Όλοι: music making to scaffold social playful activities and self-regulation

Antonella Nonnis
Media and Arts Technology CDT
Queen Mary University of London
E1 4NS UK
a.nonnis@qmul.ac.uk

Nick Bryan-Kinns
Media and Arts Technology CDT
Queen Mary University of London
E1 4NS UK
n.bryan-kinns@qmul.ac.uk

ABSTRACT
We present Olly, a musical textile tangible user interface (TUI) designed around the observations of a group of five children with autism who like music. The intention is to support scaffolding social interactions and sensory regulation during a semi-structured and open-ended playful activity. Olly was tested in the dance studio of a special education needs (SEN) school in North-East London, UK, for a period of 5 weeks, every Thursday afternoon for 30 minutes. Olly uses one Bare touch board in midi mode and four stretch analog sensors embedded inside four elastic ribbons. These ribbons top the main body of the installation which is made by using an inflatable gym ball wrapped in felt. Each of the ribbons plays a different instrument and triggers different harmonic chords. Olly allows to play pleasant melodies if interacting with it in solo mode and more complex harmonies when playing together with others. Results show great potentials for carefully designed musical TUI implementation aimed at scaffolding social play while affording self-regulation in SEN contexts. We present a brief introduction on the background and motivations, design considerations and results.

Author Keywords
Autism; children; social-play; sensory regulation; tangibles, music; e-textile.

CCS Concepts
•Human-centered computing → Interaction design → Interaction design process and methods → User centered design; Interface design prototyping **•Human-centered computing → Accessibility → Accessibility technologies •Applied computing → Arts and humanities → Sound and music computing •Human-centered computing → Human computer interaction (HCI) → Interaction devices → Haptic devices;** Sound-based input/output

1. INTRODUCTION
Play is a right for all children and its benefits for child development have been extensively recognized [7]. Children with autism often struggle with social and playful activities as they experience challenges with flexible thinking, sensory regulation, communication and social interaction [2] i.e. show decrease eye-contact by the age of two [12] and seem to favor synthetic sounds to naturally produced ones [13]. The therapeutic potential of music for SEN children have been widely recognized especially for supporting social interaction like non-verbal communicative skills i.e. joint attention, and initiation of social behaviors i.e. eye-contact [9]. People with autism respond to music similarly to typically developing people [8], prefer harmonious to dissonant sounds [4] and deliberately use music for mood management. Up to 80% of children with autism experience anxiety [16] and this seems to be correlated to social interactions while sensory processing abilities are correlated to the children's participation in leisure activities. Allen and Heaton [1] hypothesize that musical induced emotions could decrease anxiety levels. Alongside music, deep pressure touch contributes to self-regulation [10] and, contrarily to light touch, increases dopamine levels and decrease stress hormone cortisol [6]. Studies also show that children with autism prefer soft texture to hard plastic surfaces [5]. Tangible and manipulative interactions intrinsically possess cognitive, social and physical learning attributes that promote and facilitate many other aspects of child development [14]. As such, when designing technology to support social activities there is the need to expand the design space to be more inclusive by minimizing the barriers and maximizing outcome possibilities. Accessible digital instruments have been deployed in SEN settings for several years. The Skoog is one particular TUI that has been developed to support music making for everyone by minimizing the entry barriers [18]. Olly differs from previous multiuser TUIs as it is made of soft textile material and uses accessible music making as a rewarding mechanism to encourage social play between autistic children.

NIME'20, July 21-25, 2020, Royal Birmingham Conservatoire, Birmingham City University, Birmingham, United Kingdom.

2. PHYSICAL DESIGN
In this demo we present Olly (Figure 1), a musical textile tangible user interface (TUI) designed to be inclusive for children with autism. The aim was to foster social interactions and provide opportunities for sensory regulation during a semi-structured and open-ended playful activity. Olly was designed after careful observations of a group of five minimally to non-verbal children with autism who like music and builds on findings from our previous study and the literature [15, 11, 17]. In our previous study [15] we found that a semi-spherical shape fostered social behaviors, hence we reflected this feature in the design of Olly. Children could gather around the TUI and have the same rights to access and entry points [11]. Furthermore the size, shape, disposition and number of inputs of a device influence its shareability attributes and affect social interactions [17].

Figure 1. Olly played by two people.

Therefore these aspects fed into the final design. Olly uses one Bare touch board [3] in midi mode programmed using the Arduino IDE and four stretch analog sensors embedded inside four elastic ribbons. These ribbons top the main body of the installation which is made by wrapping an inflatable gym ball (65cm diameter) in a 3mm thick layer of felt. Each note is assigned to a different range of sensor' values which are read through Arduino and played via a Minirig speaker. Olly runs in stand-alone mode using a 3.7V Lipo battery.

3. INTERACTION DESIGN

Each of the 4 ribbons plays a different instrument and triggers different harmonic chords. Olly allows the users to play pleasant melodies if interacting with it in solo mode while more complex harmonies emerge when pulling more ribbons together. The more a ribbon is pulled the higher in pitch the notes. The ribbons play different chords (triads) each based on the C major scale. The purple ribbon plays Dmin, the green plays Gmaj, the blue plays Fmaj and the orange plays Cmaj. The aim was that of providing self-regulation oppurtunities by playing pleasant music and create opportunities for self-applied deep-pressure. The elastics, which could be stretched by using hands and/or other body parts i.e. legs and feet, were designed to form deep-pressure responses similar to those sought by the children during the observations i.e. by patting hands or jumping on their feet or by using a bouncing ball during P.E. lessons among other things.

