Music for Autistic Listeners: A Music Theory Community Engagement Project

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Motivation and Background

Children with autism spectrum disorders (ASD) who struggle to engage in participatory music listening do not fully benefit from the cognitive, motor, emotional, and social growth that attends this activity. Their struggle to listen with pleasure, attention, and participation (e.g. movement, singing and playing along) can owe to challenges related to sensory response and neural processing divergences that vary from listener to listener. Currently in its pilot stage, our project seeks to address these challenges by creating physical and web-based music listening interfaces that feature modular arrangements of children's songs designed specifically for children with ASD. These arrangements will allow listeners to add, subtract, and recombine musical layers according to their listening preferences and needs. As such, this music invites children to participate creatively in the musical experience, adapting the stimulus to suit their particular tastes, emotional state, and expressive desires.

The primary goals of this research are to make formative, musical experiences accessible to children with autism and to create interfaces that can collect meaningful data about user interactions with sound. We seek to provide valuable insights about listeners with cognitive exceptionalities and create new avenues for future research.

Project Genesis

Since spring 2016, first-year honors students instructed by Daniel Stevens have used community-engaged learning (CEL) to explore the relevance of their music knowledge and skills to addressing problems shared by community members and partners. In fall 2021, students developed a partnership with **Autism Delaware** to understand and address the needs of young autistic listeners. After conversations with guests from the organization and a visit to the **Rt. 9 Library's Sensory Room**, the students conceived a project in which they would compose a library of songs to be listened to on a device that would allow listeners with ASD to interact creatively with the music. Matthew Mauriello joined the project to design and fabricate a device that would facilitate this type of engaged listening and collect data about user interactions.

Figure: The Sensory Room was designed to enhance experiences of child-patrons with autism; includes light & haptic stimuli.

Figure: Sheet music for "The Ants Go Marching";first song integrated into our playback system.

Learning Outcomes

The course is structured around three strict requirements: students must (1) **identify a problem** (or opportunity) that is shared by members of the community, (2) **engage a community partner** with whom to collaborate in developing a solution or new approach, and (3) the problem must admit **solutions that integrate input** from students (musical knowledge/skills) and the community partner. Within this framework, they achieve significant music and professional learning outcomes including:

Professional Skills
> Applying musical knowledge and skill across domains to address real problems
> Explaining and marketing a project idea
> Writing professional documents including letters and executive summaries
> Collaborative ideation with community partners
> Giving and receiving meaningful feedback

Musical skills
> Developing musical designs that foster new modes of listening and engagement
> Creating sonic impact through unique combinations of timbres, texture, register, (re)harmonization, and rhythmic patterns.
> Applying modulation schemas
> Creating distinct, combinable rhythmic strata
> Composing, arranging, and transcribing music.

Music library

Based on input from an informal parent/guardian survey, music honors students created a music library containing the songs listed below. Each song includes at least 17 layers of sounds, including melodies, various countermelodies, bass lines, harmony tracks, rhythm tracks, and real-world sounds that vary in timbre, register, and intensity.

- Twinkle, Twinkle/ABCs
- Row, Row, Row
- The Ants Go Marching
- The Wheels on the Bus
- Three Little Birds (Bob Marley)
- The Itsy Bitsy Spider

Physical Prototype & Data Visualization
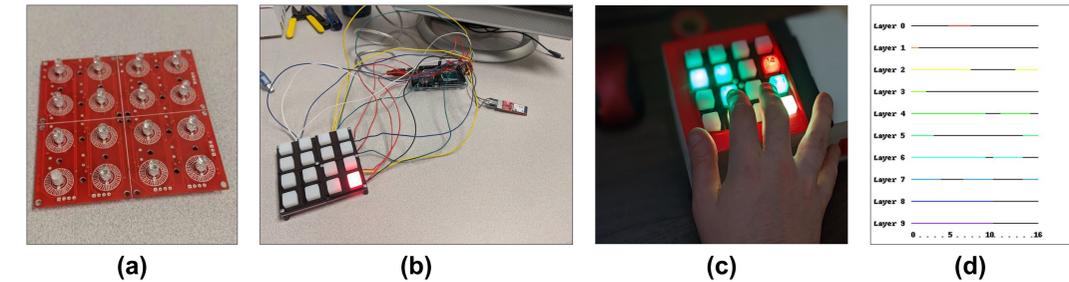

(a)　　　(b)　　　(c)　　　(d)

Figure: Our custom remote control was constructed from a 4x4 grid of multicolor LED and soft button panel (a), connected to an Arduino microcontroller and Bluetooth dongle (b), and then enclosed in a 3D printed case (c). The controller pairs with an audio player application created in Unity3D. Interactions with the remote are logged and can be output to create visualizations of the interactions that users have with the device and music (d).

Timeline & Milestones

Having wrapped up our first prototyping phase, **we plan to evaluate our results with university music students and university students with autism**. Using their feedback, we will iterate on a second version of our system over the **summer of 2022 in advance of deploying our system for evaluation with parent-child dyads** with autism at the Rt. 9 Library & Innovation Center. As part of this pilot, we will examine the dyads engagement in musical experiences with and without our modular music. If successful, **we will then explore bringing our technology into classrooms and our music library onto the web**.
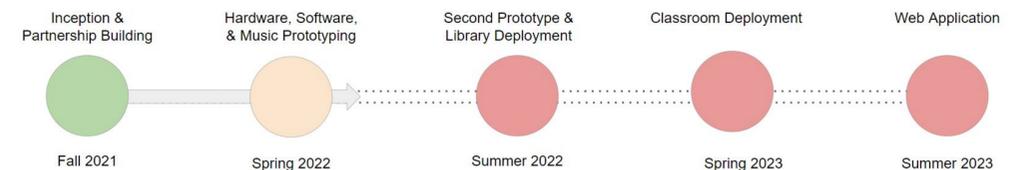

| Inception & Partnership Building | Hardware, Software, & Music Prototyping | Second Prototype & Library Deployment | Classroom Deployment | Web Application |
| Fall 2021 | Spring 2022 | Summer 2022 | Spring 2023 | Summer 2023 |

Figure: Timeline of project milestones.

Project Partners

Heidi Mizell, Family Resource Coordinator, Autism Delaware
Rt. 9 Library and Innovation Center, New Castle, DE
UD Partnership for Arts and Culture (Grant support)
UD College of Health Sciences (Grant support)
UD First-Year Honors Music Students: Catherine Gilroy, Alondra Gonzalez, Kurt Hammen, Jason Lambros, William Metten, Kaitlyn Mummert, Abby Von Ohlen, Ray Pragman, Elise Ruggiero, Robert Strauss
UD Computer & Information Sciences Students: Simon Brugel, Evan MacBride

Examples
(Music, Student Interviews, & Additional Information)

Stevens　　　Mauriello