

'A Sense of Play'

A study of using tactile objects to help children with sensory processing difficulties at school

By Levon Hutchinson

Attestation of Authorship

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person (except where explicitly defined in the acknowledgements), nor material which to a substantial extent has been submitted for the award of any other degree or diploma of a university or other institution of higher learning.

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Abstract

A child needs to feel happy for them to thrive in a school environment. Children have personal and complex needs that should be well understood to help them feel happy, comfortable and ready for learning. This study aimed to investigate the challenges for children affected by sensory processing difficulties (SPD) in a mainstream primary school and explore how teachers may be better equipped with knowledge and resources to support these children.

The benefits of tactile/sensory objects for children with sensory processing issues should be widely recognised within the context of school. Teachers should acknowledge that sensory objects can be used as tools to regulate behavioural and emotional disruption. This design-led research set out to explore how teachers may utilize sensory objects to help children with sensory processing difficulties reconnect socially and academically within a school setting.

An action research approach was used to analyse current solutions within this space, engage with experts (occupational therapists), collaborate with teachers, and act upon findings through iterative making methods.

The designed outcomes include a 'toolkit' of sensory objects intended to help support teachers in mainstream school who manage children with SPD. However, its usage may prove to help children with other diagnosed conditions and learning difficulties. The research highlighted the challenges of SPD within the context of school for both children and teachers and set a precedent for future design-led research in this area. Furthermore, it makes a compelling case for utilising sensory objects as a teaching resource.

Introduction



Positioning the Researcher

I started my research journey with no prior knowledge of, or experience with, sensory processing difficulties. My research approach was primarily informed by my relationship with good health design, my design interests, and personal values.

Throughout my three-year journey as an undergraduate product designer, I came to realise where my interests lay in design. I was absorbed in the process of making and using different technologies to bring my ideas to life in a tangible form. Communicating ideas physically is a passion rooted deep into my childhood, starting from a desire for building Lego. As I've grown older, this passion has developed into a value for craftsmanship, something that has a long heritage in design. As the distinction between 'designer' and 'researcher' fades, craftsmanship continues to inform my desire to design but applied in a way that addresses societal problems and discourses in the context of children.

My interest in designing for children first emerged in 2019 where I undertook a project centred around home gardening for children. It made my passion for making feel purposeful—the idea of empowering children through tangible, meaningful experiences.

My first taste of design for health came out of a studentship over the summer of 2020 with 'good health design'. I was given the brief to design sensory objects to stimulate older people with dementia. This project gave me my first real insight into how design can improve people's lives.

Despite my lack of knowledge regarding sensory processing issues in children, my passion for craftsmanship and interest in designing for children made me enthusiastic and curious to undertake this Master's research project. It felt like a real opportunity to create tangible experiences that could bring positivity to peoples lives.

Contextual Review

Nurturing early childhood development is exceedingly important and plays a role in ongoing physical and mental health. Good childhood development “requires investment in prevention and interventions that make the environments in which children grow” (Minister of Health, 2016, p. 4). To understand how children’s health is nourished, the aspects of their life that intrinsically matter should be recognised. Ensuring that children grow up in safe and healthy environments holds upmost importance to their development (Minister of Health, 2016). The primary school environment is worth investigating, considering all children should have access to it and spend half their waking life there. Schools have a responsibility to enable learning as well as to support the physical and mental health of children (Cahill, Beadle, Farrelly, Forster, & Smith, 2014).

Entering the schooling environment for the first time marks a turning point for children as they transition into a totally new experience. School presents many new challenges that can be scary, overwhelming, and demanding for young minds. This is particularly the case for children with sensory processing difficulties (SPD). It is common for these children to struggle to thrive in the busy nature of a school environment (Ruttlege & Cathcart, 2019). If a child feels distressed, they cannot be expected to focus, socialise, and learn effectively (Hunkeler, 2020). Teachers are the primary support for a child transitioning into this new phase of their life. Therefore, teachers should have the knowledge and appropriate resources to support all children in their care, including children with sensory processing issues.

This contextual review firstly discusses how sensory processing difficulties affect children in the school context. Then it presents the influence that tactile objects could have on children’s emotions and behaviour. This is followed by a discussion on the integration of non-traditional learning in schools. Finally, the chapter concludes with a research question and aims of the research.

According to the Ministry of Education (2010), every child in New Zealand has the right to go to school from the age of five. Starting school marks a major change for children as they step into a new environment with different people and routines (KidsHealth NZ, 2010). Through this transition, children are met with expectations to become successful learners. To be a successful learner means to thrive socially and academically (Dockett & Perry, 2004). Achieving success also comes with an ability to cope and adapt to the challenges presented to an individual. A child's ability to succeed socially and academically correlates with their wellbeing, enjoyment, and positive outlook on school (Cahill et al., 2014). The reality is that success comes easier for some children than others. All children progress through learning at different rates due to the personal challenges they encounter when adjusting to the contexts of school (environment, people, learning etc.) (Dockett & Perry, 1999). Some lack the personal and social capabilities to become successful learners naturally (Dockett & Perry, 2004). Natural learning comes down to the ability within each child to regulate their emotions, attention, and behaviour to engage in a positive school experience (Denham & Brown, 2010). Success for some comes at the price of inequity for those who cannot thrive in the same school context (Robinson & Aronica, 2015).

It is recognised that the severity of the issues children with special education needs face is considerably different to that of children without these needs (Dockett, Perry, & Kearney, 2011). Special education needs make it harder for children to thrive compared to a child who is considered typically developing (TD). Special education needs refer to children who experience learning difficulties, disorders, and/or a disability (Dockett et al., 2011). This refers to common developmental disorders such as autism spectrum disorder (ASD) and attention deficit hyperactivity disorder (ADHD). A condition commonly associated with developmental disorders yet considered overlooked at times is sensory processing disorder (Engel-Yeger & Ziv-On, 2011). Sensory processing disorder is a neurological condition that affects between 5-16% of the general population of school-aged children (Owen et al., 2013). It refers to an individual who has challenges integrating and responding to sensory information. This includes the things we see, hear, smell, taste, and touch in our environment (W. Dunn, 2007). Sensory processing disorder is not

recognised as a standalone medical disorder, which many experts believe should change ("Sensory Processing Disorder," 2019). More generally, issues with regulating and integrating sensory input are referred to as sensory processing difficulties/difficulty (SPD). In this project, the term sensory processing difficulties or SPD (rather than sensory processing disorders), will be used, as the target group is children who have difficulty paying attention or learning due to issues integrating sensory input. While a significant number of children with developmental conditions will have sensory processing issues (between 40-88%), not all children with sensory processing difficulties will have a diagnosed developmental condition (Pfeiffer, Clark, & Arbesman, 2018). SPD is also associated with certain types of temperament and commonly associated with anxiety (K. McMahon, Anand, Morris-Jones, & Rosenthal, 2019).

SPD compromises an individual's ability to self-regulate, meaning maintaining or changing how alert they feel in response to sensory input. Self-regulation is essential as it allows us to manage our energy states, thoughts, emotions, and behaviours in ways that suit our environment (Heatherton & Tice, 1994). Maintaining a calm and alert state is essential to learning as it allows the mind to be active, clear, and focused (Jacobs, 2017). When a child has difficulty self-regulating, this can affect their ability to attend and engage in daily schooling activities and with peers—in effect, compromising their ability to learn and feel happy at school (Kalish, 2020).

Every child with SPD will have a unique sensory processing pattern. This refers to their ability to self-regulate their emotions and behaviour in response to stimulation from different sensory inputs (W. Dunn, 2007). Building on this, Dunn's Model of Sensory Processing helps us to understand how children with SPD have high or low neurological thresholds (in other words, a sensory tolerance threshold) that activate different behavioural responses (W. Dunn, 1997; figure 1). Children with a low sensory threshold are sensitive to input. Therefore, they can notice sensory stimuli easily and become over-alert. On the contrary, children with a high sensory threshold tend not to notice sensory input and require strong stimuli to raise their alertness. On either end of this continuum, children respond through one of two sensory processing patterns (W. Dunn, 2007). A child who responds passively will often not react in the moment by bottling their discomfort inside. Passive behaviours are emotional and internal. In the context of school, this could result in disconnect, distraction and difficulty staying on task. A child who responds actively reacts immediately to avoid or seek more of a stimulus. For example, a child avoiding noise may move away from the area and cover their ears. Alternatively, a child with a high threshold for touch may attempt to regulate their low alertness by seeking things to squeeze and hold in the classroom (Thompson & Raisor, 2013). These are negative social behaviours in a classroom. Both passive and active behaviours affect a child's ability to learn and can be detrimental to the students around them (Thompson & Raisor, 2013).

Children with SPD will likely have a mixture of high and low thresholds for

different types of sensory input. Depending on how SPD personally affects them, they may self-regulate some sensory input types as successfully as a TD child (W. Dunn, 2007). It may be essential that teachers learn the specific senses a child with SPD is sensitive/insensitive to. This way, they can construct an environment that helps them avoid or engage with specific types of sensory stimuli to prevent the onset of disruptive behaviours. This is evidently a hard ask for teachers when supporting a class of around thirty other children.

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Figure 1. Sensory Processing Continuum. Adapted from "The Impact of Sensory Processing Abilities on the Daily Lives of Young Children and Their Families: A Conceptual Model," by W. Dunn, 1997, *Infants and young children*, 23-35. Copyright [1997] from Aspen Publishers.

Success for children with SPD at school does not lie solely within themselves, but rather the influence and support around them (Denham & Brown, 2010). Sensory driven behaviours can be disruptive and misunderstood or labelled as misbehaviour, particularly in mainstream school classrooms where there is less expertise available in sensory processing (Shaddock, Giorcelli, & Smith, 2007). Thus, it may be hard for a child with SPD to integrate with the rest of the class and reconnect in learning when the effects of SPD compromise them.

Presently, a child can be diagnosed with ADHD, whereas historically, it would be labelled as misbehaviour (Denham & Brown, 2010). Many children with significant developmental conditions that pair with SPD are referred to special education classes or schools which deliver specialised learning. These classroom environments cater to the child's condition/s, and the teachers understand how to set up learning to help them feel calm and alert (KidsHealth NZ, 2010). However, some children with developmental and SPD difficulties are disadvantaged when placed into a mainstream classroom where their needs are not recognised. These are often undiagnosed children, or children classed as having less 'high needs', and sometimes there is simply not enough room to be placed in specialised classes (KidsHealth NZ, 2010). Often, these children have ADHD, ASD and/or SPD. On average, every mainstream class of around 30 children can be expected to have a child with ADHD (Carter, 2006).

A central issue is that aspects of the mainstream school environment are not well suited to children with developmental conditions. Particularly for children with SPD, their condition is often not diagnosed or understood. Anthony Shaddock's "Students with disabilities in mainstream classrooms" (2007) reports that mainstream teachers do not have the time, training, experience, and personal resources to feel confident about teaching students with disabilities in a mainstream class (Shaddock et al., 2007). With global estimates showing between 10% and 20% of children experiencing difficulties learning, there is reason to believe that children with SPD are often not well supported (Dolton, Adams, & O'Reilly, 2020). Furthermore, all teachers may not be aware of children in their class that have SPD.

As already touched on, there is expertise and research evidence indicating how to support children with SPD. However, an opportunity presented itself in mainstream school where this is not well understood. Schools have a responsibility to support children's physical and mental health, as well as their learning. Therefore, pressure is put on teachers to provide every child with the same opportunities to learn in their class. This means understanding and supporting the needs of children with SPD so that they can thrive. Contrary to this, it is reasonable to consider the difficulty in supporting a classroom of 30 children. It is vital to not target teachers for doing something wrong but rather understand the challenges they face. Beyond the teacher's role, my research should acknowledge the school principals who "construct the possibilities for teachers to work well" (Maria, 2016, p. 214). It is essential to use a 'whole school approach' that considers opportunities within school policy, curriculum, environments etc. This also means to be conscious of what is acceptable to be used in a classroom and the different beliefs held in different schools (Cahill et al., 2014).

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Figure 2. How sensory processing difficulties effects kids. From *Little Hands*. Retrieved from <https://www.littlehandsot.com/blog/sensory-processing-issues-affect-kids-school>. Copyright [2014] by Little Hands Occupational Therapy.

Developing an understanding of school aspects that contribute to a healthy learning environment will help inform how to set it up specifically for children with SPD. The Ministry of Education New Zealand states that learning environments rely on three elements (Ministry of Education, 2011):

- Social – the people in the environment and how they interact
- Pedagogical – the teaching and learning practice
- Physical – the property, technology, and other resources

Loud noise, busyness, and lighting are a small handful of challenges that can cause distress for children with sensory processing difficulties in the physical school setting (Ruttledge & Cathcart, 2019). The challenge this presents is whether overwhelming stimulus can be overcome so that inclusion into learning may resume. The physical school environment can also present inequity, assuming that schools in poorer socio-economic areas operate differently. For instance, some schools may have much calmer and less chaotic classrooms. Different aspects of school, such as certain learning activities, times of day, and locations, should also be looked at regarding what affects children with SPD the most. In consequence, where and when support is needed. It is also worth mentioning the aspects outside of school, such as family issues. This can be responsible for setting children in a bad state of mind before they get to school (Cahill et al., 2014). However, this research intended to focus on the causes and integration opportunities inside of school, which can help children with SPD reconnect socially and academically.

Positive social relationships, both those with peers and teachers, significantly contribute to a child's well-being and learning at school. Particularly for children with SPD, positive social relationships may be hard to maintain because of the social and emotional behavioural effects touched on earlier. Behaviours that result from SPD may affect friendships/inclusion, their peer's ability to learn, or even lead to bullying (Cahill et al., 2014). This drives the question of how to support peer relationships effectively. This may involve a solution that facilitates healthy cooperation with peers or an independent solution that can help children re-enter a social space once they are calm and alert.

A healthy relationship between child and teacher relies on mutually understanding expectations and positive communication. This starts with understanding a child's sensory behaviours and how they are addressed successfully. In the 'sensory smarts' article by Lindsey Biel, she explains that treating disruptive behaviour with incentives or threats does not eliminate the underlying problem (Biel, 2012). For children with SPD, it is essential to treat behaviour by removing or providing sensory stimulation which can help them regulate (Biel, 2012). Educating teachers will enhance the appropriateness of support (Ruttledge & Cathcart, 2019). Conversely, teachers should understand that some behaviours might not come from a sensory need and require different treatment (Ruttledge & Cathcart, 2019). This refers to behaviours that could stem from other conditions a child has or external factors such as the time of day, family issues, etc. The point being that other factors can affect a child's learning (Cahill et al., 2014). Despite this, there is reason to believe that teachers would benefit from something that helps them support sensory behaviours correctly. This may involve something that makes changes to the classroom environment to lower sensory input or providing physical solutions for children to receive sensory input.

One of the challenges in supporting a child with SPD is knowing how to communicate with them (W. Dunn, 2007). Good communication can help children understand what is expected of them and help teachers understand a child's personal needs. This is a significant challenge for children with other underlying conditions like autism that already experience communication barriers (W. Dunn, 2007). The use of physical and visual elements presents an opportunity to assist communication between teacher and child. Alternate systems of communicating can help children with SPD voice their needs. Recourses such as visual timetables are effective in helping children with learning difficulties structure/plan their day and have a mutual level of understanding with their teacher (Martin et al., 2019). The implementation of a physical and visual resource could help children with SPD voice their feelings. In effect, it could help teachers know when a child needs support in learning. As a designer, there is an opportunity to design a product that supports children with SPD in a mainstream setting by facilitating healthy relationships.

The desire to interact with objects can be a natural tendency for many. What is less known is how objects can help individuals manage sensory issues, anxiety, and attention challenges (Biel, 2017). Fidget toys, focus tools, and sensory objects are a few of the terms used to describe what occupational therapists and special educators use as interventions to support children with SPD. When used correctly, sensory objects help children self-regulate and remove the need to engage in disruptive behaviours. They can help children re-enter a learning state of mind where they are able to listen, attend, focus, and participate (Biel, 2017). 90% of occupational therapists use sensory-based interventions to manage SPD in children and facilitate engagement in school activities (Pingale, Fletcher, & Candler, 2019). This refers to children who receive support through special education services at school. It is worth questioning how many children with SPD do not receive special education services and would benefit from the inclusion of sensory interventions in their mainstream classroom.

Snoezelen is a company established in the Netherlands by two therapists: Jan Hulsegge and Ad Verheul (Snoezelen, 2021). They design specialised environments that provide multi-sensory input to promote relaxation, stimulation, development, or therapy tailored for a wide range of user groups (figure 3). Snoezelen emphasises a focus on the physical environment to help children with autism. Methods such as weighted blankets, vibrating cushions, rocking horses, and bubble tubes are a small selection used to stimulate and calm the user. Snoezelen environments put a focus on giving individuals options in what they use (Collier, 2020). Designing physical solutions supports a designer's approach being appropriate for this project. I can offer my traditional craftsmanship skills to experiment with materials, textures, and functions etc. Ultimately, creating a solution that stimulates different senses to support children with diverse sensory processing patterns. Something to be conscious of is that Snoezelen modifies entire environments, which limits engagement to schools with space and budget to do so. It is important to consider scale, materials, production processes, and cost influence in how suitable and wide-reaching the solution could be.

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Figure 3. Snoezelen sensory environment. From *Snoezelen*. Retrieved from <http://www.snoezelen.info/sensory-rooms/snoezelen-image-gallery/>. Copyright [2021] by Snoezelen Multi-Sensory Environments.

There are a wide variety of sensory resources available. Because of SPD's association with other conditions, sensory objects have been targeted towards ASD, ADHD, and anxiety. Furthermore, they have helped people of all ages to regulate feelings of discomfort (Esposito, 2020) . Websites such as Sensory Corner offer a wide range of sensory objects and exercises to different ages and ability levels (Welcome to Sensory Corner, 2021). Having a wide variety of options means that every child's sensory needs can be met (figure 4). Because children with SPD have unique sensory processing patterns, it is hard to support them with appropriate stimulation without truly understanding them (Thompson & Raisor, 2013). The issue is whether mainstream school teachers know what solution is best for a child to help them self-regulate. There is reason to believe that teachers could benefit from a collection of objects which could cater to children with different sensory needs. Also, a lot of the resources on sensory corner run the risk of seeming novelty. This raises the question of how to create a more appealing aesthetic that can increase interest in the solution.

Waldorf toys are learning tools based on Rudolf Steiner's philosophy, founder of Steiner and Waldorf education. With a large focus on physical play, Steiner and Waldorf schools have used these toys since the 1920s as tools to help children nourish their senses and learn (Baldwin, 2010). Waldorf toys are open-minded, simple, and inspired by nature (figure 5). The term open-minded describes how any object or material can transform its function and meaning based on a child's interpretation (Baldwin, 2010). The integration of open-minded play could empower children by fostering their imagination. Further, it could allow children to play with an object in different ways that help them regulate. Waldorf toys embrace a simple aesthetic with natural materials like wood, cotton, and silk. In effect, they run little risk of overwhelming children with too much information, which can be an issue for those who are sensitive to sensory input (Baldwin, 2010). A simple, clean aesthetic may help distinguish the solution from other resources and toys in a mainstream classroom. In effect, this may make the solution more likely to be recognised as a special resource for children with SPD.

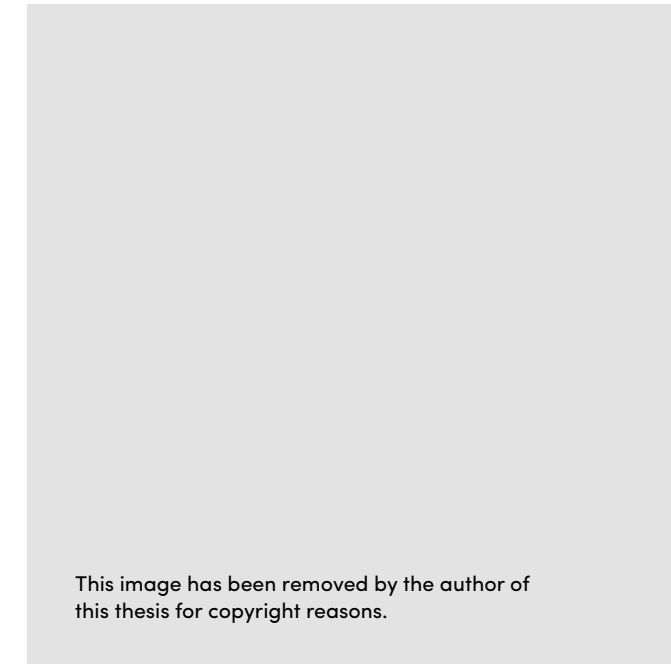


Figure 4. Tactile pack of sensory objects. From *Sensory Corner*. Retrieved from <http://www.snoezelen.info/sensory-rooms/snoezelen-image-gallery/>. Copyright [2021] by Sensory Corner.



Figure 5. Wooden nesting bowls. From *Wiwiurka*. Retrieved from https://www.wiwiurka.com/products/wooden-nesting-bowls-set-of-6?_pos=3&_sid=82077e777&_ss=r. Copyright [2021] Wiwiurka Toys.

Changing something in school that is improving teacher and learning can only be beneficial (Edchat, 2006). The integration of sensory objects into school requires consideration of what is accepted by both teachers and the curriculum. There is a strong association between play, learning skills, and classroom behaviour (Singh, 2019). Typically, play is one of the first items that teachers take away from children for misbehaving (Nash & Schaefer, 2010). However, teachers should understand that play can be used to engage children in learning. This is particularly the case for children with SPD that may struggle with some traditional methods of learning (Nash & Schaefer, 2010). Play with sensory objects can create a better learning experience for children. However, it requires teachers to be on board and understand the benefits of play for children with SPD (Biel, 2017).

Mad Love was an artefact created by the two artists, James Leadbitter and Hannah Hull, as part of the Bedlam: asylum and beyond exhibition (2017) (Madlove: A Designer Asylum, 2021). The artefact was designed to flip the viewer's judgment and feelings commonly associated with a mental asylum. An asylum may typically evoke a sense of sadness and confinement. Mad Love presents an asylum with bold colours, flowing rivers, and social hangouts to evoke feelings of freedom and joy (figure 6). It is designed to make the viewer question the way an asylum should look and how mental illness is treated (Madlove: A Designer Asylum, 2021). Unlike Madlove asylum, my research did not situate speculative design. However, the ability to change an individual's outlook made me question whether the way my solution is communicated can influence whether a teacher views it as a playtime activity or supportive learning tools. Objects may typically be associated with toys and playtime in the classroom, not used to address behavioural issues. However, how can the communication of my design solution help teachers see objects as a tool to support children who struggle with learning. Ensuring teachers use it as intended is also dependent on how children interact with the solution, ensuring that it proves effective in maintaining a calm and alert state.

Te Rito Toi is a New Zealand-based organisation Led by Professor Peter O'Connor from the education and social work faculty. They design activities for school children "following major traumatic or life-changing

events" (About Te Rito Toi, 2020). Te Rito Toi exemplifies how non-regular topics of learning are made appropriate to the school curriculum. It does so by combining standard school activities with non-traditional learnings. In 'The giant who threw tantrums' storytelling activity, the intention is to help children learn how to confront the topic of 'having fears' (J. Dunn & O'Toole, 2020). Doing so also promotes important school-based learning practices such as collaboration, problem-solving, drawing, and writing (J. Dunn & O'Toole, 2020). It may be important to consider how the integration of sensory objects can avoid isolating children from learning while helping them reach a calm and alert state. Isolation from learning refers to stopping children from participating in learning tasks and connecting with peers. The idea of integrating challenging learning activities, such as writing, may not suit the sensory needs and ability level of children with sensory processing difficulties. However, there may be more appropriate ways to accommodate learning, such as reading, motor skills development, creativity, or problem-solving. Although the aim is to help children with SPD reach a learning state of mind, there is an additional opportunity to integrate traditional elements of learning to make the solution more accepted in a classroom.

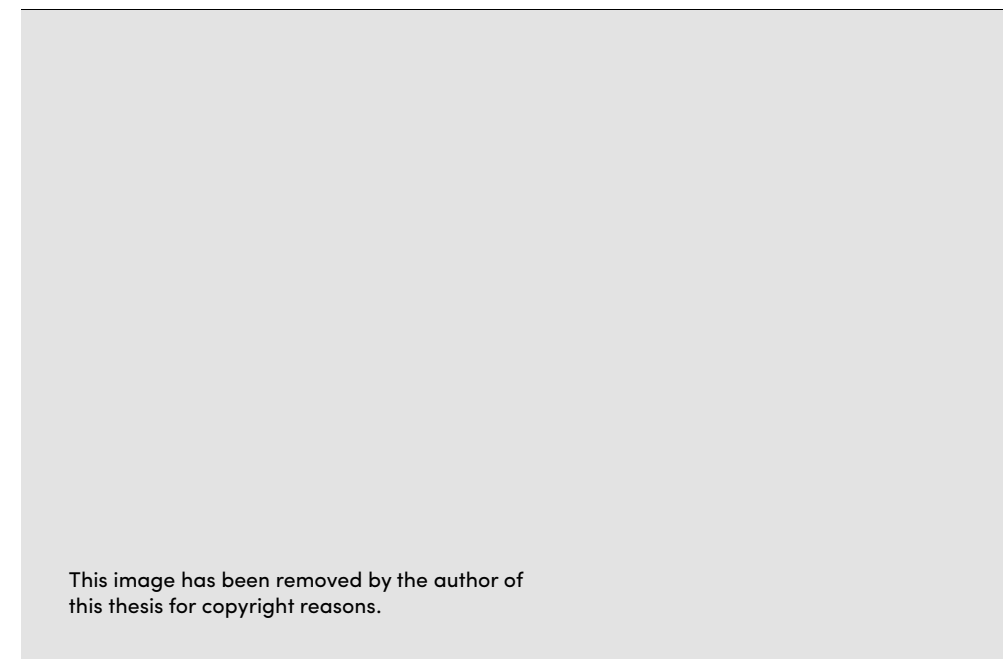


Figure 6. Bedlam: The Asylum and Beyond. From *the vacuum cleaner*. Retrieved from <http://www.thevacuumcleaner.co.uk/bedlam-asylum-and-beyond/>. Copyright [2021] the vacuum cleaner.

Conclusion

Sensory processing difficulties can affect a child's social, physical, and academic success in school. These children are disadvantaged and cannot thrive like other children. Teachers in mainstream primary schools may not have the knowledge, time, and resources to provide appropriate support for children with SPD in their care (Shaddock et al., 2007). This requires further investigation as teachers should aim to facilitate all children with opportunities to thrive at school. There is an opportunity for a design that caters to children's needs with SPD and primary school teachers. Design presents an opportunity to explore the self-regulatory benefits of objects for children with SPD. Then, implemented in a way that teachers can appropriately integrate into the classroom.

Project Aims

Understand how those with expert knowledge and experience support children with SPD. Furthermore, their knowledge can inform the implementation of my solution.

Investigate the understanding of sensory processing difficulties amongst mainstream schoolteachers and the types of disruptive behaviours they commonly encounter.

Recognise different factors in a classroom that can affect a child with SPD's attention and ability to learn (e.g., classroom conditions, peer and teacher relationships etc.)

Explore how objects can provide different types of sensory input in relation to helping all children with different sensory processing patterns reach a calm and alert state.

Explore the opportunities for sensory objects to be integrated into a school routine. This includes how scale, aesthetic, and usability can influence how it is used and how appropriate it is for a classroom.

Research Question

How might objects for sensory regulation in learning and play better support teachers who manage children with sensory processing difficulties to achieve a calm and alert state in a classroom setting?

Methodology

Epistemology (constructivism)

Epistemology is about recognising 'what it means to know' and deciding what kinds of knowledge are legitimate (Gray, 2004). In the context of my research, constructivism is the epistemological perspective I adopted. Constructivism acknowledges that meaning is constructed, not discovered, and created through an individual's interactions with the world (Gray, 2004). It was essential to acknowledge myself as an outsider who was stepping into an issue involving children's health and support. This meant challenging what 'I knew' about the contexts in which I was researching. I had limited to no healthcare expertise, experience as either a child with SPD or as a primary school teacher. Therefore, I constructed my meaning through the knowledge and experiences of individuals closely involved in my research focus. This was achieved by applying human-centred design methods. Engaging with teachers and occupational therapists (OTs) helped construct a diverse and reliable knowledge base to inform my research decisions. Constructivism also helped me to acknowledge my own life experiences and better understand how my education as a designer inevitably influenced the research (Gray, 2004). This mindset helped me to filter knowledge and better recognise what I deemed as important to the research. Furthermore, using my judgment as a designer helped me choose an appropriate methodology for the research. Action research pairs well with a constructivist stance as its participatory nature improves practical judgment on real-world issues (Swann, 2002).

Action Research

Action research (AR) is a participatory process concerned with developing practical solutions for the flourishing of people and communities. This involves bringing together action and reflection, theory and practice, in participation with people (Brydon-Miller, Greenwood, & Maguire, 2003). AR is an iterative form of enquiry that uses cycles of planning, acting, observing, and reflecting (Swann, 2002; figure 7). In my research, AR followed a systematic approach in which multiple cycles of research allowed me to explore and discover new opportunities to introduce to the primary school setting (Swann, 2002).

“A design process involves finding as well as solving problems” (Steen, 2013). When starting out my project, it was important to identify and define the issue to begin problem-solving. By developing my understanding of the problem, I was able to act appropriately in the research (Swann, 2002). AR allowed me to acknowledge that research does not occur exclusively in the early stages. Using principles of participatory action research, I recruited people with key knowledge at different stages in my research process (Swann, 2002). Their knowledge and experiences formed the basis of my data collection and analysis throughout.

The iterative and reflective nature of AR meant constantly solving problems and uncovering new ones. AR helped me explore possibilities, get things wrong, and follow hunches (Muratovski, 2016). This embraces the notion that no idea is a bad idea, as it gives the designer a chance to reflect. Reflecting on my research through practice often led to new learnings and consequently informing design iterations (Schön, 2016). Through cycles of research, the different problem parts were brought together and addressed in the development of my solution. The application of the AR methodology allowed me to produce both physical and research outcomes. Success did not lie in the immediate change to schools, but rather a valid attempt at answering the research aims (Steen, 2013).

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Figure 7. Illustration of the Plan-Act-Observe-Reflect Cycles. Adapted from “Doing it Collaboratively! Addressing the Dilemmas of Designing Quantitative Effect Studies on Narrative Family Therapy in a Local Clinical Context,” by N. T. Jorrong, 2017, Journal of Systemic Therapies, 53. Copyright [2017] Guilford Press.

Human-centred Design

Human-centred design (HCD) is an approach employed by researchers and designers to cooperate with and learn from their solution's potential users. The goal is to develop a solution to a problem that matches the users' needs and preferences (Steen, 2011). HCD gives power to the idea that people who face a particular problem every day hold the key to the answers (Muratovski, 2016). Having a human-centred perspective means acting in expectation of being held accountable for the actions taken in the research (Krippendorff, 2004). Therefore, I was intrinsically motivated to reflect both teachers and children's needs in developing my solution (Steen, 2013). As a designer tackling a health-focused issue, my responsibility was using methods that allowed users to be participants in the research. Methods associated with HCD, such as interviews and prototype testing, helped me gain a more accurate understanding of SPD and learn from potential users of my solution.

My research followed a process of diverging and converging phases, which moved my project closer to an outcome that reflected the user's (teachers and children) needs (figure 8). The divergent phase embraces new ideas and opportunities (IDEO, 2008). This phase often involved broad and explorative sketching and prototyping. When problems are identified, the convergent phase narrows down these ideas to what is most viable, feasible, and desirable to the users (Muratovski, 2016; figure 9). The convergent phase involved interviews and prototype refinement.

Without any experience as a primary school teacher or as a child with SPD, I could never fully relate to my users' position. Therefore, empathy was vital to design a solution that more accurately reflected the user's needs (Krippendorff, 2004). Human-centred design helped me to access an empathic mindset that aligned with a constructivist stance and my project's aims (Muratovski, 2016). Empathy was employed consistently throughout my research by being open to the teacher's and OT's feedback, considering the perspectives of multiple users, and reflecting on the children's experiences with my solutions. This allowed me to construct my ideas through the participants' experiences (Kolawole, 2015). Although I could not engage with a large variety of primary school teachers, HCD

helped me consider the different perspectives of those I did engage with and envision potential perspectives (Steen, 2011). Using empathy required an ability to balance my knowledge and ideas with those of the user's. Therefore, design decisions through ideation often relied on judgement to balance a concern for different perspectives (Steen, 2011). This involved being thoughtful of the function, accessibility, risks, and limitations of my solution for different children and teachers. Because I could not directly engage with children in this research, their needs may not have been reflected as accurately as they could have been. However, I enabled children to have input in the research by testing my designs, and evaluating their success through prototype testing. By developing an informed mindset, I could ultimately give form to ideas to address an opportunity that could create real human impact (Muratovski, 2016).



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Figure 8. Divergent and convergent thinking. From *Design Thinking Defined*. Retrieved from <https://designthinking.ideo.com/>. Copyright by IDEO.org.



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Figure 9. Creating real impact. Reprinted from *Field Guide to Human-Centered Design*, by IDEO. 2015, Copyright [2015] by IDEO.org.

