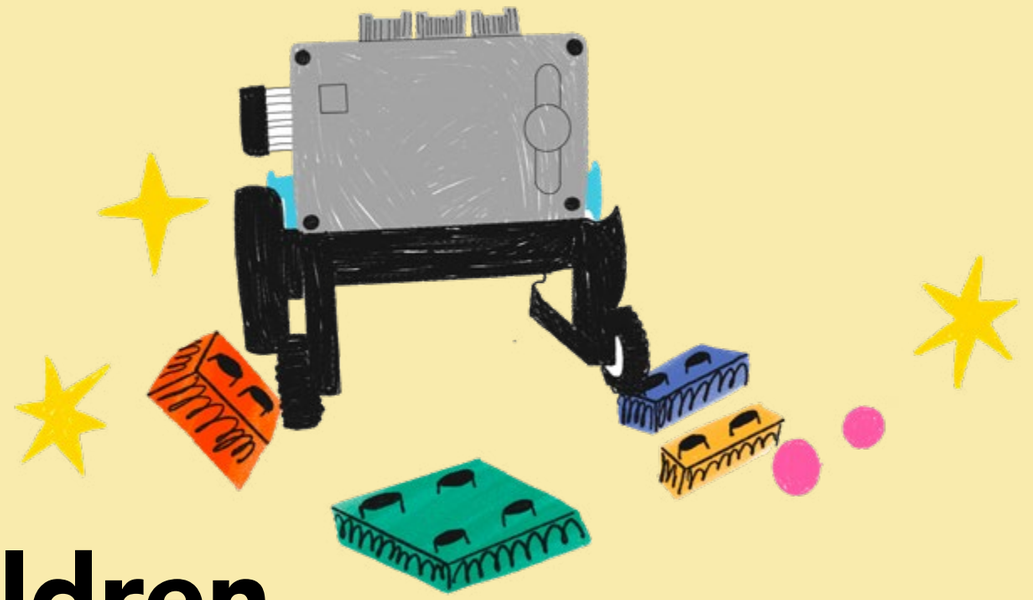
Finding resilience through music for neurodivergent children



This document is an illustrated rendition of the research project conducted by Harkirat Kaur as a component of her Master's studies in Inclusive Design, which she completed in 2023.

Contents

1. Neurodiversity and self-regulation

Neurodivergent conditions include learning difficulties, cognitive impairments, and developmental disabilities like ADHD and ASD. These challenges can make it hard for individuals to regulate their emotions, do daily tasks on their own, and keep up with friendships. Learning to control these things, called self-regulation, is super important for feeling happy and strong. It helps us handle life's ups and downs with ease and confidence!

With this in mind, the reseacher set out to create a special tool for neurodivergent children. These kids, making up 2.8% of all children, face challenges in learning and daily tasks, which affect their ability to regulate emotions and maintain friendships.

