites.