Supporting Creative Confidence in a Musical Composition Workshop: Sound of Colour

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Abstract
This paper explores and illuminates the work in progress of the 'Sound of Colour', an interactive musical installation, used to introduce musical concepts to children. Participants work in a collaborative manner to throw, roll, spin and bounce, coloured balls (typically found in children's ball pits) to create an original generative musical composition, whilst learning the basics of pitch and volume. Through qualitative analysis and observations, the research discusses how a playful, colour based table top interface, affects the way that children interact with basic fundamentals of music, and how the interface affects their creative confidence when learning musical concepts. This study provides insight into how children interact and engage with a physical musical interface, in comparison to other tangible interfaces (button based controllers and mobile devices). In particular, when these instruments are used in a workshop setting, the research reveals novel methods for interaction with children to encourage and open up access to music composition.

Author Keywords
Playful; Colourful; Interactive; Music Composition; Tangible; Table top; Sound; Tracking; Learning; Play;

ACM Classification Keywords
H.5.m. Information interfaces and presentation

Ableton

"Making music is hard. To stay in the flow, you need to be able to capture your ideas quickly, and you need technology to stay out of the way. Computers make it possible for one person to create whole worlds of sound. But instruments are where inspiration comes from. Push gives you the best of everything. It's a powerful, expressive instrument that gives you hands-on control of an unlimited palette of sounds, without needing to look at a computer."

Introduction

Despite an environment of cuts to funding[1] for the arts and education in arts based subjects, the idea of encouraging and opening up musical creativity and learning to young children is buoyant. It has become easier and more accessible for children to learn through digital technologies, either as onboarding, augmented learning, or learning through play. Learning to 'play' and appreciate music through instrument lessons or traditional music theory is often a daunting and tedious process for children. More recently, non-formal ways of learning music theory have become more popular[2], through advancements across technology, research and teaching strategies.

As non-traditional means of producing music are becoming more popular, and the field of innovative musical controllers grows through conferences like NIME (the international conference of New Interfaces for Musical Expression), these interfaces are often targeted towards professional audiences such as music producers or instrumentalists. Ableton, a pioneering music technology company whose mission is to bring music making to the masses, outlines the importance of flow and capturing ideas as quickly as possible, and that technology should be used to encourage and not hinder this process. Ableton outlined the difficulty of composition with the release of their new controller, the Push 2.

Ableton have also addressed the need for low cost musical devices to learn concepts of music making, that serve as learning materials, through their newly launched online interfaces[3].

Methods of producing sound with non-traditional controllers can range from online interface and sensor based projects, to wearables and physical objects. The mapping of objects becomes a necessity for real time composition. Therefore, camera based systems offer ideal capabilities when tracking and monitoring objects in the physical world, allowing motion, size, distance, brightness and colour data to be obtained. Yau et al explored this with 'MusiCam' [3], creating a system using a spinning wheel with coloured bricks to trigger musical samples. Through placing the blocks in different positions and revolving the wheel, users can create bespoke compositions. The authors noted that a system like this had the potential to be both a tool for professional artists in a live performance scenario, and for children as a way of learning. Further to this, children exhibit a higher level of engagement with tangible interfaces rather than screen based interfaces, especially in a collaborative setting [7].

The use of touch through tactile and tangible objects used as musical controllers has previously been explored by Rasamimanana et al with 'The Urban Musical Game' [9]. This focused on how through the use of accelerometers and gyroscopes, sports balls can be used as music controllers when installed in a public setting. Participants interacted with these physical musical controllers by rolling, throwing and bouncing in

[1] https://www.theguardian.com/teacher-network/2017/jan/31/the-reality-of-budget-cuts-in-schools-survey

[2] https://www.musicmark.org.uk/marketplace/musical-routes-a-landscape-for-music-education/

[3] https://learningmusic.ableton.com/index.html

Max Patch
MAX/MSP is a visual programming language commonly used in audio and visual installations. The visual environment brings together the intricacies of both art and programming.

MIDI
MIDI is musical data, consisting of information about pitch, velocity and notation. This is commonly used in computer music production.

Colour Mappings

Yellow – Grand Piano

Green – Sine Wave Synthesizer

Blue – Electric Keyboard

Pink - Bells

Purple - Bass Guitar

a playful manner. The subject of public installations providing interactive music has also been explored when discussing health benefits, as they often promote physical exercise and general well-being [4].

Tabletop interfaces primarily use smart sensors to send and receive information that is represented through audio feedback. The 'ReacTable' [10] uses tangible 'pucks' to represent different audio materials. Using an interactive table surface acting as a screen, users could place pucks around the area, connecting them together to create bespoke musical compositions. A similar system was explored by Ning [1] who commented on musical tabletop interfaces, "We believe that to let users see and touch while hearing music is an intuitive way for them to perceive and explore music".