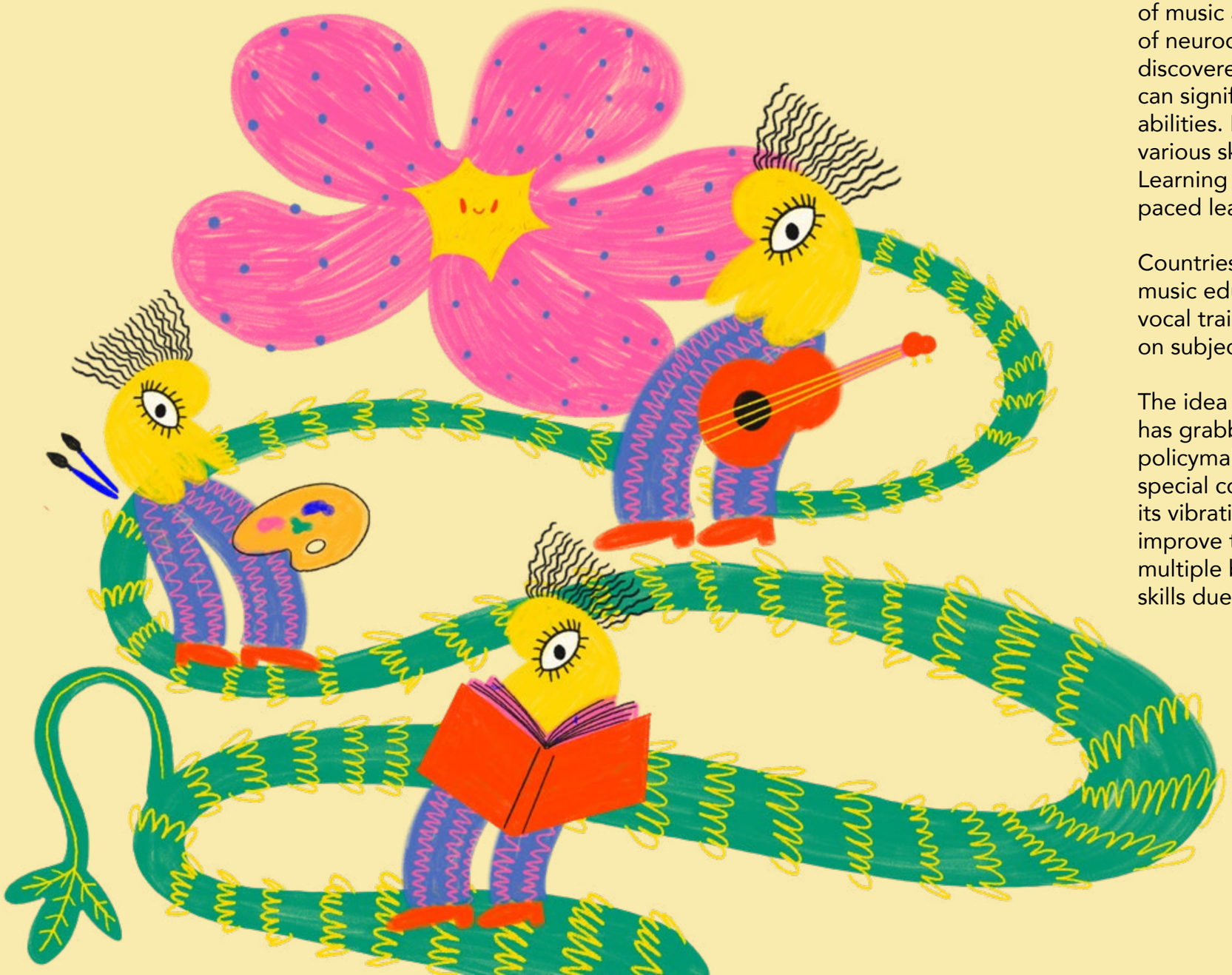
2. Social model of disability

Neurodivergent conditions are often seen as brain “abnormalities,” but looking at neurodiversity from a social perspective views them as natural differences in how our brains work. Instead of seeing these differences as problems, we can celebrate them as unique ways of thinking and learning. Embracing neurodiversity can help individuals feel more positive about themselves and better understand their differences. This mindset can also help children feel more confident in embracing their uniqueness and accepting others as they are.

3. Music as a unique strength

Neurodivergent children often struggle to fully participate in classroom activities due to their unique ways of perceiving, learning, and interacting with the world. This raises questions about the effectiveness of a one-size-fits-all approach for all students. These children may face challenges in social communication, peer interaction, and nonverbal behaviors, impacting their everyday lives.

While navigating neurodivergent conditions can be tough, it also brings unique strengths. For instance, early research by Leo Kanner highlighted musical abilities in children with autism. Subsequent studies have explored the benefits of music, showing improvements in social-emotional skills such as reduced anxiety, better speech, and increased interaction with peers.

