Tobbe

Bringing trust, warmth, and understanding into the bathroom wellness experience of people with an intellectual disability.

M1.1 Design project
Inclusive Design & Thoughtful Technology

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PROLOGUE

People all over the world enjoy the wellness experience of bathing. But not everyone has the same soothing experience. A large percentage of people with an intellectual disability (ID) are required to wear a floatation device whilst taking a bath. These floatation devices are, rightly so, designed with safety first. What if they would be designed with comfort as well?

In this report, we present Tobbe, an innovative design solution that is aimed at improving the wellness experience of bathing for people with an intellectual disability. Due to the distinct responsibility that comes with designing for this vulnerable target group, various perspectives have been incorporated into the project in order to attain a holistic understanding. Consequently, throughout Tobbe's development, a special focus was laid on establishing an extensive understanding of the target user, resulting in being able to prioritize form, texture, and sensory inclusion.

We invite you to join us as we delve into the development journey of Tobbe, where we uncover the thoughtfulness behind every design decision, and highlight the impact of how bathing with a comfortable floatation device could improve the experience of wellness for intellectually disabled individuals.

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DESIGN BRIEF

The realization of this project is a result of the collaboration between Oro, a healthcare organization accommodating houses for people with intellectual disabilities or developmental delays, and the TU/e. With the completion of new construction buildings, Oro has encountered a novel challenge aiming to enhance the bathroom wellness experience for its residents. From Oro's perspective, the handed-out project was constructed in response to the noticeable positive emotions experienced by their residents in the bathroom, and aims to address the evolving needs and preferences of these residents in light of the updated facilities.

Dutch

WELLNESS ERVARING

Hoe kunnen we door middel van techniek meer wellness -beleving in de badkamer realizeren?

Binnen ORO zijn er veel cliënten die kunnen genieten van een warm bad. Deze opdracht wordt breed ingezet met als belangrijkste doel de cliënt (nog) meer te laten genieten van haar of zijn bad of douche moment. Voorbeeld: Een jongvolwassen persoon gaat het liefst dagelijks naar de Efteling. Geniet daar intens van de sfeer, geluiden en persona's die daar rondlopen. Hoe kunnen we die sfeer terug laten komen tijdens zo'n bad moment?

English

WELLNESS EXPERIENCE

How can we use technology to achieve a (better) wellness experience in the bathroom?

Within ORO there are many clients who can enjoy a warm bath. This assignment is widely used with the main aim of allowing the client to enjoy her or his bath or shower moment (even) more. Example: A young adult person prefers to go to Efteling every day. Intensely enjoy the atmosphere, sounds and personas that walk around there. How can we bring back that atmosphere during such a bad moment?

INTRODUCTION

Individuals with profound intellectual disabilities typically require lifelong intensive support and supervision in their daily lives and often rely on full-time attendants or caregivers to assist with basic life skills such as eating, sleeping, and bathing (Belva & Mason, 2013). Additionally, they may need various assistive devices and equipment that help them maintain or improve their independence and overall well-being (Khasnabis, Mirza & MacLachlan, 2015). For instance, at the Dutch healthcare facility Oro (Figure 1), a swimming collar is commonly used to prevent accidental submersion and drowning risks during the bathing experience. Building upon this given information, our collaborative partner Niels van den Broek, Domotica specialist at Oro, has said that 8 out of 10 residents in their care facilities use a swimming collar during bathing to ensure safety. These numbers provide valuable insights into the weight of influence that this interaction provides during the bathing process within Oro's care facilities as a whole. Namely, given that the variable of wearing a swimming collar comes into play for the individuals who are required to wear it during each bathing session, this factor assumes a significant role in shaping the overall wellness experience.

While the use of a swimming collar in the bathroom effectively addresses safety concerns for disabled individuals, it may overlook their essential emotional experiences, such as happiness and comfort. Although functionality and safety are paramount, there has been limited attention given to comfort and overall well-being in the current implemented design. Nevertheless, bathing should be an experience of relaxation and enjoyment, free from any restrictions or limitations, especially for individuals who require safety assistance. Moreover, research indicates that emotional experiences play a significant role in the care of vulnerable populations, such as individuals with intellectual disabilities (De Bruijn et al., 2021). According to the provided information on the emotional experience of people with intellectual disability by Bermjo et al., the manner in which people with an intellectual disability express basic emotions in terms of happy-sad and calm-nervous is very similar to that of the general population (Bermejo et al., 2014). As a consequence, caregivers are able to assess the emotions of intellectually disabled people validly (De Bruijn et al., 2021).With this in mind, during the project, the aim was set on exploring innovative shapes, textures, and materials to enhance comfort during bathing using the general population as an emotional indicator.

Drawing from extensive research and usability testing, we have created a prototype that not only provides individuals with intellectual disabilities basic safety protection, but also offers a sense of trust, warmth, and understanding during the bathing routine. The established primary objective during the project journey is to ensure that individuals with profound intellectual disabilities can experience a bathing routine that surpasses mere safety measures, creating a shift into considering comfort, emotions as well as overall well-being within the complete bathing experience. This transformative approach has been initiated with the iteration of the swimming collar aspect as an integral component.

Figure 1. Oro Rijtven Deurne (Oro, 2023)

LITERATURE

The context of wellness

To establish a design approach within the wellness sector, it is imperative to initially grasp its definition and the context that can be associated with it. According to the educational paper 'Defining wellness and its determinants', wellness can be described as a holistic state of well-being encompassing physical, mental, and social dimensions (Foster, 2017). Looking back at the origin of the term, the subjectivity of wellness can be explained. The transformation in the health definition toward a more holistic perspective in 1999 has led to wellness expanding beyond the mere absence of illness, and emphasizing the proactive pursuit of optimal health and vitality (Foster, 2017). Therefore, subsequent to this transformation, additional elements such as lifestyle choices, environmental factors, social support, and individual resilience are regarded as variables within the determinants of wellness today (Foster, 2017).

Many researchers have investigated and defined the different aspects, or interconnected domains, that make up the subjective concept of wellness (Table 1). Defining specific areas in which wellness plays a factor in human life has been valuable for understanding which factors could be affected within the user journey of the wellness project. The seven main dimensions that key researchers have identified to define wellness are listed as the following: physical; emotional/psychological; social; intellectual; spiritual; occupational; and environmental (Foster, 2017).

Intellectual disability

Directing our attention specifically to the wellness context in relation to people with an intellectual disability resulted in additional insights that required attention. Given the limited communication abilities and cognitive functioning of the people that are living at the facilities of Oro, wellness, according to an investigation of primary care by Doody et al., focuses on their overall well-being and quality of life, and entails a twofold approach (Doody et al., 2012). Firstly, ensuring their physical health and comfort, such as maintaining proper nutrition, hygiene, and addressing any medical concerns can be considered primary needs for wellness (Doody et al., 2012). Establishing this fundamental foundation requires external heteronomous care, and is crucial to setting the stage for the subsequent dimensions of wellness to have a meaningful impact (Table 1) (Doody et al., 2012). The second approach to reaching a positive wellness experience for people with ID centers on creating opportunities for emotional expression, which in result, enables a deeper understanding of the emotional well-being from the perspective of caregivers (Adams & Olivier, 2011). Referring back to the study conducted by Doody et al., this need for emotional expression is justified by multiple barriers in daily circumstances, both from the healthcare worker's perspective and the 'client', the person with ID (Figure 2).

With this framework in mind, the significance of sensory experiences emerges as a critical factor to consider. Sensory experiences have the potential to evoke and nurture emotional expression, resulting in the justification of the wellness experience (Schmidt, 2022). On top of that, people with intellectual disabilities are often more prone to sensory experiences due to the unique way their brains process and perceive sensory information

	Physical	Emotional Psychological	Social	Intellectual	Spiritual	Occupational	Environmental
Adams et al., 1997	x	x	x	x	x	x	
Anspaugh et al., 2004	x	x	x	x	x	x	x
Crose et al., 1992	x	x	x	x	x	x	
Durlak, 2000	x		x	x			
Hales, 2005	x	x	x	x	x	x	x
Helliwell, 2005	x	x	x		x	x	x
Hettler, 1980	x	x	x	x	x		
Leafgren, 1990	x	x	x	x	x	x	
Renger et al., 2000	x	x	x	x	x		x
Ryan and Deci, 2001	x	x					x
Ryff and Singer, 2006	x	x	x				x

Table 1. Dimensions of wellness (Foster, 2017)

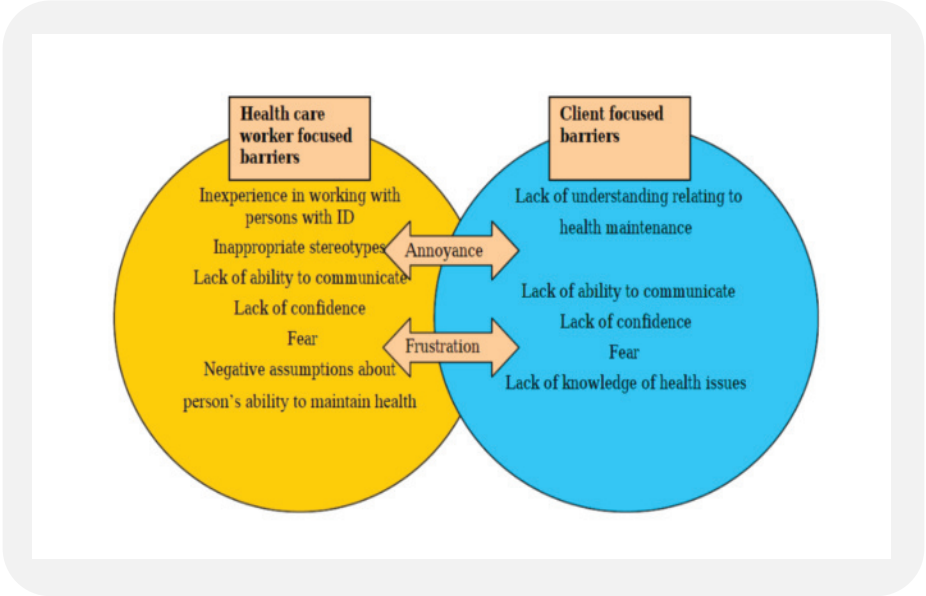

Figure 2. Healthcare worker and Client focused barriers (Doody et al., 2012)

(Abacus Healthcare, 2022). Dr. Jacques Michaud, a researcher and professor of pediatrics and neuroscience at Université de Montréal, discovered i.e. in 2007 that the SYNGAP1 gene, associated with intellectual disability and epilepsy, may also explain for the hypersensitivity to sound or touch (Scientifique En Chef, 2022). Helping individuals with an intellectual disability in relation to wellness, therefore, acquires specific attention to the senses.

The physical & mental effects of bathing

According to an intervention study that investigated the psychical and mental effects of bathing, both bathing and showering interventions showed health improvement; lower levels of perceived stress and higher levels of mood and emotional well-being has been reported (Goto et al., 2018). The levels of perceived stress, mood, and emotional well-being, however, showed significantly better benefits for the bathing intervention compared to the shower intervention (Goto et al., 2018). The bathing intervention, therefore, also shows a better subjective health status (VAS scores) (Goto et al., 2018). In addition to the mental health benefits, the study also concluded that bathing was associated with improvements in physical health; participants in the bathing group had lower levels of blood pressure and higher levels of heart rate variability, a marker of cardiovascular health (Goto et al., 2018). Furthermore, cross-sectional studies have concluded the impact of bathing every day in accordance with people who incorporated bathing into their daily routine (Goto et al., 2018). Here again, favorable outcomes of acquiring a good subjective health status, sufficient sleep and rest, low levels of stress, and high subjective happiness has been discovered.

Bathing with an Intellectual disability

Optimizing the bathing experience for individuals with an intellectual disability involves taking their sensory processing into account (Abacus Healthcare, 2022). In the research performed by Winnie Dunn et al., an aim was set on letting children participate successfully in everyday life by using sensory processing knowledge. Within the study, sensory thresholds revealed significant findings regarding how individuals with different sensory processing patterns, such as autism, ADHD, as well as developmental and learning disabilities, respond to sensory stimuli (Abacus Healthcare, 2022).

The implied threshold notion refers to a point at which a sensory input can be recognized on a neurological level (Ward, 2022). Divergents in this phenomenon have resulted in people possessing an intellectual disability, according to the study of Winnie Dunn et al., into four distinct patterns of sensory processing; sensory sensitivity, sensory avoiding, sensory seeking, and low registration (Abacus Healthcare, 2022). In accordance with this understanding, the concept of self-regulation is important to consider, implying the manner in which the person copes with these high sensory thresholds or low sensory thresholds. An overview of the 4 different patterns of sensory processing in relation to their self-regulation strategies can be seen in Figure 3.

Figure 3. Patterns of sensory processing (Abacus Healthcare, 2022)

Focusing on the bathing ritual for people with ID, this knowledge is valuable to understand the characteristics of vulnerable individuals with an intellectual disability. According to the same research conducted by Winnie Dunn et al., there are different strategies that could be applied in order to optimize the bathing experience for each different pattern of sensory processing (Figure 4,5,6,7)(Abacus Healthcare, 2022). During the ideation session, this information was utilized specifically in the user journey including both the target user and the caregiver, incorporating a new ritual that takes the identified patterns of sensory processing into account.

Maslow's Hierarchy of Needs - Safety

According to Maslow's Hierarchy of Needs theory, human motivation is driven by unfulfilled needs arranged in a hierarchical order (Figure 8)(Kanushkina, 2020). The psychological theory suggests that lower-level needs must be fulfilled before higher-level needs can be addressed (The Interaction Design Foundation, 2023). At the base of the pyramid, the basic physiological needs are illustrated: food, water, rest, and warmth (Kanushkina, 2020). Directly above them, once an individual's physiological requirements are satisfied, the need for a safe environment is listed (Kanushkina,

Sense:	Strategy:
Touch	Using rough and various textured wash cloths, towels and soap, increased pressure when drying
Movement	Use sprayer to vary water temperature. Place bath toys out of easy reach. Prior to bath time, encourage movement and activity.
Visual	Incorporate soap crayons into routine, dry in front of a mirror to help with planning
Auditory	Provide lively music, singing during bathing
Smell	Scented bath products

Figure 4. Low registration (Abacus Healthcare, 2022)

Senses:	Strategies:
Touch	Use rough and various textured wash cloths, soap and towels, provide deeper pressure touch with massage attachment on shower head and when drying with a towel
Movement	Place toys/ wash items out of reach. Prior to bath time encouraging movement.
Visual	Colour bath bombs, soap crayons, colour lights, dry in front of a mirror to help with planning
Auditory	Provide loud music/ singing during bath time
Smell	Scented bath products

Figure 5. Sensory seeking (Abacus Healthcare, 2022)

Senses:	Strategies:
Touch	Use contact knit for wash cloth and towelling. Press soap bar directly on skin. Consider a shower as they may not tolerate water moving over body in different directions in a bath.
Movement	Pick one position and stick with it. No bending over/ moving. Using bathing rails to get in and out of the bath more comfortably. Hand held shower nozzle so not tipping their heads.
Visual	Dim lights, be aware of reflective nature of metals in the bathroom
Auditory	Close bath door. Draw bath before child is in the bathroom. Using ear plugs to prevent water going in the ears and echo sound of bathroom.
Smell	Use unscented soaps/ lotions

Figure 6. Sensory avoiding (Abacus Healthcare, 2022)

Senses:	Strategies:
Touch	Press firmly on child's skin
Movement	Pick 1 stable position for bathing
Visual	Limit 1 or 2 toys
Auditory	Play soft background music
Smell	Identify scents child likes to incorporate them

Figure 7. Sensory sensitivity (Abacus Healthcare, 2022)

2020). According to Maslow, the need for safety is often manifested in the 'fight or flight' response; "environmental information is used to determine whether we are safe – in which case, we will usually stay – or unsafe – which will typically encourage us to leave (i.e. flight) or attempt to change our current circumstance (i.e. fight)" (The Interaction Design Foundation, 2023). Accordingly, when environmental information suggests there is some potential threat, we experience an emotional response, preparing us for action (The Interaction Design Foundation, 2023).

Within the design process of designing a new iterated version of a safety collar, it is crucial that the safety aspect is considered and the emotional response of fight or flight will not be activated. Moreover, safety can be considered the roadway to allaying fears and moving a step closer to gaining the user's trust, a term that is next to 'understanding' and 'warmth' established in the *Geborgenheid* definition within this project (The Interaction Design Foundation, 2023).