This work in progress builds on the research of Rasamimanana, Ning, and Yau, combined with Piaget's form of *interest, initiative, experimentation, discovery, play, and imagination* in learning through play [5, 8], to create an interactive installation that encourages creative confidence through musical composition. The interface known as, the 'Sound of Colour' attempts to open up music making to a wider and general audience, allowing the creative music making experience to be accessed by anyone and everyone, while making the composition process as engaging and as easy as possible. The Sound of Colour was demonstrated at a technology festival, bringing together children of all ages and adults to experience alternative forms of music making, other than traditional musical instruments.

Sound of Colour

The Sound of Colour is an interactive musical installation, comprised of a camera based MAX/MSP patch, feeding MIDI information into several different sampler instruments within Ableton Live Suite 9. A bespoke table top surface (Fig. 1) creates a blank canvas for multi coloured balls acting as physical instruments to compose music. Surrounding the table with guttering provides storage and safe keeping of the balls, enhancing the experience and keeping the flow of the musical process steady. The decision to use soft, playful and brightly coloured balls was adopted as they are easy to move, throw, spin and bounce across the table top surface, while also being attractive to children [2].

Five different coloured balls were used in this study, Yellow, Pink, Green, Blue and Purple. These coloured balls were processed by a bird's eye view camera feed, which mapped the position of the balls against an XY grid within MAX/MSP. Depending on where the balls were positioned along the X grid determined the pitch of the instruments, whereas the Y grid determined the volume of the notes. The camera image took a 320 by 240-megapixel resolution image of the table top service, the X and Y coordinates were then converted to fit within a 128 range (the range of MIDI data is 0-127) and sent as both note value and velocity. The saturation of each colour was increased within the webcam's preferences, and by converting each colour's RGB (red, green, blue) value to luma (black, white, brightness), MAX/MSP was able to track the movement and position of the balls (Fig. 2). The software instruments that were used spanned several octaves, and covered a wide range of timbres from a grand piano, to bells and electronic synthesizers. A design

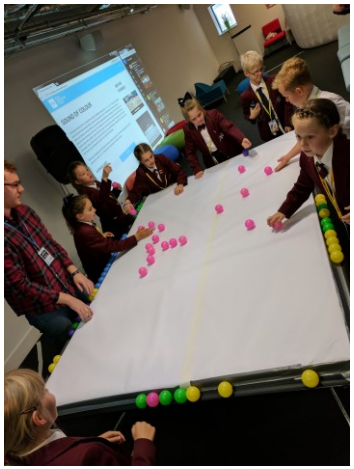

Figure 1. Photograph of children playing with the Sound of Colour instruments.

Figure 2. Screenshot of the bird's eye view camera tracking the position of the purple balls.

approach of 'Which colour best represents a particular instrument?' featured understanding connotations of colour extracted from colour psychology [6] and the meaning of colour. For example, yellow has connotations of warmth, happiness and energy, so was mapped to the grand piano, whereas pink has connotations of more light, angelic things, so was mapped to bells. This notion of a relationship between the colour of the balls and the sound of their respective instrument is something that children discussed when interacting with the interface. Through observations, it was noted that children regularly discussed their favourite ball in terms of colour preference, and also instrument preference. The children also confirmed the suitability of the sound to colour options when talking to the research team.

Through performing alpha and beta testing, it was determined that the XY position of the balls intending to trigger pre-composed musical loops for different instruments was not suitable for the types of interactions children would be more inclined to make (roll, throw and bounce). Therefore, it was decided to 'free up' the musical process, and allow for a more fluid and natural musical experience. To allow for a tonal and harmonic composition, all the instruments were programmed to the C minor pentatonic scale, to offer a 'no wrong note' approach. The piece was set at a tempo of 120 BPM, with the rhythm of the notes being quantized to crotchets (quarter notes, four beats per bar, 2 notes per second). There was a design experiment with not quantizing the instruments, but it was decided for the first version of The Sound of Colour, a quantized method would result in a more sonically pleasing experience, that children would find interesting to listen to and engage with.

Discussion

The SoC was first presented at the Lancashire Science Festival 2017, an annual event that encourages children to interact with science, engineering and technology. The workshop focussed on playful methods of engagement and interactions to encourage musical composition. The researchers identified a range of musical activities and devices to engage children in composing music. These devices ranged from mobile apps to web interfaces, semi-professional and professional controllers. The commonality of these devices was touch (buttons, screens and pads) and colour. Colour is used throughout these platforms as a way of encouraging playful behaviour and continuous play. The SoC takes the theme of colour and couples it with a different interaction, that of motion.