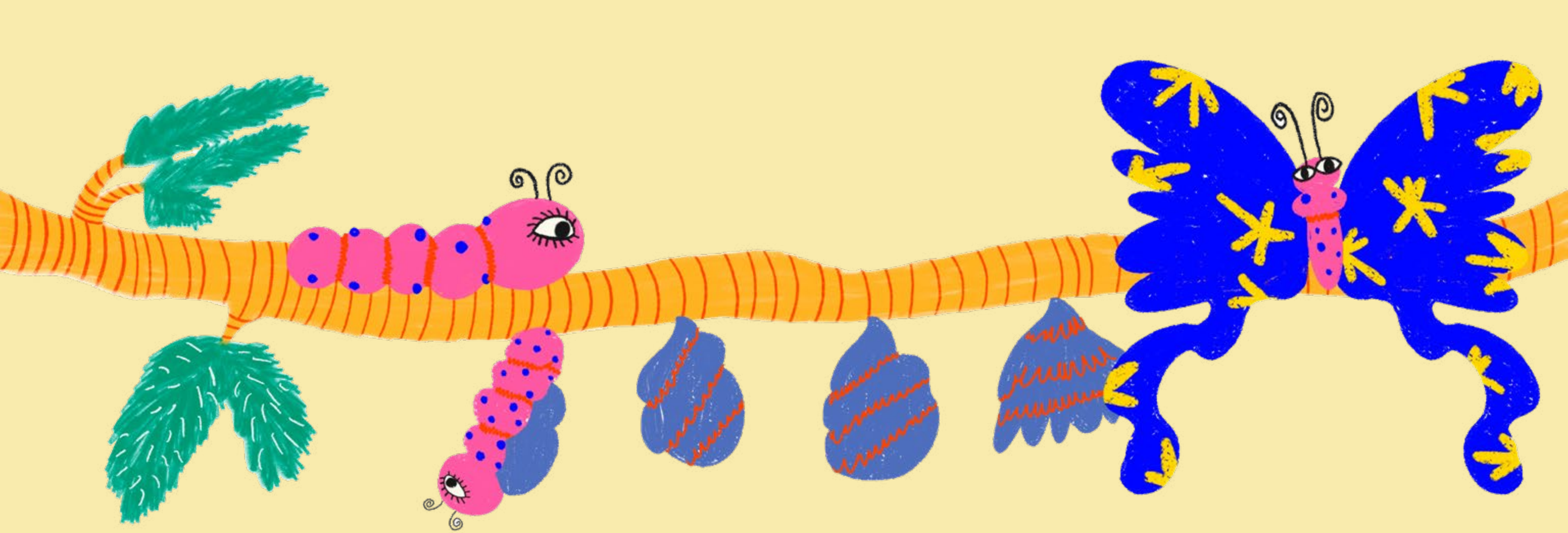


4. Benefits in non-musical skills

How can designers and researchers harness the power of music amidst the many distractions in the lives of neurodivergent children? Some researchers have discovered that music training, especially piano lessons, can significantly enhance children's abstract reasoning abilities. Engaging in musical activities helps develop various skills like coordination, memory, and language. Learning music alongside others also improves self-paced learning, concentration, and social awareness.

Countries like Hungary, Netherlands, and Japan prioritize music education in schools, offering instrumental and vocal training to students. This differs from the emphasis on subjects like math and science in the United States.

The idea that learning music can boost intelligence has grabbed the attention of parents, educators, and policymakers. Children with autism often display a special connection to music, responding positively to its vibrations. Researchers are exploring how music can improve their unique behaviors. Music practice involves multiple brain areas, potentially enhancing non-musical skills due to shared neural resources.



5. Music in informal settings

Music is widely recognized as a powerful tool for communication and regulation, especially in music therapy. However, its potential in informal and personal settings deserves more attention. Learning an instrument can be mentally challenging and often requires a teacher's guidance. Designers can help neurodivergent children experience the joys of music by creating systems that ease them into formal music practice, fostering collaboration between designers and music practitioners.

Neurodivergent children may benefit from sensory regulation strategies to aid in sustained concentration and focus across various modalities. These resources can assist them in better self-regulation, reducing fatigue, worry, and agitation while enhancing stress resistance and confidence. By incorporating play episodes into their routines, children can develop crucial skills like flexibility, goal-setting, negotiation, and task focus.