Ethical Considerations

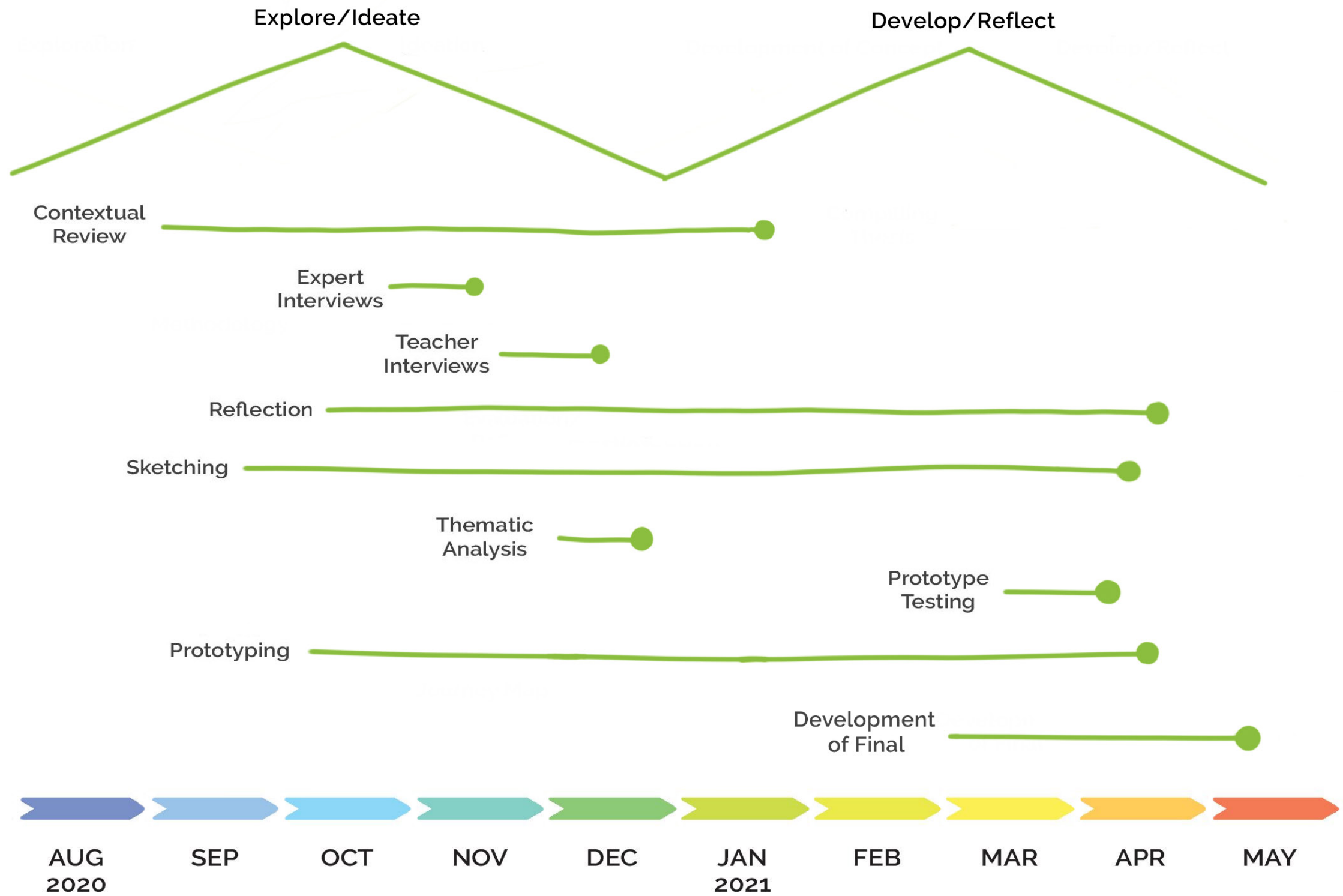
Using human-centred design meant that user involvement was vital to the success of the research (Swann, 2002). Furthermore, it was essential to implement a system of moral principles that guide my approach (Parsons, 2009). People have a democratic right to be involved in design that affects them (Boyd, 2012). Furthermore, their privacy and safety should be respected throughout (Applying for Ethics Approval: Guidelines and Procedures). Ethics was relevant in determining how to engage with my three user groups (occupational therapists, teachers, and children). This played a vital role in the methods I used and the collection of data.

In this research, all the teachers and OTs that participated in interviews were viewed as equal regardless of their age, ethnicity, cultural background, etc. I acknowledged that topics relating to their practice could make participants feel uncomfortable. As such, I aimed to implement the principle of partnership. This meant maintaining positive and respectful relationships with participants. All individuals had the opportunity to participate individually or with others. They also had the choice of taking part at their place of work, at AUT facilities, or online via Zoom call. To protect privacy, the identity of participants remained anonymous to the public throughout data collection and documentation.

Initially, it was advised that working directly with children may pose too many ethical limitations for this Master's research. For example, recruitment would have to take place through the child's teacher, and children can only give assent. OTs provided good clarity regarding SPD and how it affects children. However, I could not measure the success of my research without understanding how children engaged with my design outcome. To include children within ethical boundaries, I conducted prototype testing by discussing primary school teachers' observations when using the kit with their students. The three teachers and one teacher aid that took part were recruited by expressing interest in addition to participating in teacher interviews. Children remained anonymous and had to provide verbal consent to take part. If this research progressed to a PhD, it would be important to gain ethical approval to engage with and observe children with SPD directly. This would allow me to explore further

the specific effects my design solution could have on a child with SPD's ability to learn at school.

Formal ethics approval was provided by AUT ethics committee (AUTEK) for this project (reference number: 20/259). After amendments, full approval was given by AUTEK on 2nd September 2020.



Discover Methods

Literature Review

A literature review is used to summarise, interpret, and evaluate existing literature (Collins, 2018). It helps to build a base of knowledge around a subject, which in turn helps define an inquiry and establish a need for further research (Collins, 2018). In this project, I employed a thematic literature review. Exploring various themes helped examine different perspectives and converge knowledge into a research approach (Muratovski, 2016). A broad selection of literature covered topics such as SPD, schooling success, sensory objects, and the integration of non-traditional learning methods. The analysis of these themes helped to identify gaps in existing knowledge. Literature was sourced online through Google Scholar and AUT library data bases, or on campus at AUT. Search results were found using key words such as children, learning, self-regulation, and sensory processing difficulties. Relevant literature was saved and stored in Endnote. Information was categorised in Word documents to form themes for the written literature review.

Expert Interviews

An expert refers to an individual with a high level of skill or knowledge in a particular field (Definition of Expert, 2021). Expert interviews were used to explore and collect data in specific contexts of my research (Döringer, 2020). When recruiting experts, it was essential to identify what specialized area of knowledge I required (IDEO, 2015). Both OTs and teachers were considered experts in the research. However, in my documentation of research, experts referred exclusively to OTs.

Occupational Therapist Interview

I interviewed two qualified OTs working as teachers at the same special learning school in the central Auckland area. The interview was conducted following a contextual review and phase of early ideation. Participants were identified from information in the public domain by searching for OTs with child therapy expertise. An invitation to participate was sent via email, giving them the chance to reach out to me if interested in participating. Upon receiving a reply, a date and location for the interview were organised with the participants.

There was difficulty in recruiting participants due to the consideration of busy schedules. However, I felt that engaging with two OTs was sufficient to inform my understanding of how SPD affects children and how to better support them in a learning setting. This interview also allowed me to build on my knowledge of contexts from the contextual review and address questions that were not easy to answer. For example, how well understood SPD is by mainstream school teachers.

It was necessary to recruit OTs who had experience working with children to gain both factual and practical-based knowledge around their practice. This helped bridge the gap between OTs and teachers by using expert insights to inform change in the mainstream school setting (Döringer, 2020). It was also an opportunity to investigate the contrast between OTs roles in special schools that are experienced supporting children with SPD, and mainstream schoolteachers. Each interview took place face to face and was audio recorded with the two OTs permission.

As the interviewer, audio recording allowed me to focus more on leading the interview instead of notetaking. Each interview was approximately 30–45 minutes in duration. A semi-structured interview approach was taken, using open-ended questions (Muratovski, 2016). This allowed me to explore more specific areas of focus while allowing new interests, issues, and questions to emerge (Muratovski, 2016). Often, questions were prewritten to help ensure conversation remained on topic and relevant to the research focus. Each interview was focused on five main themes: expert's role, SPD in children, schooling effects of SPD, strategies used, and concept feedback.

Prototypes and drawings from my initial ideation phase (figure 17, 18, 19 & 21) were used as talking points throughout the interviews. These were intended to give the OTs a better understanding of my approach to the research, helping them provide more insightful feedback to my line of questioning. Their insights on my concepts were carried into the development of new design iterations that were subsequently used in teacher interviews.

Teacher Interviews

Interviews with primary school teachers were undertaken to identify the needs, challenges, and limitations within the schooling space. I contacted various primary schools in the Auckland area via email. Contact was first made to the principal of the school or admin office. I asked whether an invitation to participate in my research could be forwarded to teachers within the school. Those who replied were emailed more information about the research (see appendix). Following this, a time and date were arranged for the interview. I was able to recruit four teachers from two schools in the central Auckland area. This allowed me to generate rich data from a variety of perspectives. Teacher interviews took place after my interview with the OTs and the second phase of ideation. Participants had various levels of experience and had collectively taught at all age levels (from year 1–6). It was essential to capture teachers' perspectives from different year groups to avoid bias and understand the influence

age has on a child with SPD at school.

The initial intention was to implement co-design through a focus group in which 4-6 teachers would facilitate a group discussion of contexts. Unfortunately, due to busy schedules, I was unable to recruit enough teachers from each school to accommodate a focus group. Focus groups allow for sharing different perspectives between participants, which can then be discussed (Muratovski, 2016). Comparing perspectives was subsequently undertaken through thematic analysis proceeding the individual interviews (figure 28).

When possible, interviews were conducted within the participant's place of work. Two of the three interviews took place face-to-face, while one took place online (via Zoom) at their request (for convenience). Each interview lasted approximately 30-45 minutes, covering four main themes: common behaviours, strategies, the opportunity to integrate a kit, and feedback on the concepts under development. The interviews were audio-recorded with the teacher's permission, and findings were analysed using thematic analysis (Clarke & Braun, 2014). A semi-structured interview style was adopted, with open-ended questions at times that stimulated participants to relate their perspectives to the issue (Döringer, 2020). Questions were often broad rather than focusing specifically on children with SPD. My understanding was that some teachers might not have taught children with SPD. Therefore, the focus was understanding the challenges they face supporting children who have the most trouble paying attention and learning.

By presenting ideas that could bring change to their practice, it was important teachers could understand my approach. The use of prototypes acted as communication tools to explain the intent of my research (Lauff, Knight, Kotys-Schwartz, & Rentschler, 2020). The scale, form, materiality, and function of my prototypes helped teachers to better understand how they might integrate my designs into their practice. The use of prototypes also helped draw out strategies that teachers had seen or used in the past concerning supporting children with special education needs.

Survey Interview

Due to the challenges with recruiting teachers in my research, surveys were employed to make participation more convenient for those who could not do interviews. The ability to sit down with a participant to ask questions does facilitate more in-depth discussion and opportunity to learn. However, surveys were a reasonable compromise which allowed me to gather richer data from a wider variety of perspectives. Surveys are known as a form of statistical research that is used to document people's characteristics, opinions, attitudes, and experiences (Muratovski, 2016). The core of a survey is relatively similar to interviews. The different being questions must be prepared in a way that can be measured. It was vital answers were relevant and could easily be interpreted. This meant restricting questions to a single idea that was clear and concise for teachers to understand (Muratovski, 2016). Survey participants were recruited the same way as teacher interview participants. Two teachers took the survey. Surveys were sent to participants as a Word document via email. This contained a short description of my research, followed by a list of 10-15 questions. The questions covered three main topics: their role, behaviours & triggers, and strategies. Pictures of my prototypes and drawings (fig 17, 18, 19 & 21) were also included which allowed participants to give feedback on my designs. Participants handed the survey back within two weeks, in which the answers were analysed, and reflected in the thematic analysis and documentation of research.

Prototype Testing

Once responding to insights by developing my design outcomes, their impact should be explored by testing in the real world (User Testing: A Beginners Guide to Stage 5 of Design Thinking Process, 2020). Prototype testing was a chance to validate my solutions and highlight opportunities for further development (User Testing: A Beginners Guide to Stage 5 of Design Thinking Process, 2020). It is a valuable tool in most design projects with a human-centred focus. The end goal was to design a solution that validates desirability, feasibility, and viability for its end users (Rikke Friis Dam, 2020). Prototype testing was employed in the last phase of the design process to test the success of my refined sensory objects, booklet, and packaging. This informed further incremental changes.

It has been argued that researchers cannot understand the world from a child's point of view (Kirk, 2007). Considering children were the end-users of my product, their inclusion in the research was still valued highly despite not working directly with them. Prototype testing presented an opportunity for children's voices to be heard through observation. Due to the limitations posed by observing children first-hand, observations were made through teachers. This was well suited to the research, given that teachers facilitated the usage of the prototypes. It was vital that testing utilised the natural setting (in the classroom, in school hours), so that the findings were true to real life.

Prototype testing took place on two separate occasions in two schools. The first school included one junior school teacher and one teacher aide, and the second included two junior school teachers from the same classroom. Participants were recruited from those who took part in teacher interviews. They were offered to further participate in the research by testing my prototypes, in which three teachers expressed interest. The teacher aide was recruited by expressing their interest to myself through one of the teachers that took part. Closer to the time, a date was arranged for the teachers to receive the prototypes.

The two schools were given the prototypes for one week, including six

objects, a booklet, and a box. The teachers were given freedom as to how they chose to introduce the prototypes in their class, as this would help me realise if they chose to use them appropriately. The teachers were asked to try to observe children as they interact with the prototypes and reflect on how, as a teacher, they found them valuable (or not).

The purpose was to give children a voice in how the prototypes influenced (or not) their feelings and ability to learn by proxy due to ethical limitations. Following a week with the prototypes, a short 20–30-minute interview was held with the teachers at each school. The teachers were asked to reflect on how they integrated the design solution in their class, and whether their students' interactions with the objects, booklet and box were positive, distractive, calming etc. There was potential for bias. For instance, teachers could not have been honest about their observations, and children could have been encouraged to be extra careful with the prototypes. However, I assumed that participants would give their true opinion and feedback. These interviews were then analysed and used to refine my design solutions and reflect on my outcome.

Design Methods

Sketching

Sketching is a tool used to express and generate ideas in a quick and iterative manner (Parsons, 2009). Sketching was used continuously throughout this project. As a designer, holding onto ideas in one's head becomes difficult. Therefore, sketching provides a quick output for this. It was used to generate and give form to new ideas (Parsons, 2009).

Sketching was employed at different stages in the research. As a tool for communicating ideas, sketching was valuable in the decision-making process to reflect on and pick favourable ideas, leading to the development of physical prototypes (Parsons, 2009). Sketching was employed to refine the form and aesthetic of all my physical design outcomes. This included my sensory objects, booklet, and packaging. Rough and unrefined sketching was often applied when creating multiple iterations. Refined sketches were often created digitally using the Sketchbook Pro software. These helped communicate ideas clearly in interviews and supervisor presentations.

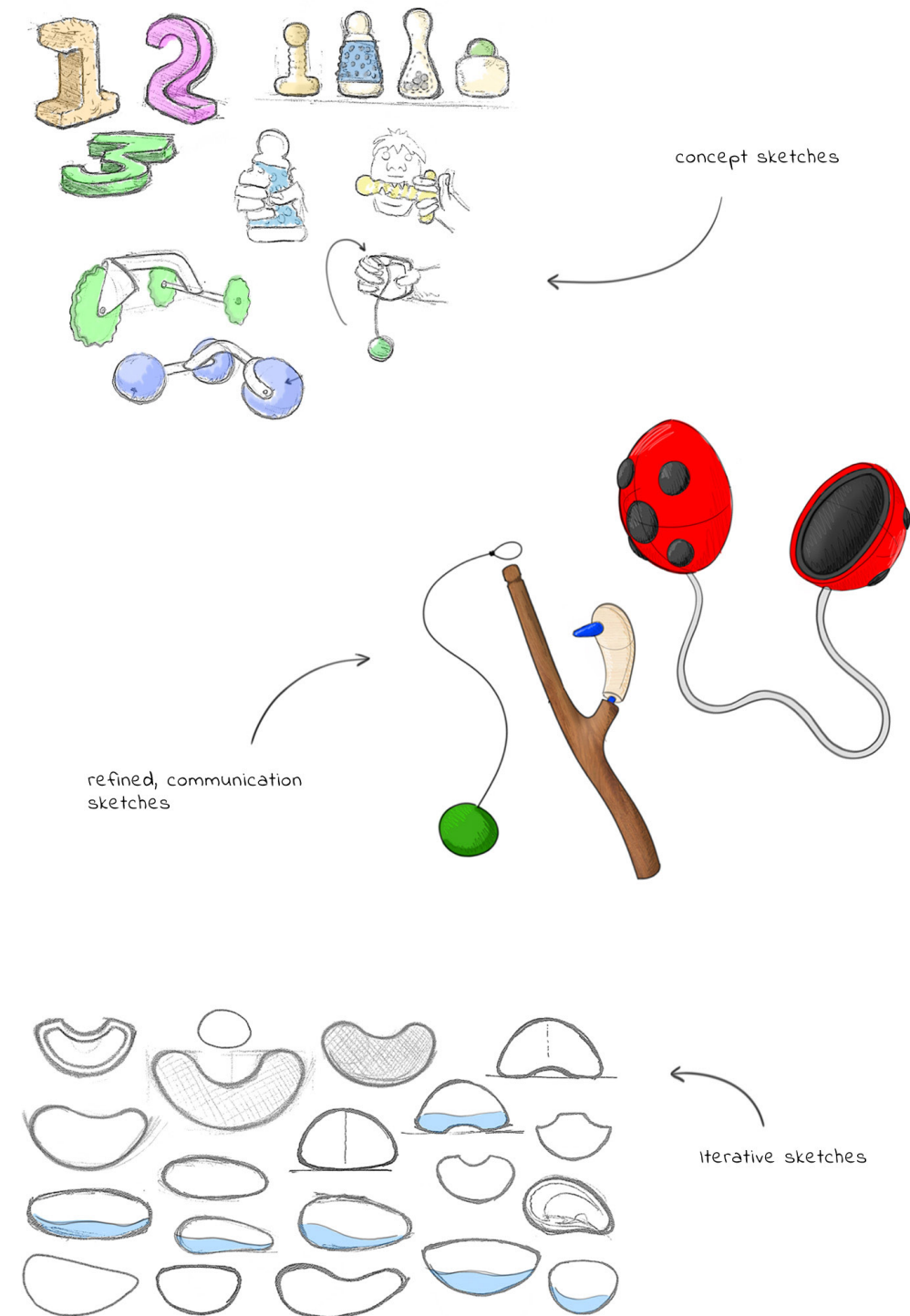


Figure 11. Hutchinson, (2021). Examples of sketch types used

Prototyping

Once a literature review was formed, and the methodological approach was understood, prototyping could commence (Muratovski, 2016). Prototyping allowed me to communicate my ideas in a tangible way (Muratovski, 2016). Giving ideas form allowed concepts to be tested and evaluated. Not only did prototyping inform the development of new iterations, but it allowed me to explore new possibilities and ways of thinking concerning form, aesthetic, materials, and interaction (Coughlan, Suri, & Canales, 2007).

Prototyping is aligned with an action research methodology that encourages iteration and learning by doing (Koskinen, Zimmerman, Binder, Redstrom, & Wensveen, 2011). The progression of prototype development was led heavily by the insights of participants. However, prototyping also inevitably relied on my design instinct and judgement at times when making incremental changes (Koskinen et al., 2011).

Through most of the research project, prototypes were often well resolved and used materials such as wood, plastic, and rubber. Initially, prototyping involved quick handcrafting methods such as sawing, sanding, cutting, etc. As the project progressed, making methods such as 3D printing, laser cutting, computer numerical control routing (CNC), and mould-making were adopted to produce highly resolved models. Rough, rapid prototyping was also used later in the design process for producing quick iterations to refine specific elements of my designs—this used basic materials such as cardboard and MDF (Coughlan et al., 2007). The final design was communicated with materials that reflected my research insights and making methods that produced a high quality, durable, and sustainable outcome.



Figure 12. Hutchinson, (2021). Examples of prototype styles used

Thematic Analysis

Thematic analysis is a method used to analyse qualitative data. It allows the researcher to identify, analyse, organise, describe, and report themes from a collection of data in a structured manner (Nowell, Norris, White, & Moules, 2017). I used a thematic analysis to compare the findings from OT and teacher interviews. The result of my analysis helped to produce a set of insights that addressed the research question.

After conducting all of my interviews, recordings were reviewed and transcribed to identify the key insights. For each interview, insights were categorised based on their relevance into one of five categories: layout of setting & curriculum, behaviours/triggers, current strategies, implementation, and concept feedback. By laying all insights out next to one another, common themes were identified through each of the categories. Analysing these themes allowed me to generate findings that were reflective of all participants. From the findings, I composed a brief that reflected the needs of children with SPD and primary school teachers.

Reflection

I used reflection at different stages in the research to become aware of implicit knowledge, learn from the actions I took, and plan further development (Schön, 2016). Reflection aligns with an action research methodology. It was undertaken at the end of each research phase to voice thoughts and feelings, interpret the positive and negatives, and plan future actions in the research. Reflection involved looking backwards and forward in the research to define and give clarity to the actions that needed to be taken as I progressed (Reymen & Hammer, 2002). Reflecting on the research often helped me be self-critical and surface assumptions that could have limited my actions and the research's overall success (T. McMahan, 1999). Some reflections were documented in this thesis to give insight into the learnings I made through the design process.

Documentation of Research



Phase 1

Initial Sketching

After a contextual review, I had an understanding that I may be creating a tangible solution/solutions that would provide different types of sensory input to help children with SPD regulate their behaviour. However, a lot was still unclear and could not be answered until I could engage with occupational therapists and teachers. I tried not to be too hard on myself in this early stage of the project. Quick (and loose) sketching was a chance to imagine possibilities and explore what I considered may be relevant to the research (figure 13 & 14). The intention was to explore different ways that objects could provide sensory input. It also allowed me to start exploring themes, colours and aesthetics that might appeal to children. Both traditional (pen + paper) and digital drawing methods were used.



Figure 13. Hutchinson, (2021). Initial Sketching pg. 1 'exploring senses through objects'



Figure 14. Hutchinson, (2021). Initial Sketching pg. 2 'exploring senses through objects'

The seven sensory systems

There are seven sensory systems in the body that respond to and receive information from the outside world. At this phase of the research, I began considering the integration of all seven sensory systems and their ability to help children with different sensory needs regulate. Two senses which are lesser-known to most are the vestibular and proprioceptive systems (controls body awareness) (Eyas Landing, n.d.). The vestibular system is responsible for an individual's balance and spatial orientation. Activities that stimulate the vestibular system include rocking back and forth, swinging, and spinning. Proprioceptive refers to an individual's awareness of their body and movements. This sensory system can be stimulated through deep pressure (e.g., weighted blankets and vests) or intensive input to the muscles and joints (e.g., climbing, pulling) (Eyas Landing, n.d.). Children with SPD more commonly have a high proprioceptive and/or vestibular tolerance, which can result in boisterous and physical behaviours such as squeezing things, spinning, stomping etc. Therefore, these children may benefit from exercises to help them regulate/stimulate more appropriately in a classroom setting. Alternatively, children with a low threshold will be sensitive to movement and will benefit from simple exercises to help foster their participation in activities that require balance and coordination (Eyas Landing, n.d.).

Separate from the seven senses, breathing patterns have shown to affect an individual's ability to self-regulate. Deep steady breathing relieves stress, anxiety, anger, and emotional disturbance - all symptoms that can often pair with SPD (Sellakumar, 2015). As well as the seven senses, at this time, I was exploring concepts that promoted steady breathing as it can help children lower their level of alertness to better succeed in learning (Sellakumar, 2015).



Figure 15. The seven sensory systems. Adapted from 7 Senses foundation. Retrieved from <http://www.7senses.org.au/what-are-the-7-senses/>. Copyright by 7 Senses Foundation.

Material Exploration

Material exploration felt an appropriate way to start thinking about how objects can stimulate the different sensory systems. Using my senses, I searched for objects and experiences that could be calming for a child with SPD. At this time, I had no way to validate materials beyond my experience with them. However, I tried to make decisions based on my instinct and knowledge of other sensory products.

Some of my experiences in the natural environment and playing with different materials are presented in Figure 16. One main take away was realising/ thinking how our different senses may respond to an object based on our interpretation of how to use or engage with it. For instance, a stick provided tactile input (touch) when held in hand but became auditory (sound) when hit against a surface. The interpretation of objects relates to the idea of open-ended play shown in Waldorf toys (refer to contextual review). Objects can mean different things to different people. Children will build an experience with the things around them (Green, 2017). It made me think about how children with SPD may use/respond to an object in a way that satisfies a particular sensory need, regardless of what sense the object might intend to stimulate. I recognised it was important to better understand how to promote calming experiences and not provoke children to interact in a way that might be distressing or disruptive for them or others.

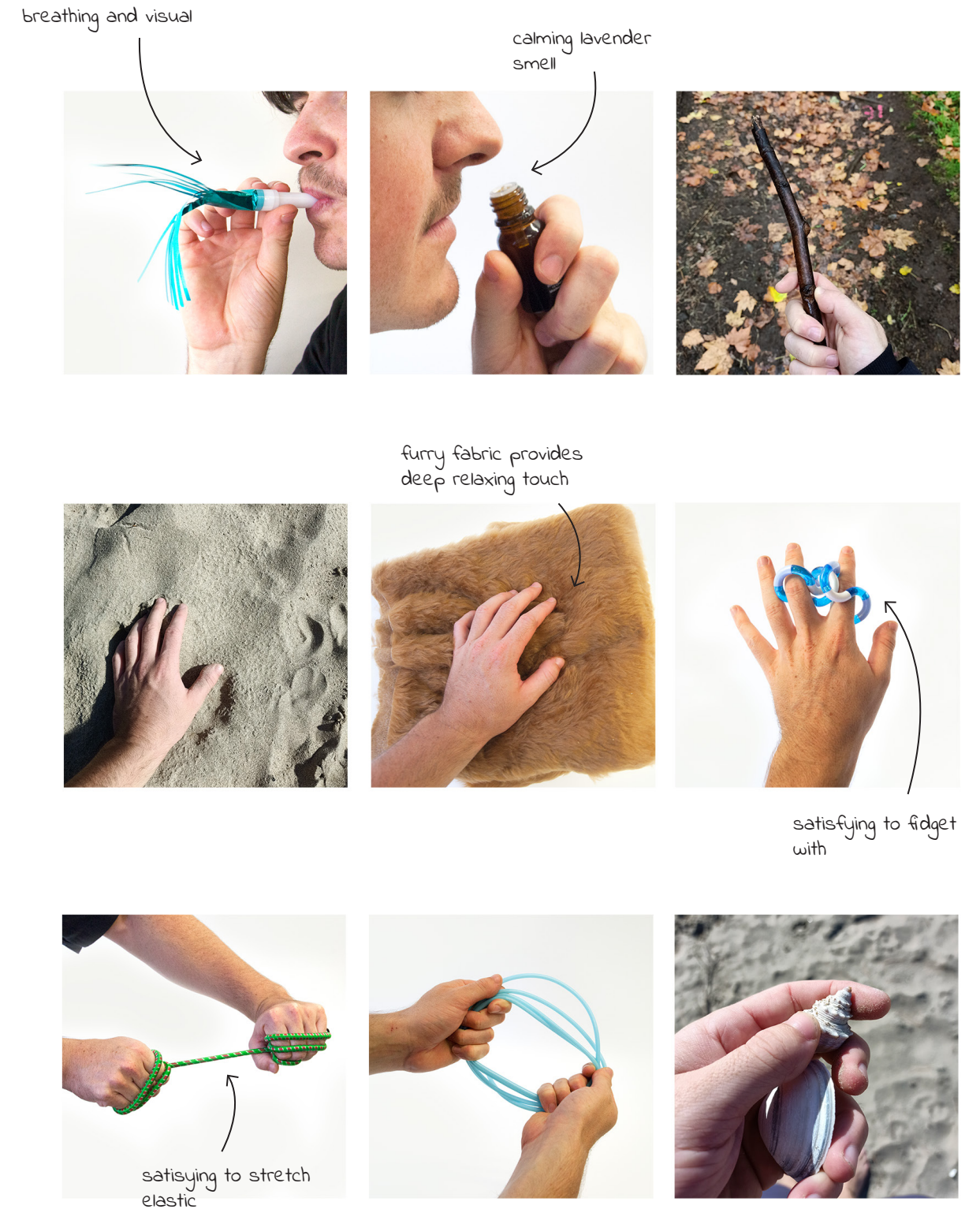
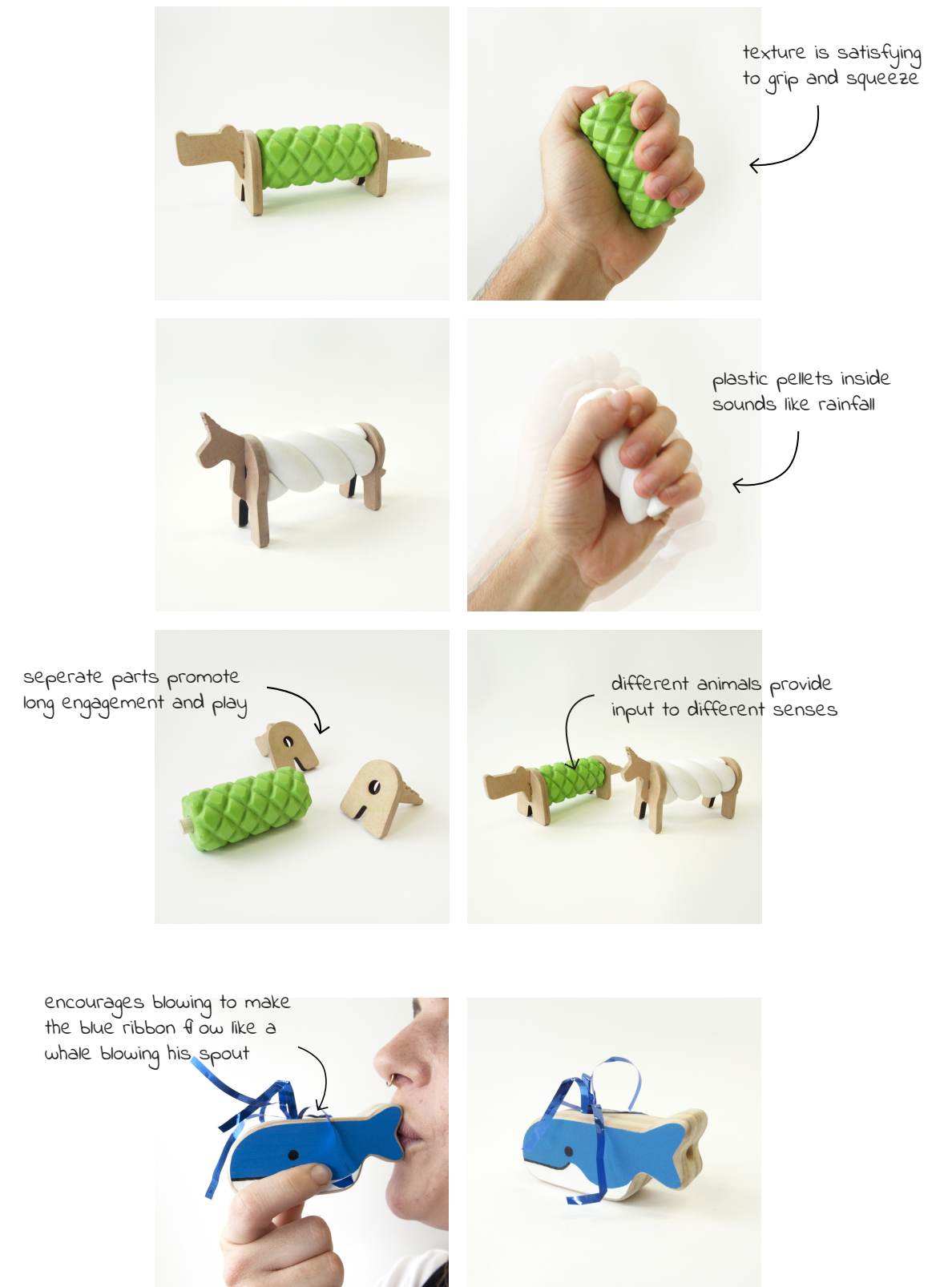
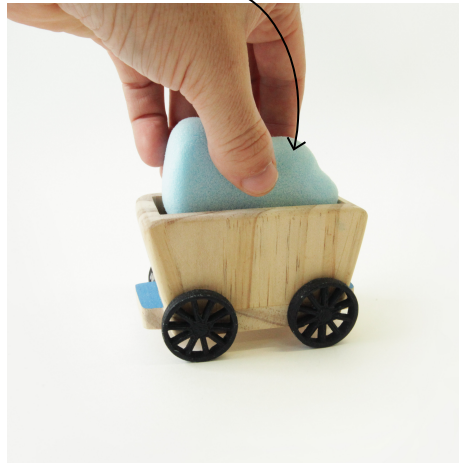


Figure 16. Hutchinson, (2021). Material (and object) exploration images

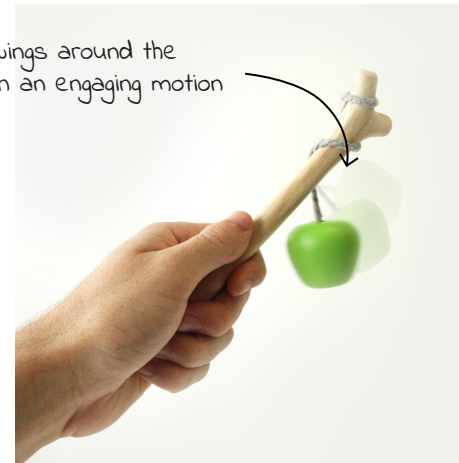
Prototyping



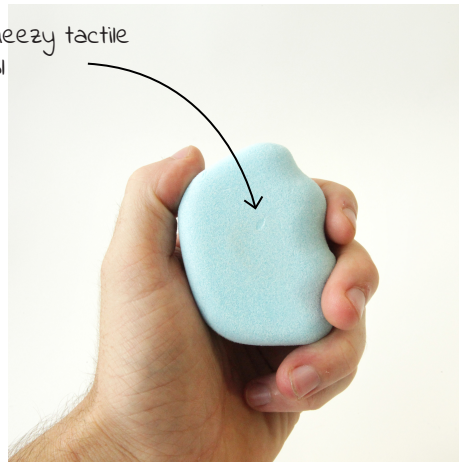
train cart acts as storage and accommodates more play



ball swings around the stick in an engaging motion



squeazy tactile grip



tangle worm for fidgeting



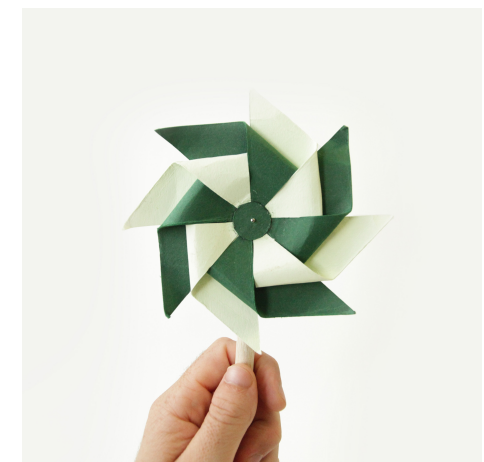
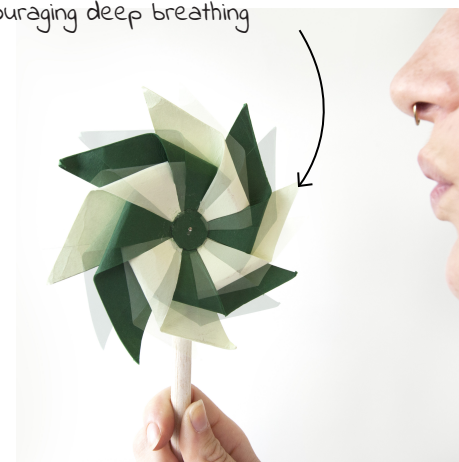
holder for storing on a desk



different uses/ ways of stimulating senses



provides visual stimulation as well as encouraging deep breathing



Early concepts (rapid prototyping)

The focus of prototyping was to give form to my ideas. I had to consider a form, function, aesthetic, and scale suitable for a child with SPD. Although prototyping was explorative, my models were more refined than they typically would be in the early stages of a design process (figure 17, 18 & 19). This is because I found myself with plenty of time to prototype while finalizing ethics approval. I also felt that participants could give better feedback when presented with more tangible and refined ideas. Prototyping explored a variety of materials such as wood, plastic, and foam. I mostly used traditional woodworking, 3D printing and laser cutting to develop my prototypes.

Developing more refined prototypes also helped me to reflect and consider their potential to affect children in a classroom. This refers to the benefits and risks with how a child might choose to use an object, what senses it stimulated, how it could affect behaviour, and how teachers view them. These questions could not be answered without users' input but encouraged me to think about concepts that seemed most promising.

The 'stick and apple' concept was my personal favourite. The natural surface of the stick felt nice to squeeze. Swinging the apple around also produced a very satisfying visual motion that I felt could provide an alternative to fidgeting. I did question how distracting and potentially harmful the swinging ball could be. The animal and train concepts also showed promise for their appealing aesthetic. However, I felt they might risk seeming too toy-like. Since I had not identified a target age, I wondered whether these concepts were limited to younger children.

A lot of my prototypes shared the commonality of being a collection of objects attached to a theme. Creating a collection of objects had developed from my analysis of Snoezelen environments which focuses on stimulating an individual's different senses in different ways (Collier, 2020). This was an idea I chose to explore further.

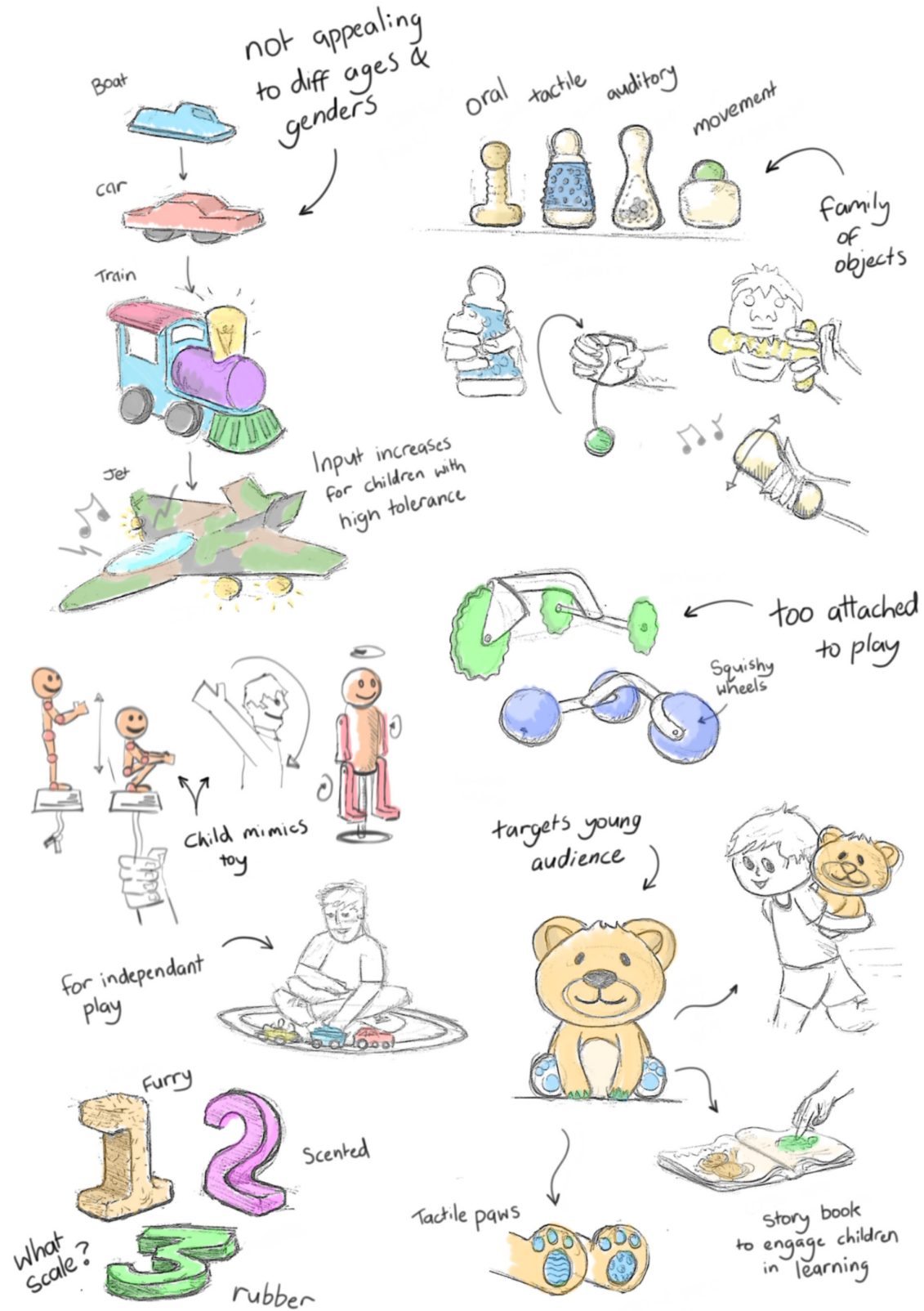


Figure 20. Hutchinson, (2021). Collection of object sketches pg.1



Figure 21. Hutchinson, (2021). Collection of object sketches pg.2

Reflection

The first phase of ideation generated a broad selection of ideas that could be taken into interviews for feedback and to help me communicate my ideas and thinking to participants. Ideation also surfaced some new opportunities that I was keen to explore as I engaged with experts (OTs) and teachers.

I felt Producing a family/selection of objects could be a promising direction for the research. A family of objects could be suitable to cater to a broader group of children with SPD. Multiple objects with different functions might give children the ability to stimulate their touch, smell, taste, sound, sight, proprioceptive, and vestibular systems. Up to this point, my focus had primarily been small scale objects that fit in children's hands. However, I stayed open-minded to the prospect of larger solutions (not handheld objects) as I engaged in interviews. This meant I was not limiting my project's potential and making big decisions based solely on my own judgment.

Feedback from experts would help to validate or confirm whether sensory objects were a suitable direction for a school setting. Engaging with experts was an opportunity to better understand the resources currently used to support children with SPD. I hoped that experts would improve my understanding of SPD and how to approach helping children in the mainstream school setting using design.

Phase 2

Occupational Therapist Interview

I conducted an interview with two qualified occupational therapists working at a Special School in the Auckland area. This interview developed my understanding of SPD in children. It included understanding strategies to help children with SPD and how a potential solution could be designed appropriately to the conditions in a mainstream school setting. The two experts were also forthcoming with feedback on my existing concepts. This helped to realise what is important to an individual using sensory objects in their practice. Understanding how SPD can be supported in special schools was necessary to introduce this knowledge to the mainstream school setting.

Both experts were clear that SPD was a severe issue for most children at their school. Therefore, it was something they dealt with on a daily basis. They explained that the structure of a typical day is similar to that of mainstream schools. Children go to class, have break times, and do activities like writing and physical education. The difference being there is normally no more than ten children per class, with 2-3 teacher aides supporting the main teacher. One expert explained that their challenges are very different from mainstream school teachers because all 'their' children have different sensory needs.

"In a mainstream class, you may find one kid with sensory processing disorder. Whereas in our classes, we have eight kids with totally different sensory readings. You've got to try and cater for eight different kids so that they're not all blowing up." – Occupational Therapist 2

The challenge for special school teachers was a need to cater to multiple children with SPD in the same class. Therapy (treatment of conditions) was aligned with their class activities in order to structure learning that catered to all their children's needs. In effect, it would keep them calm, alert, and happy. One of the experts had previous experience working in a mainstream primary school. They explained that mainstream teachers often have less time, knowledge, and resources to support a child with SPD. This is exaggerated when a child with SPD is in a class of 30 other children that need attention. Consequently, they suggested that the mainstream setting is not well suited to

the few children with SPD who are amongst children who do not need the same type of support to learn. This insight added additional support to the need for my research. Teachers in mainstream schools cannot quickly adapt their practice and do not always have sufficient knowledge around catering to children with special needs. Therefore, teachers would benefit from access to an easy-to-use resource that supports the few children in their class who have difficulties with learning due to SPD.

Special school teachers were described as having a more personal understanding of how to cater to each child in their care. They learn to understand the sensory processing pattern of each child. The result is knowing the types of sensory input they benefit from, and contrarily, the stimulus they should avoid. The expert went onto explain that...

"In mainstream, they (children with SPD) would benefit from a kit they can explore and find what works for them." – Occupational Therapist 2

Their insight supported the idea of creating a collection of objects. As they suggested that mainstream teachers are not as aware of their children's specific sensory needs, these children would benefit from the opportunity to self-regulate through/by trying different things. This way, they would not need to rely on a teacher knowing what sensory stimuli was best for them. The notion of a 'toolkit' was coined in the interview. I found this fitting as it more accurately captured a collection of objects with a purpose to support children.

Both experts touch on the importance of the relationship between sensory needs and behaviour.

"Behaviour might be the effect of a sensory need, but behaviour as such is not always going to be sensory. But in the end, both will benefit from sensory regulation." – Occupational Therapist 2

The difficulty in distinguishing what behaviours stem from a sensory need and stem from other factors was stated as important. This further supported the opportunity for a kit of sensory objects where a specific behaviour would not

rely on providing the right solution/sensory stimulus straight away. However, this also opened the opportunity to support a wider demographic of children with a future solution. Non-sensory behaviours can be treated with self-regulation. Therefore, teachers could potentially use the objects to support children that display behavioural issues that do not stem from SPD. This encouraged me to think about how my product could prioritise children with SPD but be flexible to support other children. The experts described that teachers should be encouraged to look out for over or under-alert behaviours, particularly for children with significant learning difficulties. This might include when a child is fidgeting and struggling to sit still, or oppositely, tired, lethargic, and uninterested. Any designed objects had to tailor to the diverse sensory needs that a child, specifically SPD, commonly encounters in a classroom.

Both experts referred to a wide variety of sensory exercises they use. When supporting a class full of children with different sensory needs, it is essential to have enough resources to provide input through all seven sensory pathways. The experts both explained that most special school classrooms would have essential resources. This includes things such as trampolines, squishy balls, swings, and weighted blankets, which stimulate high vestibular and proprioceptive tolerances. The experts did acknowledge there being ways to exercise the proprioceptive system with smaller solutions such as stretchy bands and weighted products, but not so much the vestibular system. It was felt that a small set of solutions that could be less distractive and costly might be best suited to a mainstream school setting. Small solutions also meant I could keep everything to a relatively cohesive and packageable size.

When sensory exercises are integrated, they usually take no longer than 5 minutes.

"Give them something to fiddle and calm down, but then move on. Otherwise, it'll take their attention away for too long." - Occupation Therapist 1

Objects should only be used for short periods in a class. This means that the objects should be convenient to access and suggestive of quick use. The experts talked about aligning therapy with their learning activities. Similarly,

they suggested that a design solution should be easily integrated into learning time if a child needs it. This was largely dependent on teachers figuring out when children with SPD struggle with learning the most. The experts emphasized a strategy to normalize its function, meaning to make it a routine intervention when a child needs it.

"Repetition is key." - Occupation Therapist 1

Since teachers and teaching aides are in control of normalizing the products function, they need to know why they should integrate it into their practice to keep it going. Therefore, they need to understand what the kit is for, how it works, and that it could prove beneficial to the children's learning. For children, it can take time to find sensory exercises that help them. Children will not know what type of input they need straight away; the opportunity is to find what they need. Through repetition of use, children could find an input that helps them feel calm and alert. A further incentive for children is providing a product that is appealing and engaging for them.

It was considered that the target age of children played into how successful the product was. SPD is fixed; therefore, it never goes away. It is about learning how to cope independently.

"older children might have more success recognising things that help them regulate". - Occupation Therapist 2

The experts explained having more success in teaching older children how to recognise their feelings and understand when they need to self-regulate. As children with disabilities get older, they become more aware that they are different. The effect is that older children start having more success seeking support independently when affected by SPD. On the other hand, young children struggle to recognise how they feel and rely more on their carers. This means teachers are responsible for identifying when a child is affected by SPD and needs regulation.

Both young and older children should be taught about the importance of self-regulating when they feel over and under alert. It matters how their condition

is managed when they are young to help them better manage it as they get older. Ideally, children would be able to engage with a design solution independently when they need to self-regulate.

The experts introduced me to a resource they use with their children called The Alert Program. The alert program is an online training course for self-regulation developed by MarySue Williams and Sherry Shellenberger (Self-Regulation Alert Program Online, 2021). They publish various books, songs and games designed to teach children of all ages practical ways to understand and manage their self-regulation. The experts explained using the 'zones of regulation' program with their older children to teach them to register the different levels of alertness. This is achieved by associating feelings with different colours. Green being ready to learn, blue being you're ok (under-alert), yellow being agitated (over-alert), and red being you're about to blow up (figure 22). Eventually, children learn to use sensory exercises independently to get themselves back in the green zone.

The younger children use a more simplistic program referred to as 'My body is fast. My body is slow'. The alert program also inspires this program. It helps children focus on knowing when they feel up or down (under-alert or over-alert) and what they can do to get their body 'just right'. The experts explained how children start to learn how to recognise their feelings independently with repetition. However, this relies heavily on the teacher initially to help them learn. Another point touched on was that teachers should look for disruptive behaviours before becoming too much of a problem. Once children start to have an outburst, it is a lot harder to bring them back to learning.

"...it works, but it doesn't work when they're blowing up" "they're not in a state to go do an exercise and feel good again". – Occupational Therapist 1

This insight helped to capture the importance of helping teachers realise when the right time is to use the solution. Furthermore, I needed to explore how to teach independent self-regulation so children might manage SPD more successfully as they grew. It was expected that implementing these learnings would be as important as the sensory tools themselves to help children regulate their behaviour.



Figure 22. Different Zones of Regulation. From *The Zones of Regulation*. Retrieved from <https://www.zonesofregulation.com/learn-more-about-the-zones.html>. Copyright [2011] Leah Kuypers.

Concept Feedback

I received a lot of positive feedback on the creativity of my concepts and their visual appeal. I was advised to further explore stimulation of the proprioceptive and vestibular systems. As touched on earlier, this includes stimulation such as deep touch or getting children moving their body. It was identified that there was an opportunity to exercise proprioceptive and vestibular with smaller solutions by experimenting with elastic materials that encourage pulling and tugging. The benefits of breathing for self-regulation were also emphasized. The experts explained helping children take long, steady breaths can go a long way to helping them bring their alert levels down. Visual input was also described as essential. Slow, fluid visuals like sand timers and oil drippers are typical used in special schools to calm children down (lower alert levels) and capture their attention. Finally, noise was identified as a common issue for children with SPD. Some children require silence, while others need loud noise. The experts also touched on the prospect of my concepts being able to stimulate different senses based on how a child interprets them. The experts pointed out that while my 'whale' object was intended as a breathing exercise, it could also provide visual input for some children (figure 17). This was seen as positive, given children with SPD could benefit from a variety of objects when they are able to determine which sense each one stimulates.

Summary of Key Findings

Teachers in mainstream schools do not have as much time and knowledge to cater to children with SPD as teachers in special schools. The interviews confirmed an opportunity to create a kit of objects which children can explore and find what works for them.

A successful solution was described as one that:

Should explore ways that all seven senses, as well as steady breathing, can be exercised. There was potential to experiment more with smell, proprioceptive input, and vestibular. In addition, exploring ways to encourage body movement might help children self-regulate.

Potentially help more than children with sensory behaviours. Children with other behaviours can also benefit from objects for sensory regulation.

Teachers need to understand the purpose of the kit and how to integrate it into their class/teaching. To prove valuable in their practice, it should promote easy repetition of use.

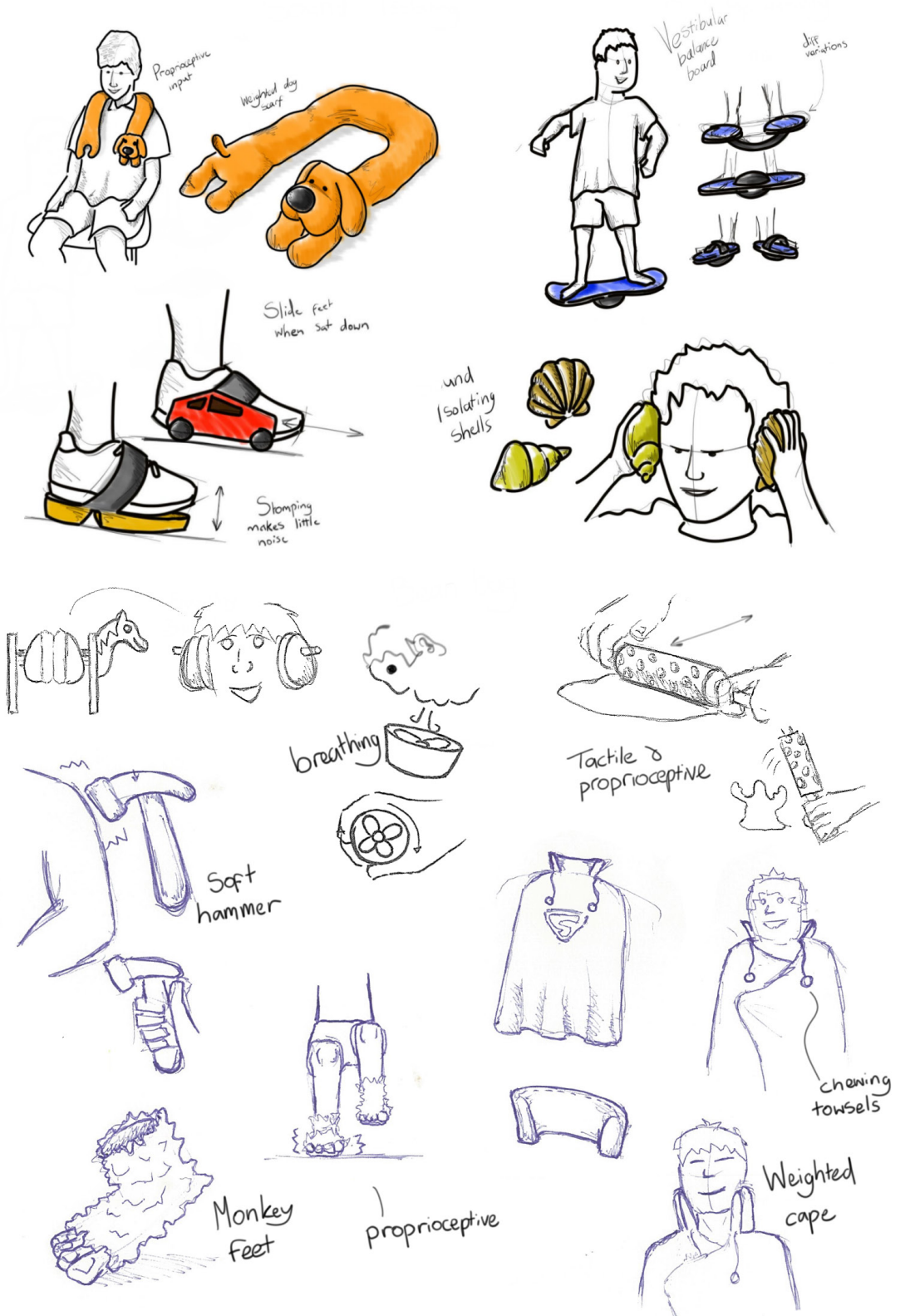
Sensory exercises should be short and easy to do - no longer than 5 minutes. Children mustn't need to rely on the objects at all times (i.e., to prevent using becoming habitual). Ensure that they are used primarily as an activity to settle and prepare them for learning.

Children can learn how to identify feelings of discomfort/disruptive behaviours to seek self-regulation independently. My solution could integrate a learning component (e.g. Alert Program).

Older children may have more success when independently seeking self-regulation strategies. However, it is essential to teach young children how to self-regulate. Early intervention is key.

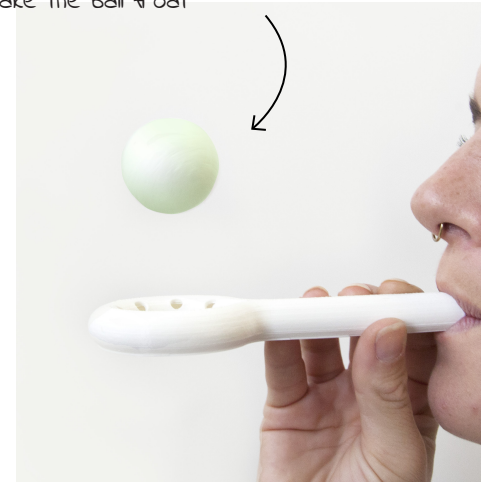
Sketching

Proceeding expert interviews, I had new insights to consider when ideating. I had a better idea of what might be suitable in the hands of children with SPD. I also had more clarity about stimulating each sensory system, particularly the proprioceptive and vestibular systems that were previously less clear. This helped to guide more informed ideas that considered how to design different objects to stimulate different senses. Objects for different senses might prove to help children avoid stimulation that distresses them. Another key insight picked up was that sensory exercises should be no longer than five minutes. Therefore, my concepts had to be easy to pick up and use and encourage short meaningful engagements. This next phase of sketching and prototyping continued to stay broad and explorative.



Prototyping

encourages long steady breaths
to make the ball float



shell for blocking out sound



Blow up balloon. when air is
let out, it provides a nice
sensation on skin



baby oil, water & food coloring.
satisfying visual effect



Reflecting on prototypes

Prototyping produced some promising ideas to be developed further. I was able to think deeper about how different senses might respond to each prototype as follows (figure 24 & 25).

The sound-isolating shell would be helpful for children who find noise alerting (figure 24). It needed to be developed by experimenting with other materials and shapes that could block sound more effectively than foam.

The liquid box was a very satisfying visual motion (figure 24). Similar liquid sensory products are available through websites like the sensory corner. However, I found the rectangular shape created a unique wave formation as it was rocked from side to side. There was also potential to develop this concept with softer curves and different materials that could provide calming tactile input.

The green bag I found to be a very calming tactile experience (figure 25). I found it to be the most intimate and calming tactile experience when squeezed. I felt this could be great for relieving tension and helping children calm down. The weight of the bag could also provide proprioceptive input.

I also produced a couple of concepts involving stretching, which experts stated can stimulate the proprioceptive system (figure 25). I imagined that children who are physical and boisterous (have a high proprioceptive tolerance) could benefit from an object they could be rough and physical with without causing distraction.

Curation of a toolkit

Stemming from the insight made in my interview with experts, it became more apparent that my product would benefit from being developed into more than a set of objects. "A toolkit is a curated resource that provides relevant information that can guide users to replicate promising practices and emerging practices" (Lesley, 2015). I found the term 'toolkit' an appropriate label for my design as it evolved. My solution would take insight from how occupational therapists support children in improving how children with SPD are supported in mainstream school. The inclusion of an instructional/ educational resource became a possibility to teach both teachers and children about self-regulation. This would help establish the kit to be used appropriately. As I moved forward, the kit would start to develop as a set of objects for different senses, as well as an educational resource.

Teaching children the levels of alertness

I was curious to explore what an educational resource that teaches children about self-regulation could look like in my toolkit. The alert program, introduced to me by the occupational therapists, was a great starting point. The alert program emphasizes the value of teaching children self-regulation. Their tools often use colour and imagery to help children recognise different feelings. A prime example is the alert level speedometer (figure 26). It compares an engine running low, high, and just-right to feelings of over and under-alertness. This helps children recognise how they feel inside and match their feelings to an engine-level (Therapy Works, n.d.). The benefit of this is that children with SPD could learn to manage their condition and seek support when they are not engaged in learning. The use of colour and themes would be further explored concerning how they could help children associate with their different feelings and levels of alertness. I felt that colour and themes could also be an opportunity to tie the objects and teaching resource more cohesively.

Following this, it was equally important to ensure the objects in my kit were used appropriately. The alert program had designed a resource book called Take Five. It provides simple, low-budget sensory exercises that are easy to find or create with materials at home. Take five focuses on home- and classroom-friendly activities to teach children about using their senses to be calm, alert, and focused (Williams & Shellenberger, 2001). Take five made me consider the importance of an instructional resource to guide children through using the objects. Ensuring both children and teachers understand how to use the objects appropriately may determine the toolkit's success and effectiveness. Misuse of objects could lead to further disruption in the classroom.

It was unclear what the most appropriate format would be for the educational resource (e.g., a book, poster, digital app etc.). However, the alert program certainly influenced how I approached the design of the resource to be appropriate for children.

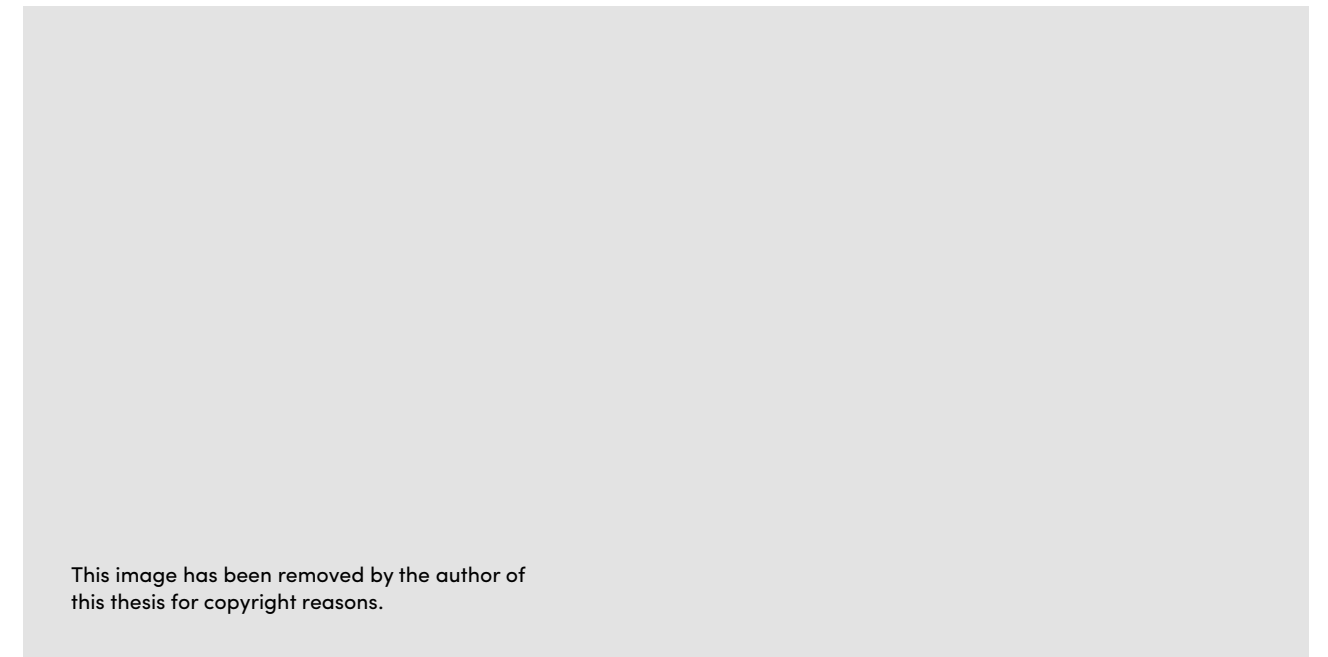


Figure 26. Alert Level Speedometer. From The Alert Program. Retrieved from https://www.alertprogram.com/?attachment_id=33000&doing_wp_cron=1615319658.561614990234375000000. Copyright [2021] TherapyWorks.

Toolkit Sketching

Having decided to include two elements in my design (sensory objects and an educational resource), I set about sketching how this could look (figure 27). There were design considerations that had to be made when sketching. Firstly, experts described that sensory exercises should be no longer than 5 minutes. Therefore, the toolkit had to be designed to be quick and easy to bring out and use in a classroom. I also had to consider how a toolkit would accommodate the sensory objects and the teaching self-regulation element. Using themes seemed appropriate to make the two elements cohesive. I thought about theming the objects to help teach the three alertness levels (over-alert, under-alert, and just right). For instance, fast and slow animals could correspond with levels of alertness. I also started to think about how to package the kit and store everything together.

Although sketching a toolkit was great to imagine possibilities, I felt the kit's development could go no further until I had spoken with mainstream school teachers.



Figure 27. Hutchinson, (2021). Sketching to imagine a toolkit.

Thematic Analysis

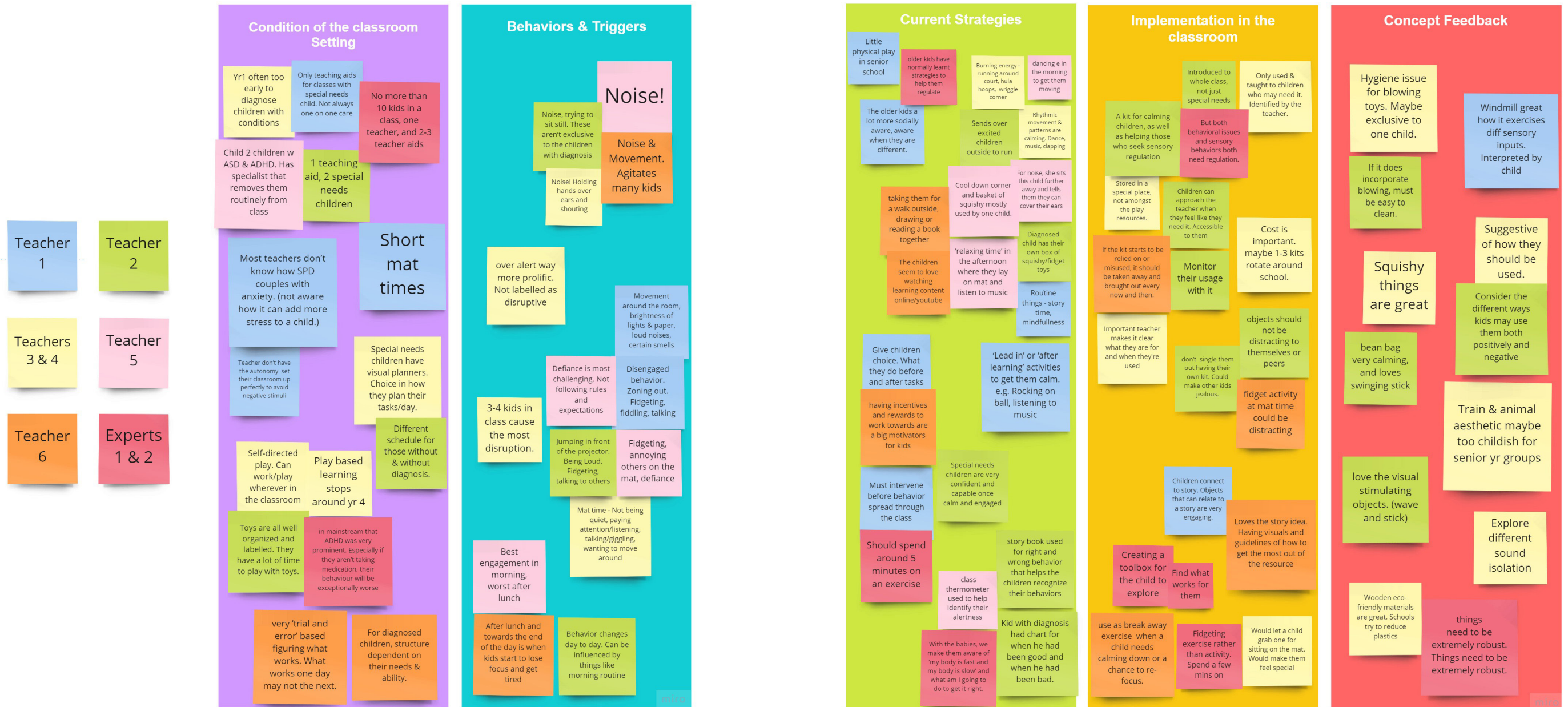


Figure 28. Hutchinson, (2021). Thematic Analysis of all interviews and surveys.

A thematic analysis was undertaken to collectively compare and analyse the insights from my expert and teacher interviews. It was used to help form the written summary of my interviews. Using a thematic analysis, I could better recognise and reflect all the participants' perspectives in my summary of findings. Furthermore, how these findings reflected the development of my design.

Teacher Interviews Summary

I conducted three interviews with four different primary school teachers (one interview included two teachers) from schools in the Auckland area. All participants had varying years of experience teaching (4-35 years) and had taught children of all ages from 5-13. One of these teachers also had experience as a teaching aide where they taught in multiple mainstream classes providing support to children with special needs. I also had two primary school teachers complete online surveys as they could not participate face to face. These surveys also informed the findings below. In the interviews, I gained insight into the types of behaviours that are disruptive to their learning. I also learnt about the common routines and strategies teachers use to manage disruptive behaviours. Teachers also had the opportunity to observe my prototypes, which drove discussion around how my designs could be integrated into a classroom setting.

None of the teachers I spoke to were aware of any children in their class that had SPD. Teacher 3, who taught in a year one classroom, stated that...

"We don't have any diagnosed conditions. What I find is a lot of them just find it hard to sit still on the mat and focus." – Teacher 3

Teacher 3 explained she often taught children that experience significantly more difficulties learning than most. However, children often do not get assessed and diagnosed with conditions until year two and up. Teacher 3 explained that even then, it is rare to have a child diagnosed with SPD. More commonly, children are diagnosed with other developmental conditions such as ASD or ADHD. SPD is likely an issue for certain children within their classrooms, but it was not diagnosed. Since SPD was not well known to teachers, it seemed more appropriate to suggest that the kit be used with children who have 'significant learning difficulties'. Teacher 6 made the point that children with learning difficulties, including those with SPD, would be most drawn to the kit anyway.

"If the resources were made available to all children, the ones that would be drawn to them the most are probably the kids that would get the most value out of them." – Teacher 6

All the teachers shared the variety of behaviours they encountered, which were disruptive to learning. There was a lot of similarities between their feedback. It was unanimous that over-alert behaviours were significantly more common than under-alert.

"We rarely get children that are tired and sluggish, everyone is super hyperactive and full of life" – Teacher 3

It was fairly unanimous from all the teachers that they often find children need bringing down to an energy level suitable for learning rather than 'lifting'. The teachers described that fidgeting and distractive behaviours were most common. This included wriggling on the mat, wandering off, or talking to peers. These issues seemed to be particularly problematic for some teachers at mat time.

"once we're on the mat, that's when these hyperactive behaviours can get a bit harder to control" – Teacher 4

"it would be amazing for them to have something they can touch or fiddle with, without taking away from their concentration or disrupt the rest of the class" – Teacher 4

Teacher 4 explained that it is usually a small handful of children who have difficulty concentrating at mat time. All the teachers described that mat time is generally between 5-10 minutes long to prevent children from becoming unengaged and distracted. However, it was still challenging to get all the children to focus together. There was an opportunity to use the kit proactively. Teachers could plan to use the kit knowing a child that might struggle to concentrate at mat time. Sensory objects could stimulate a fidgety child and provide an alternative to engaging in distractive or disruptive behaviours. The key was to ensure the objects would not cause a distraction for other children.

Teacher 4 mentioned the possibility of other children getting jealous or fighting over the objects. Therefore, she explained it is essential to monitor a child's use with the kit. This is particularly the case when first using the kit before children can be trusted to use it independently. Teacher 6 stated that using the kit may cause distraction at mat time and not help a child's ability to listen.

"I like the idea of using them as a breakaway exercise that can be used when a child needs calming down or a chance to refocus... it is great to have options of interactive resources to bring out that you can do one-on-one with them". – Teacher 6

Teacher 6 shared how the kit could be a 'breakaway exercise' to help children reset and refocus when they start to get flustered. They explained that there was potential to use the kit to intervene when a child was noticeably not in a state to learn. Using the kit in this manner also presented an opportunity for teachers to use the kit with children and navigate it together.

Author and occupational therapist, Lindsey Biel, supports both opportunities for integrating sensory tools in learning (Biel, 2017). She explained that tools could enable students to remain tuned into learning without disturbing others (like at mat time) or give students a much-needed break from class activity to regulate (Biel, 2017). My kit would aim to provide teachers the flexibility of choosing to use it when they find it appropriate for a child.

"Teachers don't have the autonomy (the ability) to choose equipment and set up their classroom". – Teacher 1

Teacher 1 explained that normally teachers are not able to perfectly set up their classroom for children with learning difficulties like SPD. They stated conditions such as lighting, sound, or equipment in the classroom are things they have little control over. All the teachers were forthcoming with triggers in the classroom that they noticed could set off a disconnect in learning for certain children. Noise and movement were the two most common triggers. It was essential to consider how my objects could support children who struggle with noise and movement, given they are out of the teacher's control.

All the teachers shared the similarity of using physical activities to help children burn energy when they are over-alert. This included dancing, hula hooping, or sending them to run around on the field. There seemed to be a heavy focus on getting kids to move their bodies, which exercises the proprioceptive and vestibular systems. Some of the teachers also talked about using resources to help teach their children about their feelings. Teacher 2 described using a storybook in her year 2 class to teach children about right and wrong behaviours. She explained using this either with the entire class or with a single child. Teacher 2 also talked about a 'feelings thermometer' she uses with her special needs child to help them recognise when they feel happy, sad, angry etc. Integrating a story element/visual book in the kit would help the teacher to introduce and establish the purpose of the objects with their children. Teacher 6 supported this point, describing that...

"Having visuals and guidelines of how to get the most out of the resource and when might be best to use...it would also prevent them getting used for the wrong reasons." – Teacher 6

Another key insight I picked up from teachers was giving children a voice. Teacher 4 described the importance of giving children some control over the things they do. Many group class activities are a routine part of the day. However, playtime is a chance for children to choose what resources and activities they use. Special needs children have even more choice than most children in structuring their own day. They use visual planners to decide what order they do activities. Because my toolkit is a resource intended for intervention and controlled by the teacher, it may be necessary that children still get some form of choice. Teachers could supply the kit to a child, but the child should choose to use an object that works for them. Over time, as children engage with the kit and understand how they should appropriately use it, teachers might choose to give children the freedom of accessing the kit themselves.

A few of the teachers also raised a point that children do not want to be seen as different.

"They want to be with everyone, and they want to be accepted." – Teacher 4

Teacher 4 stated that older children in particular (years 4-6) are more socially aware if they are different. It is essential not to make children feel singled out, even when they are disruptive—teacher 3 built on this point.

“Kids are sensitive to any feedback that can be negative.” – Teacher 3

Teacher 3 stressed the importance of focusing on positivity when working with children. If they feel anxious or display disruptive behaviours, addressing this becomes about helping them recognise their behaviour and what they can do to feel right. Focusing on positivity was critical to consider when designing the educational aspect of my kit.

Teachers stated that cost was another important aspect that most schools have to consider due to limited funding. With a small budget each year for new resources and toys, it is important that my toolkit will be cost-efficient yet ‘kid proof’ (well-made). Teacher 2 talked to this point, stating that one kit per classroom would be enough for most classrooms. The scale of the kit should also be considered. Teacher 4 described how it would be nice to store the kit in a tray or cupboard that allows it to be either accessible for children or out of reach if a teacher prefers.

Feedback on concepts

Teachers provided a lot of valuable feedback on my prototypes. While some of their insights I had considered while designing, others were new to me. For example, hygiene was something that teachers stated to be an issue with my blowing toys. Unless it is easy to clean or includes a disposable nozzle, blowing objects would have to be exclusive to one child in the class.

Teachers were interested in the idea of my objects being interpreted and used in different ways. This would provide more possibilities for sensory stimulation. Also, this was considered important to help keep their engagement long term as children tend to get over things quickly.

Teachers showed an awareness of what appeals to children and pointed out that something like the train’s aesthetic may be too limited to engage a specific young group of children. It was stated that themes like animals and

creepy crawlies would be engaging for more ages.

“Teachers are less understanding of toys and think that children have learnt other ways to manage.” – Teacher 3

The interviews helped me see how play with objects and toys is an essential part of the day for juniors (years 1-3). For the older year groups, play is more limited to break time and outdoor activities. Children in years three and up might also feel as though they are too old and grown out of toys. Although the kit could prove valuable to the older age groups, it was felt that the kit would likely find the most value with junior school children. Therefore, junior classrooms (years 1-3) became the focus moving forward.

Although my concepts were relatively unrefined, it was clear that the teachers believed in the project and were eager to see it develop into a kit they could introduce to their class.

Summary of Key Findings:

Interviews uncovered how the kit could effectively be used in a teacher's practice. My solution should consider the following aspects.

A visual book could educate both teachers and children about the purpose of the kit, helping to establish how the kit can be used.

My objects should prove to benefit the children that use them. This means helping children feel ready to learn while not causing more disruption or distraction.

The kit should not make children feel singled out or 'different' from others. It should focus on helping children feel ready to learn.

Aesthetic should be attractive, minimal, and simple. This may help widen its appeal to different children from different year groups. Furthermore, these objects should not be perceived as toys and should be stored separately from playtime resources.

Give the teacher/teaching aide flexibility in how they choose to integrate the kit into their practice. This refers to who they allow to use it, and how they choose to integrate it in class (either as a break from learning, or to help them stay tuned into a learning activity).

Mindful of my kit's scale so that it fits in common storage trays. The price should also be affordable for low budget schools to acquire, and materials and manufacturing methods should consider sustainability.

Designing the Brief – design considerations and objectives.

Proceeding my interviews, I formed a list of design considerations/objectives. These would serve as a reminder of the key factors that matter when designing my toolkit.

- The kit should teach children to identify their feelings and use the objects to self-regulate. Over time, this will help them to recognise their sensory issues and manage them independently.
- The narrative/theme element should capture the purpose of the kit in an engaging and easy to understand way for both children and teachers. Furthermore, narrative can empower children who may feel discouraged by the thought of being 'different' when they use the kit.
- Objects should encourage interpretation. This allows children to receive different types of sensory input depending on how they interact with each individual object. This widens each objects potential to address different sensory needs.
- My objects should prove to have positive calming effects on the children that use them. This includes ensuring children use the objects appropriately and that they do not cause more disruption or distraction.
- Aesthetic should be attractive, minimal, and simple. This can widen its appeal to different to children of different year groups. Furthermore, these objects should not be perceived as toys and encouraged to be stored in an exclusive place in the classroom.
- Give the teacher/teaching aide the freedom to either use the kit as a break from learning or help a child stay tuned into learning. Freedom of use also refers to who they allow to use it and whether the child should ask for permission to use it. However, it should be known that children with SPD will find the most value from the kit.
- Mindful of the scale and accessibility of my kit so that it can be kept out of children's reach if required. It should be small enough to fit into a tray or on a shelf and easy to pull out and use.
- The price of the kit should be affordable enough for low budget schools to acquire. Therefore, materials and manufacturing methods should be cost-effective, while design outcomes should be robust sustainably made.

Phase 3

Reflection/Framing the design direction

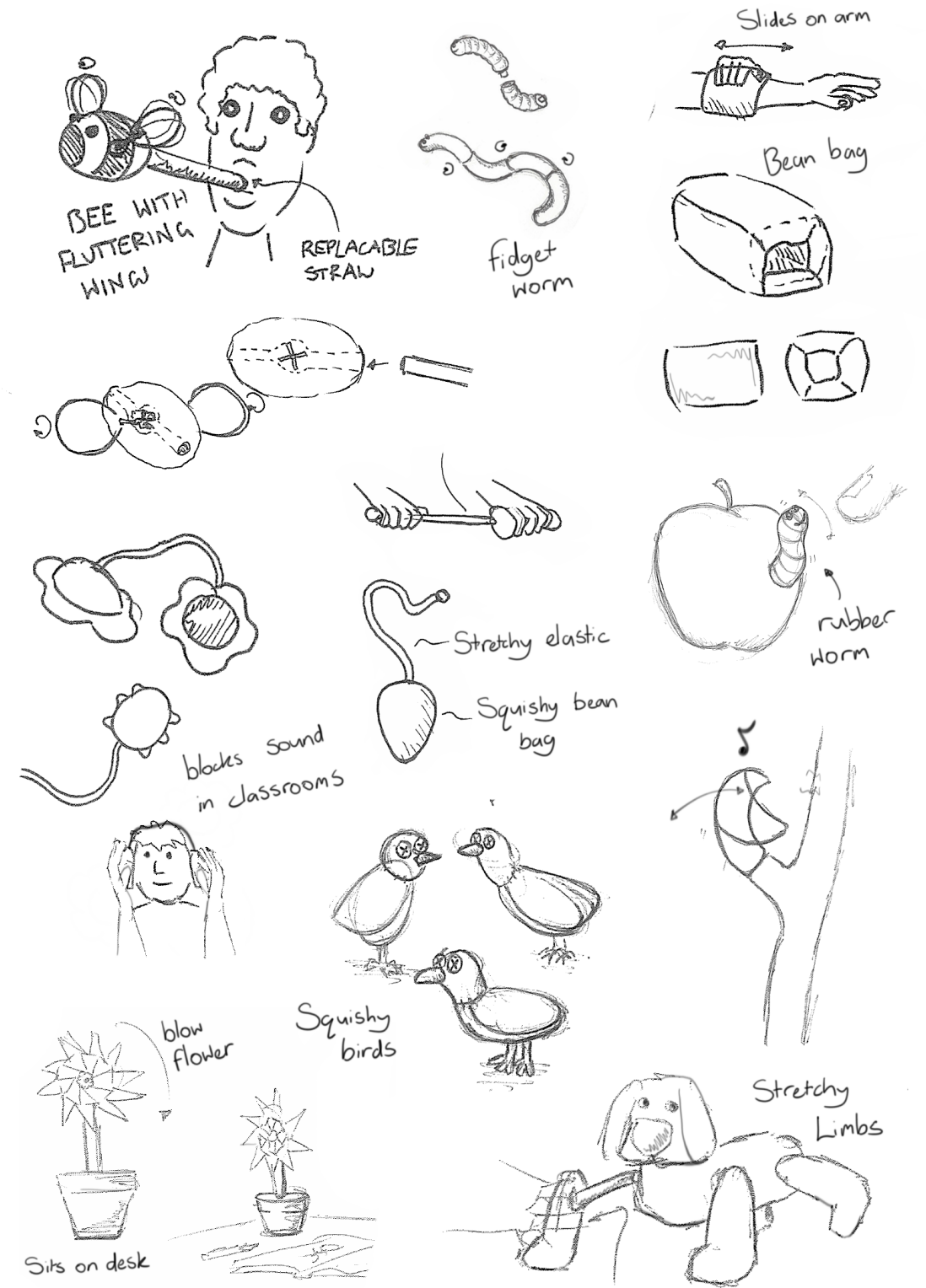
While AUT' 3D workshops (where all my making was situated) were closed over the summer break, I had a lot of time to reflect on my designs and the insights I had gained from interviews. I began to question how to move forward. Up to this point, I had produced a clear design brief and had some promising concepts. However, I felt the kit needed a strong theme that would tie the objects and booklet together as I started developing and resolving these elements.

I found that teachers could suggest themes that their children enjoy, but this did not answer what would be best for the toolkit. Initially, I had the idea of creating an animal-themed kit but felt this would limit the form language of my objects. It felt as if my project had reached a standstill in progression. At this time, it was important to recognise that the design process can often lead to dead ends, which requires us to reflect and rethink assumptions (Pressman, 2018). I was under the assumption that the objects in my kit would need to look the same to be cohesive. On reflection, I began to rethink this and realised that a particular form or design language should not limit my kit's development. My objects had to focus on the sensory experience and not compromise too much with regard to form. I should embrace the diversity of my ideas and their ability to encourage a child's imagination.

I thought back to the beginning of my project as I looked for inspiration from nature. From this, I formed the idea of creating a 'garden' of sensory objects. A garden was a fitting metaphor that captured the essence of my kit. Gardens can offer a place of comfort, often associated with feelings of happiness, calm, and freedom. In the context of my kit, children can visit the 'garden' as a break for their minds. A garden embraces diversity and invites all forms of life. This direction also supported the notion to not limit the objects to look a certain way. Children should be able to interpret the objects however they like, encouraging creativity and open-minded play much like Waldorf toys (Baldwin, 2010).

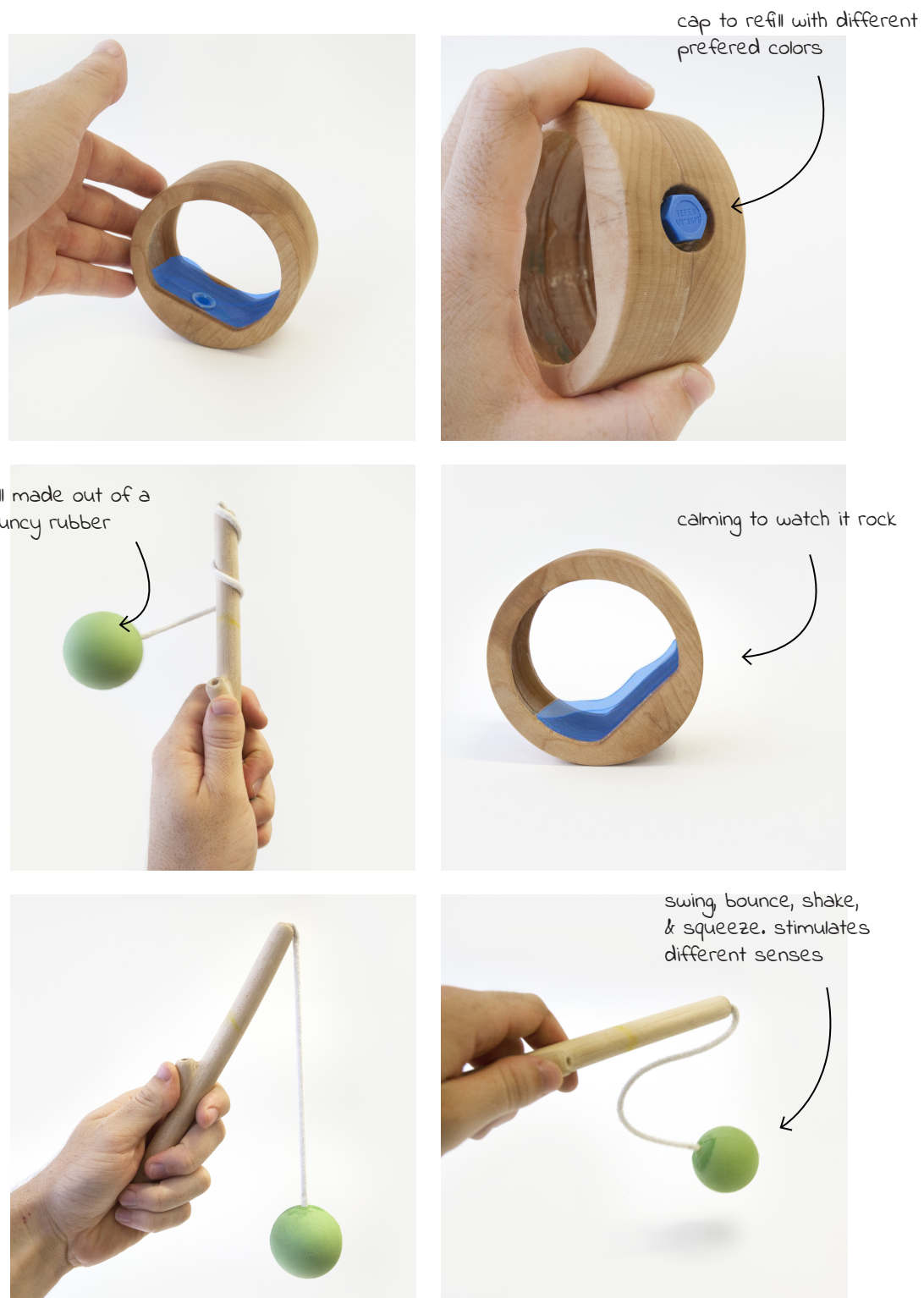
I was eager to explore this idea of a garden further. This initiated a new phase of ideation as I developed the different elements of the toolkit.

Sketching



Prototyping





Reflecting on my prototypes

Sketching and prototyping involved exploring new ideas for objects, as well as developing on previous concepts. Visually, a lot of these concepts were able to be attached to the garden theme quite naturally. However, I tried to maintain a simple aesthetic that could let children use their imaginations. There were four main concepts that stood out for further development.

From my teacher interviews, noise was said to be a common challenge for some children. The 'ladybug ears' concept was designed for children to hold over their ears as a momentary break when the auditory stimulus was too much. I felt the plastic material did block out some sound. However, it was worth considering other materials that could be more effective as I progressed.

I found the 'pecking bird' concept successful as it could stimulate both the visual and auditory systems. The action of making the bird peck at the stick felt as if it could help a child regain their focus. The main areas for improvement were making the bird wobble more effectively and making the bird slightly less loud and distracting.

The 'water wheel' concept develops on a previous concept displayed in figure 24. The circular shape aimed to give children different ways to interact with the object, such as rolling it along a surface or in their hands. The wooden finish felt smooth and satisfying; however, the shape did not feel very ergonomic. Also, liquid eventually leaked through the wood.

The 'swinging ball' also built on a previous concept from figure 19. Improvements were made by making the ball out of a squishy rubber and designing a more aesthetic and ergonomically shaped stick. Some improvements could be made moving forward. Firstly, making the ball smaller and lighter (less dangerous), exploring another way of attaching the string to the stick (rather than glueing), and considering other stick shapes that may look and feel nicer to hold for an improved tactile experience.

Storybook Design

I began to develop an educational story booklet in response to incorporating an element to the kit that could help children understand when they should use the objects and how they can help them in learning. Taking inspiration from the alert program, I wanted to use colour, metaphors, and imagery to capture my ideas in an engaging and easy-to-understand way. I intended the book to capture three main elements.

Firstly, teaching children the different levels of alertness; under alert (e.g., tired, sad, uninterested), over alert (e.g., fidgety, overexcited), and just right (calm, alert and ready to learn). The book starts with an illustration of three characters displaying the three alert levels. This should encourage children to think about how they are feeling when engaging with the kit. With repetition, they may start to identify these different feelings more independently.

Secondly, the booklet should guide the user through how to use the kit. Once a child has identified themselves as feeling under or over-alert, the book should help them learn to associate the kit with helping them fix negative feelings. The book tells children to 'take 5', encouraging a break to help them feel calm, alert, and ready for learning. The idea is that it should suggest enough about using the kit without telling teachers whether to integrate the kit as a break from learning or help children stay tuned into learning.

Finally, the book included a visual representation of some potential uses for the objects. This coincided with some common behaviours/feelings that the object could be used to support. As the experts pointed out, you cannot prescribe a solution based on a child's specific feeling or behaviour. However, I felt the inclusion of these suggestions could help paint some scenarios where the objects can support certain common behaviours.

Illustrations were drawn digitally using sketchbook pro. The booklet's visual language was kept simple and clear with the use of pencils and watercolours. I felt further development was required to make it more eye-catching and engaging. Furthermore, some of the wording in the booklet required reviewing to make it more straightforward for children.

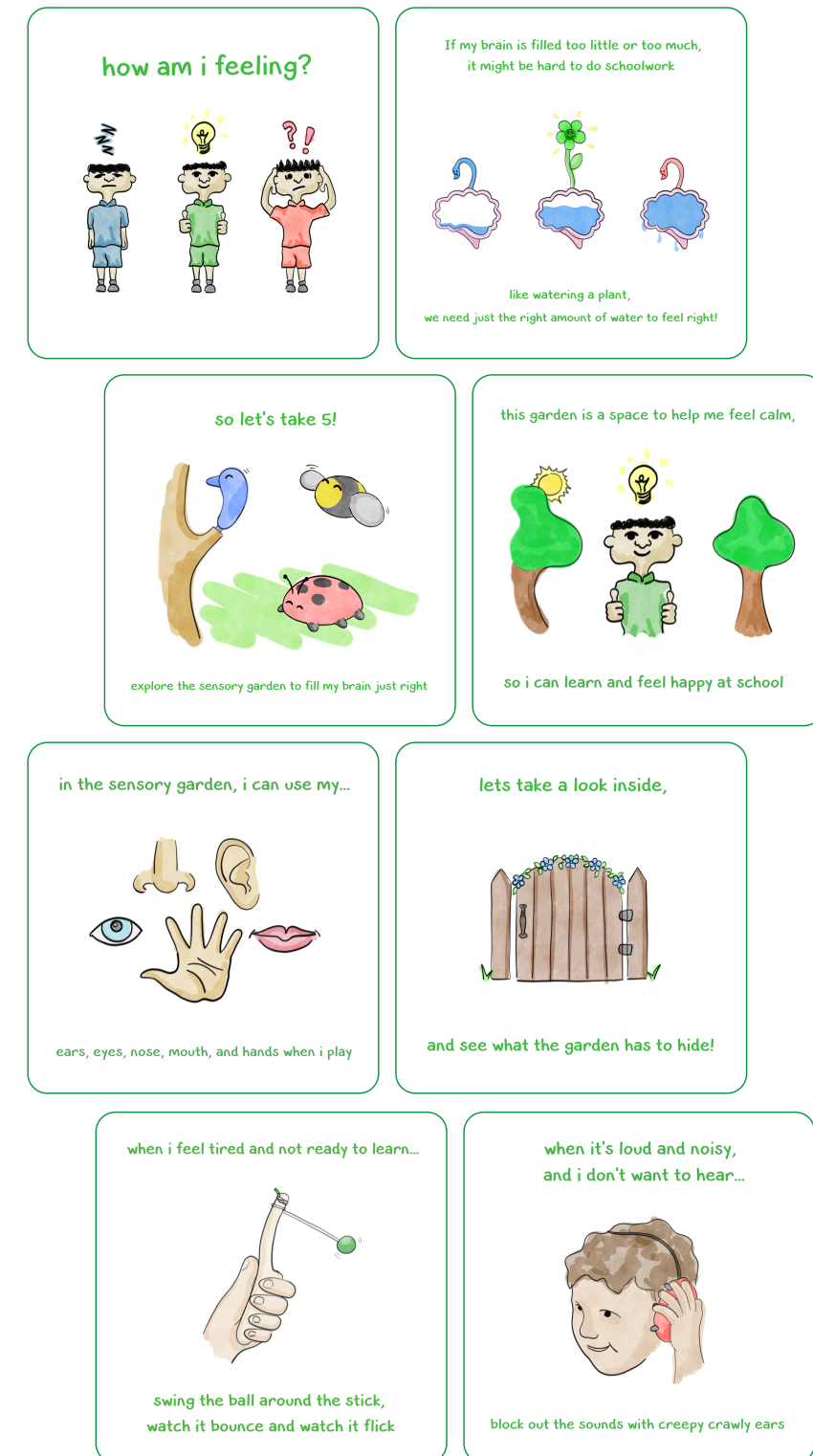
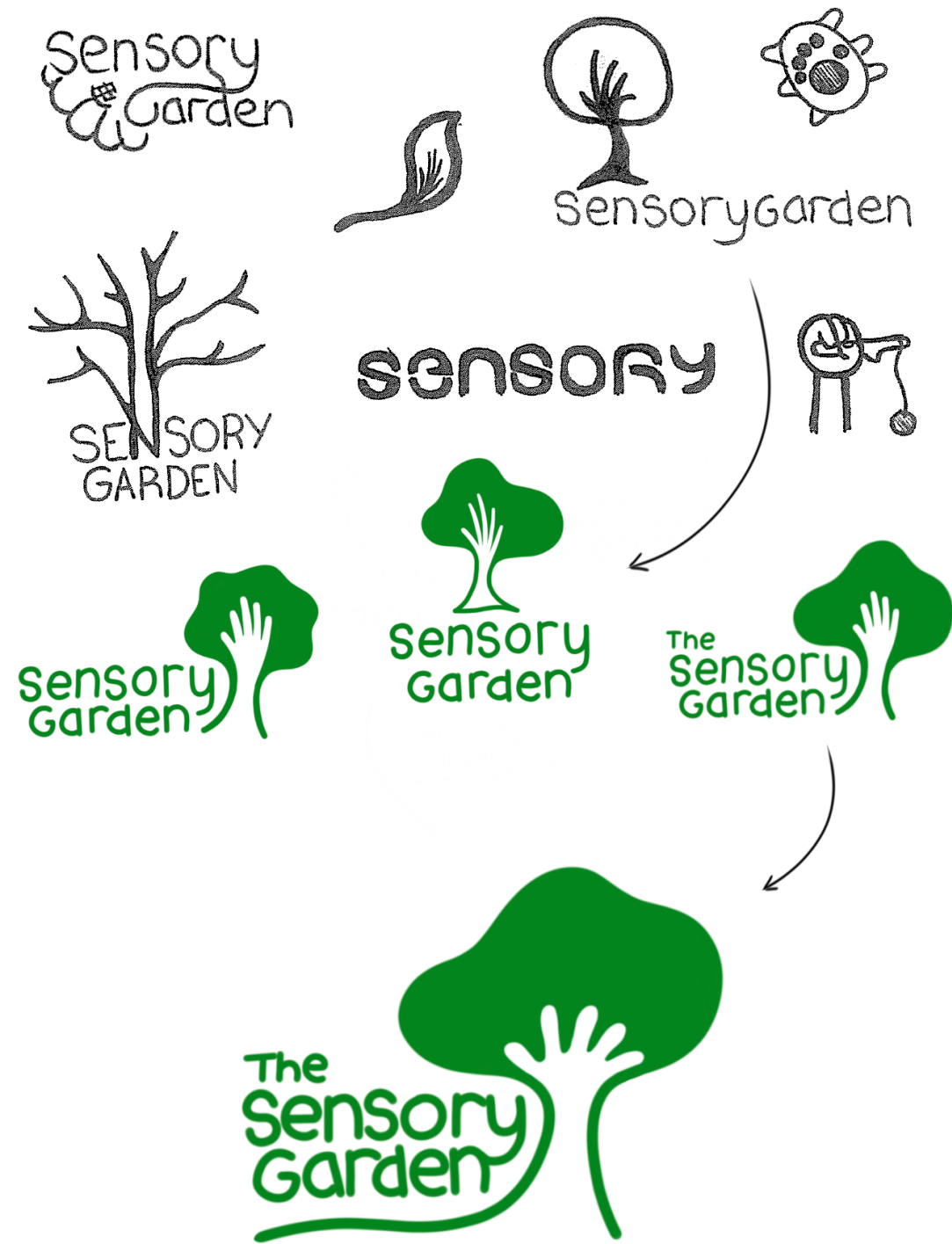


Figure 32. Hutchinson, (2021). Story booklet First development



Logo Design

When designing the logo, I wanted to create something eye-catching and appealing that could entice a child. It had to relate to the rest of the kit in the sense of being clean, simplistic, and playful. The inclusion of a strong visual icon intended to capture the two elements of the name - 'sensory' and 'garden'. The icon I chose resembled a hand reaching up into a tree as the trunk (figure 33). It is also designed to convey a sense of empowerment.

Object Development

In the next stage of development, I set out to refine the concepts that I found promising. These concepts were heavily focused on the tactile, visual, and auditory systems. I continued to explore new ideas that considered the sensory systems that my current concepts did not stimulate. Through more making, I hoped to finalise a collection of objects that could target all of the senses.

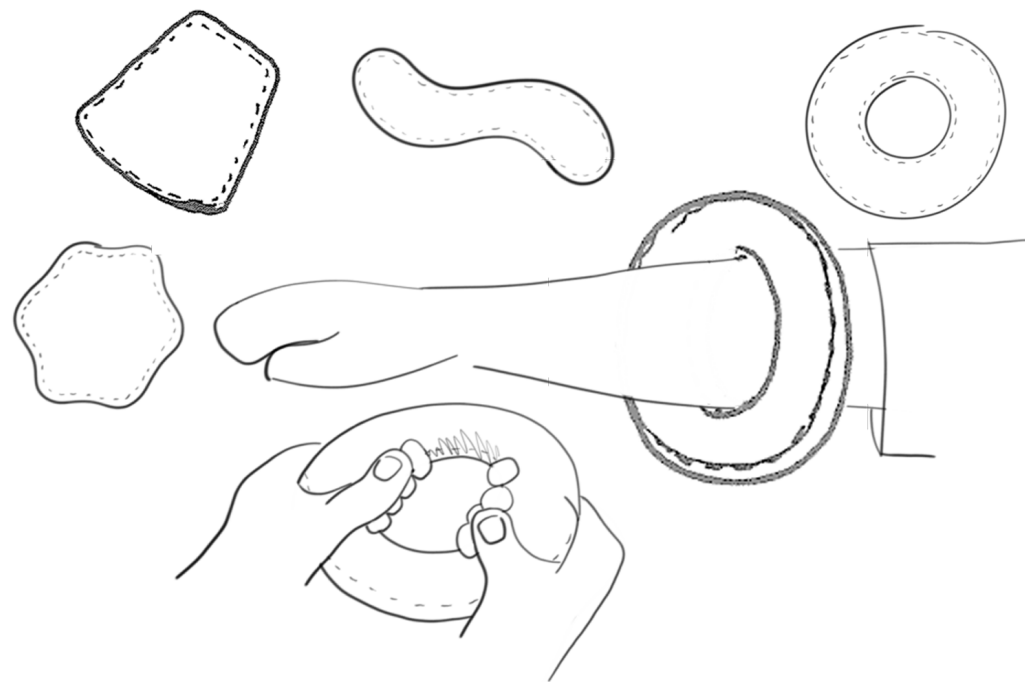


Figure 34. Hutchinson, (2021). Proprioceptive bag sketches

Experts stated the importance of weighted products in supporting children with SPD. This prototype developed from a previous concept shown in figure 25, in which the intention was to provide deep touch/proprioceptive input. The bag was filled with plastic pellets that are calming to squeeze. The circular shape allowed for multiple interpretations that could provide proprioceptive and tactile input. For instance, putting it around an arm, shoulder, or on your head. For further development, I felt the bag needed to be heavier to provide a more sufficient amount of proprioceptive input.



