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Abstract: Active Prolonged Engagement: When Does it Become Active Prolonged "Learning"?

Do people learn better when the "flow of experience is under their control"? (Gureckis & Markant, 2012). The results from cognitive science and educational research have been mixed, though the preponderance of the evidence suggests that such active learning is beneficial, with recent work in machine learning providing additional support for this idea (Gureckis & Markant, 2012). For the informal learning community self-directed or free-choice learning is the centerpiece of the visitor experience (Falk & Dierking, 2010). In this study, we investigated whether free-choice *active prolonged engagement* (Gutwill & Allen, 2009) with a multiuser interactive touch-table exhibit provides a learning experience that differs from that provided by viewing a video on the same topic. The extant cognitive research finds that objects that are within reach of hands or tools elicit different cognitive resources than do more distal objects (Brockmole et al., 2013). Thus the specific question addressed in this study, is whether such hands-on or embodied learning can help youth acquire relatively abstract STEM topics, such as the core evolutionary concept that all life on earth is related through common descent.

The exhibit topic, an understanding of evolution, is difficult to convey, in part because evolution is a dynamic process that is not easily communicated by viewing static exhibits of prehistoric life (Evans et al., 2010); further, static tree-of-life representations are often too complex to grasp (Novick & Catley, 2012). To offset these problems, both exhibit components in this study, the *Peabody Museum* video and *Life on Earth* interactive touch-table, provided a dynamic visualization of evolution. *Life on Earth* also included two types of "embodied" experiences: *DeepTree,* an interactive macroevolution visualization representing the entire tree of life, enabled the visitor to "fly through" an array of diverse living species and identify common ancestors; *FloTree,* a multi-user simulation of microevolutionary processes, encouraged visitors to add environmental barriers by placing their hands on the table to interrupt gene flow between populations.

During their visit to one of two large natural history museums, 248, 9-15 year-olds (*M*=11.56, *SD*=1.68; 126 females) were recruited in dyads and randomly assigned to one of four conditions: Two touch-table conditions, A (*DeepTree* & *FloTree*), B (*DeepTree*, only), C (video), or D (control: no intervention). For 10 minutes each dyad freely interacted with one of the touch-table exhibits or watched the video; afterwards, all were interviewed individually with a 52-item assessment. Parents completed a demographic form and survey. There were no differences between conditions in parent completion/non-completion of college, parents' or children's self-reported knowledge of evolution, religiosity, or compatibility of evolution with their religious beliefs.

Dyads in both touch-table conditions were more likely than those in the control group to agree that humans, other animals, plants, and fungi had ancestors in common, a long time ago and to use evolutionary concepts and terms in their responses to open-ended questions. Dyads in touch-table Condition B were most likely to interpret a tree-of-life graphic accurately and agree that all living things share DNA. All were multi-question scaled measures. Age effects, timed interactions, responses to open-ended questions, and parental data will also be reported.

This study suggests that a collaborative, embodied, self-directed learning experience creates an opportunity for absorbing complex content that is more difficult to convey in a video presentation. Discussion will focus on the learning affordances of environments that encourage active hands-on participation.