6. Technology's intention of 'fixing people'

Interactive technology and robotics are emerging as tools for children's therapy and rehabilitation, addressing various needs. Experimentation has explored the therapeutic benefits of using robots to assist individuals with autism, who often enjoy interacting with computers. Social robots specifically target children with impairments that hinder their ability to play, thus impacting their learning potential.

Despite significant progress in technology for neurodivergent individuals, there's limited discussion about underlying intentions and outcomes. Much of this work aims to help and support but may unintentionally promote a normative agenda of "fixing people" without critical reflection. According to Kientz et al. (2013), much of the focus is on the physical or functional limitations of autistic individuals, aligning with the medical model of disability. This narrow approach limits design possibilities and raises ethical concerns about society's perceptions of disability.

7. Understanding disability

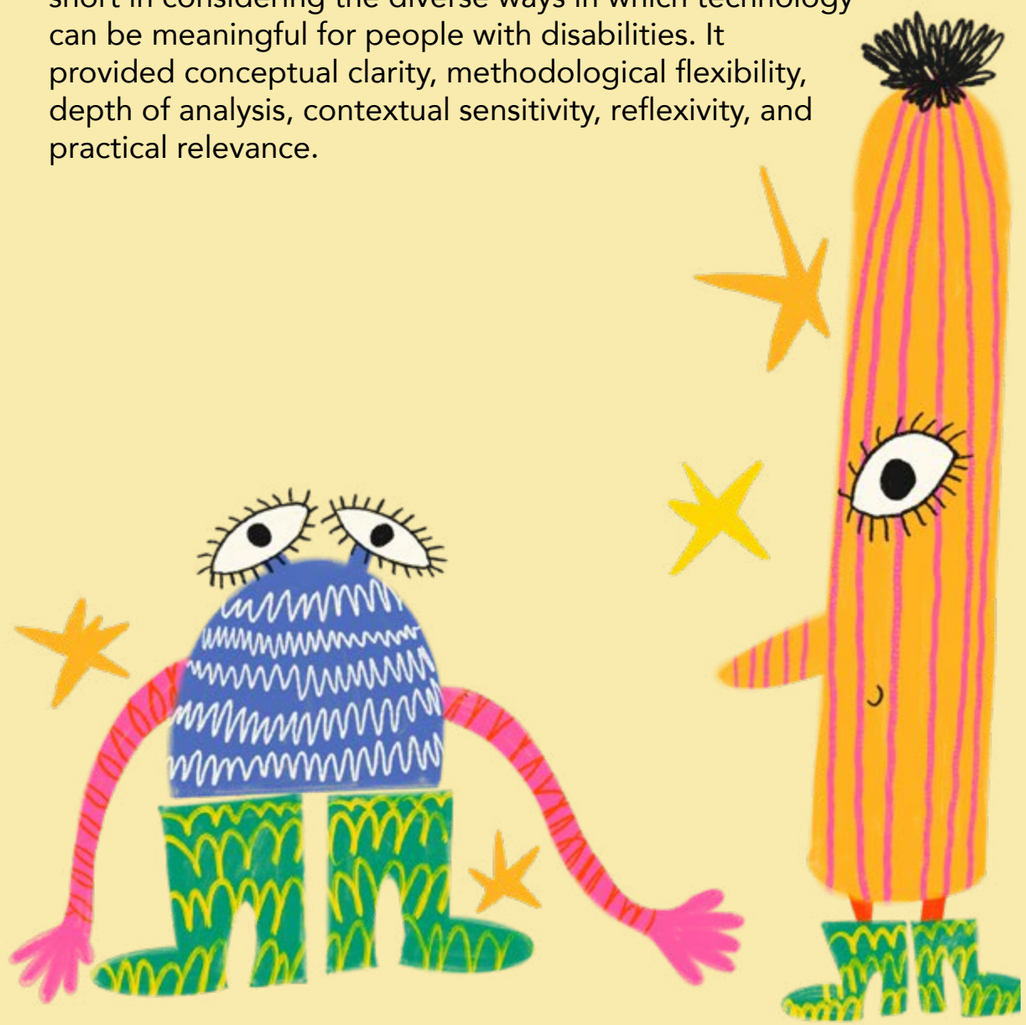
When collaborating with autistic individuals in research, it's vital to establish a relationship that empowers them to actively participate in the design process, contributing their unique perspectives and desires. As designers, we aim to create positive technology experiences for autistic children and evaluate their impact. By recognizing their strengths like hyperfocus, creativity, and attention to detail, we unlock their valuable contributions, promoting inclusivity in design for all users.