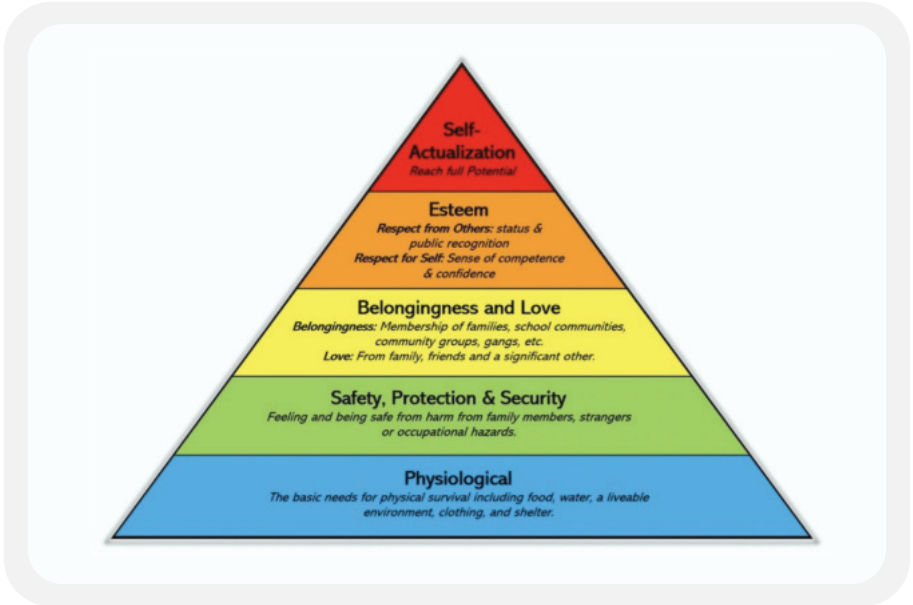

Figure 8. Maslow's Hierarchy of Needs (Kanushkina, 2020)

RELATED WORK

When designing environments and using items for individuals with intellectual disabilities, factors such as materials, colors, sounds, and space need to be taken into consideration. It is important to prioritize safety and flexibility while also creating a sense of calmness and happiness for them, in order to reduce the anxiety, tension, or feelings of depression that they may experience in unfamiliar situations (Jebril & Chen, 2021). Selecting neutral colors and incorporating natural materials, can greatly enhance the feeling of ease and comfort for individuals, especially for people who are prone to anxiety and uneasiness (López & Díaz, 2022). Specifically focusing on color, blue has consistently been identified as the hue that best symbolizes calmness and peace (López & Díaz, 2022). Additionally, among the various elements examined, texture has been found to elicit more positive emotions in respondents within the studied concepts. Soft textiles like cotton, polyester, linen, and wool are particularly recognized for their ability to evoke positive feelings and create associations with coziness, a sense of home, and cleanliness (López & Díaz, 2022). The subsequent designs showcase the utilization of tactile sensation, enveloping feeling, and visual color as common elements that enhance the overall user experience.

1. Snoezle mobiel (controlled multisensory environment, MSE)

Snoezel is a well-known therapy in healthcare designed for individuals with autism, developmental disabilities, dementia, or brain injury (ZorgInnovatiel, 2020) (Masonic Home NY, 2023)(Figure 9,10). The term "Snoezel" combines the words "sniffing" and "dozing". A Snoezel room is equipped with a variety of multi-sensory elements, including lighting, sounds, and tactile items. The main objective is to provide users with maximum pleasure and engagement in the activities facilitated by the caregiver. The specially designed sensory environment of a Snoezel room induces both physical and emotional changes, promoting relaxation and reducing anxiety or pain. Its primary goal is to enhance an individual's ability to focus, engage with motivational

stimuli, and ultimately improve communication and functioning. Originating in the Netherlands in the 1970s, Snoezel rooms have gained global recognition and can now be found in institutions worldwide (Wikipedia, (n.d.)).

Figure 9. Snoezle mobiel (ZorgInnovatiel, 2020)

Figure 10. Snoezelen room (Masonic Home NY, 2023)

2. Residence Inn by Marriott in Cambridge (Hotel)

Residence Inn by Marriott in Cambridge has taken color contrast into careful consideration for its senior audience (Thornell & Skift, 2022). They have installed Sensory Suites that incorporate soothing shades of blue (Figure 11). These Sensory Suites are designed to provide support to children with autism, attention deficit hyperactivity disorder, and other disabilities who may require assistance with relaxation or sleep. Each suite is equipped with features such as a projectable changing light, a HugglePod, and a sensory mat (Figure 12,13). Additionally, guests are provided with take-home gifts, including a worry rock, a fidget spinner, and the book "Why Does Izzy Cover Her Ears".

Figure 11. Sensory suite (Thornell & Skift, 2022)

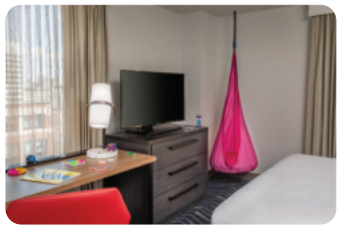

Figure 12. Hugglepod (Thornell & Skift, 2022)

Figure 13. Hugglepod (Hearthsong. (n.d.))

3. Bath Crayons Set With 6 Colors & Sponge - Kitpas

The Bath Crayons Set With 6 Colors & Sponge is a bathing product provided by Kitpas Japan, a Japanese company that values inclusivity and supports employees with intellectual disabilities (Kitpas Japan, (n.d.)) (Figure 14). They have adapted their manufacturing methods and work environment to create opportunities for individuals with different abilities, aiming to bring happiness and satisfaction to their workforce. The Bath Crayons Set includes a waterproof mesh holder that can be easily attached to the bathroom wall. It also features special crayons that allow users to draw on wet surfaces, adding an element of fun to bath time for individuals with intellectual disabilities.

Figure 14. Bath crayons (Kitpas Japan, (n.d.))

BENCHMARKING

Delving deeper into existing safety collars or body-related products for bathing, we can classify these products using the "body-neck" axis on the horizontal and the "comfort-safety" axis on the vertical (Figure 15). Oro's current product is included in the quadrant analysis. Taking the example of safety collars, as depicted in the diagram, it is evident that the majority of these products primarily focus on safety aspects. However, they often

overlook the essential features necessary to provide comfort, such as being excessively rigid, consisting of ill-fitting shapes, and having a tight neck coverage.

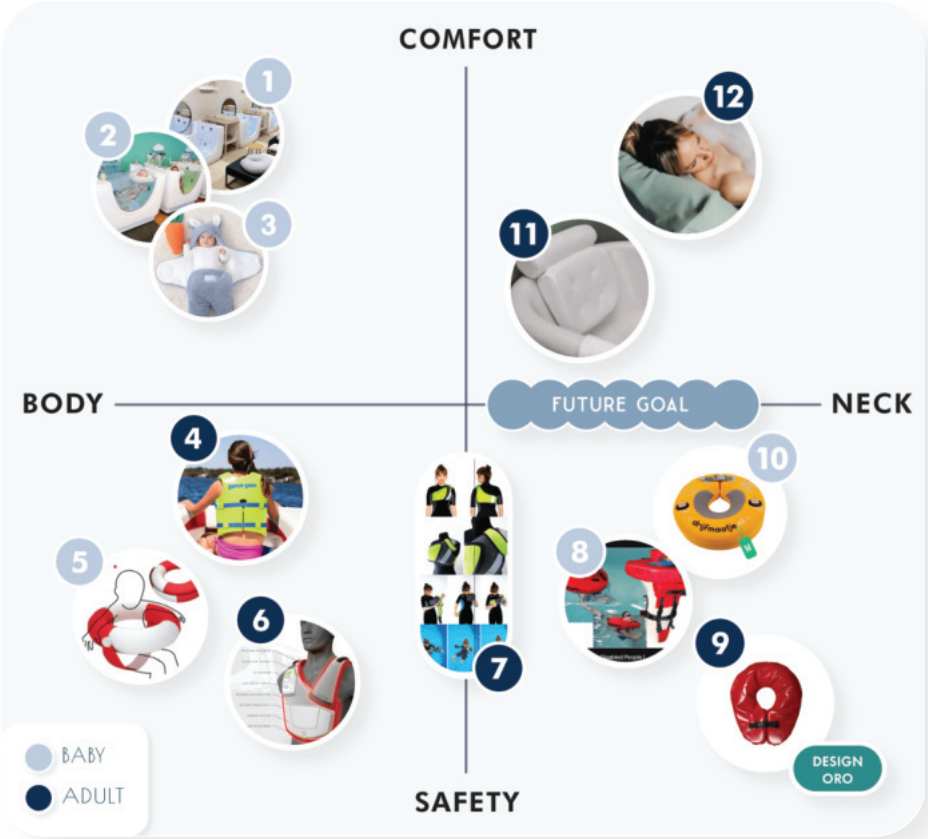

Figure 15. Comparison of existing safety collars and bathing products

1. IUW flotation device

IUW is a flotation device created by Polish product designer Julia Grochal, specifically designed for water sports (Designboom, 2016) (Figure 16). This innovative product combines the features of a sport lifejacket and a throwable device, ensuring compliance with safety regulations outlined by the SOLAS convention (Mettler Toledo, 2016) —an international maritime treaty focused on the safety of life at sea. The primary objective behind this design was to create an invention that would encourage more individuals to engage in water-based activities while prioritizing their safety.