Figure 35. Hutchinson, (2021). Proprioceptive bag prototype photos

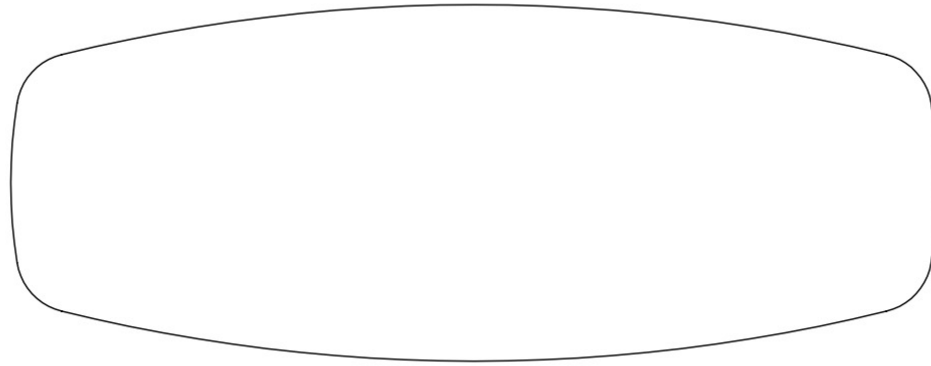


Figure 36. Hutchinson, (2021). Liquid box shape outline

In response to the previous concept leaking (figure 31), this further development was made out of clear acrylic. The model was created by first cutting my desired shape out of MDF. Following this, I used a heat gun to bend acrylic around the MDF to match its shape. The heat-formed acrylic was then glued to flat acrylic sheets on either side. This shape was designed to improve on three design elements. Firstly, I felt this was more ergonomically comfortable to hold and an appropriate size for a young child. Secondly, the long boxy shape created a calming and engaging wave motion as the liquid moves from side to side. Thirdly, the curved sides allowed it to rock on surfaces while a child observes. I felt this concept was a step forward from the previous concept from both a functional sensory standpoint and aesthetic. Pictured in the bottom right of figure 37, I also tried adding glitter to the water. However, I felt this did not work well and took away from the simplicity of the concept. The main areas for improvement were making it less fragile for children and potentially making the shape curvier to rock in a slower, smoother, and ultimately calmer motion.

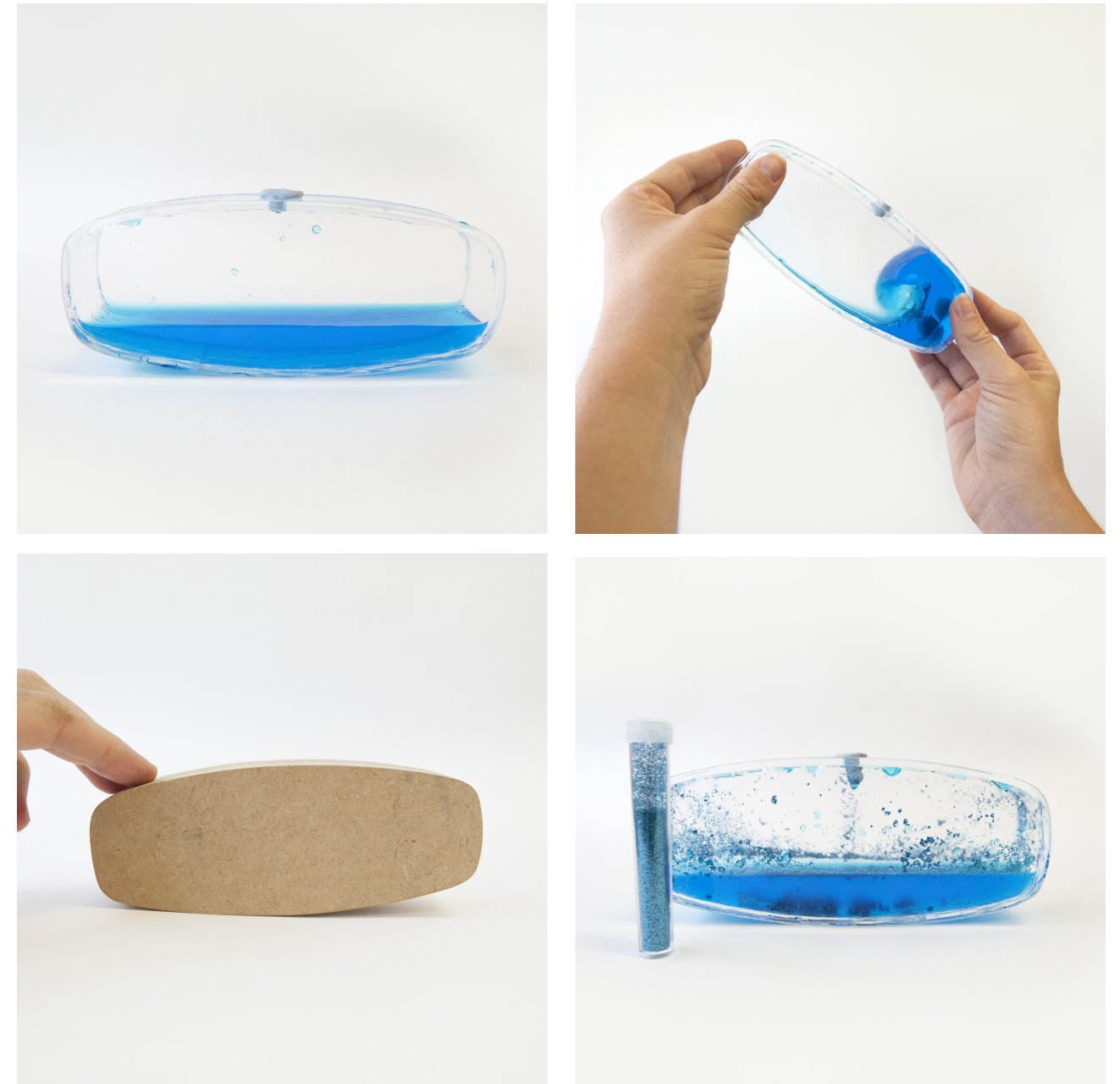


Figure 37. Hutchinson, (2021). Liquid box prototype photos

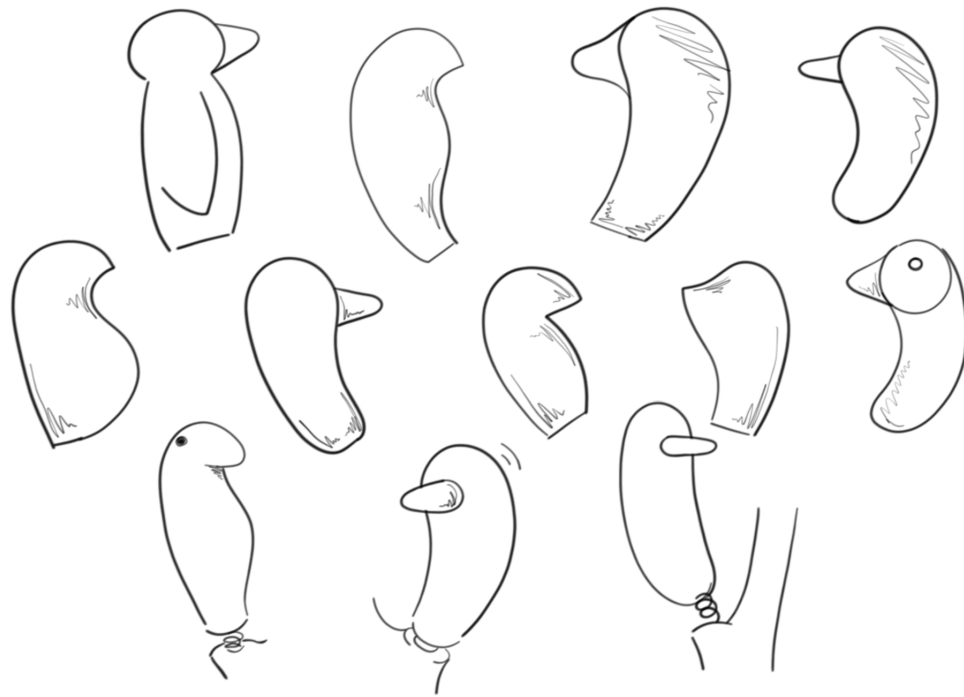


Figure 38. Hutchinson, (2021). Bird sketches

I saw an opportunity to integrate the bird concept into the stick and ball concept, removing the need for an extra stick. The bird design was stripped back to a much more simple and appealing aesthetic. Making the bird wobble was achieved using a spring that pushed into a hole on the stick. I found it hard to control the bird's short and fast motion. This felt like it detracted from the exercise's appeal and potential to foster focus. Although some children might find this fast motion satisfying, I felt it might be more successful with a slower wobble that could be controlled more easily. Also, the beak made a sharp knocking sound as it hit the stick, which seemed potentially irritating or distressing for some children.



Figure 39. Hutchinson, (2021). Bird prototype photos

The most important consideration in the development of the ladybug was soundproofing. Plastic was well suited to the concept as it is robust and easy to manufacture. However, I felt it did not provide enough isolation from auditory input.

In response, I tested five different materials to explore which was best suited to the concept (figure 41). I found ceramic and low-density foam were best for sound isolation but did not feel appropriate to the concept because of their fragility.

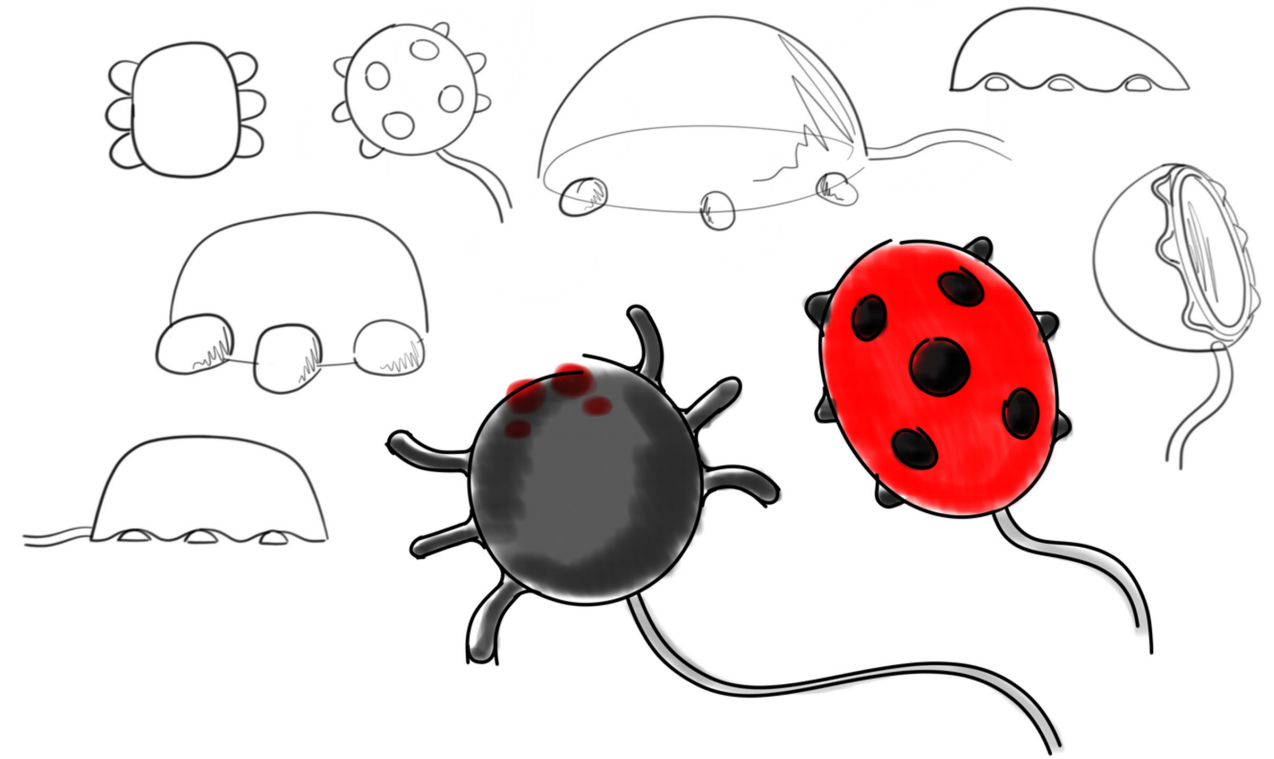


Figure 40. Hutchinson, (2021). Ladybug Sketches



Figure 41. Hutchinson, (2021). Material testing for sound isolation

I came to a conclusion to make the ladybug in two separate parts. The top part would be plastic to act as a robust protective layer. For the second layer, I explored using polyurethane rubber which soft, durable, and could provide additional tactile stimulation. The next obvious step was to test this materials' soundproofing capabilities. However, making a mould to cast the polyurethane would prove time-consuming and only worth testing once I had refined the lady bug's shape. I also added an elastic string to join two ladybugs together (one for each ear). Inspired by earlier concepts displayed in figure 25, the elastic could stimulate proprioception by pulling and stretching.



Figure 42. Hutchinson, (2021). Ladybug prototype photos

Reflection

The toolkit had developed to the point in which I had four promising sensory object concepts and a booklet. Collectively, the four objects aimed to stimulate the visual, auditory, tactile, and proprioceptive sensory systems, as well as provide avoidance from auditory input. However, to be more successful in supporting a wide variety of children with SPD, I had to consider the other sensory systems that can help them self-regulate. I had found that the taste sense may not be appropriate for my kit because of a significant hygiene issue that would not allow the kit to be shared with different children. Also, the vestibular system is best stimulated through outdoor play (swinging, jumping, dancing etc.). However, all the teachers I spoke with stated that getting children outside and moving was already a regular part of their day.

The two sensory strategies that still needed attention were deep, steady breathing and smell. Smell stimulation had received less attention in my research, mainly due to lack of conversation around it compared to other senses. However, the experts did state some scents to be valuable in promoting calm and self-regulation. Smells such as lavender and vanilla were stated as most common for calming and have a low risk of triggering discomfort. I wondered whether smell would be best suited as an addition to one of the existing concepts. The experts did warn not to overwhelm children with too many objects. 4-5 objects felt like an appropriate amount for the kit, which was achievable in the time frame. The inclusion of a final object that promoted slow, steady breathing felt appropriate based on how important the occupational therapists stated it is for self-regulating. I did not see an opportunity to integrate breathing into one of the existing objects. Therefore, the next stage was to develop my four concepts further, along with a fifth object that would promote slow, steady breathing.

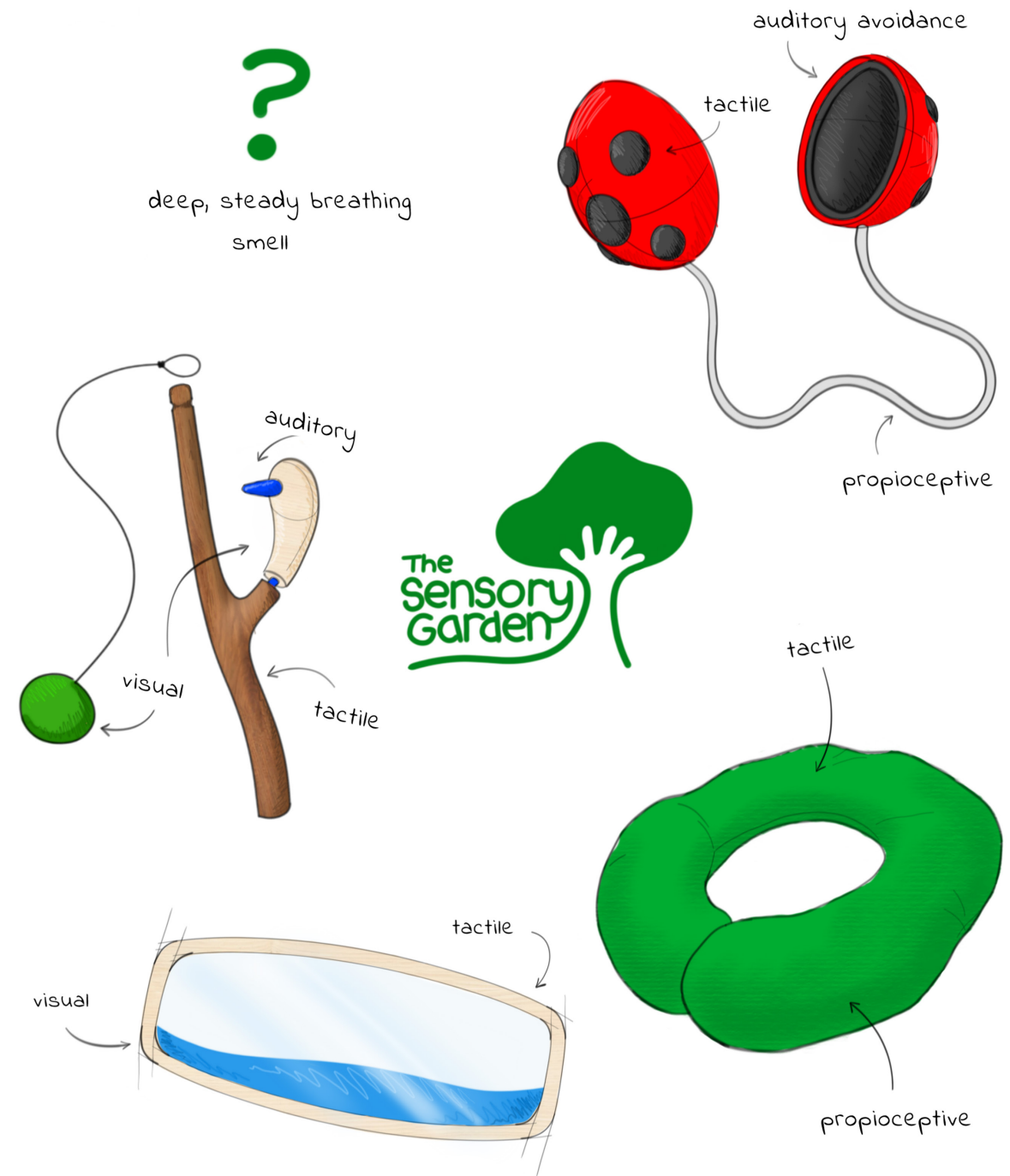


Figure 43. Hutchinson, (2021). Toolkit communication sketches

Phase 4

Developments and Refinements

This led me to the idea of blowing onto the object and removing the need for a mouthpiece. The user should be encouraged to blow in order to make the propeller spin around, which provides visual and auditory feedback. As the propeller spins around, it created a subtle buzzing sound. I felt this was a great starting point for developing my fifth object (fig 45).

Following this, I created a shape that would make the object easier to hold (figure 46). I took inspiration from the shape of a bee, which pairs nicely with the buzzing sound it produced. Although this concept was a step forward, I felt there were some underlying issues. Given the handle surrounds the propeller, there is a risk that it could easily gather and share germs when different children use the object. Also, although adding two extra wings to the propeller helped it spin, the size and weight made it difficult to spin with slow, steady breaths.



Figure 45. Hutchinson, (2021). Blowing prototype 1

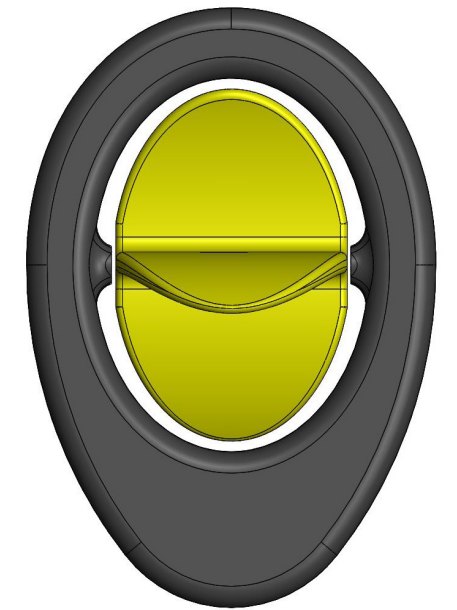


Figure 46. Hutchinson, (2021). Blowing prototype 2

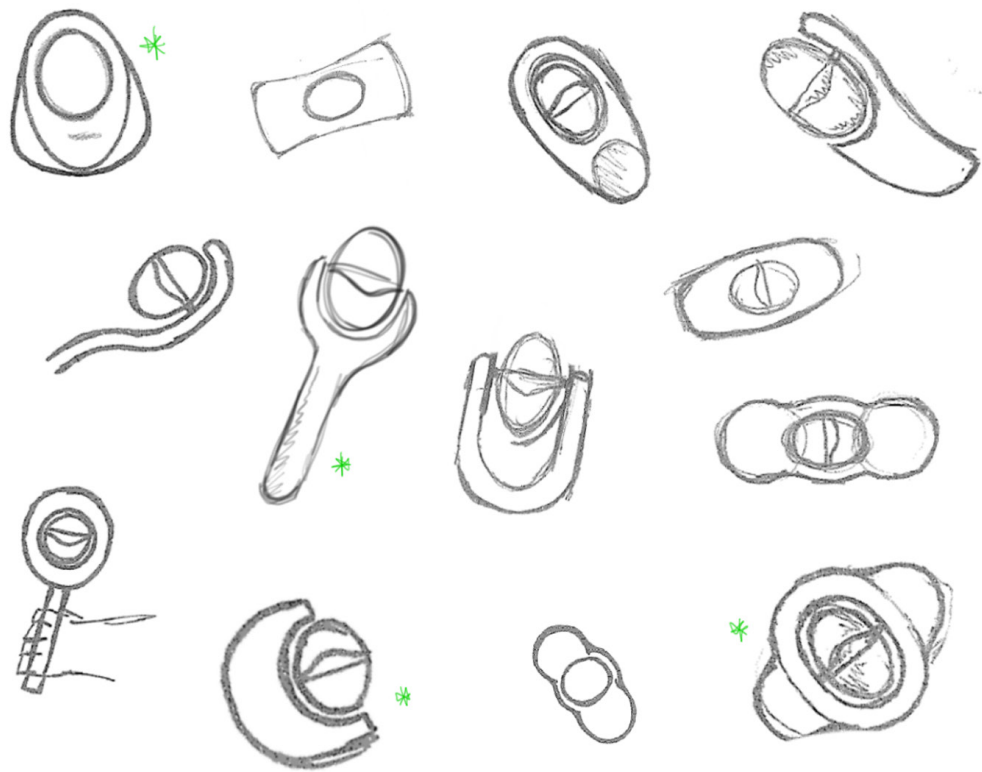


Figure 47. Hutchinson, (2021). Blowing object shape iterative sketching

A need to change the shape was addressed by undertaking quick iterative sketching to produce a variety of designs. The most promising designs were then prototyped and tested (figure 48). Number four was my favourite for many reasons. Firstly, using a long handle made it much easier to hold and felt more suggestive of being used for blowing. Secondly, I felt hygiene was less of an issue given the handle and propeller were further apart. Lastly, this design could be interpreted as a roller that provides tactile stimulation (figure 49).

I developed this design further by creating the handle out of wood. I also introduced a smaller propeller that could spin much easier, encouraging lighter, steadier breathing. This design was a great success and allowed me to catch up to the other objects' level of development.



Figure 48. Hutchinson, (2021). Blowing object shape rapid prototypes



Figure 49. Hutchinson, (2021). Blowing object development photos

The Buzzy Spinner



Figure 50. Hutchinson, (2021). Blowing object final photos

My final iteration made minor changes (figure 50 & 51). Firstly, I added two extra wings to the propeller, making it easier to blow or roll on surfaces. The propeller was painted yellow and black to maintain a subtle reference to a bee. The objects' connection to a bee would be more apparent as a child blows on the propeller to make it buzz.



Figure 51. Hutchinson, (2021). Blowing object final photos

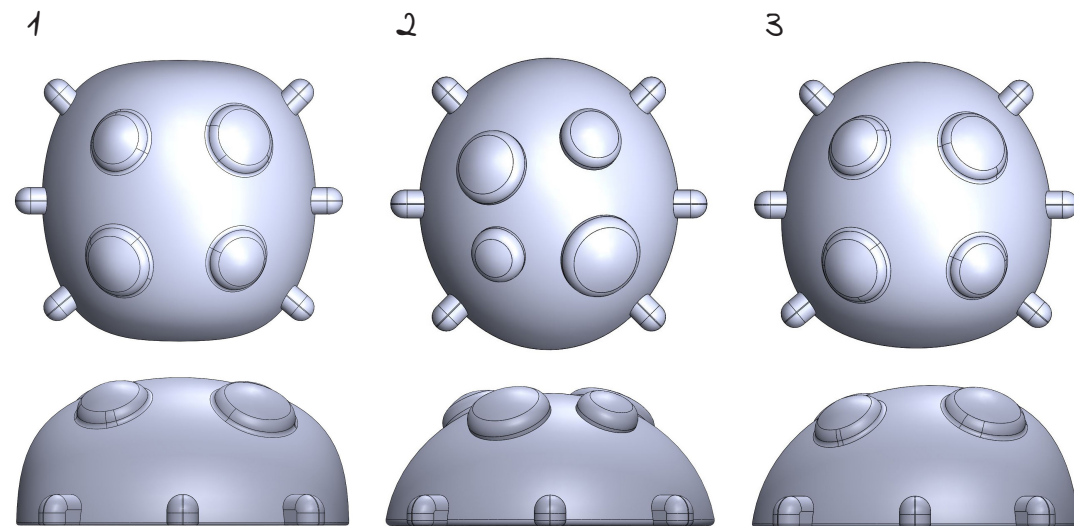


Figure 52. Hutchinson, (2021). Ladybug CAD concepts

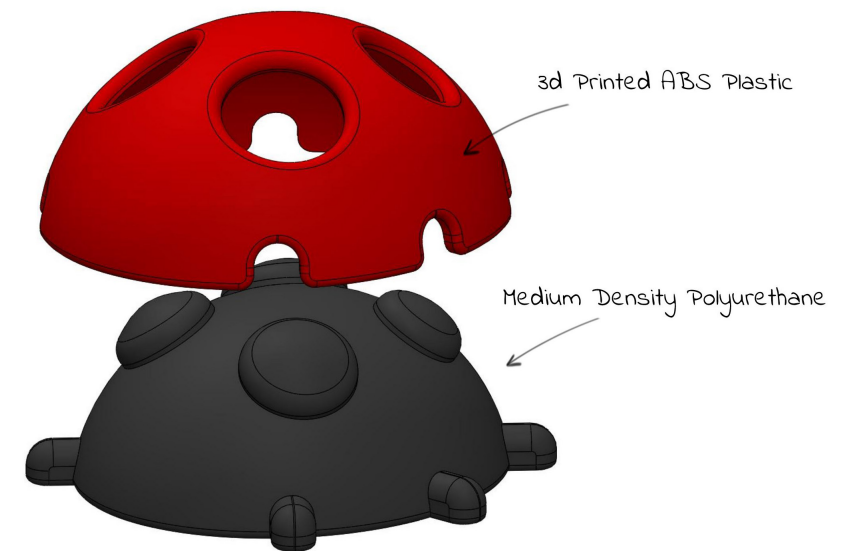


Figure 53. Hutchinson, (2021). Lady Bug 3D Printed Iterations

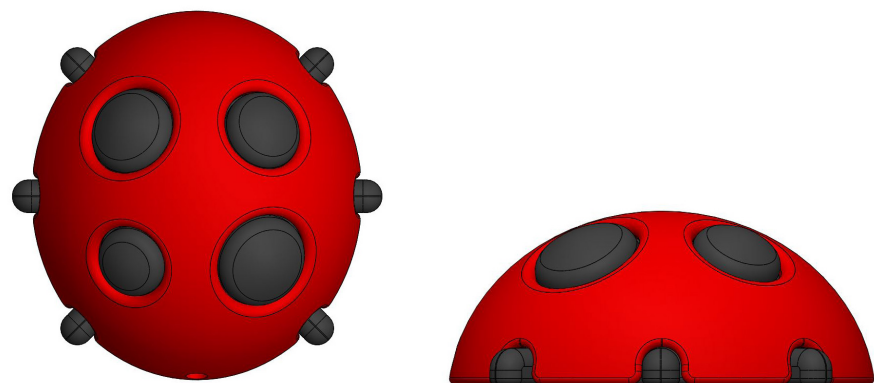


Figure 54. Hutchinson, (2021). Ladybug development CAD pictures

The intention behind changing the shape of the ladybug was to make it more visually appealing. Irregular sized spots were added to my new design iterations for additional visual and tactile engagement. Out of the three designs, my favourite two were 3D printed and assessed based on aesthetic, how they fit on the ear, and how they felt in hand (figure 53). I found concept 2 to be most appropriate.

For my final development, I kept the ladybug spots a similar size to avoid the object from looking too cartoon-like. For the bottom layer, I cast a medium-density polyurethane into a 3D printed mould (figure 54 & 55). The top layer was 3D printed out of ABS plastic. I felt the polyurethane was successful both for its tactile and sound-isolating properties. I found the tactility of poking the rubber spots on the ladybug to be very engaging. From testing in a loud environment, I found the material dulled sound significantly. Complete isolation from sound would require much more research and perhaps not necessary without knowing how much it would benefit a child with SPD.



Figure 55. Hutchinson, (2021). Lady bug polyurethane mould

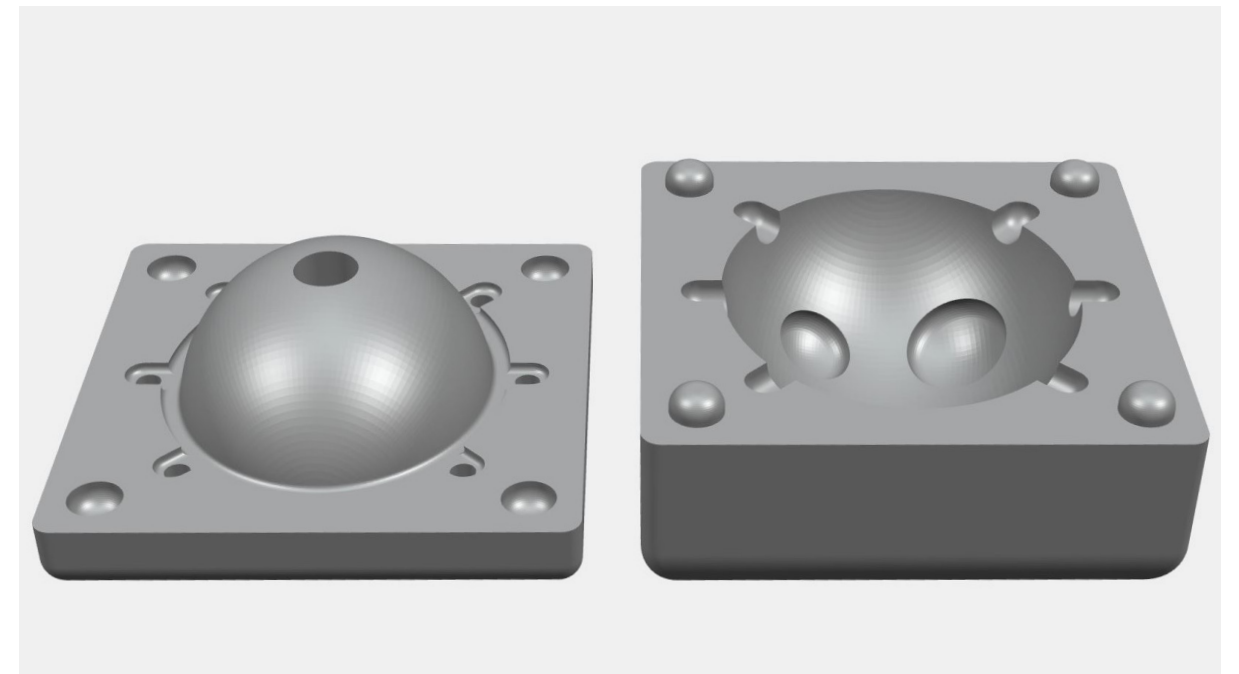


Figure 56. Hutchinson, (2021). Lady bug polyurethane mould 2

The Ladybug Ears



Figure 57. Hutchinson, (2021). Final Ladybug Photos 1



Figure 58. Hutchinson, (2021). Final Ladybug Photos 2

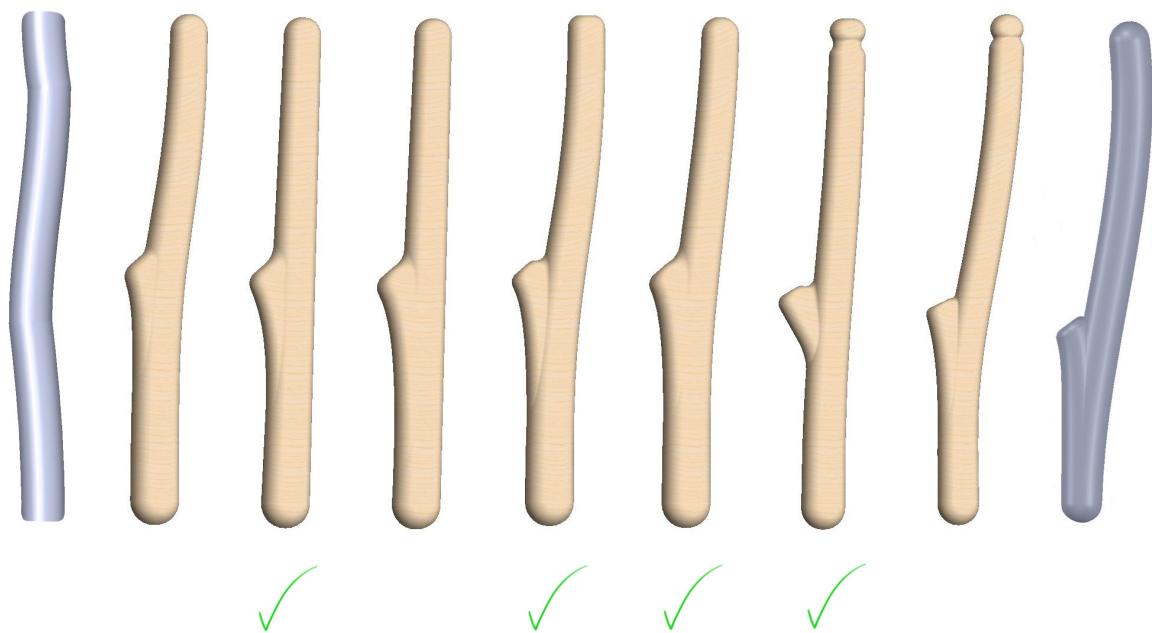


Figure 59. Hutchinson, (2021). Stick CAD concept generation

I felt the aesthetic of the stick previously felt underdeveloped. I set out to refine the look and feel by designing nine iterations using CAD (figure 59). From those eight, I used a mixture of CNC cutting and handcrafting to produce four physical concepts that I could assess in their tangible form (figure 60). I found concept one most appealing for its organic shape and soft curves. The chunkiness of it also felt more substantial and nicer to hold.