4. RESULTS

Olly was tested in the dance studio of a special education needs (SEN) school in North-East London, UK, for a period of 5 weeks, every Thursday afternoon for 30 minutes. Children have appreciated the TUI and the sounds. This was exhibited through the positive reactions showed by the children i.e. by smiling and/or singing along. They also made eye-contact several times and positively shared the device. Considering the challenges faced by children with autism during social interactions these findings showed positive results in regards to social play and sensory regulation. Moreover, teachers commented positively about the children's experiences. One Teaching Assistant reported that Olly "*was good because it was round, there were no edges, and so there was access to everyone. And it was soft, so it's really welcoming. It made sound, like song. Something that might have been familiar to them from a musical instrument [..] As a shape, there was no gender of this [..] It was just like a nest. It was accessible. It was really good".* The dance teacher who facilitated the sessions reported "*I think it's a beautiful piece. I love the lycra. I loved all the colors you chose. I loved them and the way it could be manipulated"* and added that the children all liked the sounds *"it was like they were creating music [..] and it was quite lovely when it got going".*

A video of Olly can be seen at https://vimeo.com/358480037

5. ACKNOWLEDGMENTS

We thank all the children, families and the staff of the Garden School who collaborated patiently with us. Supported by EPSRC and AHRC Centre for Doctoral Training in Media and Arts Technology (EP/L01632X/1) .

6. ETHICAL STANDARDS

The study was done in compliance with the Queen Mary University Ethics Committee and signed consent was given by the parents of the children. Children were free to leave at any point if they showed will to do so or if it was considered appropriate by the teachers.

7. REFERENCES

[1] Allen, R., & Heaton, P. (2010). Autism, music, and the therapeutic potential of music in alexithymia. *Music Perception*, *27*(4), 251–261.

[2] American Psychiatric Association. (2013). *Diagnostic and Statistical Manual of Mental Disorders*, Fifth Edition.

[3] *Bare Touch Board.* (2014). https://bareconductive.com/

[4] Boso, M., Comelli, M., Vecchi, T., Barale, F., & Politi, P. (2009). Exploring musical taste in severely autistic subjects: Preliminary data. In *Annals of the New York Academy of Sciences*, 1169(1), 332–335.

[5] Cascio, C., McGlone, F., Folger, S., Vinay, T., Baranek, G., Pelpherey, K. A., & Essick, G. (2008). Tactile Perception in Adults with Autism: a Multidimensional Psychophysical Study. *Autism Dev Disord*, *38*(1), 127–137.

[6] Field, T., Hernandez-Reif, M., Diego, M., Schanberg, S., & Kuhn, C. (2005). Cortisol decreases and serotonin and dopamine increase following massage therapy. *International Journal of Neuroscience*, *115*(10), 1397–1413.

[7] Frost, J. L. (1998). Neuroscience, Play, and Child Development.

[8] Gebauer, L., Skewes, J., Westphael, G., Heaton, P., & Vuust, P. (2014). Intact brain processing of musical emotions in autism spectrum disorder, but more cognitive load and arousal in happy vs. sad music. *Frontiers in Neuroscience*, *8*, 192.

[9] Geretsegger, M., Elefant, C., Mössler, K. A., & Gold, C. (2014). Music therapy for people with autism spectrum disorder. *Cochrane Database of Systematic Reviews*, (6).

[10] Grandin, T. (1992). Calming Effects of Deep Touch Pressure in Patients with Autistic Disorder, College Students, and Animals. *Journal of Child and Adolescent Psychopharmacology*, *2*(1), 63–72.

[11] Hornecker, E., Marshall, P., & Rogers, Y. (2007). *From entry to access: How shareability comes about*. *Designing Pleasurable Products and Interfaces*. In Proceedings of the 2007 conference on Designing pleasurable products and interfaces (DPPI '07). Association for Computing Machinery, New York, NY, USA, 328–342

[12] Jones, W., Klin, A. (2013). Attention to Eyes is Present But in Decline in 2–6 Month-Olds Later Diagnosed with Autism, *Nature*. 427–431.

[13] Kuhl, P. K., Coffey-Corina, S., Padden, D., & Dawson, G.(2005). Links between social and linguistic processing of speech in preschool children with autism: Behavioral and electrophysiological evidence. *Developmental Science*, 8, 1–12.

[14] Montessori, M. (1912). The Montessori method: Scientific pedagogy as applied to child education in 'the children's houses' with additions and revisions by the author (AE George, Trans.). *Cambridge, MA: Robert Bentley.*

[15] Nonnis, A., & Bryan-Kinns, N. (2019, May). Mazi: Tangible Technologies as a Channel for Collaborative Play. In Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems (pp. 1-13).

[16] Rodgers, J., Wigham, S., McConachie, H., Freeston, M., Honey, E., & Parr, J. R. (2016). Development of the anxiety scale for children with autism spectrum disorder (ASC-ASD). *Autism Research*, *9*(11), 1205–1215.

[17] Rogers, Y., Lim, Y. K., Hazlewood, W., & Marshall, P. (2009). Equal opportunities: Do shareable interfaces promote more group participation than single user displays? *Human-Computer Interaction*, *24*(1–2), 79–116.

[18] *Skoog*, http://skoogmusic.com/, Accessed 2020/04/20