Figure 16. IUW flotation device (Designboom, 2016)

2. Life Jacket-Vertical for disabled people

The Life Jacket-Vertical is a product specifically designed to effectively support an individual in a vertical position (Life Jacket-Adapted Inc., 2023) (Figure 17). It caters to the specific needs of clients with multiple disabilities by providing enhanced stability in cases of involuntary movements, exaggerated startle reflexes, muscle cramps, stiffness, spasms, or seizures. The design ensures that the face remains out of the water, and it has a remarkable ability to instantly keep the body in a vertical position, promoting safety and security.

Figure 17. Life Jacket-Vertical (Life Jacket-Adapted Inc., 2023)

3. Bath pillows | Baby blankets

On the other hand, products such as bath pillows (Figure 18) and baby blankets (Figure 19) are specifically designed to offer a comfortable and relaxing experience. Bath pillows are created with soft materials and ergonomic shapes that conform to the contours of the body, providing support and comfort during bathing (MomJunction, 2023). Baby blankets, on the other hand, are made of thick, cozy, and stretchy materials like 100% Polyester Fleece, ensuring optimal warmth and comfort for infants (TurtleTub, 2022). However, it is important to acknowledge that the primary emphasis of these products is not on safety.

Figure 18. Bath Pillow (MomJunction, 2023)

Figure 19. Baby bath blanket (TurtleTub, 2022)

Based on the above case studies, when designing products for individuals with intellectual disabilities, we believe that the most important aspect is resolving the issue of prioritizing safety without compromising comfort, and ensuring comfort without sacrificing safety features. It is crucial to consider design elements that promote calmness, relaxation, and anxiety reduction for the target population's specific needs. This includes factors such as neutral colors, soft and tactile materials, and proper coverage, in order to achieve positive user feedback.

UNDERSTANDING

To properly gain insights into the user and their context, we place emphasis on what we call understanding - relating to comprehension of the design space. In our process, this happened in two distinct phases: initial understanding and revised understanding. It is important to note these distinct phases, as it holds parallels to the design decisions and design directive.

Initial understanding

This initial understanding was mainly based on the third-person perspective, deriving the wants and needs of the target group from Oro's supplementary information, and the design brief itself. As a result, within this 4-week time frame, the pressure cooker method as well as the beginning of the ideation phase were established mostly on assumptions, and a limitation in the needed deeper analysis was noticed.

Understanding

We are designing for intellectually disabled people, who do not have any comorbidities, and are relatively independent. A small section of this group experiences issues in human-to-human interaction as well as daily life tasks. The target user lives in a group home assisted by caregivers, where the bathroom is a shared space. A visual representation of the initial understanding is illustrated in Appendix H.

Revised understanding

The revised understanding was initiated after incorporating the second-person perspective by meeting with the challenge owners, and later having a site visit to deepen the understanding of both the context and user. Primarily, by incorporating the second-person perspective, we were driven to transition from designing for entertainment purposes to iterating the existing swimming collar design. The remaining project duration based its method on the revised understanding, leading to a final suitable design solution.

Understanding

We are designing for intellectually disabled people with a mental age between 0 and 1 years old, who have comorbidities, of which the majority suffer from impairment in movement. The target user lives in a group home assisted by caregivers, where there is both a personal bathroom with a shower and a shared bathroom destined for bathing. A visual representation of the revised understanding is illustrated in Appendix I.

METHODOLOGY

Our design process holds parallels with the Double Diamond design methodology, incorporating iterative cycles of divergence and convergence building upon one another. Throughout the process, we used a variety of methods to get to our insights. This chapter highlights the followed steps with their subresults, elaborates on pivotal design decisions, and introduces the final design concept.

Pressure cooker

To initiate the design journey, a one-week pressure cooker method was utilized, where the steps; *empathize*, *define*, *ideate*, *prototype*, and *test* were followed. Building upon the initial understanding and utilizing a third-person perspective, we defined the needs of the user, conducted a free-form ideation session (Figure 20), developed a Lo-Fi prototype (Figure 21), and internally tested the concept (Figure 22). Additionally, we engaged in a discussion

Figure 20. Free-form ideation session

regarding the created concepts, focusing on aspects of *independence*, *practical notions*, *physical environment*, *reward-based representation*, *general ambiance*, and *personalization*.

Results

Highlighting one of the most prominent bathroom features, namely the shower, resulted in touching upon 3 specified concepts; *independence*, *physical environment*, and *reward-based representation*. As the shower can be considered a place of independence in the general experience, it is up to the user to turn off the water and step out of a warm steaming cabinet, into the colder bathroom. Although different scenarios could influence the exact moment when this shift from environments occurs, creating a transition to making the experience of stepping out of the shower rewarding can result in making it easier for people to independently choose when they will make this transition (Figure 20).

During the prototyping stage of the pressure cooker, this exploration has been materialized into the design concept Hugsy, an inviting and posable standing towel that embraces you while drying off, aiming to provide individuals with a comforting experience when stepping out of the shower (Figure 21). In order to practically achieve this comforting sensation, an embodied exploration session has been conducted (Tomico et al., 2017). During the enactment of the experience within the testing phase of the pressure cooker, various heights and positions were explored. In addition, the person embodying the design was either moving her arms, remaining stiff, or acting malleable (Figure 22). A clear preference during the embodied exploration testing stage was noticed regarding the design being malleable, and giving in to the movements the user was making.

Figure 21. Lo-Fi prototype

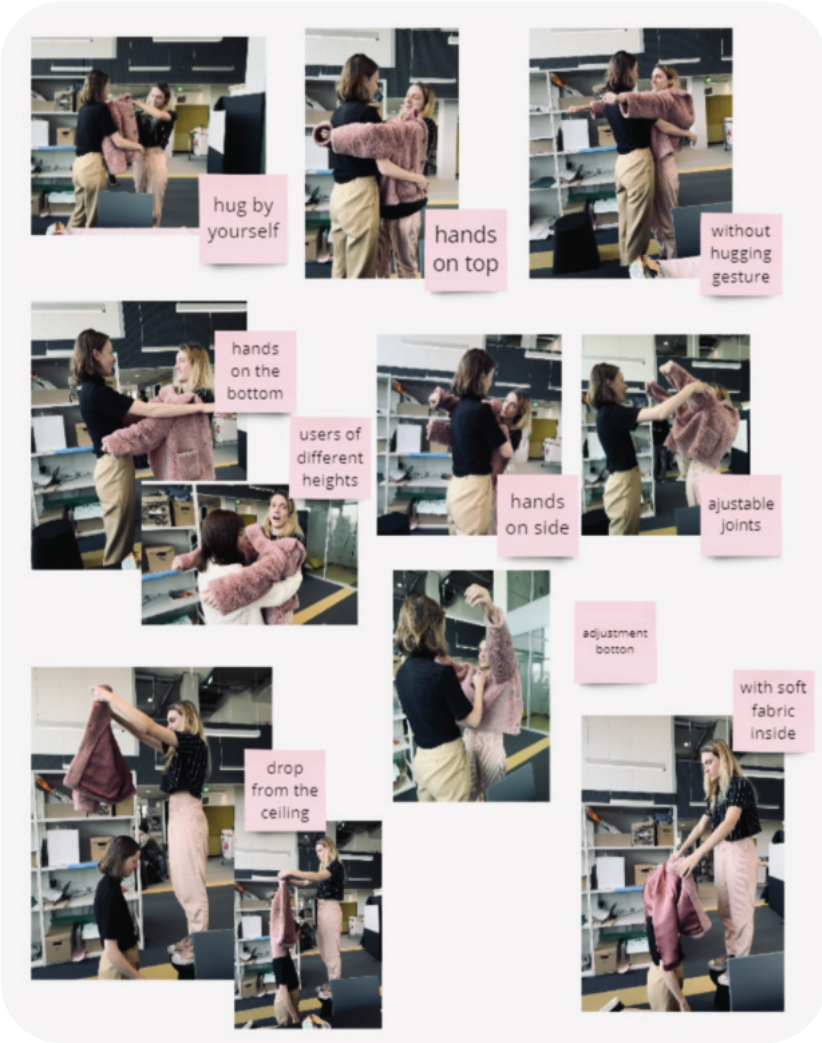

Figure 22. Testing the desing concept

IDEATION PHASE 1

The relatively extensive ideation period undertaken in the design project can be divided into two phases corresponding with the initial and revised understanding. Starting with phase 1, a focus was set on increasing the independence of intellectually disabled people in the bathroom. This vision has been established as a consequence of third-person perspective research focussing on The United Nations declaring that people with ID should be enabled to live as independently as possible, and a greater level of independence has been related to increased feelings of happiness, satisfaction (Haigh et al., 2013) and higher quality of life (Dollar et al., 2012; Sigafoos et al., 2005). Consequently, the design challenge that has been established in this ideation period has been the following;

"*How might we enhance the independency in a group assisted living bathroom by creating a more personal wellness experience (in the context of Oro)?*"

With this design challenge in mind, multiple ideation sketches had been created (Figure 23), such as guiding the person with ID through the bathing routine with spotlights (Sketch 1), or implementing an interactive talking friend in the shape of a whale on the wall (Sketch 8).