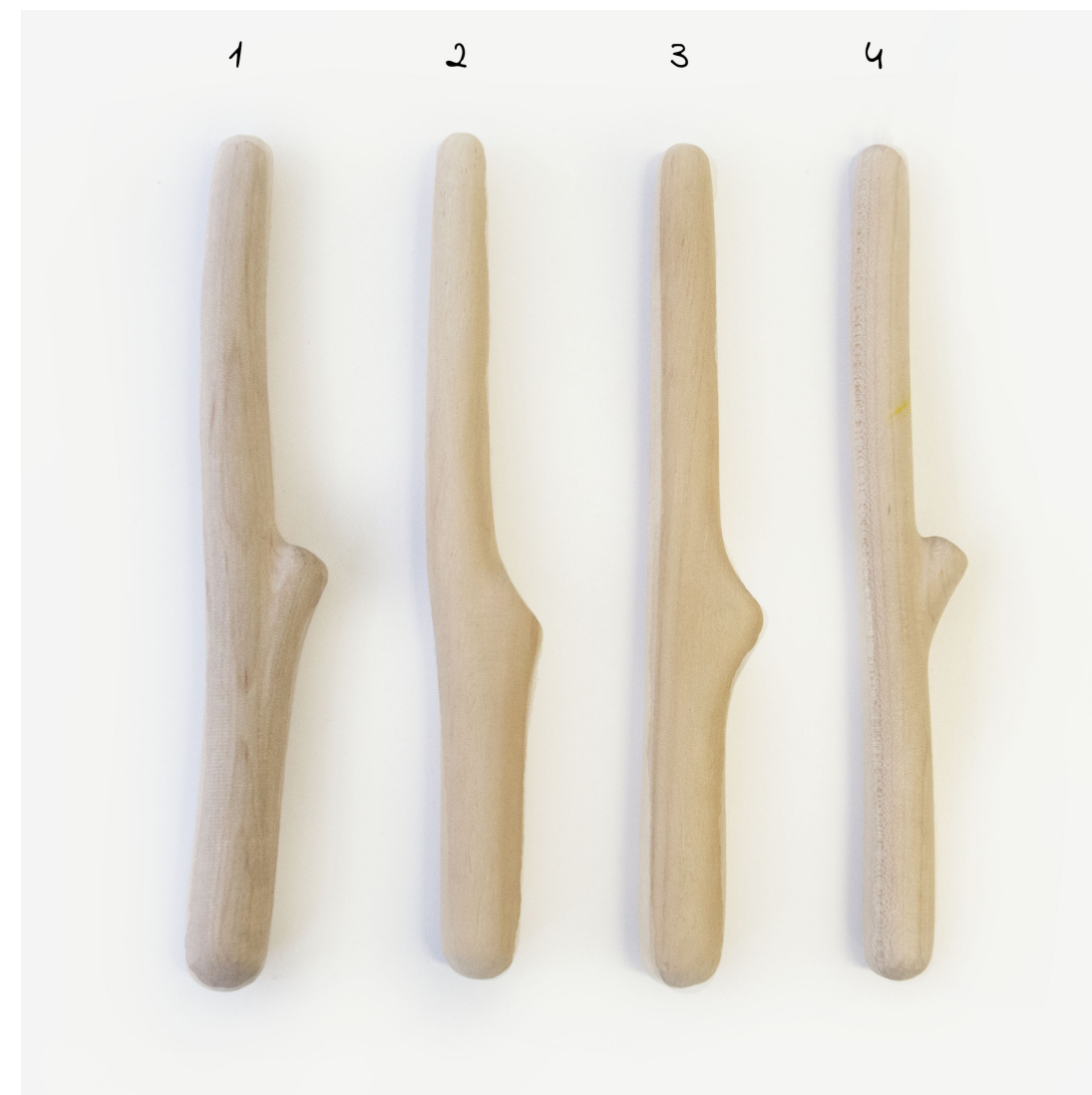


Figure 60. Hutchinson, (2021). Stick concept developments

I was confident that making the ball detachable from the stick would be most appropriate. This would allow children to use the stick, bird, and ball separately if they dislike the stimulation that one of them provides. Two iterations were designed for attaching the string to the stick (figure 61). After assessing the ease of use, I found option two more successful. The primary benefit was that the string did not have to be re-tied every time a child attaches it. I felt this was important as it makes the action less fiddly and challenging for children. Once the loop is tied, it could be slid on and off the stick. Another benefit to this attachment method is being able to adjust the length of the string for a shorter swinging motion.

I also developed the ball by making it smaller to reduce the harm it could cause if swung at a child (figure 62). The colour was also changed to a darker shade of green that made it more visible when swung around.

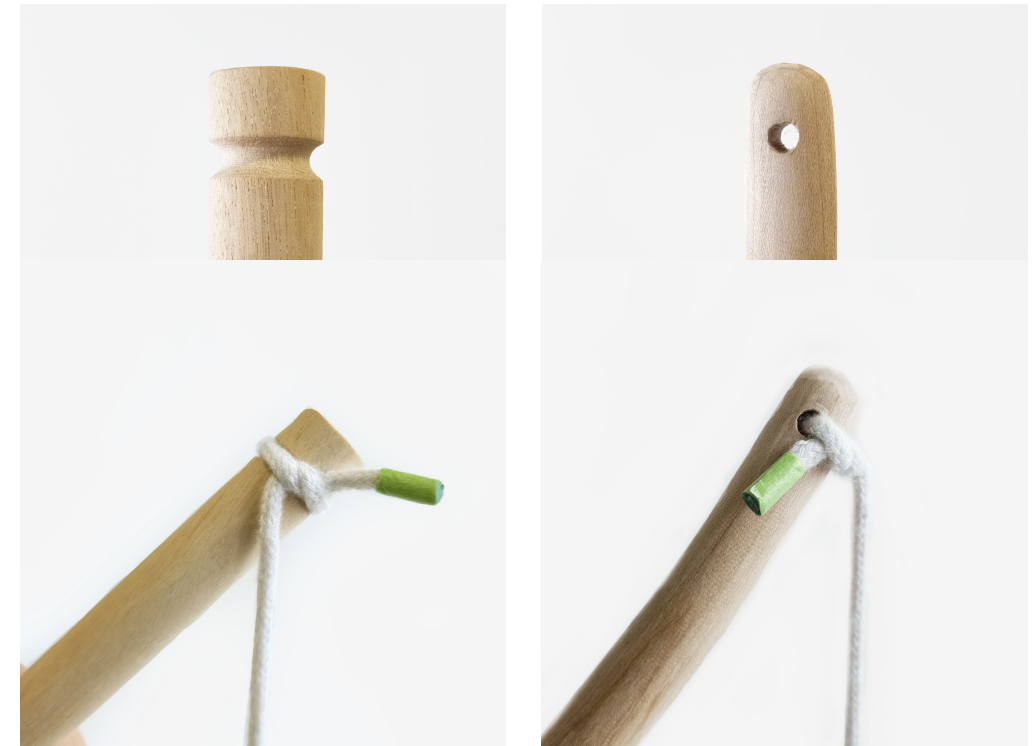


Figure 61. Hutchinson, (2021). Ball attachment iterations

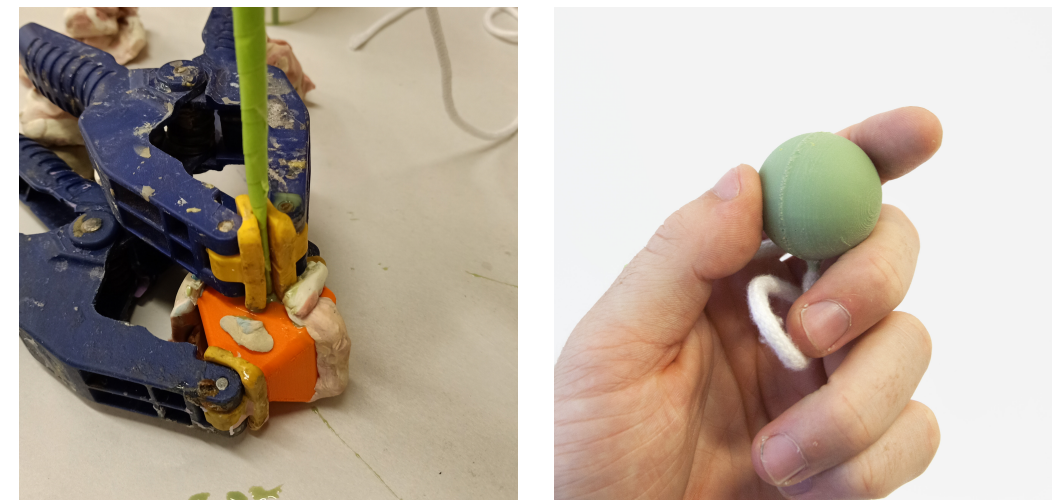


Figure 62. Hutchinson, (2021). Ball production

The stick and ball

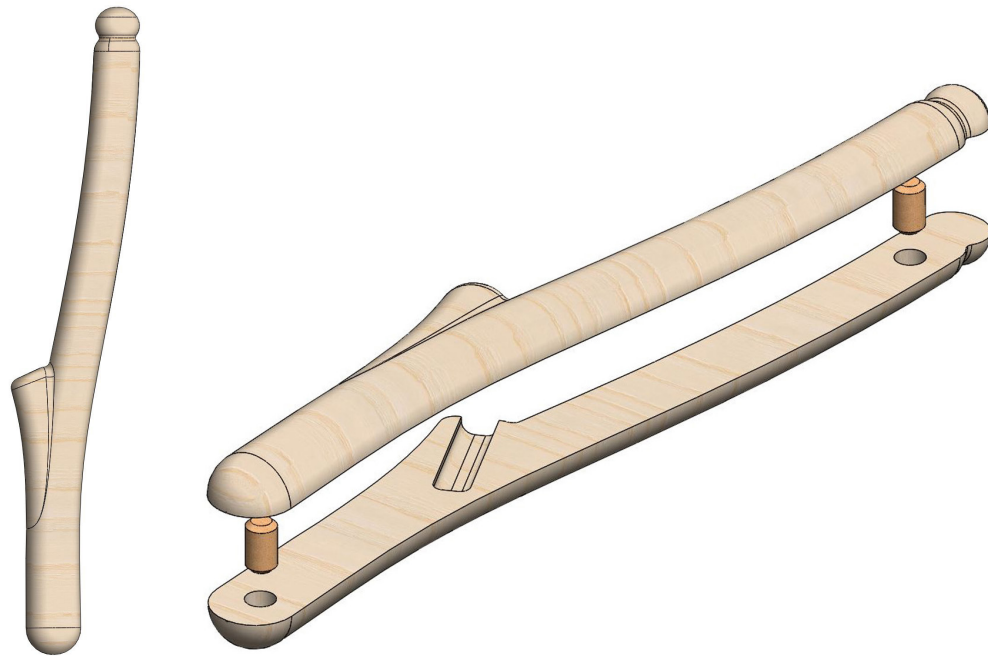


Figure 63. Hutchinson, (2021). Stick final CAD pictures

My final development combined the previous refinements with extra incremental changes to the production and form of the stick. The shape embraces more curvature than the previous design. At the end of the stick, the divet for attaching the string had soft curves that made it easier to slide the string loop on and off. In order to produce the exact desired shape, the CAD model was used to CNC cut the stick in two halves out of American hard maple. The AUT technicians recommended that this wood was appropriate for a children's product as it is durable, does not mark easily, and could be sanded to a super smooth finish. The light shade of the wood was also much easier on the eye than darker woods and showed the form off well.



Figure 64. Hutchinson, (2021). Stick final photo

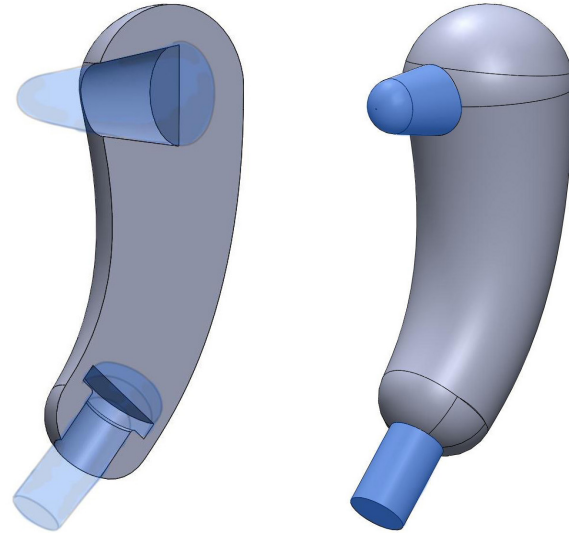


Figure 65. Hutchinson, (2021). Woodpecker development CAD pictures

The main consideration for the bird was finding out how to make it wobble successfully, attach to the stick easily, and reduce the irritating sound the beak made. I felt polyurethane rubber (the same used for the ladybug) would be ideal based on its softness and ability to bend. To test this, I made two separate moulds for the beak and tube part to cast the polyurethane. The rubber parts were then inserted between the two halves on the 3D printed bird. After testing, I noticed the rubber needed to be denser so the bird did not over-bend. I also found that it was hard to stop the rubber from slipping out of the stick when shook. Furthermore, the rubber parts needed to be more secure inside the bird as they risk being pulled out by a child.

In light of the positives, the rubber beak successfully dulled the irritating sound and sent a vibration through the stick as it pecked, which offered more tactile stimulation. I also found the rubber parts made the bird more enticing to hold and fiddle with as its own object. The bird's aesthetic was also developed. In particular, the size was increased so that it would fit nicer in a child's hand and prevent it from being a choking hazard.



Figure 66. Hutchinson, (2021). Woodpecker development photos

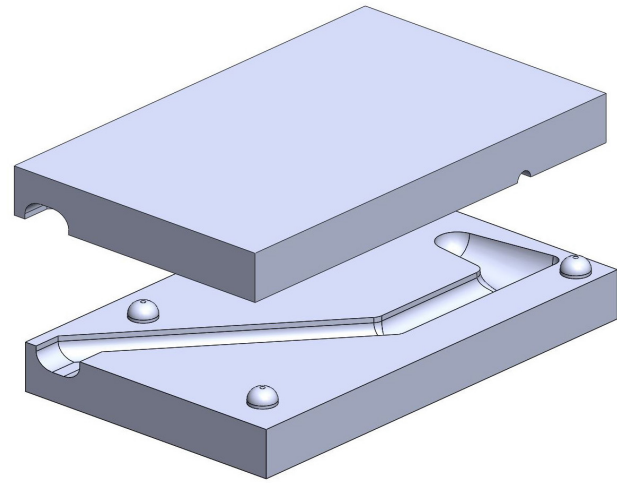


Figure 67. Hutchinson, (2021). Woodpecker beak CAD mould

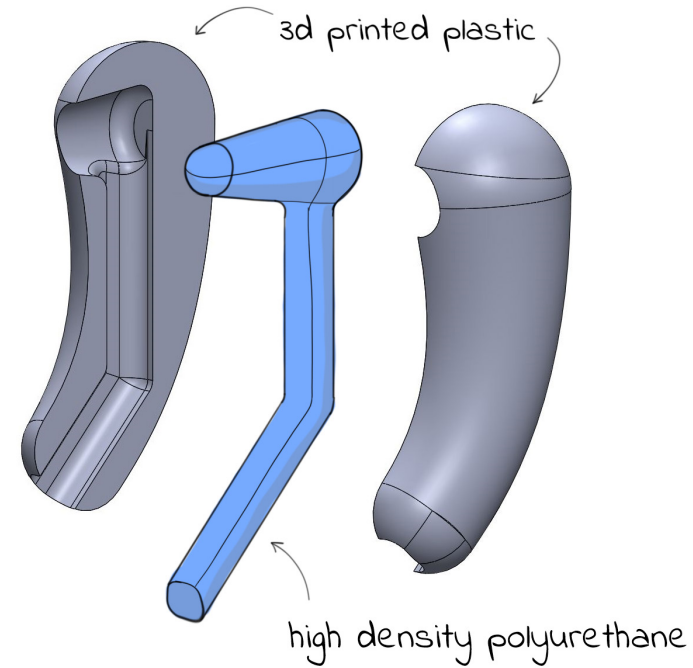


Figure 68. Hutchinson, (2021). Woodpecker CAD exploded view



Figure 69. Hutchinson, (2021). Woodpecker development testing

I acted upon the issues with the last development by first creating a single polyurethane piece that went all the way through the bird. This diminished the risk of the rubber being pulled apart from the bird. I cast the part out of a high-density polyurethane which provided the perfect amount of tension for the bird to wobble. The denser polyurethane ensured the bird inserted and stayed in the stick a lot easier. Although the softer rubber may have felt nicer (may have offered better tactile stimulation), it was a small compromise to make the bird wobble more successfully. Getting the wobble component most successful was my main intention in order to provide visual input and foster a child's focus. Also, the polyurethane part was given flat sides to stop it from swivelling when inserted into the stick.

The Woodpecker



Figure 70. Hutchinson, (2021). Final Woodpecker photo 1

The bird underwent a final refinement by making it out of the same American maple wood used for the stick. I felt this made the bird and stick more cohesive and suggestive of being used together. The bird was CNC cut in two halves and glued together.

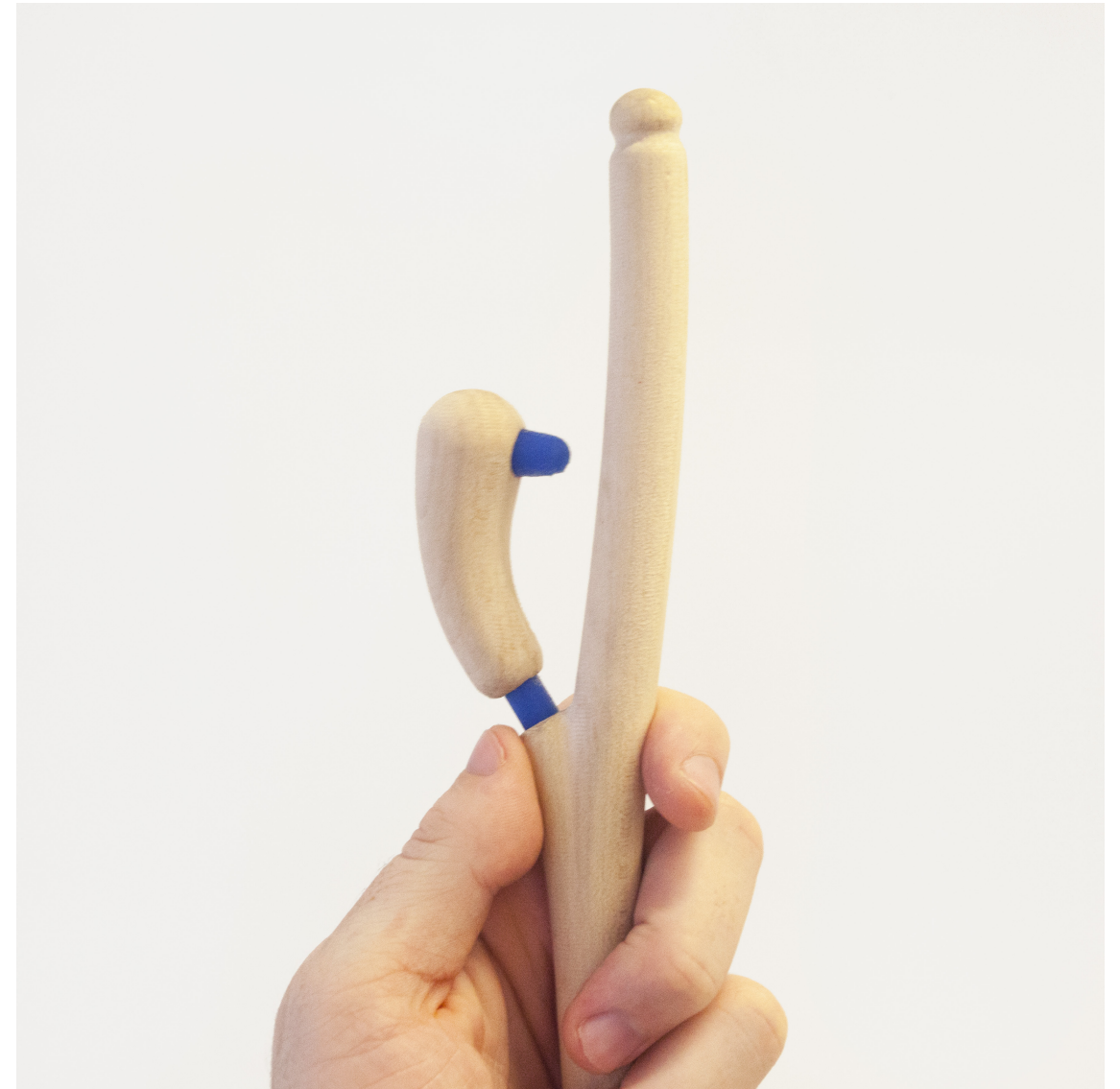


Figure 71. Hutchinson, (2021). Final Woodpecker photo 2

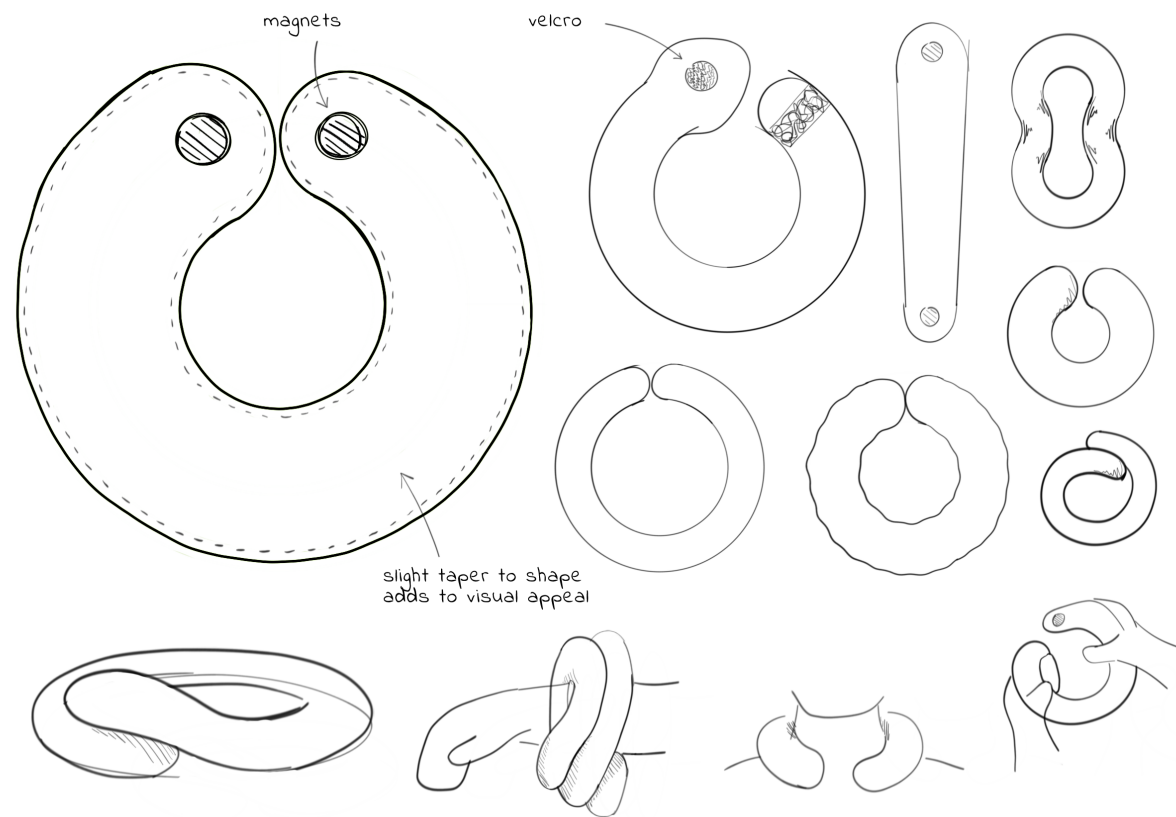


Figure 72. Hutchinson, (2021). Worm Sketches

The main motivation in developing the circular bag concept was to make it heavier for more substantial proprioceptive input and offer more ways for children to use the object. In response to sketching, I formed the idea to create a divide in the circular shape that would allow it to be placed around the shoulders like a neck pillow. The reasoning behind this came from weighted vests, which supply a calming deep pressure to the muscles in our shoulders for proprioceptive input (Morrison, 2007). The object included magnets to connect the two sides to maintain its potential to be interpreted as an armband/bracelet.

This new aesthetic led me to label this object as 'the worm' (figure 74 & 75). I kept the same fabric as the previous concept due to its softness and flexibility that felt appropriate for calming. I used a bright yellow colour to help associate the object with feelings of joy and happiness. The worm concept was produced with the help of a seamstress who sewed the two pieces of materials together and added magnets via circular stitched pockets. Once stitched, the worm was filled with brown rice, which provided much more weight than the previous design. I also added a few drops of lavender oil to the rice that produced a mild scent (figure 73). This allowed for the inclusion of olfactory (smell) input.



Figure 73. Hutchinson, (2021). Materials used for the worm

The Wiggly Worm



Figure 74. Hutchinson, (2021). Final Worm photo 2



Figure 75. Hutchinson, (2021). Final Worm photo 3

In response to the previous wave box development, I felt the need to explore other shapes before creating the final object. Following a quick sketching phase, I chose six designs to shape out of MDF and assess their aesthetic appeal, ergonomics, and ability to rock on a surface. I found that the objects with deep, circular curves rocked in a slow, calming motion. However, none of the designs felt more ergonomic or aesthetically pleasing than my previous design. From this assessment, I thought it was best to develop my previous wave box design.

Firstly, the size and thickness were reduced to better suit a child's hands. The new size and shape felt more suggestive for shaking, which introduced a unique visual effect as the blue liquid broke into bubbles (figure 78 & 81). The wave box's curves were also softened, which felt nicer in hand and allowed the form to roll smoother on a surface.



Figure 77. Hutchinson, (2021). Wave box shape testing

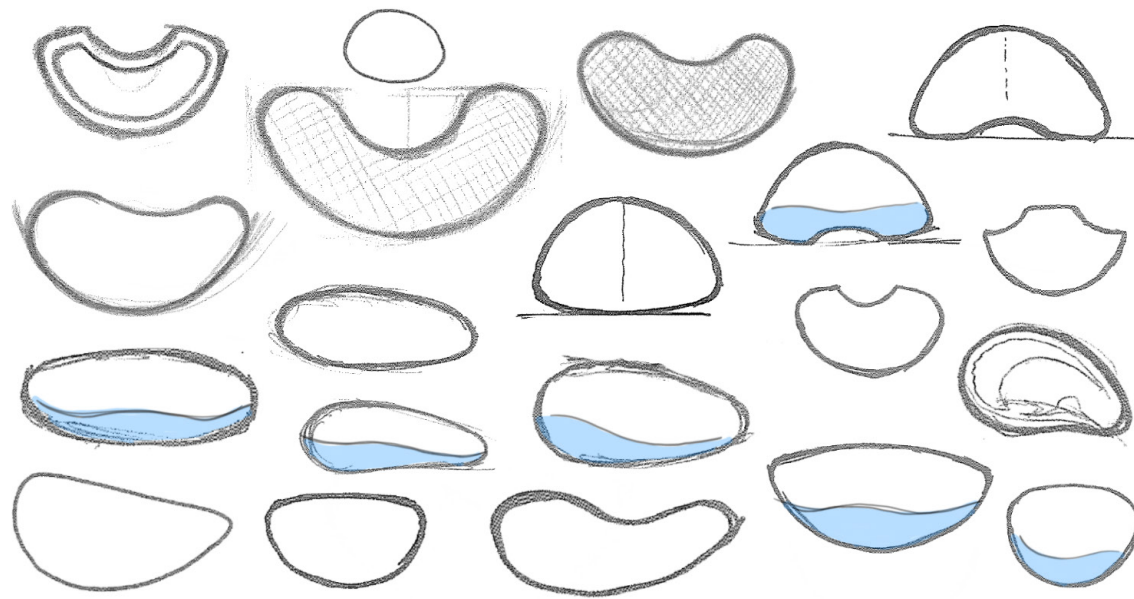


Figure 76. Hutchinson, (2021). Wave box shape concept generation

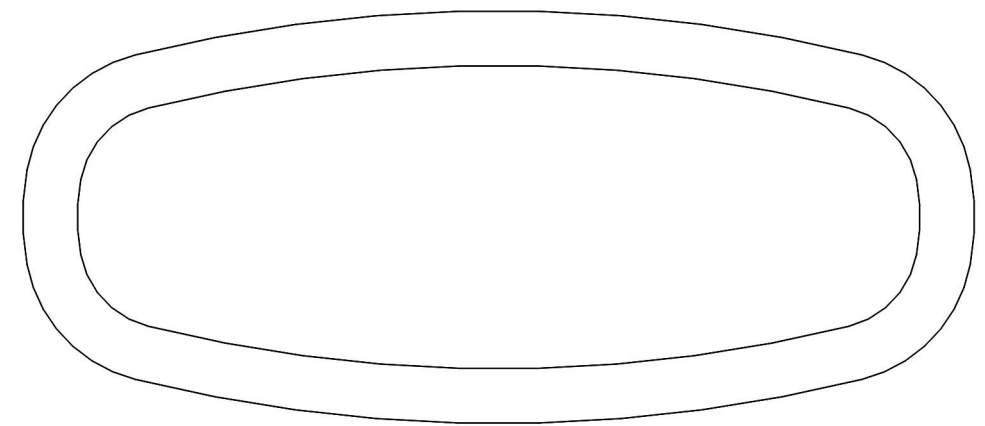


Figure 78. Hutchinson, (2021). Wave box Final Shape Outline

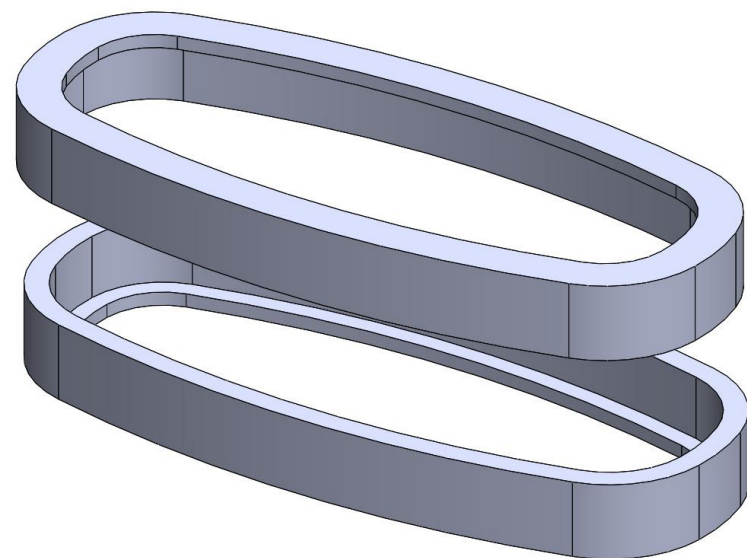


Figure 79. Hutchinson, (2021). Wave box case CAD view

In response to the last wave box developments issues, I CNC cut a casing out of American hard maple that acted as an enclosure for the acrylic box. Not only did this make the object much more durable, but it captured a much more comforting feel with the smooth wooden surfaces.

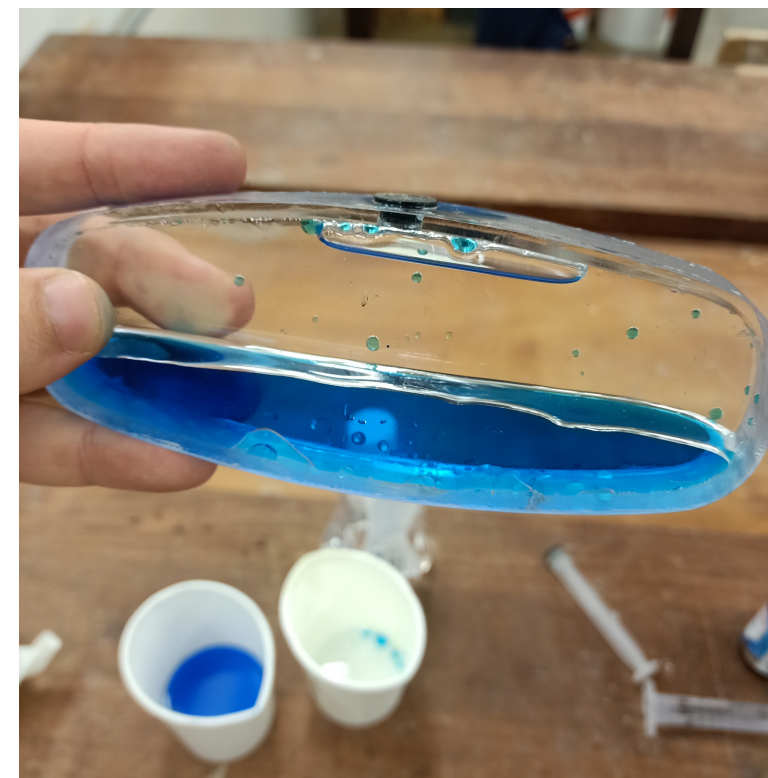


Figure 80. Hutchinson, (2021). Wave box final production

The Wave Box

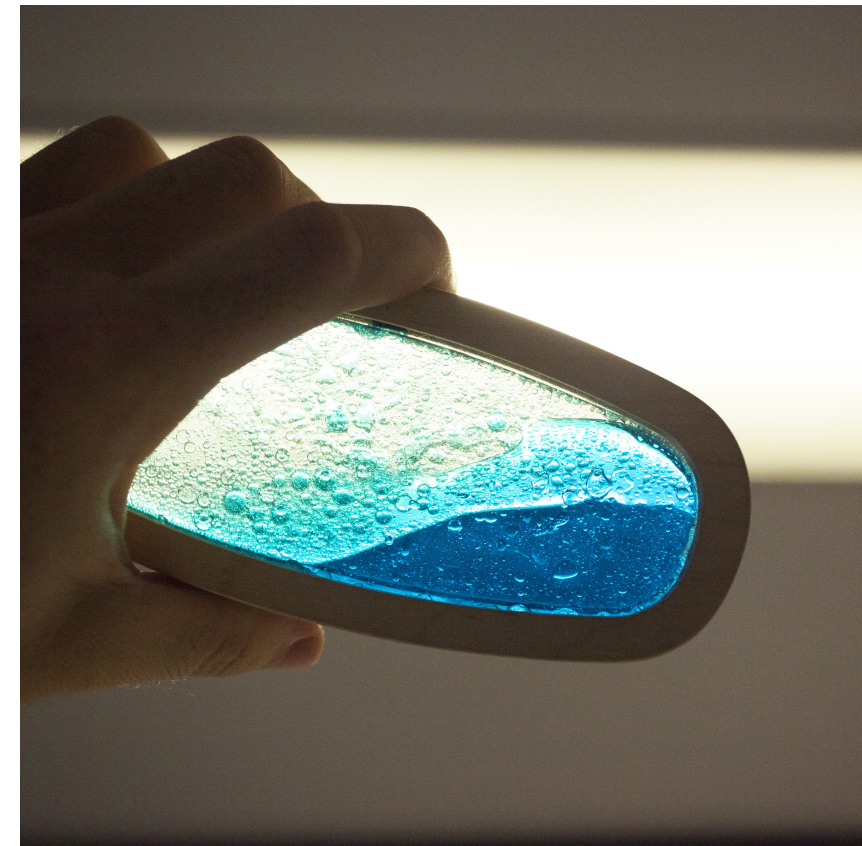


Figure 81. Hutchinson, (2021). Wave box final photos 1

Figure 82. Hutchinson, (2021). Wave box final photos 2

Development of story booklet

The Sensory Garden

My Garden Book

comparing weather to different alert levels

how am i feeling?

