Pre-Learning Experiences with Co-Creative Agents in Museums

Duri Long

Georgia Institute of Technology
85 5th St NE
Atlanta, GA 30308
duri@gatech.edu

Abstract

Co-creative agents, or artificially intelligent computer agents that can collaborate creatively in real-time with human partners, have proven successful in being both creatively engaging and fun to interact with. Prior research in museum experience design also indicates that due to their incorporation of embodied interaction, creative narrative construction, and personal identity, co-creative agents have potential to drive pre-learning experiences that motivate participants to learn more about technology in museum settings. However, many co-creative agents fall short in effectively communicating technology-related educational outcomes. My work aims to explore how museum experiences involving co-creative agents can be designed and evaluated such that they both foster creative engagement and facilitate pre-learning experiences, using two interactive installation projects (*LuminAI* and *TuneTable*) as technical probes.

Introduction

Co-creative agents are "computer colleagues" that collaborate in real-time with humans in order to foster and inspire human creativity (Davis et al. 2014). There are numerous existing co-creative agents that collaborate with humans in creating visual art, contemporary dance, and theatrical and musical improvisation (Davis et al. 2016; Magerko, DeLeon, and Dohogne 2011; Jacob et al. 2013; Hoffman and Weinberg 2010). These agents have a lot of potential to facilitate pre-learning experiences in museums. *Pre-learning* in this context is used to refer to experiences that provide learners with some initial knowledge about a particular subject and motivate them to learn more.

Co-creative agents are well-suited for facilitating pre-learning experiences because interaction with them involves embodied interaction, the generation of creative narratives, and the incorporation of personal identity, all of which are activities that have been identified as being central to visitor-centered museum experience design (Bedford 2014). Curatorial interdisciplinarity has also been highlighted as an issue of increasing importance in museum exhibit design (Muller and Edmonds 2006), and co-creative agents are well positioned to cross disciplinary boundaries by simultaneously

fostering creativity and encouraging participants to learn more about technology.

However, while many of these agents have proven to be creatively engaging, artistically inspiring, and fun to interact with, technological educational outcomes are not always communicated effectively. Participants frequently fail to grasp even at a high level how the agents work, and often they do not even understand that they are interacting with an AI agent (Jacob et al. 2013). This is not an issue unique to co-creative agents; prior work in AI has found that people often either underestimate (Meehan 1977) or overestimate (Weizenbaum 1966) the intelligence of the agent they are interacting with. While certainly no one would expect a museum visitor to walk away from a brief interaction with an in-depth knowledge of computer science or AI research, clearly connecting the museum experience with certain accurate technological concepts is important if we want to foster a pre-learning experience that equips participants with a valid knowledge foundation that they can use as a jumping-off point to learn more. Thus, the question I am interested in is: how can we design museum experiences around co-creative agents that are truly interdisciplinary in that they both foster creative engagement and help motivate participants to learn more about technology? I am also interested in developing evaluation methodology to accurately assess whether these experiences effectively facilitate engagement and motivate learning.

Current Work

My work aims to utilize strategies employed in visitor-centered museum research to inform the design of pre-learning experiences centered around co-creative agents. I am currently working on two different interactive museum installation projects as technical probes for investigating this problem space: *TuneTable* and *LuminAI*.

TuneTable

TuneTable is an interactive tabletop experience in which participants can collaboratively learn coding concepts by creating sample-based music compositions. The TuneTable by itself is not a co-creative agent, but it is a strongly collaborative creative experience that utilizes complex technology. Thus, my work on this project is focused on designing and evaluating methods for motivating participants to learn more

Figure 1: TuneTable collaborative coding environment

Figure 2: LuminAI shadow theater installation. Old visualization (left) and new visualization (right)

about this technology, with the goal that this work can later be applied to co-creation between a human and an AI agent.

Specifically, my work on this project investigates how to augment the existing TuneTable exhibit with interactive stations designed to reinforce the connection between the music-making experience and technology. This idea builds on prior work that supplements art exhibits with "contemplation rooms" in which participants can learn more about the artist's inspiration and intent (Kortbek and Grønbæk 2008). The *contemplation stations* I am developing are built on five key ideas.

1. Contemplation stations should maintain a "conceptual affinity" (or clear reference) to the original installation in order to be effective (Kortbek and Grønbæk 2008).

2. Embodied interaction (i.e. interacting with an exhibit while utilizing multiple senses) can increase learning and the construction of meaning (Bedford 2014).

3. Allowing participants to debrief and document their interactions can serve both to increase reflection and learning as well as facilitate social interaction and provide a method of entry for less active participants (Loke and Khut 2014).

4. Exhibits that are designed to expose the research process create "living laboratories" that offer participants educational and engaging insight into the research/development process (Muller and Edmonds 2006).

5. Stations should ultimately reinforce the coding concepts that are central to the goals of the TuneTable pre-learning experience.

I have recently developed proposals for three different contemplation stations for the TuneTable exhibit, which are detailed here.

Documentation and Coding Concepts When participants finish creating a song at the TuneTable, they have the option to print out a note card with a unique fiducial mark on it (see Xambó et al. for more information on how interactive tabletops work). This fiducial mark corresponds to the song that they created. The user can then walk over to the *Documentation and Coding Concepts* station, where they can place their unique fiducial on another react-table.

Once the fiducial is placed on the table, the user's song will play. As the user's song plays, a projection will be shown on the wall. This projection will display the code operating behind the song. The corresponding code will be highlighted as the song plays, and the original fiducial(s) responsible for generating this code will be displayed on the side. The user can choose to leave their fiducial behind so that other participants can play back their song later. They can also remain at the station to listen to other participants' songs and watch the code playback.