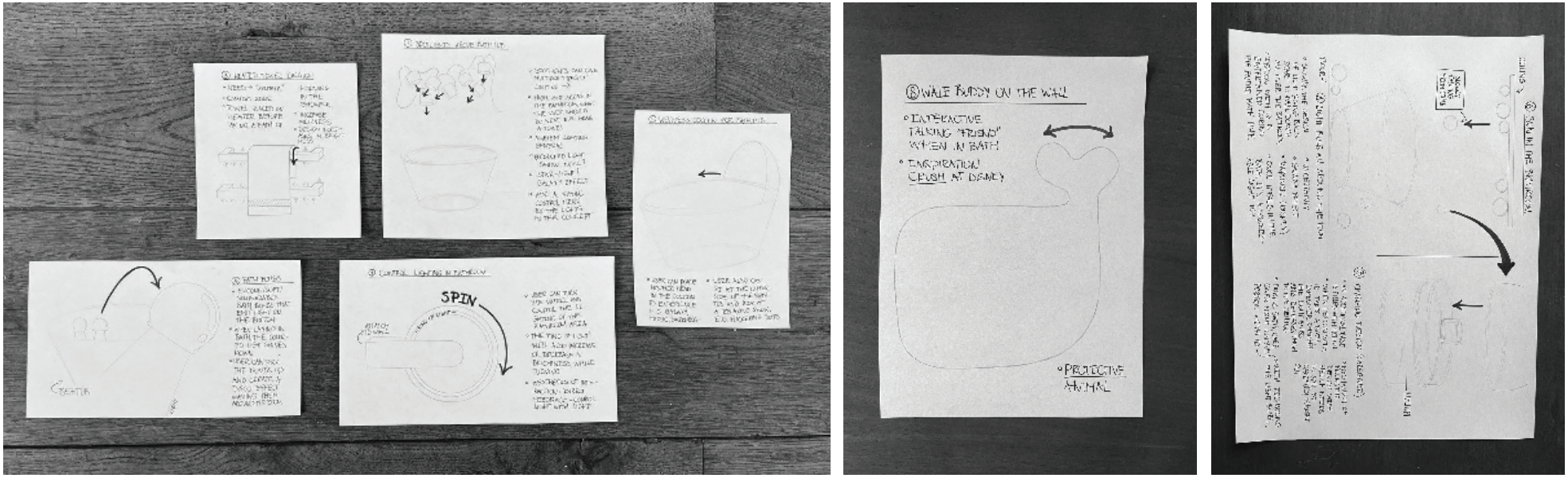

Figure 23. Ideation sketches Phase 1

IDEATION PHASE 2

Continuing from the first ideation period (Phase 1), a second phase was embarked upon after meeting with Niels van den Broek and Evelien Joosten, both being representatives of Oro. As a result, ideation Phase 2 starts with the key highlights of residents of Oro being mentally 0-1 years old, and the Dutch term *Geborgenheid* being recognized as a fundamental requirement. In order to establish what the term *Geborgenheid* precisely encompasses, a brainstorm was held from the first-person perspective (Figure 24). It was detected during this brainstorming session that *Geborgenheid* can be considered a feeling, and that multiple notions are included in the term, such as e.g. security, understanding, warmth, and vulnerability. Examples that correspond to these notions had been written down, such as a parent reading a bedtime story to their child and gently tucking them in, or being covered by a cocoon of blankets within a secure home environment. Subsequently, an ideation roulette technique was performed where elements of the bathroom, i.e. bath, shower, floor, temperature, light, and smell were written down, and ideas were generated around them (Figure 24). The last sketching ideation technique that had been utilized was the SCAMPER method (Figure 25). The SCAMPER ideation method is a brainstorming technique that aims to resolve a problem through a set of directed questions (Van Boeijen et al., 2014). Consequently, each team member concentrated on a distinct realm of ideas that emerged during the previous ideation sessions, and it was possible to create a robust collection of design concepts that captured the essence of our exploration. Both Ideation Phases 1 and 2 came to a close after carving out and categorizing every ideated design sketch, as can be seen in Figure 26.

Figure 24. Brainstorm *Geborgenheid*

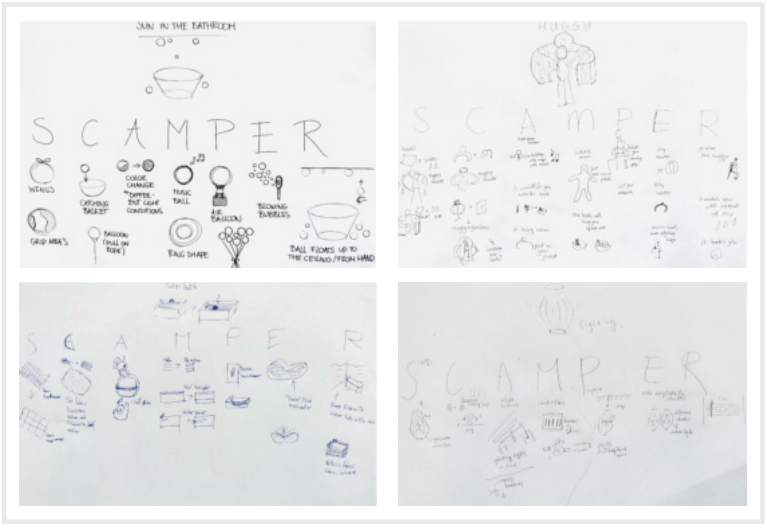

Figure 25. SCAMPER ideation technique

Figure 26. Categorization ideated sketches

GEBORGENHEID

For the continuation of the process it is important to look at the new core pillar of this design project, *Geborgenheid*. As previously mentioned, *Geborgenheid* is a Dutch term that does not have a direct English translation. During the ideation phase, multiple notions were touched upon, that are hidden in the *Geborgenheid* feeling. In order to create a clear and emphasized image of what is meant by *Geborgenheid* in the further duration of the project, a Venn diagram had been created (Figure 27). In this Venn diagram the 3 main notions are considered trust, warmth, and understanding, but what do these individual categories actually mean?

Trust

Trust encompasses the ability to place reliance on the actions of others. It involves relinquishing worry and encompasses feelings of dependence, confidence, and safety towards both the caregiver and the design.

Warmth

Warmth represents a nurturing ambiance, in which emotions of care, empathy, and comfort are easily evoked. In essence, warmth revolves around feeling loved, encompassing intangible holistic aspects that are not easily quantifiable.

Understanding

Understanding signifies the empathic bond between the caregiver and the user, resulting in awareness and consideration of the distinctive requirements and obstacles that are faced by individuals with intellectual disabilities.