If my brain is filled too little or too much, it might be hard to do schoolwork

like watering a plant, we need just the right amount of water to feel right!

so let's take 5!

explore the sensory garden to fill my brain just right

this garden is a space to help me feel calm,

so i can learn and feel happy at school

in the sensory garden, i can use my...

ears, eyes, nose, mouth, and hands when i play

lets take a look inside,

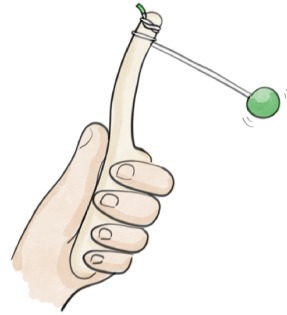
and see what the garden has to hide!

Figure 83. Hutchinson, (2021). Storybook pages 1

Figure 84. Hutchinson, (2021). Storybook pages 2

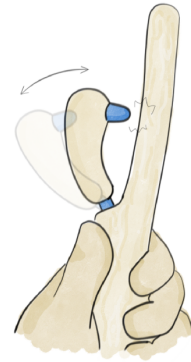
page for each object

when i feel tired and not ready to learn...



swing the ball around the stick,
watch it bounce and watch it flick

When my focus starts to wobble...



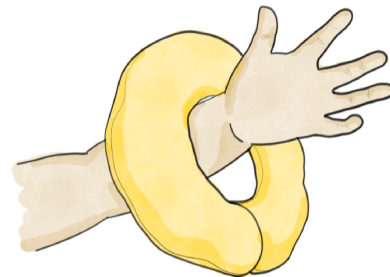
wave the stick and make the bird bobble

when it's loud and noisy,
and i don't want to hear...



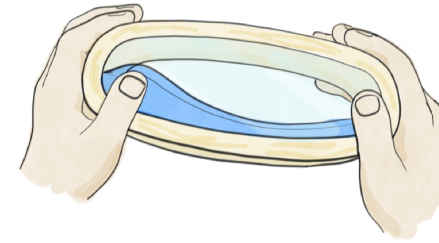
block out the sounds with creepy crawly ears

When i feel fidgety and need something to hold...



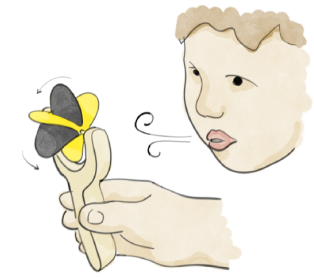
squeeze the worm in my palms,
or crawl around my arms

When i feel upset and need a distraction...



watch the water splash and flow,
like watering a garden to make it grow

When my brain overflows
and i need to slow down...



help the bee buzz in the sky,
blow long slow breaths and count to 5

Children are exposed to a lot of sensory information in the classroom. Some young minds might struggle to process and respond to information around them more than others. Our body is like an engine; sometimes it might run too high, sometimes it might run low, creating some disruptive behaviours as a by-product. It is ok to feel the way they feel. What is most important is helping them to get back to a calm and alert state where they are ready to attend, relax, and learn!

It may be the stress of trying to complete a task, the noisiness in the classroom, or simply trying to sit still and listen. There are so many causes that might stop a child from flowing through the day. The reality is some children find it harder to stay alert and focused because of their difficulties self-regulating. This kit is to help children recognise their feelings and get back into a learning state of mind. It provides the tools to self-regulate those disruptive, irritable, or anxious feelings rather than be at mercy to them and hinder their ability to thrive.

Each object is designed as a unique exercise to engage different senses and help our mind reach a calm and alert state. What works for one child won't work for all. Allow them to explore the kit and find an object in the garden that works for them and how they are feeling.

The sensory garden is a toolkit to help you manage a class full of children with their unique and personal needs. We recommend using it as a 5 minute exercise to help get their mind back on track for learning. These sensory exercises can help any child who needs help returning to a learning state of mind. Otherwise, you may choose to make it exclusive to children who struggle often.

When we can help children flow in a calm and alert state, their potential is boundless!

Figure 85. Hutchinson, (2021). Storybook pages 3

Figure 86. Hutchinson, (2021). Storybook pages 4

section explaining the kit more in depth for teachers



Figure 87. Hutchinson, (2021). Storybook picture 1



Figure 88. Hutchinson, (2021). Storybook picture 2

Packaging

I found it vital that the packaging considered more than simply keeping the objects together. It was an opportunity to build on the sensory experience a child has when interacting with the kit. Furthermore, it would ensure the kit is easy to access and store away for teachers. Based on this, designing the packaging considered three elements: size/scale, materiality, and ease of access. I developed the following brief to reflect the design elements that would make my packaging a valued element of the kit for both children and teachers.

Materiality/Aesthetic

Materials should feel nice when handled

It should be a cohesive aesthetic to the rest of the kit

Simple and minimal form

Strong and robust to withstand years of use in a classroom

Size/Scale

Appropriate size to be stored on a shelf or cupboard in a classroom

Light enough to be handled by a child

Comfortably fits all sensory objects and the booklet

Ease of Access

Easy to open, place, and remove items

Accommodates an opportunity to explore the objects inside

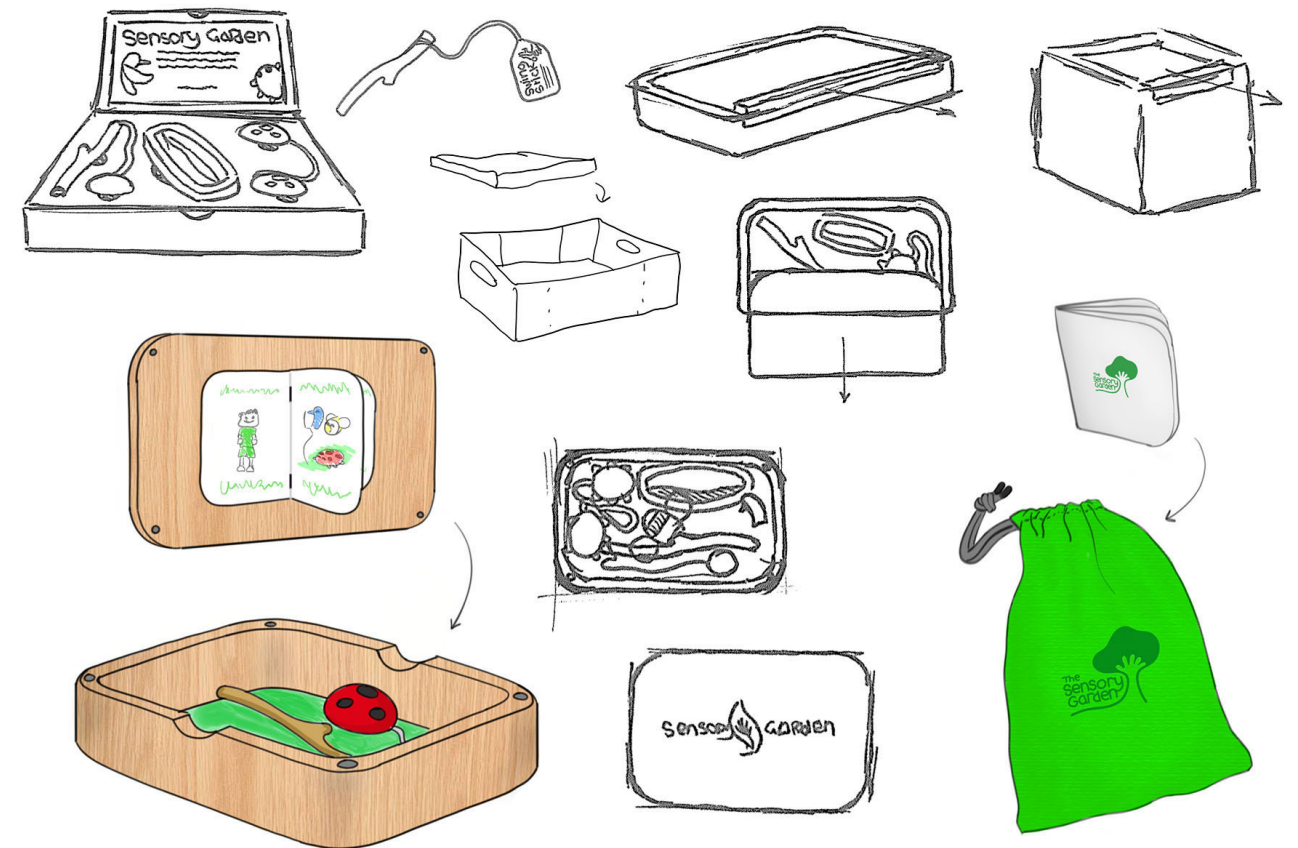


Figure 89. Hutchinson, (2021). Packaging initial concepts

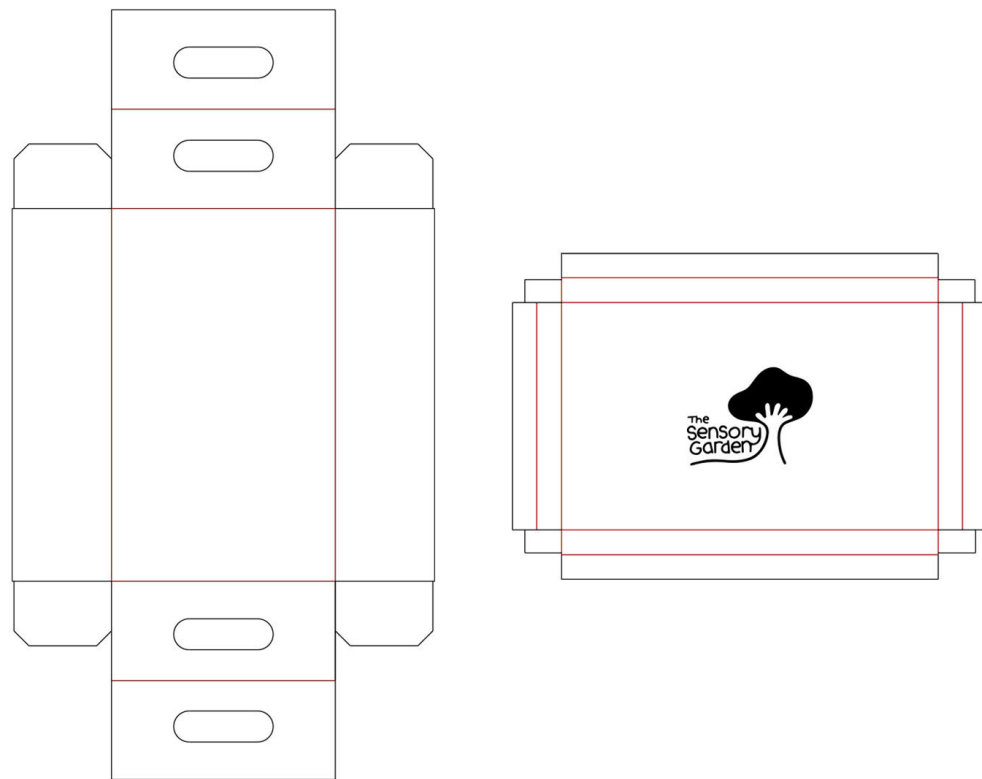


Figure 90. Hutchinson, (2021). Packaging initial concepts

I produced a simple, shoebox-style box made from corrugated cardboard for prototype testing. I felt it was important to keep the packaging simple to avoid unnecessary weight and material. It included a removable lid that could be tucked underneath and kept out of the way when in use. The oval cut-outs on the sides made it easy to carry. The inside of the box was covered with a soft green felt that I felt could offer calming tactile input. The green also captured the idea of the objects being part of a garden. I also decided to have the objects placed randomly in the box, rather than having a set place, to support the idea of letting children explore and rummage through the kit. This also considered an opportunity for teachers to add to the kit if they have objects of a similar sensory nature.



Figure 91. Hutchinson, (2021). Photos of box for prototype testing

Prototype Testing

At the start of my project, my decision was not to have children give feedback in the research due to ethical considerations. This is because the consultation process suggested that children would be difficult to recruit and engage with directly. There was a power imbalance as the only way of recruiting school children would be through teachers and school associates. Furthermore, children cannot give consent, only assent. However, it was important that my design solutions were evaluated. Therefore, I conducted prototype testing through the reflections of three different primary school teachers and one teacher aide from two schools in the Auckland area.

Each school received the sensory garden toolkit, including my six developed sensory objects, the story booklet, and the box (figure 91). The kit spent seven school days at both schools. In the first school, the kit spent most of the week with one teacher in a junior school classroom with 5–8yr old children. It also spent a short time each day with a teacher aide from another junior school class. This teacher aide used the kit with a special needs child they supported in a mainstream class. In the second school, the kit stayed with two teachers in a shared-space classroom with 6–8yr old children. I explained to the teachers that the kit was designed to support sensory needs and bring the most value to children with significant learning difficulties since no children were diagnosed with SPD. However, I left it entirely up to them how and with who they chose to use the kit.

The teachers observed exciting feedback from the children showing their high level of positive engagement with the kit. In response, some teachers chose to include pictures and quotes from the children interacting with the kit in their feedback. However, this data was excluded from the research due to ethical considerations. The results below are summarized from two 20–30-minute discussions with the teachers who took part (the teaching aide left written feedback instead, also included in the data below). I asked them to reflect on their observations and experiences using the kit with the children. This discussion talked about the booklet, the integration of the kit into their teaching day, the objects, and the packaging.

The booklet

Teacher one described how she first introduced the kit to all the children in class by reading them the storybook. She explained all the children enjoyed listening and looking at the pictures. The book was very appropriate to the age level, and the teacher said that the children seemed to pick up on the idea of using the concepts for calming down. She described that many children might struggle reading independently in her class and only pick up certain words. Therefore, the illustrations were essential to help convey the ideas. On this point, the teachers did state that the book could be slightly bigger to be easier to read. Teacher one also recommended introducing a much larger A3 size book for teachers who would like to read it with the whole class. However, she imagined this could be a separate purchase to the kit as some teachers and teacher aides might choose to use the kit one on one with a child.

Integration of the kit in the classroom

Teacher one explained that they created a ‘calming corner’ to use the kit in the classroom. The objects were used as a routine activity where a couple of children each day had the chance to explore the kit while the teacher monitored. Teacher one explained that, given more time with the kit, she would let children access it independently once trusted. They did put the kit away at times to stop kids from using them too much or use them as toys. Teacher three explained that because of the children’s interest and enthusiasm in the objects, most children had a turn throughout the week trying the kit. Teachers two and three stated that, given more time, they would have liked to set more rules around the kit and make it exclusive to a few specific fidgety children. Both teachers suggested that the kit would be perfect for using one-on-one with a child who has higher needs. They went onto suggest the kit’s potential in supporting parents at home who have children with sensory needs. The teacher aide explained that they found a lot of benefit in using the kit as a one-on-one activity with the special needs child she looked after. They introduced one object each day with the child to ease them into the kit. With more time, it would have been interesting to see if the child may have interacted with the kit and chosen objects independently. It was stated how great it would be if every teacher aide had

access to a sensory garden for using as a one-on-one activity to support children with learning difficulties.

The sensory objects

Teacher one explained many positive and meaningful interactions as she reflected on the use of the different objects. They explained that some children simply found enjoyment, while others noticeably seemed to be calmed through their interaction. Teachers two and three said that given the objects were shared between all the children, a lot of them were using the objects for enjoyment. In saying this, the objects were used very sensibly and did not provoke any negative behaviour. Teachers two and three brought up a point that objects may have seemed a little small for the 6–8yr olds. They brought up that some teachers from early childhood education classrooms (3–5-year-old children) expressed an interest in using the kit if I was to take the research further. There was no significant damage to the objects, which proved their durability to an extent despite teachers likely encouraging children to be delicate and careful.

In teacher one's classroom, the wave box was most children's favourite. All the teachers spoke on interactions the children had, such as rolling it on their legs, shaking it up to watch the bubbles, and holding it up to the light. Teacher one explained one child talked about how it calmed them down like the ocean. Conversely, the teacher aide described that her child was curious about the object but quickly became distressed. This negative interaction may be because the child has a low visual input tolerance.

All the teachers explained it was amazing to see children using the buzzy spinner for blowing without needing guidance. Teacher one explained some children liked the feeling of the air blowing back at them from the propeller. A couple of other children enjoyed blowing on it for the buzzing sound it made. Teacher one and two also noticed children rolling it on their legs. The teacher aide also described that her child was very vocal while rolling it on their body.

Teacher two and three stated the ladybug ears were most children's favourite in their classroom. They explained that the children found many different ways to use them. Teacher one described that one child told them that it makes them feel happy when they put them on their ears, and all the noise goes away. Another child closed their eyes and pushed on the ladybug's spots. Some other children enjoyed stretching the string out. The teacher aide child used the ladybug ears at mat time. She explained the child seemed to be listening to the teacher quietly while squeezing them.

All three teachers stated that the worm was very popular. Teacher one found it interesting the different things children would call it, such as a monkey's tail, a fishing rod, or a worm. The teacher aide's and teacher one's children loved the worm's weight and being able to put it around their neck, arms, and head. There appeared to be a small hole in the worm's stitching after testing in both schools.

The consensus was that the stick, ball, and woodpecker were the least popular but still successful at times. They all noticed that some children seemed to use it much more for enjoyment rather than for calming. The teacher aide stated struggling to get the woodpecker off her student because they wanted to hold onto it. However, all the teachers saw this object's value in the kit and noticed children loved to hold the stick for its smooth surfaces.

The packaging

The box gained a lot of positive feedback. All the teachers seemed to agree it was a perfect size to be stacked and stored away when needed. The children liked the cut-outs on the side to pick it up or feel the objects through the box.

Summary

Overall, the sensory garden toolkit received very positive feedback from the two schools. The kit provided meaningful experiences for children through the perspectives of their teachers. Given the high interest from children, the kit was often shared around the entire classes. This meant the teacher's observations centred around all children, which likely made it hard to separate the experiences of those who solely found enjoyment and those who might have used it for calming and self-regulating.

Teachers and teacher aides did notice calming experiences that some children had with the objects, showing the potential to take the kit further and test more thoroughly. Given more time at each school, it would have been valuable to see whether teachers would prioritise the kit more so to children with significant difficulties learning. To more accurately test the kits' ability to help children overcome disruptive behaviours and feelings, it would need to be utilised as an intervention when a disconnect in learning is noticeable.

It was rewarding to find that the kit provided positive experiences for children in mainstream schools. It showed that teachers saw value in the kit and had reason to integrate it into their practice. However, I felt the kit's value as a self-regulation tool was not fully explored. In particular, the kit seemed well suited for teacher aides. Given that teacher aides work predominantly with children with learning difficulties and other developmental conditions, the kit would be prioritised to children who likely find its value as a resource for calming and enabling learning. The teachers also advised some other potential user groups where the kits value as a learning and calming resource could be appreciated. This included early childhood learning classrooms or parents who have children with SPD and/or other developmental conditions.

Based on feedback, there were small incremental changes to make to the kit.

- The booklet needed to be slightly bigger to comfortably read one-on-one. Also, a much larger one for reading as a class could be purchased separately.
- Stitching or material on the worm needed to be stronger to prevent it from breaking easily.

Final Refinements

Based on the positive feedback from prototype testing, there were no major changes that needed to be made to the kit. As I progressed towards producing a final product, the last phase involved small incremental changes to the objects, booklet, and packaging. The changes made were led by the feedback from prototype testing and aspects that I felt would benefit from further refinement. It could be argued that the kit could be developed further. However, I felt that without testing the kit more thoroughly in schools, particularly with children diagnosed with SPD, there was not enough reasoning to make significant changes. This should be the subject of future research (see discussion).

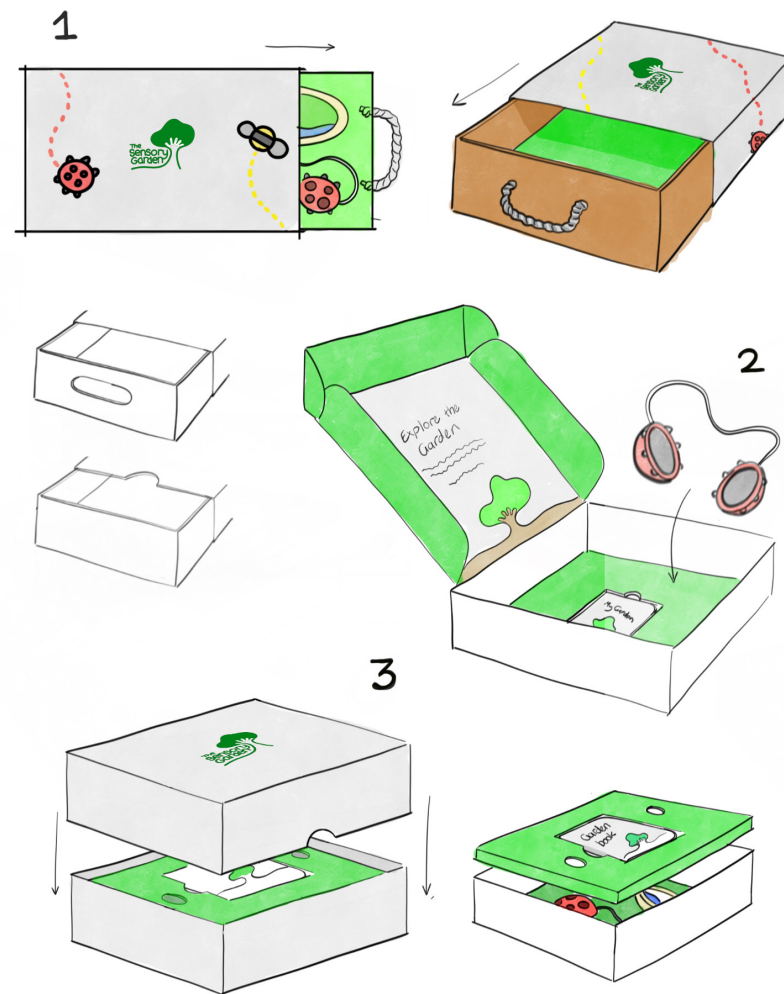
Booklet

In response to prototype testing feedback, the booklet was increased in size from 100mmx100mm to 130mmx130mm. I felt this size would make the book much easier to read independently or one on one with a teacher or teacher aide. If the kit was sold to schools, I would consider making a much larger booklet as an optional separate purchase for teachers that wanted to introduce the kit to their entire class. However, I did not think this was appropriate for every kit, given some teachers and teacher aides might prefer to use it exclusively to support children with SPD and/or other conditions. This could be tested further in the next stages of the research.



Figure 92. Hutchinson, (2021). Final storybooklet photos

New packaging design/future development.



Despite not receiving criticism from teachers, I felt the box could be resolved further to match the high level of resolution of the rest of the kit. Out of the three sketched concepts, option one was my favourite. I wanted to maintain the natural aesthetic and feel of my original cardboard box but add a protective sleeve to contain the kit more securely. It incorporates a slide-out design that is reminiscent of a school storage tray. This box will be completed in the weeks following handing in my thesis.

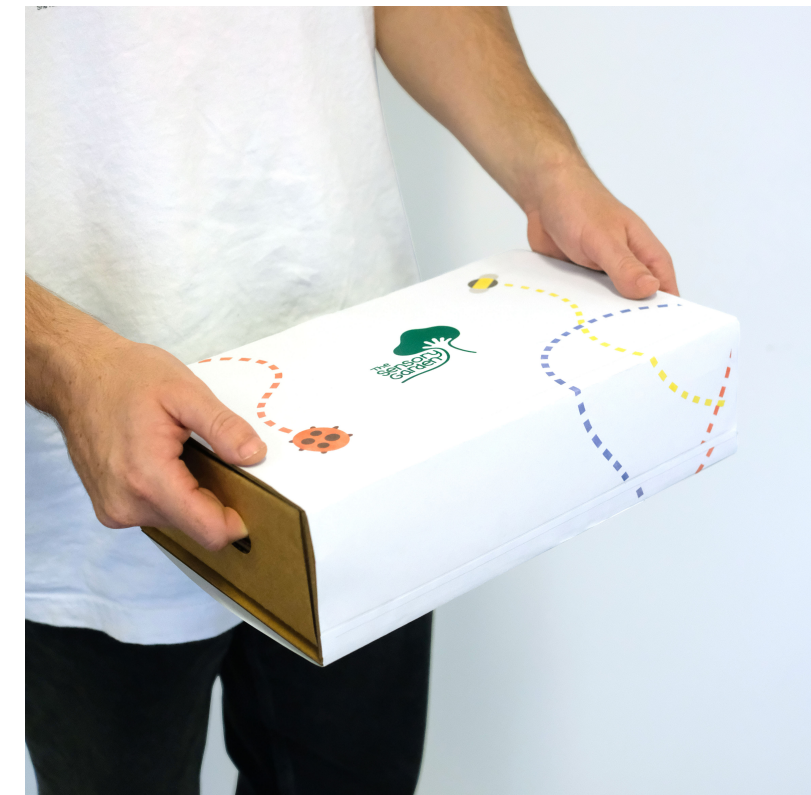


Figure 94. Hutchinson, (2021). Packaging final prototype photos

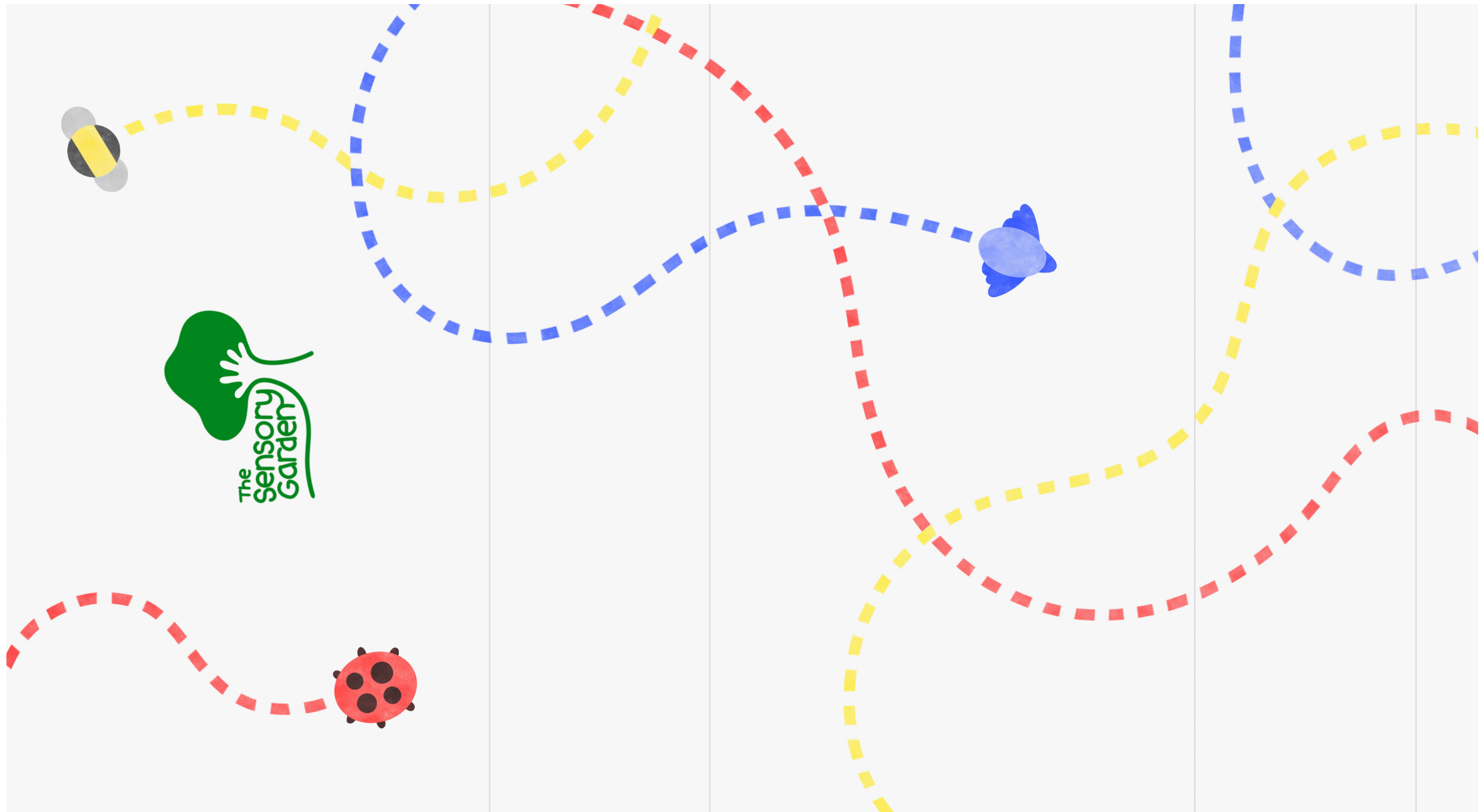


Figure 95. Hutchinson, (2021). Packaging graphic for sleeve

Discussion



A literature review at the outset revealed that mainstream school settings present many challenges for children with SPD which affect their ability to succeed in learning. It was found that mainstream teachers should be better equipped to support children with SPD and other conditions that cause significant learning difficulties. The inclusion of sensory objects presented a great opportunity based on their success in special schools and therapy settings. My research project sought to investigate the potential for sensory objects to be utilised more by teachers in mainstream school classrooms to support children with SPD. I hoped that the outcome of this research would prove to bring value to children's learning and a teacher's classroom practice. Furthermore, set a precedent for further research that explores the integration of sensory tools in mainstream schools to support children with SPD and other conditions that contribute to significant learning difficulties.

Through my initial literature review, I found that many children with SPD and developmental conditions like ADHD who are classed as having less 'high needs' don't receive special education support ("Starting School," 2010). Furthermore, teachers in mainstream classrooms do not have the time, knowledge, or resources to feel confident teaching children with disabilities (Shaddock et al., 2007). By engaging with occupational therapists (OT), I was able to better identify the distinct contrast between the support children with conditions receive in special education services compared to mainstream classrooms. It appeared that the issue for mainstream teachers is often supporting a class of thirty children in which one child might have SPD and/or developmental conditions. This supported the insight that teachers in mainstream classes would benefit from a resource that helps them better manage and support those who have more trouble staying engaged in learning. Through further investigation, the teachers I spoke with were relatively unaware of what SPD is. However, many of the behaviours they highlighted as disrupting to learning (fidgeting etc.) seemed related to sensory needs. Behaviours that stem from sensory needs cause disruption to a child's own learning and affect their ability to concentrate, communicate etc. Furthermore, sensory behaviours can often cause disruption for other children within a class (Biel, 2012). It was found to be essential that teachers understood that sensory-related behaviours are

are not easily controlled and require specific treatment to help children overcome them (Biel, 2012).

An abundance of literature and video content pointed towards sensory objects being effective tools to help children with SPD overcome disruptive behaviours and reach a calm and alert state (Biel, 2017). The success of sensory objects/tools/resources seemed well researched in therapy and special school settings (Pingale et al., 2019). Literature review content, such as Snoezelen, exemplifies multi-sensory rooms that can support children with learning difficulties in a variety of applications, including schools (Flaghouse, 2018). However, the large scale and cost of these solutions were perceived to be a limitation. There seemed to be an absence of literature focussed on mainstream school teachers utilising sensory objects to support children within a mainstream school setting. This supported the idea of giving mainstream teachers the tools to provide expert support to children with SPD learning difficulties. Engaging with occupational therapists backed up the value of using sensory tools, claiming they were an essential part of their practice to help children regulate and better connect in learning. Once sensory objects were confirmed as having potential, the next step was to use my knowledge to give my toolkit form. Although many teachers I spoke with were aware of sensory objects, most had little to no sensory tools available to them. I felt that they might not fully appreciate the value of sensory objects until using them in their practice.

Perhaps the most rewarding learning was getting validation from the three teachers and teacher aide that their children interacted positively with my sensory objects. This helped confirm that teachers saw the value that the kit brought to their practice. While some children simply found enjoyment, others were noticeably calmed and had their alert level lowered by using the objects. Although it was validating to hear that my objects positively impacted children in a mainstream class setting, it highlighted areas for the research to be taken further. I felt that the kit might be best suited for teacher aides who work alongside teachers to support children in the class with significant learning difficulties. This way, the objects may be prioritised to children who would use them for self-regulating and feeling ready to learn.