Inside the Table Prior work has found that students that interact with the TuneTable are interested in how the table hardware itself works (Xambó et al. 2017). This station consists of a (miniature) physical model of the table that participants can open, touch, and learn about. When participants touch part of this computational diorama, it lights up, and a description of that piece is projected onto the wall.

Research Process Participants can learn about the process of building the table and the research questions that went into its design at the final station. Using a react table, participants can use fiducials to "play" different videos/images showing the process behind constructing the TuneTable (e.g. physical construction process, software development, research questions, evaluation, etc.). In addition to being in line with the idea of "living laboratories" (Muller and Edmonds 2006), this station also serves as a point of entry for older participants who might be accompanying children that are interacting with the table.

LuminAI

LuminAI is an interactive art installation in which human participants and AI agents can engage in collaborative movement improvisation. My work on LuminAI explores how changes to visual aesthetics and installation design can make the technology operating behind-the-scenes more understandable while still preserving the creative and fun atmosphere that is central to participant engagement. Specifically, my work has focused on improving the visualization of the LuminAI agent so that its responses and movements are clearer (see Figure 2) and making the experience more social (Long et al. 2017). This latter approach is motivated by work that shows that social experiences aid in learning and increase motivation (Bedford 2014; Durlak et al. 2015).

Research Plan and Next Steps

As I am early on in my PhD studies, I am currently exploring numerous different types of interventions in order to promote pre-learning experiences with co-creative agents. The next step in moving forward with this work will involve evaluating which of these interventions are effective in motivating participants to learn more about technology. We are currently collaborating with both the Children's Museum of Pittsburgh and the Museum of Science and Industry in Chicago to install LuminAI and TuneTable and conduct formal evaluations in museum settings. Next, I hope to focus on iterating on a particular technique or strategy for creating effective pre-learning exhibits.

In addition, I am interested in creating a testbed of evaluation methods that can be used to measure and draw connections between engagement, interaction dynamics, and learning outcomes. I have begun investigating how to combine existing evaluation methods for assessing engagement with museum exhibits (Tisdal 2004) with new methods for evaluating open-ended collaborative experiences (Davis et al. 2017) to create a testbed of mechanisms and tools to use in evaluating co-creative agents in museum spaces.

Acknowledgements

References

Bedford, L. 2014. *The Art of Museum Exhibitions: How story and imagination create aesthetic experiences*. Left Coast Press.

Davis, N.; Popova, Y.; Sysoev, I.; Hsiao, C.-P.; Zhang, D.; and Magerko, B. 2014. Building artistic computer colleagues with an enactive model of creativity. In *Proceedings of the fifth international conference on computational creativity. The International Association for Computational Creativity*, 38–45.

Davis, N.; Hsiao, C.-P.; Yashraj Singh, K.; Li, L.; and Magerko, B. 2016. Empirically studying participatory sense-making in abstract drawing with a co-creative cognitive agent. In *Proceedings of the 21st International Conference on Intelligent User Interfaces*, 196–207. ACM.

Davis, N.; Singh, K. Y.; Lin, B.; and Magerko, B. 2017. Quantifying Interaction Dynamics in Co-Creation. In *Proceedings of the 11th Conference on Creativity and Cognition*.

Durlak, J. A.; Domitrovich, C. E.; Weissberg, R. P.; Gullotta, T. P.; and Comer, J. 2015. *Handbook of social and emotional learning: Research and practice*. Guilford Publications.

Hoffman, G., and Weinberg, G. 2010. Shimon: an interactive improvisational robotic marimba player. In *CHI'10 Extended Abstracts on Human Factors in Computing Systems*, 3097–3102. ACM.

Jacob, M.; Coisne, G.; Gupta, A.; Sysoev, I.; Verma, G.; and Magerko, B. 2013. Viewpoints AI.

Kortbek, K. J., and Grønbæk, K. 2008. Communicating art through interactive technology: new approaches for interaction design in art museums. In *Proceedings of the 5th Nordic conference on Human-computer interaction: building bridges*, 229–238. ACM.

Loke, L., and Khut, G. P. 2014. Intimate aesthetics and facilitated interaction. In *Interactive Experience in the Digital Age*. Springer. 91–108.

Long, D.; Jacob, M.; Davis, N.; and Magerko, B. 2017. Designing for socially interactive systems. In *Proceedings of the 11th Conference on Creativity and Cognition*.

Magerko, B.; DeLeon, C.; and Dohogne, P. 2011. Digital improvisational theatre: party quirks. In *International Workshop on Intelligent Virtual Agents*, 42–47. Springer.

Meehan, J. R. 1977. Tale-spin, an interactive program that writes stories. In *Ijcai*, volume 77, 91–98.

Muller, L., and Edmonds, E. 2006. Living laboratories: making and curating interactive art. *SIGGRAPH 2006 Electronic Art and Animation Catalog* 160–163.

Tisdal, C. 2004. Active prolonged engagement.

Weizenbaum, J. 1966. Elizaa computer program for the study of natural language communication between man and machine. *Communications of the ACM* 9(1):36–45.

Xambó, A.; Drozda, B.; Weisling, A.; Magerko, B.; Huet, M.; Gasque, T.; and Freeman, J. 2017. Experience and ownership with a tangible computational music installation for informal learning. In *Tangible and Embedded Interaction*, 351–360.