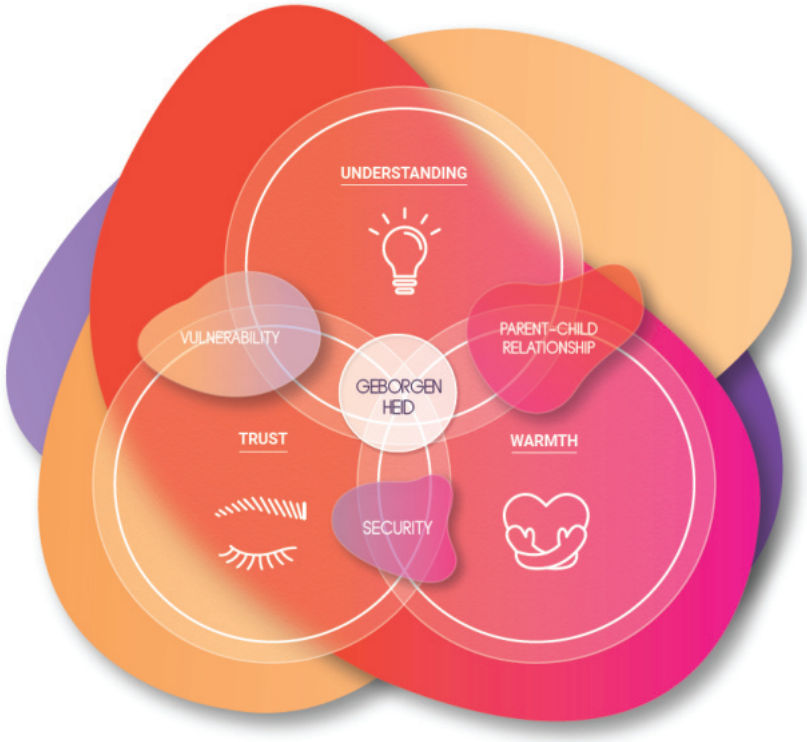

Figure 27. Venn diagram *Geborgenheid*

Intersections

A Venn diagram allows us to focus on the intersections of the three categories introduced above, as shown in Figure 27. The intersections that are subsequently created are illustrated as islands and can be listed as the following; the intersection between *trust* and *understanding* results in the island **vulnerability**, the intersection between *trust* and *warmth* results in the island **security**, and the intersection between *warmth* and *understanding* results in the island **parent-child relationship**. The rationale for illustrating islands derives from the understanding that the intersection of two categories does not necessarily equate to the exact term positioned in the middle of the definition. Instead,

a focused emphasis can be considered relevant within the context of this particular project.

In the initial stages of the project, there has been an emphasis on the three main categories of constructing Geborgenheid; encompassing trust warmth, and understanding. However, as the design process progressed, the interconnected islands came more explicitly into play as well.

EXPLORATORY PROTOTYPING

In order to redirect the design focus towards Geborgenheid and explore its potential, we conducted an exploratory prototyping session where we created a collection of prototypes (Figure 28). During the session, the central question of how *Geborgenheid* can be translated and applied in the context of the bathroom and wellness experience stood central. Due to the Obtained novel understanding of the target group during Ideation Phase 2, the utilization of the exploratory prototyping method has allowed us to explore various dimensions and possibilities of the *Geborgenheid* concept through tangible prototypes.

Results

During the discussion following the results that the exploratory prototyping session brought, it was detected that most ideas took importance on physical properties, and on the emotional feeling behind material choices. An example can be given by visualizing the temperature of the bath with orange or blue droplets which in turn informs the caregiver about the temperature of the bath at any given moment. In conclusion, the exploratory prototyping method gave a soft reboot in creativity, leading to the initial consideration of the material experience in the design.

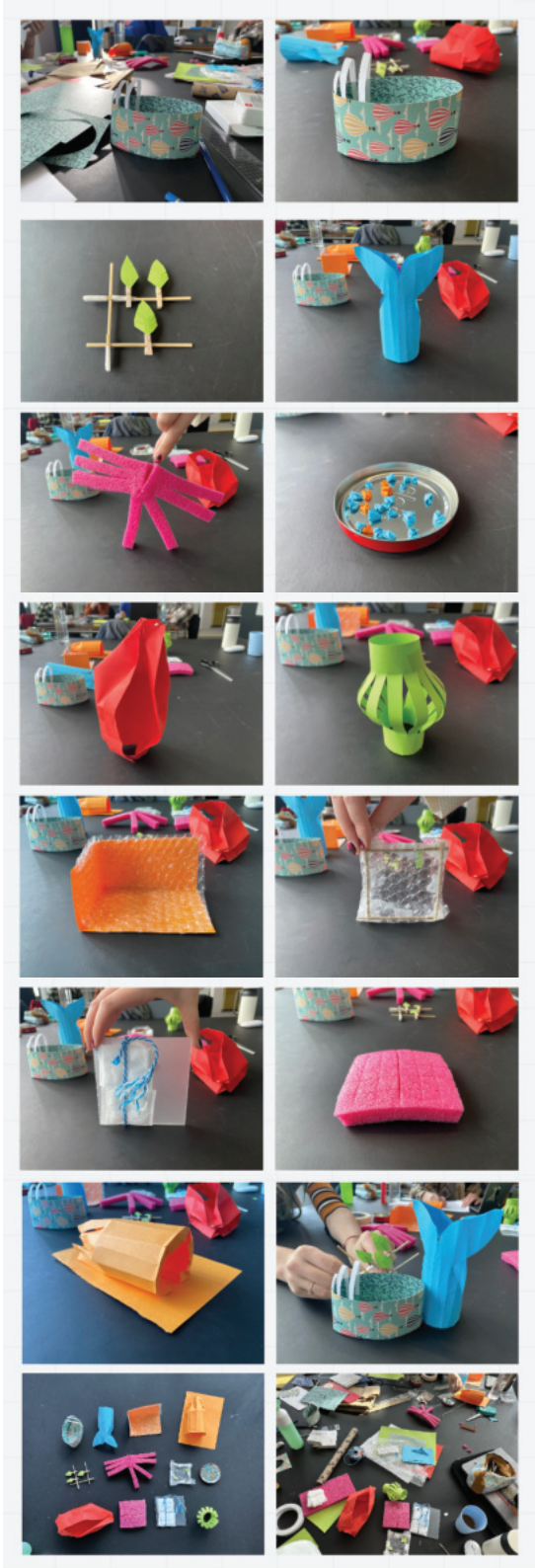

Figure 28. Exploratory prototyping

FOCUS PIVOT

Due to physically visiting the location Oro Rijtven Deurne (Appendix A), a pivotal change was introduced to the design project, choosing to iterate the currently used swimming collar design (Figure 29). Namely, the observation of the original swimming collar being made out of bisonyl material, having a flat and rigid shape, and being positioned neck-tight around the user results in an uncomfortable experience according to the spokesperson of Oro which was thereafter supported by the first-person perspective. Consequently, a shape exploration and a material exploration have been conducted, in order to create a solvable transformation into the currently established pains that are limiting the wellness experience during bathing.