Design Output

A breadth of literature and resources helped me see how sensory objects are well-utilised tools by those who work closely with children who have SPD and other developmental conditions. My intention was to use this knowledge as an opportunity to address an issue in mainstream schools where teachers cannot easily support children with SPD in the same manner as those schools with specialised facilities can. Informed by my literature review, primary data, and my design perspective, the final design outcome presents an attempt to bridge the gap between expert support for children with SPD and teachers who support children with similar issues (SPD) in mainstream classrooms. The outcome was manifested in the form of a toolkit, which aims to help teachers and children better understand how to manage sensory needs and provide the tools to help reach a calm and alert state ready for learning. It consists of three main elements: 5 sensory objects, an educational booklet and packaging.

The primary goals for my design output included:

- Support children with SPD in their ability to self-regulate so that they can re-connect with learning
- An attractive solution that could be appreciated as a tool for supporting learning rather than a toy
- A solution that is valued by teachers and appropriate to integrate into their classroom practice

My solutions presented the case that many existing sensory-based resources, such as Snoezelen, are large scale and/or expensive (Snoezelen, 2021). In order to be accessible to more classrooms, it was acknowledged that a small scale and cost-effective solution was most appropriate for integration in a mainstream school classroom. Building on this, I found that one single object would not work for all. Children have different tolerances

for different sensory systems. Therefore, children self-regulate through a sensory input which is appropriate for their need (Thompson & Raisor, 2013). Both literature and the occupational therapists I engaged with supported the idea that to effectively support a wide range of children with different sensory needs, the solution should consider as many of the seven sensory systems as possible. The decision to design multiple objects for exercising different senses was supported by the idea that mainstream teachers are likely not aware of a child's specific sensory needs. The OTs I spoke with stated that children would benefit from the opportunity to explore different objects to find what helps them. It was also considered that multiple objects would support a child's interest and ongoing engagement with the kit.

While implementing an effective and calming sensory experience for each object was essential, I also felt it was crucial to maintain an attractive aesthetic. While my solutions may have appeared quite ambiguous, this was an intentional design choice to encourage children's imagination. Initially taking inspiration from Walldorf toys (Baldwin, 2010), I made the decision to implement a simple aesthetic that would encourage open-ended play where children could interpret the objects however they liked (Baldwin, 2010). As a result, each object could exercise different sensory systems based on how a child interacts with it. Thus, giving the objects greater value. The idea that 'form language' and aesthetics could influence whether teachers would view my objects as sensory tools or toys initially came from Mad Love asylum (Madlove: A Designer Asylum, 2021). Mad Love helped me acknowledge that the communication of my objects could convey a purpose that is deeper than play. Therefore, a clean, simple aesthetic was chosen to set my objects apart from toys. Furthermore, this aesthetic supported the potential for the kit to appeal to a wider range of primary school age groups.

Ensuring the sensory objects were utilised appropriately was identified by the OTs I interviewed to be as important as the object's effectiveness. The OTs stated the importance of educating both teachers and children on how and when objects are needed. The inclusion of an educational story booklet was introduced as an additional element in an attempt to normalise the function of the kit. The booklet takes inspiration from the alert program

(a resource used by the OTs I interviewed), which helps children identify their feelings and understand how sensory tools can help them reach a calm and alert state ready to learn (Williams & Shellenberger, 2001). Storytime was identified as a standard, well-valued practice for all teachers involved in the research. The inclusion of a story/narrative was designed to foster student-teacher communication, which is key to a successful learning environment (Cahill et al., Melbourne Graduate School of Education/2014). Taking insight from Te Rito Toi, the booklet offers familiarity and helps children confront feelings in a playful way (About Te Rito Toi, 2020). Teachers and students are encouraged to look through the storybook together and establish a mutual understanding of when and how the kit is used. Through repetition of use, the learning inside the book aims to help children self-manage their condition. The booklet is considerate of the fact that the kit could be used in a multitude of scenarios. Thus, it encourages independent use, one-on-one with a teacher, or as a group.

There were various 'disruptive behaviour' scenarios identified in classrooms that the kit could prove useful (e.g. at mat time). Therefore, flexibility and ease of use were key ideas I recognised as important to implement. The kit was kept to a small, handheld scale to prioritise quick and easy integration into a classroom environment while minimising distraction for those not needing to use it. Furthermore, the occupational therapists I interviewed pointed out that sensory objects should be used as short 5-minute exercises. The packaging was also designed to reflect quick and accessible use, implementing a simple tray-like design where the objects can easily be explored, picked out, and used.

My theoretical framework, methodology, and methods proved appropriate to the research project. The application of action research allowed the research to progress in cycles, in which I was able to step back and reflect at the end of each phase to make important decisions. The iterative nature of these cycles allowed me to explore the application of all the different sensory inputs thoroughly. The application of human-centred design ensured that I could justify design decisions by learning from individuals with expert knowledge. Furthermore, this helped to ensure the final solutions matched teacher's and children's needs and preferences. Despite the success of the research, there were challenges that I encountered and things that could have been done differently. The research could have been co-design focused in regard to recruiting more participants and engaging directly with children in the research.

Ideally, more schools and teachers would have been involved in the research, which would have provided richer data from a variety of perspectives. Many schools were approached in my research. However, few participants expressed interest. Given the interest in my kit following it being tested, there is reason to believe that recruitment in future research would be less difficult as the kit could be used as part of the recruitment process.

Looking back, I should have engaged with more teacher aides that work directly with children with learning difficulties. This did not seem like an obvious decision in the research at the time since my focus was supporting teachers who don't have extra help from teacher aides and have to support a class of children alone.

Working with children in person would have also been beneficial to the research. However, challenges with the ethical process made this difficult (refer to limitations section). With support from teachers and educational researchers, it may have been possible to work with children, more specifically, those with SPD. Unfortunately, this is the constraint of a single discipline approach. A larger, fully funded study with many disciplines involved would resolve this issue.

Limitations of the research

Covid-19

Covid-19 had a large impact on my research. Firstly, the occurrence of multiple lockdowns throughout my masters meant that AUT university facilities were forced to close. Many of my objects were time-consuming to produce and relied on the AUT workshop facilities. The workshop closures caused by Covid-19 delayed the production of prototypes and meant I was not able to do as much development as I would have liked. The studio space where I undertook most of my work was also closed during Covid-19 lockdowns, which meant adapting to working from home. This was a much less creative space, leading me to some moments in the project where I felt unmotivated and uninspired.

Covid-19 also impacted the recruitment of my participants. Teachers and OTs that I reached out to likely had extra busy work schedules as a result of Covid-19. This may have played a part in the difficulty of finding participants that were willing to take part. It is also possible that participants were cautious of taking part in interviews face-to-face due to Covid-19. Luckily, only one interview had to take place online via Zoom, which otherwise would have drastically limited the feedback I could receive on my physical prototypes.

Ethics + scope

Ethics had a major impact on my research. The inclusion of children in the research was seen as crucial to receiving validation for my outcome and answering the research question. However, it was suggested that the consultation process required to work directly with children was too difficult and time-consuming within the scope of a Master's project. Children would have to be recruited through their teachers and parents. Furthermore, children could only give assent, not consent which would need to come from their parents. Recruitment of children via teachers may come with power imbalances (not to mention that many kids may not get invitation sheets to their parents). Recruitment would need to happen via parent-teacher teacher associates (PTA's) or school boards. The admin and associated

hurdles would have resulted in a lengthy process that was more suited to PhD level research. Therefore, I recruited teachers to test my prototypes in their class. There were limitations to this testing method. Firstly, I could not witness children's reactions first-hand. Therefore, I had to rely on teacher's reflections on the potential of the toolkit. Furthermore, the toolkit was not always utilised/tested for its potential to calm and self-regulate children with learning difficulties (some children used the objects for enjoyment purposes). Since I could not mediate how the kit was used in class, it was often not prioritised to those with learning difficulties and SPD. It is also worth considering that, given teachers only received the kit for one week, this might not have been enough time to provide an opportunity to try the kit in a wide variety of situations. Given more time, teachers could have been able to integrate the objects and storybook routinely and given better feedback on how it was used to intervene when a child was disconnected from learning.

Next Steps

It was understood that teachers valued my kit as an addition to their practice. However, the next necessary step to expand on the research, either in a PhD or outside of academic studies, would be to more thoroughly test the kit in helping children self-regulate to feel calm, alert and ready to learn. To do this, I would need to target my testing specifically with children who have significant learning difficulties in the schooling environment. Testing the kit with teacher aides would likely be valuable given they work closely with children in mainstream classes who have learning difficulties. Building on this, it would be beneficial to work directly with children in classrooms to better understand children's needs and assess first-hand their experiences with the kit. I feel that with a high level of thorough testing, the kit could develop into a product worthy of bringing to market for primary schools across New Zealand. As some teachers from prototype testing indicated, further research may also explore the kit's potential for other users. For instance, parents who have children with SPD and/or developmental conditions, early learning centres, special education facilities, hospitals etc.

Taking the research further, I believe the research could evolve into something more than a toolkit. In partnership with other disciplines (teachers, occupational therapists etc.), a holistic approach to mainstream classrooms could be taken to consider all the aspects of school (environment, people, learning practices etc.) that could adapt to help children with all different types of learning difficulties and conditions. Perhaps the outcome of this could be a new sensory classroom and learning system designed to lessen the gap between those who thrive in learning and those who struggle in a mainstream school classroom.



Garden Time!



e sensor
can help me fill
brain/j
right!



The garden h
me



so I can learn and do we







When it's lo
and I don't v
hold...

Boom!

block out the
creepy crow

palms,
my arms!



Hands
When I play in the garden!



When my brain is filled too little or too much,
it is hard to do schoolwork.



Like watering a flower,
I need just the right amount of water to feel good!

wave the stick and make the bird bobble!



blow long steady

So let's take a 5 minute break!



The sensory garden can help me fill
my brain just right!

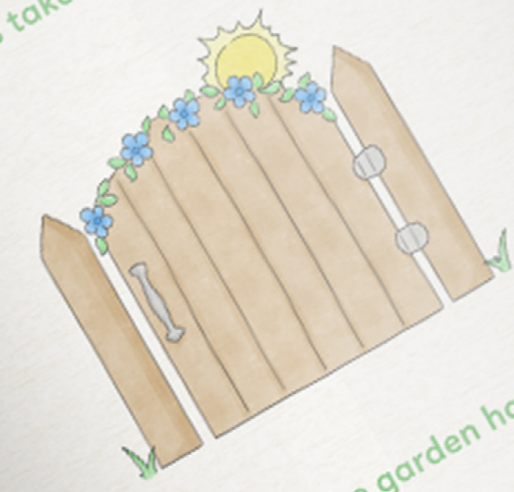
The garden
so I can learn and do



Garden Time!



Let's take a look inside,



and see what the garden has to hide!

When it's loud and noisy,
and I don't want to hear...



block out the sound with
creepy crawly ears!

When I feel upset, or tired and slow



watch the water
like watering





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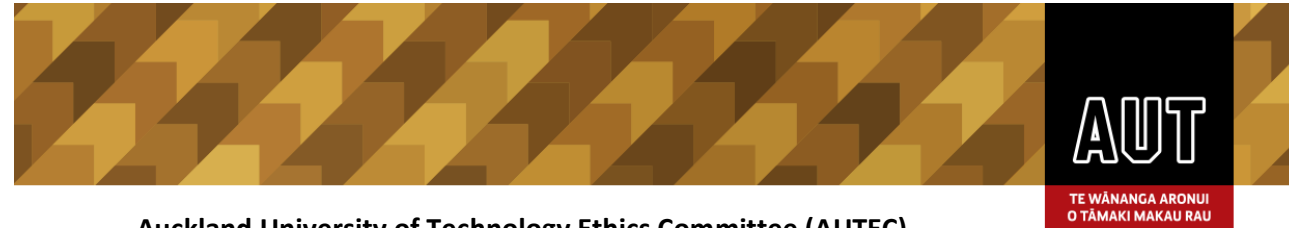
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Appendices



Auckland University of Technology Ethics Committee (AUTEK)

Auckland University of Technology
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T: +64 9 921 9999 ext. 8316
E: ethics@aut.ac.nz
www.aut.ac.nz/researchethics

2 September 2020

Stephen Reay
Faculty of Design and Creative Technologies

Dear Stephen

Re Ethics Application: **20/259 Sense of play: A study of using sensory objects to help children overcome sensory processing difficulties at school**

Thank you for providing evidence as requested, which satisfies the points raised by the Auckland University of Technology Ethics Committee (AUTEK).

Your ethics application has been approved for three years until 2 September 2023.

Standard Conditions of Approval

1. The research is to be undertaken in accordance with the [Auckland University of Technology Code of Conduct for Research](#) and as approved by AUTEK in this application.
2. A progress report is due annually on the anniversary of the approval date, using the EA2 form.
3. A final report is due at the expiration of the approval period, or, upon completion of project, using the EA3 form.
4. Any amendments to the project must be approved by AUTEK prior to being implemented. Amendments can be requested using the EA2 form.
5. Any serious or unexpected adverse events must be reported to AUTEK Secretariat as a matter of priority.
6. Any unforeseen events that might affect continued ethical acceptability of the project should also be reported to the AUTEK Secretariat as a matter of priority.
7. It is your responsibility to ensure that the spelling and grammar of documents being provided to participants or external organisations is of a high standard and that all the dates on the documents are updated.

AUTEK grants ethical approval only. You are responsible for obtaining management approval for access for your research from any institution or organisation at which your research is being conducted and you need to meet all ethical, legal, public health, and locality obligations or requirements for the jurisdictions in which the research is being undertaken.

Please quote the application number and title on all future correspondence related to this project.

For any enquiries please contact ethics@aut.ac.nz. The forms mentioned above are available online through <http://www.aut.ac.nz/research/researchethics>

(This is a computer-generated letter for which no signature is required)

The AUTEK Secretariat
Auckland University of Technology Ethics Committee

Cc: twp1707@autuni.ac.nz

Expert Recruitment Information Sheet

EXPERT INTERVIEW INFORMATION SHEET

DATE PRODUCED 14.08.2020

A Sense of Play

Using objects for sensory regulation to support children with sensory processing difficulties in the classroom

Hello, my name is Levon Hutchinson. I am currently a masters student studying product design at the Auckland University of Technology (AUT). I am interested in designing meaningful experiences that empower young people.



As part of my post graduate study, I am currently working on a research project that aims to explore how the introduction of objects in learning and play can help children with sensory processing difficulties maintain a calm and alert state in the classroom setting.

What is the purpose of this research?

I am interested in exploring how physical objects can support children with sensory processing difficulties. My solution should help children maintain a calm and alert state that enables them to focus, socialize, and learn effectively. The purpose of this research is to recognize some of the disruptive behaviours that may result from sensory processing difficulties and identifying factors that may cause children to behave in this way. With your help, the end outcome of the research will include product design prototypes which could be introduced in classrooms to help children overcome sensory challenges, and reach a calm and alert state suitable for learning. The results of this research will also be published in a master's thesis and an Honour's dissertation, which you will have access to once finished.

What will happen in this research?

You will be asked to offer 30-60 minutes of your time for the researcher to conduct an interview with you. This will take place in your workplace, or a public location that is most convenient to you, at a time and date that suits you. While New Zealand is undergoing lockdown due to COVID-19, all interviews will be conducted digitally (e.g. using Zoom/Skype) until AUT determines that that face to face interviews can progress safely. You will be asked about behaviours that make it difficult for children to engage in learning, and approaches that can help children who are sensitive to different types of sensory stimuli. You will also have the opportunity to view and share your opinion on my current design concepts (sketches and models) related to addressing disruptive behaviours through the use of sensory objects and activities. You may be able to critique concepts and suggest changes to develop designs which are more effective and suitable for the classroom.

What are the benefits?

I, the researcher, will benefit from this research by using the insights, learnings, and design outcomes to complete my qualifications. I will also benefit from the practise and experience of running a project like this. In return, I hope that you will benefit from the opportunity to contribute towards supporting children with sensory processing difficulties in the classroom. The outcomes produced from this research also have the potential to benefit children with sensory disorders, and the teachers working with these children.

How was I identified and why am I invited to participate in this research?

You have been invited to participate in this research as you have experience as an occupational therapist. I believe you might be able to suggest some valuable approaches used to help children who become over-alert or under-alert in their classroom environment. I am looking for participants that have experience regarding helping children with sensory processing difficulties, and can offer their knowledge to myself, the researcher.

If you would like to participate in this research, please get in touch with me, the researcher, Levon Hutchinson at 022 321 8781 or twp1707@autuni.ac.nz. Your participation in this research is voluntary (it is your choice) and whether or not you choose to participate will neither advantage nor disadvantage you. You are able to withdraw from the study at any time.

What are the discomforts and risks?

We have no intention of making you feel discomfort at any point; however, you have every right to respond that you would prefer not to answer any of our questions.

We don't expect there to be much discomfort or risk in this research. However, you may feel uncomfortable sharing your opinions, in which you have every right to respond that you would prefer not to answer any of the questions. You may also feel tired if the sessions are too long.

How will these discomforts and risks be alleviated?

The sessions have been designed to encourage casual conversation. However, you are free to not participate if you feel uncomfortable with any questions. You can also talk to myself, the research, at any time if you have questions or concerns about the interview. You can leave or withdraw from the interview at any time, no questions asked.

What are the costs of participating in this research?

There is no cost to you participating in this research other than the 30-60 minutes of your time.

How will my privacy be protected?

You will not be anonymous to myself, the researcher, and my supervisors, Steve Reay and Daniel Sutton. However, for my research documentation, your name will be removed from any documented findings for your privacy and protection. Everything that we collect during the interview will be kept for a minimum of six years and then destroyed.

Whom do I contact for further information about this research?

Please keep this Information Sheet and a copy of the Consent Form for future reference. You are also able to contact the research team:

Researcher:	Levon Hutchinson	twp1707@autuni.ac.nz
Project Supervisors:	Stephen Reay	stephen.reay@aut.ac.nz
	Daniel Sutton	dsutton@aut.ac.nz

What do I do if I have concerns about this research?

Any concerns regarding the nature of this project should be notified in the first instance to the Project Supervisors:

Stephen Reay stephen.reay@aut.ac.nz / 09 921 9999 ext 6719
Daniel Sutton dsutton@aut.ac.nz

Concerns regarding the conduct of the research should be notified to the Executive Secretary of AUTEK:

Dr Carina Meares ethics@aut.ac.nz / 921 9999 ext 6038

Teacher Recruitment Information Sheet

FOCUS GROUP INFORMATION SHEET

DATE PRODUCED 14.08.2020

A Sense of Play

Using objects for sensory regulation to support children with sensory processing difficulties in the classroom

Hello, my name is Levon Hutchinson. I am currently a masters student studying product design at the Auckland University of Technology (AUT). I am interested in designing meaningful experiences that empower young people.



As part of my post graduate study, I am currently working on a research project that aims to explore how the introduction of objects in learning and play can help children with sensory processing difficulties maintain a calm and alert state in the classroom setting.

What is the purpose of this research?

I am interested in exploring how physical objects can support children with sensory processing difficulties to achieve a calm and alert state that enables them to focus, socialize, and learn effectively. The purpose of this research is to identify some of the disruptive behaviours that may result from sensory processing difficulties and how this affects a teacher's practise. With your help, the end outcome of the research will include product design prototypes which could be introduced in classrooms to help children overcome sensory challenges, and reach a calm and alert state suitable for learning. The results of this research will also be published in a master's thesis and Honour's dissertation, which you will have access to once finished.

How was I identified and why am I invited to participate in this research?

You have been identified by the researcher, Levon Hutchinson, who contacted the principle of your school, who then forwarded this invitation to you. You are invited to participate in this research as you have experience teaching primary school-aged children and have expressed an interest in participating in this focus group or interview. I am looking for participants who can describe some of the challenges working with children who display disruptive behaviours or perhaps seem anxious in the school setting.

If you would like to participate in this research, please get in touch with me, the researcher, Levon Hutchinson at 022 321 8781 or twp1707@autuni.ac.nz. Your participation in this research is voluntary (it is your choice) and whether or not you choose to participate will neither advantage nor disadvantage you. You are able to withdraw from the study at any time.

What are the benefits?

I, the researcher, will benefit from this research by using the insights, learnings, and design outcomes to complete my qualifications. I will also benefit from the practise and experience of running a project like this. In return, I hope that you will benefit from the opportunity to contribute towards supporting children with sensory processing difficulties in the classroom. The outcomes produced from this research also have the potential to benefit children with sensory disorders, and any teachers working with these children.

What will happen in this research?

The focus group will be approximately 30-60 minutes long. This will take place in your workplace, or a public location that is most convenient to you, at a time and date that suits you. While New Zealand is undergoing lockdown due to COVID-19, all focus groups will be conducted digitally (e.g. using Zoom/Skype) until AUT determines that that face to face interviews can progress safely. You will be asked about problematic or disruptive behaviours you may encounter within the classroom and how this affects your practice. This could include sharing strategies you currently use to manage disruptive behaviours. You will also have the opportunity to look at and share your opinions on my current design concepts (sketches and models) related to addressing disruptive behaviours through the use of sensory objects and activities. You may be able to critique concepts and suggest changes to help develop designs which are more suitable for use in the classroom. These sessions may be conducted as a group with other teachers from the same school, or if preferred, one-on-one interviews with the researcher.

I would like to extend an invitation for you to take away some of my developed prototypes for you to reflect on how you might use them in a classroom situation if you chose to do so. You may take the prototypes you choose with you for a week and then will be asked some follow-up questions (either in person, via zoom, or email) regarding your reflections. Further information may be provided by emailing the researcher, Levon Hutchinson, at twp1707@autuni.ac.nz.

What are the discomforts and risks?

We have no intention of making you feel discomfort at any point; however, you have every right to respond that you would prefer not to answer any of our questions.

We don't expect there to be much discomfort or risk in this research. However, you may feel uncomfortable sharing your opinions in a group situation, in which you have every right to respond that you would prefer not to answer any of the questions. You may also feel tired if the sessions are too long.

How will these discomforts and risks be alleviated?

You may already know or be familiar with some of the other focus group participants, which we hope will make you feel more comfortable. The sessions are designed to encourage casual conversation. However, you are free to not participate if you feel uncomfortable with any questions. You can also talk to myself, the researcher, at any time if you have questions or concerns about the focus group. You can leave or withdraw from the workshop at any time, no questions asked.

Whom do I contact for further information about this research?

Please keep this Information Sheet and a copy of the Consent Form for future reference. You are also able to contact the research team:

Researcher:	Levon Hutchinson	twp1707@autuni.ac.nz
Project Supervisors:	Stephen Reay Daniel Sutton	stephen.reay@aut.ac.nz dsutton@aut.ac.nz

How will my privacy be protected?

You will not be anonymous to myself, the researcher, and other teachers participating in the focus group. This means people within the focus group will know your name and what you say. However, it is expected that you and the other focus group participants will respect each other and maintain each other's privacy and confidentiality. For my research documentation, your name will be removed from any documented findings for your privacy and protection. Everything that we collect during the workshop will be kept for a minimum of six years and then destroyed.

What are the costs of participating in this research?

There is no cost to you participating in this research other than the 30-60 minutes of your time. If you choose to take my prototypes to reflect on how they might be used in your teaching practice, it is entirely up to you to consider how you might do this and how long you might spend.

What do I do if I have concerns about this research?

Any concerns regarding the nature of this project should be notified in the first instance to the Project Supervisors:
Stephen Reay stephen.reay@aut.ac.nz / 09 921 9999 ext 6719
Daniel Sutton dsutton@aut.ac.nz

Concerns regarding the conduct of the research should be notified to the Executive Secretary of AUTEK:
Dr Carina Meares ethics@aut.ac.nz / 921 9999 ext 6038

Pre-written questions for Expert interview

What do they do?

So I just wanted to start by asking what exactly is it that you do? You work in special schools right?

What ages of children have you worked with/most commonly work with?

Do you work with children in a therapy room? classroom setting? Outdoor setting?

Are sensory processing difficulties something you commonly come across with the children you work with?

SPD Symptoms

Do most of the children you work with have other underlying conditions? What other conditions commonly come along with SPD? (ADHD, ASD etc.)

Since it's not classed as a 'diagnosed' condition, what are the showing signs or 'symptoms' you might commonly see for a child with sensory processing difficulties? There may be a lot, but are there some showing signs that are most common? How can you tell when a kid has SPD? Is it hard to tell?

From what I have read on so far, it seems most children have a mixed reactivity to sensory input, which as I understand it means they're neither exclusively hypo or hypersensitive to sensory input. Do most of the children you have worked with display mixed reactivity? Based on this, what are the most common behaviours you encounter with these children? What underlying factors cause children to behave in this way?

What would an over alert child look like? What would a under alert child look like? How is your approach different in terms of setting up their environment, the activities you do, how you communicate, the things you avoid etc.?

How is the avoidance of a child becoming over or under alert different to supporting them once they are over or under alert? For instance, would you tend to remove them from the environment they're in when they become distressed?

How is the way you communicate important? Do you use a lot of visual cues instead of language or writing?

AGE

Do you think SPD is just as common in the younger school age (5-8) as it is in the older school age (9-12)?

How do you think it is different in younger and older children? Are the sort of behaviours different in younger children, or perhaps younger children have more trouble managing their feelings independently?

Usage/Strategies

Do you have some go to strategies that you use with most of the children you work with to help them become calm and alert?

What are the sorts of strategies you use? Do you use a lot of physical tools and toys? Do you engage in play-based activities? What type of play works well? Outdoor play, playing with toys, constructing things etc.

Do have any popular themes that are great for engaging kids? E.g. characters, stories etc. Do you use many sensory tools with the kids you work with? If so, are there particular ones that work best?

What type of sensory input (tactile, visual etc.) would you commonly use to help a child? Does this change depending on their behaviour? If I was to target specific sensory techniques, which would be most needed? (which sensory stimulation is most effective for children)

How long would you ideally want to spend on one activity for a child with SPD?

Do you think most kids with sensory processing difficulties would be able to engage in a product independently? Or is this very much dependent on the child and whether they have other underlying conditions?

School Environment

Is there a specific place or time of day where children are most effected by SPD?

Do you think children are more often over alert or under alert at school?

Where are the main challenges for a child with SPD in the school environment? Is it the busyness and noise?

Do you think most teachers teaching in mainstream primary schools are aware of SPD?

Would you have any sort of 'go to' advice that you would give to a teacher who has a child with SPD in their class? By this I mean, what is the best thing they can do for that child? Or is it rather dependant on the conditions of the child?

When and how often do you think children would need some sort of sensory based activity?

Feedback on Prototypes

What is your opinion on this idea of creating a 'toolkit'?

Do you think my solution should remove them from what they are doing in the class (act as a learning task/game or calm down activity) or accompany them through class activity (perhaps something they can even take outside of class around school)?

What sort of themes would stick out to kids the most?

How do you think teachers should be integrated into my product? Do you think a system where the teach can give the child a certain sensory object based on their behaviour would work? Would this become stale quite quick for children?

Can behaviour relate to choosing the right strategy? Or should this be more so lead by the child experimenting with different things? Perhaps something more task/learning based?

If I was going to make a toolkit with different sensory elements, do you think it's important to have all types of sensory input included?

Pre-written questions for teacher interviews

Introduction

How long have you been working as a primary school teacher?

What age/s of children do you have experience teaching? What age are you currently teaching?

Do you have any children with diagnosed conditions? Any with sensory processing disorder?

Are you aware, and are most teachers aware, of what sensory processing disorder is?

Are the children with a diagnosis aware of their condition/how they are different?

Are you often accompanied by another adult/teaching aid in your class to help with these children? If so, how often?

Behaviours

Can you think of any sensory triggers that you know might affect any children in your class?

Do these triggers only effect your children with conditions or any children?

How do these sensory triggers effect their behaviour?

What are the differences in daily schedule and learning from your child/children with a diagnosed condition and those without? Do you have day planners for certain children? Do all children have this? Do children with diagnosis get more choice in terms of what they do? Is there more 'routine' for children with diagnosis?

What are some of the most common disruptive behaviours you find in the classroom aside from sensory behaviours?

Is there a certain time of day, class activity etc. that causes this? Is it leading into certain activities? Mat time?

Are these children aware when they are being disruptive and what causes it? Do you have anything to help them realise their disruptive behaviours?

Do you more commonly encounter under-alert behaviours (such as tired, sluggish, uninterested), or over-alert behaviours? (hyper-active, boisterous, anger etc.)

Is it normally a single child displaying these behaviours? And how does this effect the rest of the class?

Strategies

What strategies do you have to alleviate a single child's behaviours?

Do you try to address it early before it becomes a bigger problem, or can it be absorbed by the class? Do you use 'lead in' activities to alleviate?

What whole class 'calm down' activities do you have? Story time, mediation etc.

What individual 'calm down' activities do you have?

Do you incorporate any physical objects (such as toys) to help address disruptive behaviour?

When do these toys get used? If so, do other children become jealous?

Are there any themes, such as characters from movies, animals, race cars etc. that work well for engaging the age of children you teach?

Do you have an independent play or working space for children? Area for play?

Feedback on concepts

Where do you think there's an opportunity for these sorts of products? Based on when children are agitated or misbehaving and might need help regulating their emotions. Should it be designed as a 'lead in' or 'after learning' individual activity. Scheduled into routine? Maybe a 5 min exercise that can be integrated at random times in the day where a child might need calming down, or lifting up etc. Maybe something they can carry with them while doing any activity or on the mat? Like a fidget style activity? Maybe a class activity?

Would you use these/introduce these to all your children or exclusively to those with notable sensory difficulties?

Would it be something you would give to children, or they could get it themselves?

Do you use any models like the zones of regulation? And do you think this is something kids would be able to learn at that age level? Are there any similar models to this you use in your classroom?

Are there any underlying factors you'd look for before buying a kit of this nature for your classroom? Is there a cost it should be within? certain materials you wouldn't want in the classroom?

Teacher Survey Questions Sheet

Introduction

How long have you been working as a teacher and/or teacher aid?

What age/s of children do you have experience working with? What age are you currently working with?

Do you manage any children with diagnosed conditions? Any with sensory processing disorder?

Do you work in the same class all year?

Behaviours

Can you think of any sensory triggers that you know might affect any children in your class? Things like lighting? Noise? Smells? Movement in the room? etc.

How do these sensory triggers effect their behaviour? Is it hard to tell when their behaviour is affected by sensory triggers?

How is the structure of the day different for children with a diagnosis/special needs compared to the rest of the class?

Aside from sensory behaviours, what are some of the most common disruptive behaviours you find in the classroom? Is there a certain time of day, class activity, mat time etc. that behaviour is the worst?

Are there a few specific children in the class which perhaps misbehave the most or are harder to focus?

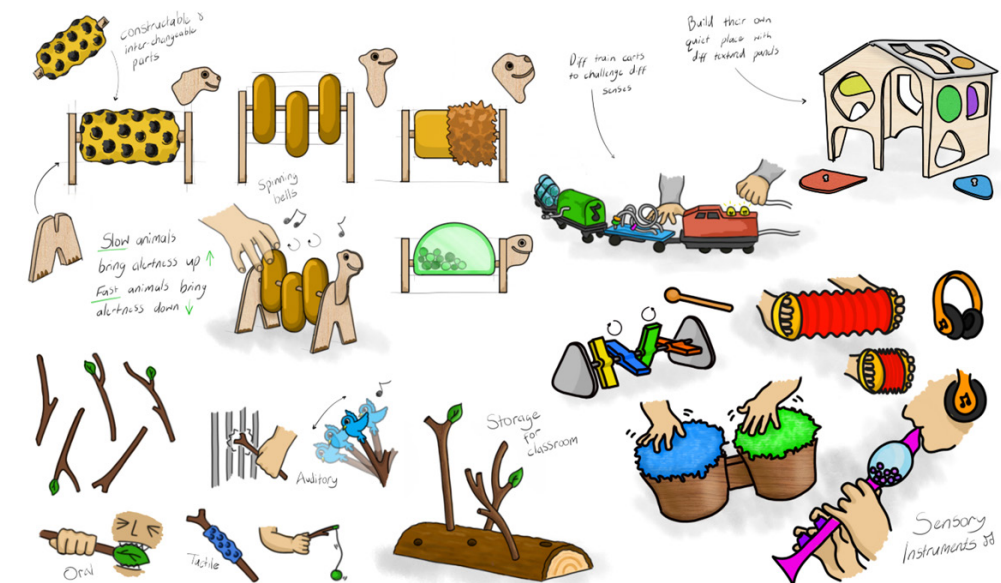
Are these children made aware when they are misbehaving/not calm and focused? Do you have any resources to help them realise their disruptive behaviours?

Strategies

What strategies do you have to calm down/focus/manage the behaviour of an individual child? Is there somewhere specific in the classroom they can go to calm down?

Do the child use many physical objects (such as toys) in your class? When do they have the opportunity to use these? Are there restrictions on them?

Any recourses you use regularly that you find very effective to help children manage their behaviour/emotions? Any resources you have seen that you wish you had available?



Feedback

Here are some sketches and models I have produced over the past month. Its mostly a collection of random ideas at this point, but what I am hoping to produce by the end is a toolkit of objects designed to regulate the senses in different ways in order help children stay calm and focused. This might be something they can hold/squeeze, some they can shake and rattle, something calming they can watch, something they can smell, something they can hold over their ears (for those who don't like noise) etc. I understand that sensory processing disorder as a condition isn't commonly diagnosed in children, so I envision this kit generally being used to support children with special conditions, anxiety, or even kids that are just too fidgety at mat time.

My main question for teachers and teaching aids like yourself is how and when would you use this in the classroom? Based on when children are agitated/misbehaving/not focused, when would they need this kit? Should it be designed as a 'lead in' or 'after learning' individual activity. Scheduled into routine? Maybe a 5 min exercise that can be integrated at random times in the day where a child might need calming down, or lifting up etc. Maybe something they can carry with them while doing any activity or on the mat? Like a fidget style activity?

Your thoughts on this?

Would you use these/introduce these to all the children in class or exclusively to those with special conditions?

Would it be something you would give to children, or they could get it themselves? Would it be stored somewhere they can grab it?

I have thought about integrating some sort of story or teaching resource into it, something with a similar motive to the 'calm down' thermometers if you have seen those. This could help children identify when they should use it and how the objects can be used. Any thoughts on this as an idea to be paired with the kit?