Understanding disability involves considering various factors such as biological differences, societal attitudes, and accessibility challenges. Using critical realism as a philosophical framework allows for a comprehensive exploration of the disabled experience. Incorporating diverse research methods, including quantitative, qualitative, and mixed approaches, enables a deeper understanding of social, historical, and cultural contexts, revealing hidden processes that shape our world.

8. Critical realism stratified ontology

The needs of children are not just physical, but also relative to history, society, and politics. The development of education systems, technology, and understanding of disability is influenced by powerful economic and political groups in society. These groups direct schools to produce the kind of workers and supporters that benefit their interests. Due to pressure to offer mass education in a cost-effective way, schools often contradict the moral view of education as a public good that aims to meet diverse needs. Ignoring deeper forces such as these leads to blaming individuals under a medical gaze. Inclusion shifts away from this perspective by demanding that traditional society, which is often disabling and oppressive to people with disabilities, must change.

A better understanding of disability and inclusion can be achieved by combining the most useful findings and practices from medical and social research into a larger framework called the critical realism stratified ontology. Instead of starting with the disability as the central focus, the researchers propose a holistic approach that takes into account the unique needs and perspectives of autistic children. While a medical model provides practical guidelines for designing technology, it falls short in considering the diverse ways in which technology can be meaningful for people with disabilities. It provided conceptual clarity, methodological flexibility, depth of analysis, contextual sensitivity, reflexivity, and practical relevance.



9. Co-design with children

Design approaches like cooperative inquiry emphasize involving users in the design process to better understand their needs. In this study, gathering diverse information offered valuable insights and helped identify the appropriate context. Participatory Design goes beyond viewing users as mere providers of information or evaluators of the end-product; they actively contribute design ideas and decisions throughout.

The aim was to discover techniques supporting design teams in understanding neurodivergent children's current technology use, future possibilities, and aspirations. These techniques offer a philosophy and research approach rather than a magic solution, facilitating data gathering, prototype development, and new research directions. Participatory design focuses on empowering children to impact technology themselves, with both children and adults contributing to data gathering. While adults bring expertise in areas like computer science and education, children offer insights into childhood experiences.

10. Starting off with co-design

For this study, the researcher invited neurodivergent children aged six to 12 who could self-regulate, along with music therapists, to participate. Self-regulation meant the children could sit through two one-hour co-design sessions with their parents and converse with the researcher about their experiences. The study aimed to accommodate each participant's unique needs within the neurodiversity spectrum.

The researcher created a robot that responds to different colors with sound output using the LEGO Mindstorms robot inventor kit. Launched in 2020, this kit allows users to design and code electro-mechanical devices through interactive in-apps. It utilizes scratch coding, a visual coding environment designed by MIT Media Labs for children. The robot reads various colors of LEGO blocks to produce different musical notes. The combination of block length, color, and robot speed determines the resulting audio output, which includes different pitches corresponding to musical notes. Currently, the robot recognizes five colors: red, blue, green, yellow, and black.

11. The robot design

This tool explores the potential benefits of a musical interface that uses color to create music, focusing on its application for creative expression and self-regulation in neurodivergent children. By combining robotics, music, and color recognition technology, this innovative interface becomes an interactive learning companion, sparking curiosity and engagement.

The main aim is to offer children a unique way to express themselves through music using colors. By associating musical notes with different colors, the interface enables children to experiment, compose, and adjust musical pieces by interacting with various color combinations. Through co-design sessions involving neurodivergent children and a music therapist, this study investigates how linking colors with musical outcomes can enhance self-regulation, as well as critical thinking and logical reasoning abilities in these children.