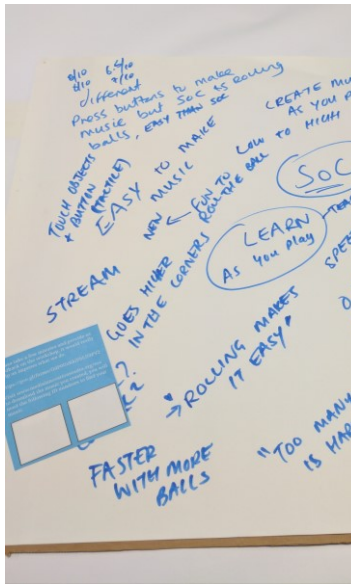

Figure 3. Photograph of feedback back board, showing the capturing of notes and participant take away card.

The workshop ran from 29 June to 1 July 2017, hosted in the Media Innovation Studio at the University of Central Lancashire. Split over the three days, the workshop saw 130 participants, as groups of six each interacting with the SoC for (on average) 15 minutes over a 45-minute period. Participants worked together to create an improvised composition using the SoC interface. These recorded compositions were hosted online and made available to download. Over the three days, 130 cards were presented to participants (Fig. 3), labelled with an identification number as a method for downloading their recorded interaction. Aside from the practical reasons of sharing musical compositions online, directing participants to the website is twofold; a method of gaining analytical data through download and page impressions, and qualitative data through an online questionnaire. The questionnaire was aimed at teachers or parents, encouraging them to sit down with the children to capture feedback on engagement, creativity, playfulness and confidence. For studies and installations alike, the method of collecting feedback through questionnaires, which are read post event, tend to have relatively low return rates[4]. Due to the limited time during the workshop, using the time to fill out questionnaire would not have yielded high participant satisfaction. However, during the workshops, the researchers acting as facilitators were able to capture feedback through semi-structured interviews (Fig. 3) during play and through the recording of player participation through videos and photographs. Moreover, a simplified questionnaire, broken down into three questions was printed for quick-fire feedback, used not to disturb play. Initial feedback from participants gathered via observations and semi structured interviews was captured describing the project as *"Amazing, exciting, very fun, playful".*

Children really enjoyed identifying the different sounds, distinguishing between which colour represented which instrument. Organising the coloured balls around the sides of the table became an end of performance ritual, or during quiet parts of the composition to keep everything 'organised and tidy'. Furthermore, how the installation worked created many discussions between children (and teachers), some thought the surface was the technology, whereas others thought the balls had sensors inside them. Even though the wires and camera were on show, none of the participants saw this and commented on how the system was 'magical', conforming to the quote from Ableton '...you need technology to stay out of the way".

Children suggested that more colours be added in future version to represent the whole spectrum of the rainbow with even more sounds. One child suggested that the relationship between the type of colour and the timbre of instrument could be mapped, for example darker coloured balls (black, brown, purple) could represent instruments that fit in lower frequency ranges (bass guitars, drums, cellos) whereas lighter shades (pinks, yellows, baby blues) could represent instruments with higher frequency ranges (whistling, bells, xylophone, flutes). As each performance was recorded, one child suggested that rather than go back to the laptop and hitting record, a new method could be implemented on/under the table to record, stop, and playback whatever composition they made. Whereas, another child suggested the ability to change the sounds that each ball represented, i.e. a button that

[4] http://www.responsivemanagement.com/news_from/2010-05-04.htm

changed the green ball from a synthesizer to a bell sound, moving the control of the sounds from the software and the laptop, to the table, the main area for play. What became apparent was the activities that provided novel methods of interactions, i.e. SoC and the push controllers were the most enjoyable. The researchers typically found that those that enjoyed the SoC also liked the push controllers 'the same' or 'a little bit less'. It was also identified that the children who played specific instruments (trombone, trumpet) said 'that if the sounds of those instruments were used then they would understand it better'. When using screen-based apps like YOOP and musical step-sequencers, some children stated that the apps were too restrictive and got very boring, very quickly, due to the repetitive nature of their design, (this could be due to the fact these children grew up with touch screen interfaces).

Conclusion

Through observing 130 children from ages 7-13 as they used the Sound of Colour, the general consensus was that the playful nature of the interface allowed for an informative and enjoyable experience. Several children offered ideas about how to further the playful experience, through the addition of features like tempo control, the ability to change instruments or sound banks, and use of other coloured objects like gloves to interact with the table top interface. The Sound of Colour offers a new way of experiencing and learning very basic musical concepts. Through observations and user feedback, this interface will be refined and redesigned to make it more interactive and portable. Moreover, it is important to trial this work with schools and teachers, to explore what impact interactive installations can have on learning musical concepts in a longitudinal study.

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