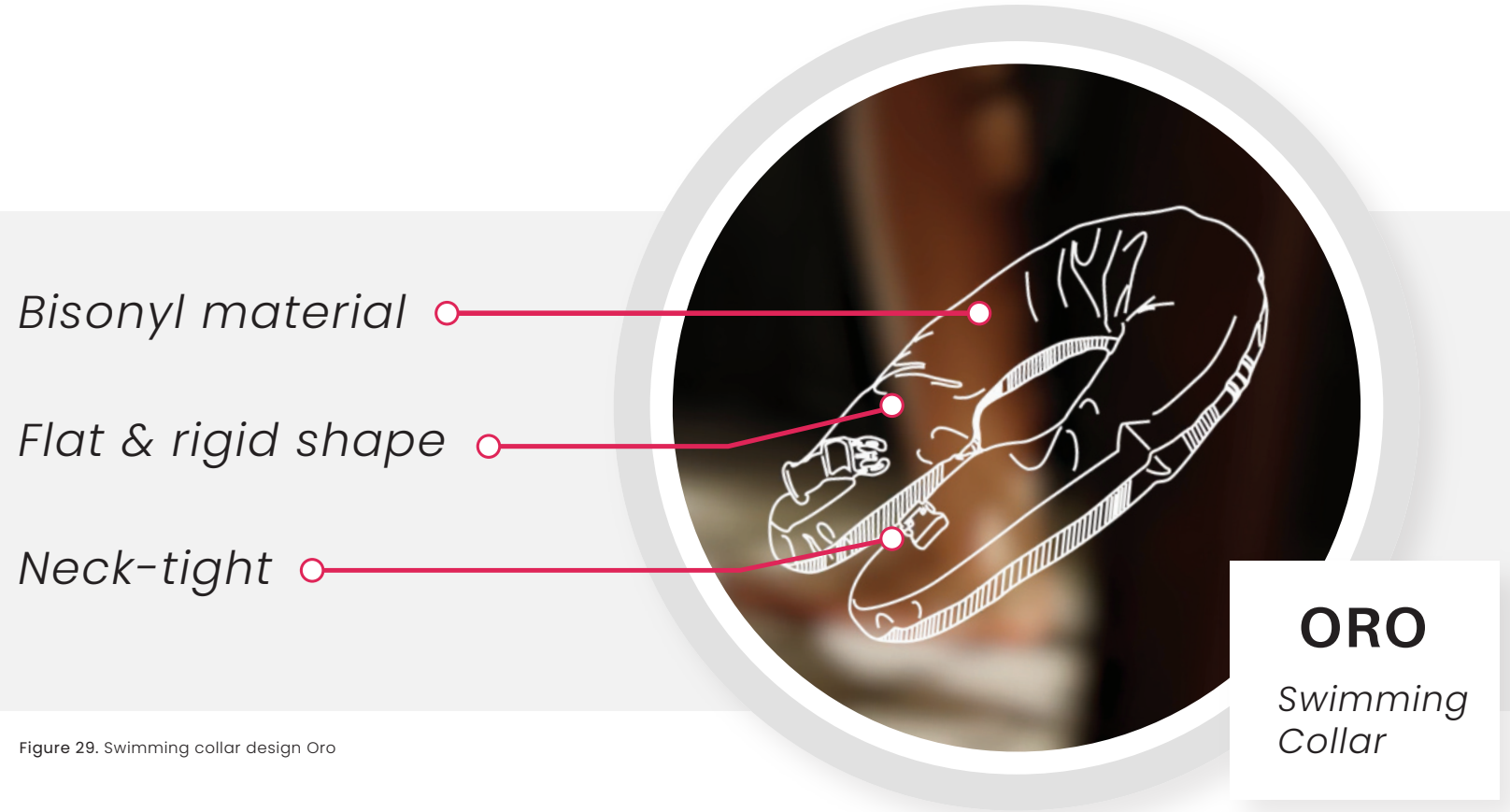

Figure 29. Swimming collar design Oro

SHAPE EXPLORATION

Obtaining inspiration from the pressure cooker 'Hugsy' result, and including the need of *Geborgenheid* within the design concept, an initial testing prototype has been created to explore where the swimming collar could be placed on the body (Figure 30). The two longer branches of the fabric ensure that multiple manners of hugging can be attempted, investigating preferred areas of fabric contact on the body and identifying any instances where it may be undesired or even perceived as irritating. Ultimately, the testing prototype served as the foundation for a series of shape exploration sketches, which are illustrated in Figure 31.

Results

Based on the testing of the prototype, it was determined that the fabric pressing against the front of the neck was perceived as uncomfortable and irritating, realizing the vulnerability of this body part. A possible explanation of this feeling can be drawn from the trachea, vocal cords, and esophagus being present in this area of the human body (Wikiwand, (n.d.)). Furthermore, it was experienced that embracing two branches of elongated fabric was perceived as surplus, as it resulted in a restriction in movement. Positive aspects that were perceived within the testing sequence, were the increased feeling of *Geborgenheid* when the caregiver would stand behind the user and placed the design around the neck in this position. Additionally, it was observed that leaning on fabric with the back of the head provided a comfortable experience when encountering an edge.

Figure 30. Test prototype during practical exploration

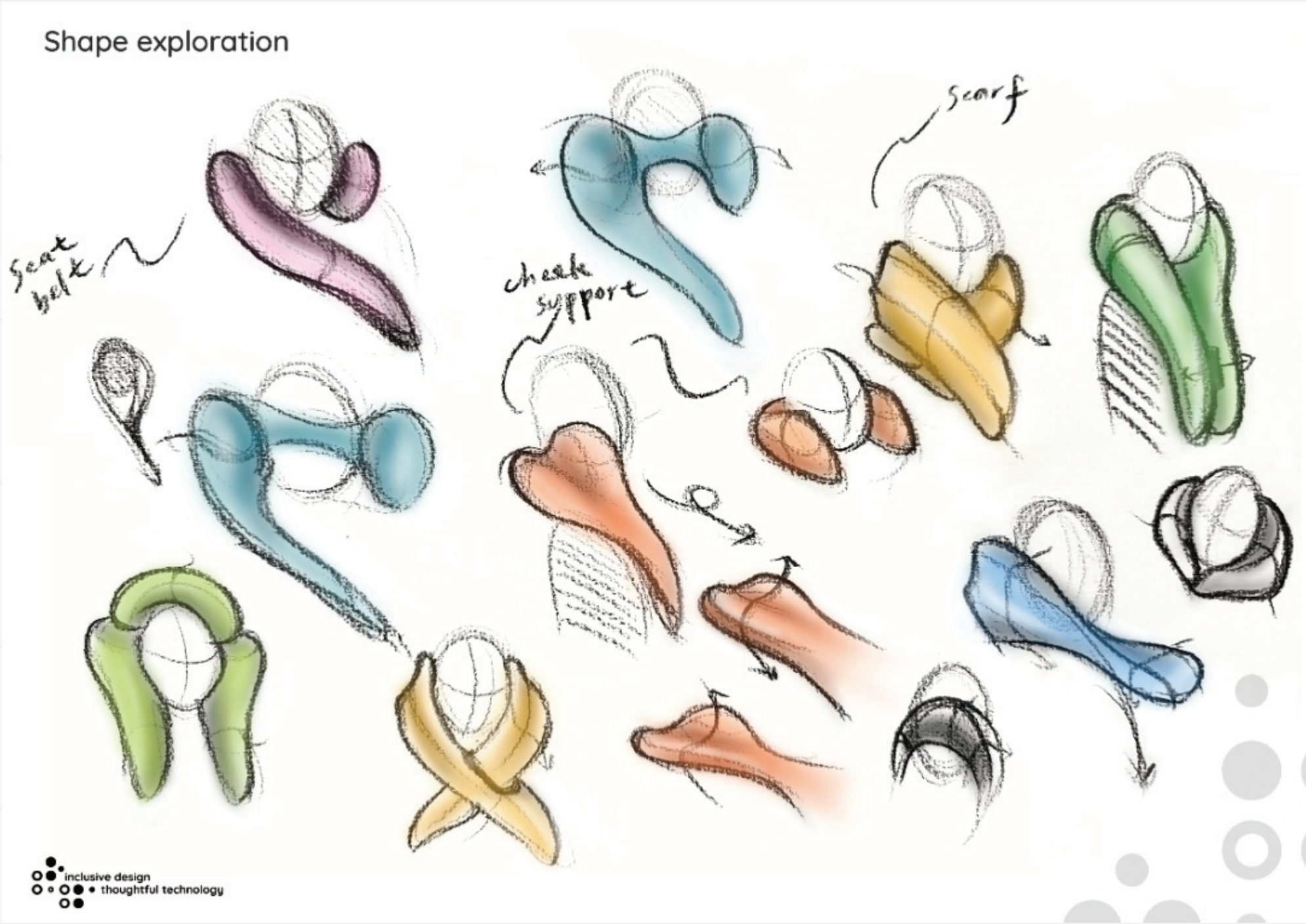

Figure 31. Shape exploration sketches

MATERIAL EXPLORATION

Due to the earlier encountered third-person perspective research on sensory experience being increasingly important within the target group of people with an intellectual disability, an elaborate material exploration has been conducted. With an emphasis on experiencing the feeling of comfort, 15 distinct fabrics with an aspect ratio of 15x15 cm have been pressed against the arm, hand, and chin of each team member in dry, wet, and half-wet conditions. Statements on the material experience that has been felt have been written down after each encounter, resulting in an overview that can be seen in Appendix C. Finally, specific scenarios with either a red or green label have been marked, indicating an utmost negative or utmost positive sensory experience.

Results

Firstly, reflecting on negative sensory experiences such as roughness, coldness, stickiness, and an unpleasant visual appearance resulted in being recognized and marked with a red label. The 'acoustic foam' in the dry condition for instance felt very rough and caused a burning feeling on the skin after rubbing it for a significant period of time. The 'silk & cotton' fabric, however, felt very smooth but was experienced as sticky, which in turn resulted in a preferred sensory avoidance rather than sensory engagement. In contrary, positive experiences such as softness, fluffiness, warmth, luxury, and a large weight were labeled as positive, indicated with a green mark. Giving an indication of the preferred large weight; the 'polyester & cotton (thick)' fabric was preferred over the 'polyester & cotton (thin)' counterpart. Furthermore, luxury was detected in the 'polyester layers', revolving around the felt quality of the material. The material exploration had come to a close after choosing a final material for the design based on the generated sensory data. Among the fabrics "velvet cotton" and "polyester layers", both of which have received 3 green labeled marks, the polyester layers were ultimately chosen for the final design. This decision took the notion of velvet cotton being prone to stains and the accumulation of dirt between its strands into account (Yorkshire fabric shop, (n.d.)).

FINAL PROTOTYPE

Based on the findings discussed in the previous paragraphs, the final iteration of the current lifejacket design for Oro bathroom facilities has been developed with a broader focus beyond mere safety considerations. Consequently, the culmination of these efforts has given rise to Tobbe, a flotation device that prioritizes comfort and ensures a sensory satisfying user experience. The embodiment of the *Geborgenheid* concept in the design can be observed in Figure 32, showcasing its integration within the overall solution.