12. Learnings

During the robot's interactions with children and a music therapist, valuable data points were collected, shedding light on children's lives, music therapy practices, and perceptions of such technology. The children shared their thoughts on using the technology, providing key insights from co-design sessions analyzed through actor-network theory and thematic analysis.

Experience with Interaction: Children with prior musical instrument experience found the tool easier to engage with and were excited by unexpected musical outcomes when arranging LEGO blocks. Some attempted to create chords and visual patterns instead of focusing solely on musical notes. Coding colors to match piano notes enhanced the experience in subsequent sessions, with discussions about using seven or eight colors to represent an octave.

Robot Positioning and Color Recognition: Determining the robot's front side and its positioning proved challenging, as it sometimes moved unexpectedly. Some colors were not recognized due to thin marker strokes or insufficient intensity. The shapes of strokes and gaps between colors on paper influenced how the robot read color codes. Questions arose about the necessity of a screen for interaction, with clarification that the robot operates independently on battery power.

Material: During discussions about using different materials for music creation, a child suggested using paint. However, trials revealed that markers worked better for this interaction. To enhance accessibility, it was proposed to print graph-like patterns on the paper, making it easier for children to draw patterns.

LEGO Blocks and Robot Developer Kit: The use of LEGO blocks played a crucial role in capturing children's attention and enhanced the overall experience for young participants, making it more accessible and enjoyable. Additionally, LEGO blocks offer additional cognitive benefits, including improved spatial reasoning, problem-solving skills, and creativity. These advantages are particularly valuable for neurodivergent children, such as those with Autism Spectrum Disorder (ASD), who may have distinct learning preferences.

User Testing or Participatory Design: Incorporating a premade robot isn't just about product testing; it serves as a catalyst for participatory design. By involving these children as co-designers, we move beyond traditional product testing boundaries, unlocking valuable experiential knowledge essential for creating solutions that meet their unique needs.

Alternate Music Creation: Simplifying the current interaction design can broaden accessibility. Integrating different colored electronic blocks, rather than a single robot, can produce various musical outputs with similar interactivity. This innovative approach allows for exploration, where combining color-coded electronic blocks generates unique musical responses.

Spontaneous vs. Structure: Observations from two sessions with Child Participant One revealed their spontaneous engagement with the tool. However, insights from the music therapist suggested that the tool's suitability may vary among children, with some preferring a simplified and more planned approach. It's important to recognize that self-regulation strategies differ among neurodivergent children, each having unique needs and preferences. While some may benefit from sensory-based strategies, others find comfort in routines and predictability.

Augmented Music Therapy: Overall experiences with the tool and insights from the music therapist suggest its potential as a valuable resource for children's therapy, offering therapeutic benefits and an enjoyable experience. The researcher plans to introduce this music interface to Dementia care centers as a recreational activity. Exploring its long-term effects in sustained music therapy sessions and across different age groups and therapeutic contexts presents exciting avenues for future investigation.

Accessibility Enhancement: Incorporating a mobile app with color pattern recognition expands the tool's accessibility, making it available to a wider range of users. This democratization contrasts with potential financial barriers of elaborate robot systems. Using smartphones' cameras to interpret color patterns transforms these ubiquitous devices into creative instruments.

13. Ending thoughts

Further research is essential to examine the long-term effects and efficacy of such interventions, while prioritizing ethical considerations and inclusivity in the design and implementation of these technologies. In conclusion, this research emphasizes the importance of innovative and interactive approaches to music creation for neurodivergent children. By providing a nurturing and empowering environment, these tools have the potential to enhance their well-being and creative expression, unlocking new possibilities for their personal growth and development. As further investigations unfold, the transformative impact of these music interfaces on the lives of neurodivergent children and the largest child population becomes increasingly evident, offering optimism for a more inclusive, supportive and more importantly, kind future.

14. Thank you!

The complete research can be viewed here:
https://openresearch.ocadu.ca/id/eprint/4161/

I look forward to feedback and am open to collaborating with fellow practitioners working in similar fields. I can be contacted at harkiratk@ocadu.ca.