Face-to-face communication and collaboration are important aspects of children's healthy development. With technology becoming ubiquitous in children's lives, we need to better understand how to best support face-to-face activities when they use technology. Social activities are important not only for developing social skills, but also for learning in general. The need for supporting face-to-face interactions has only become stronger with the increasing pervasiveness of computing technologies in children's lives, as most children in high-income countries have access to tablets or smartphones. These changes however, have also brought about concerns about technologies getting in the way of face-to-face activities.

My research supports social physical activities for young children through interactive technologies, where the technology does not distract or impede the social and physical aspects of play. The emphasis of this research physical space combined with people and technology, which are blended together to enhance learning activities. My contributions are the design, development, and evaluation of technologies that best support social, collaboration activities through interactive technologies for children under five. I concentrate on research that upholds the tenets of Creating, Connecting, and Communicating to Learn (3Cs technology). Activities that have a clear orientation toward children creating in a social context, connecting with their social and physical environment, and communication with each other empower children to develop into self-sufficient learners. I developed a 3Cs technology called StoryCarnival, with the expressed goal of supporting children's improvements of self-regulation and executive function skills using Voice Agents to support high-quality, creative social play. This technology supports activities which advance math ability, reading, literacy and vocabulary, theory of mind, and creativity. My focus to date has been to create applications to support a blend of technology and face-to-face collaboration for children.

**StoryCarnival**

*StoryCarnival* is a part of a three-year National Science Foundation (NSF) funded project (award number 1908476 for $499,994.00) which supports high-quality social play. I collaborated in writing the grant proposal. The technology consists of: 1) an application with interactive stories to introduce children to characters and story settings that are the basis for collaborative, face-to-face play; 2) a play planning tool; and 3) a tangible voice agent.

My research approach places children at the center of the design process and gives those children as much of a voice in the design process which meets them at their cognitive level. The children took the research in the direction it ended up going, which ultimately become a surprise to the research team.

I iteratively designed the *StoryCarnival* system through a design method called Play-Based Design. This method consists of three parts: 1) an adult facilitator utilizes *StoryCarnival* on a tablet to present a context for the design session in the form an interactive story; 2) children break into groups of no more than four with two adult facilitators to use *StoryCarnival* to plan the play session by negotiating specific character roles from the context story; 3) children play, pretending to be the chosen character in the context of the initial story using generic physical props, while an adult controls the speech of a tangible voice agent.
In total, I have conducted 54 design sessions with 26 children between the ages of 3 and 4 over three years. I continue to these totals with ongoing research related to the NSF grant. I conducted all research activities in rooms at the children's small preschool. I video recorded all design sessions, then met with an interdisciplinary design team to summarize the session and note any design requirements. I used the outcomes from those design sessions to adapt the StoryCarnival technology based on observations from participants.

StoryCarnival supports creative, make-believe play in the style of the Tools of the Mind curriculum. The Tools of the Mind preschool curriculum involves groups of children engaged in pretend play that includes common goals for play, planning, role-play, interactive social dialogue and negotiation, improvisation, and the use of generic physical props as opposed to realistic toys. There is significant evidence that this style of play helps children develop self-regulation and executive function skills, which in turn leads to improvements in mathematical ability, reading, emergent literacy and vocabulary, theory of mind, and creativity.

I created the system which guides participants through the phases of initial story to create the context for play, play planning tools to support negotiation for roles within play, and voice agent to combine caregiver control with smart recommendations to facilitate the make-believe play session.

Future Work
I plan to continue research which supports the creation of collaborative ecologies that more accurately model real-world creative situations. I will support research which demonstrates that learning environments must understand the involvement people and technology in a physical space. This approach emphasizes the physical ecology where technology will be utilized and a necessary consideration at all levels of education. I see research in this area leading to new approaches in both Computer Science education and technology which supports face-to-face collaboration.

I strive to answer the questions: 1) where are areas that need support for both collaboration and communication that can be facilitated by technology; 2) what role should be filled by technology in those areas; 3) does current technology really support the collaboration and communication in the places where it is used?

I see these broad questions being answerable from a variety of approaches. For example, communicating with a potential client to determine design requirements and ensuring the right technology supports for collaboration at all education levels. During my teaching, I noticed new sets of students that are harder to get to participate in classrooms. It is assumed that students have social and collaboration skills; however, universities may need to place greater emphasis on teaching collaboration skills. I would like to explore how we integrate those collaboration skills as part of the typical lessons. In addition, this exploration will allow me to explore what it means to do a 3Cs education in a field.

Additionally, I plan to draw on my background with teaching at the middle school and high school level to support community outreach by getting students involved in determining how current technology can support communication and collaboration.