Material

Tobbe consists of two distinct components: an interior stuffing and an exterior cover. The exterior cover is carefully crafted from polyester block-out blinds fabric, specifically chosen for its pleasant feel on the skin, as validated through positive material-to-skin contact in dry, half-wet, and wet conditions (Appendix C). Within the design concept, the exterior material can be easily removed by the caregiver for drying and washing purposes, facilitated by a zipper mechanism (Figure 36).

The internal stuffing material that has been used to give the prototype its volume is memory foam. Based on buoyancy calculations, this material ensures that the Tobbe design is capable of floating in water [linking to buoyancy calculation](Figure 33). However, due to the excessive water absorption observed during prototype testing in wet conditions, the design has been modified to improve drying efficiency. This has been accomplished by replacing the water-exposed portion of the Tobbe design with water-resistant foam. A cross section can be seen in Figure 34. Nevertheless, the initial memory foam material has been retained in the neck area, to ensure and enhance a comfortable and soft sensory experience.

Shape

The final shape is inspired by the bean bag neck cushions that are used for sleeping purposes in environments such as e.g. planes. A higher volume at the back of the neck was specifically considered, in order to prevent the user from accidentally hitting their exposed head on the edge of the bathtub. Furthermore, as it was noticed during the prototype testing that hearing was

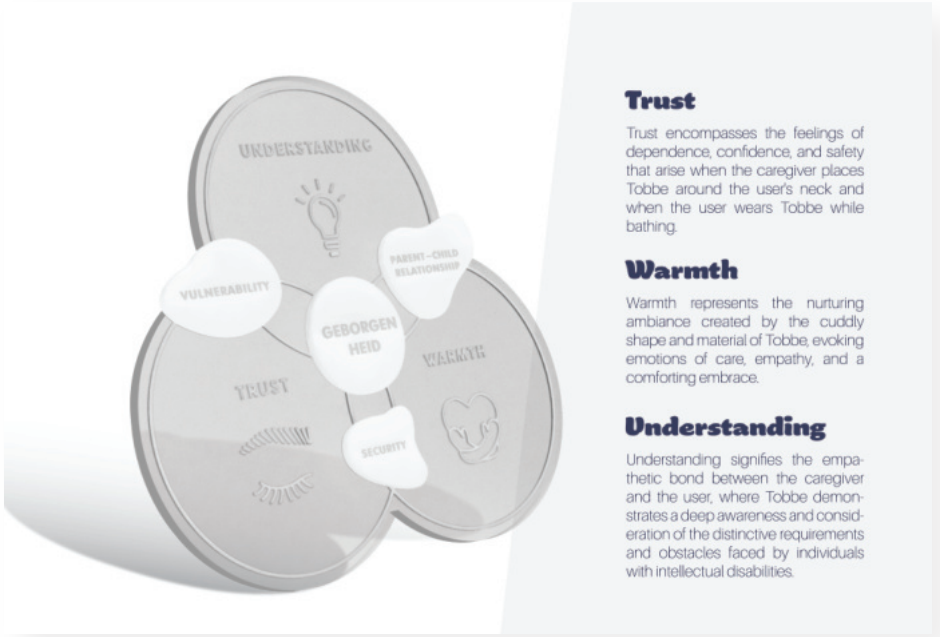

Figure 32. *Geborgenheid* integrated in the Tobbe design

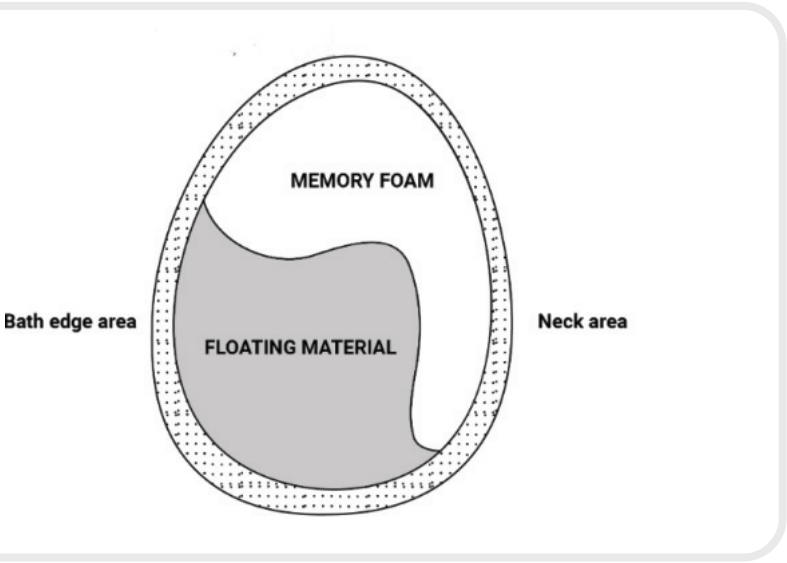

Figure 34. Cross section Tobbe

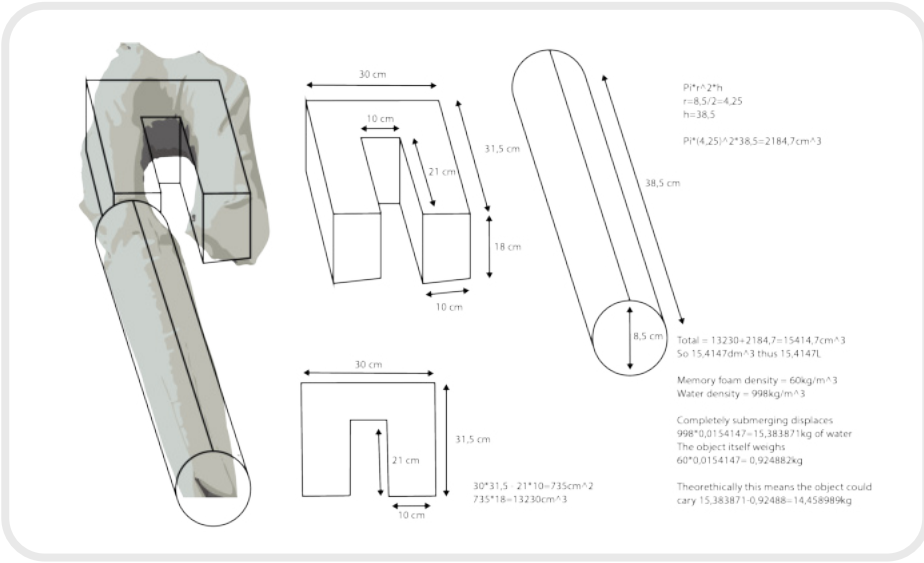

Figure 33. Buoyancy calculations

minimized, and the Tobbe design caused the user's ears to double-fold, additional room for the ears had been created within the interior material of the design. Additionally, during the process of form exploration, it was observed that pressure exerted by the material on the front side of the neck was uncomfortable. This aspect was considered and incorporated into the final design.

Closing mechanism

In order to guarantee the utmost safety and prevent the Tobbe design from being inadvertently removed during the bathing experience, an additional closing mechanism has been incorporated in the front area of the neck. For this mechanism, there has deliberately been chosen for a plastic clasp that is designed for excluding parts of the skin during closing as well as keeping unnecessary sensory experiences to a minimum. Additionally, the plastic mechanism is positioned away from the neck area to avoid direct skin contact, and can be tightened when necessary (Figure 35).

Customization

The option to customize the design with a pattern of choice is included in the design concept, allowing for a personal connection to be established between the user and the design. This customization feature adds a sense of individuality and ownership, enabling people with ID to express their unique personality through their Tobbe (Figure 38). Whether it's a favorite color, or a beloved pattern, the ability to personalize the floatation device aims for deeper emotional connection to the product, ultimately enhancing the overall user experience. The chosen fabric allows for printing and dying.

Name tag

The addition of a name tag on the Tobbe design has been incorporated as a consequence to the target group being facilitated in a group assisted living environment (Figure 37). As every resident receives their own personal Tobbe, the caregivers are able to match each design with a specific person due to the name tag provided. This also allows the user to create a personal bond with their Tobbe since it is only their property. Furthermore, the name tag is positioned on the outside ridge of the design, preventing the user to grab the label during its usage.

Figure 35. Closing mechanism

Figure 36. Remove exterior cover

Figure 37. Name Tag

Figure 38. Tobbe in practice

USER JOURNEY

In relation to the insights gained from the physical visits to Oro, as well as the third-person perspective literature research, an ideation brainstorming method was initiated to develop the user journey routine for Tobbe. Three user journey concepts were developed, taking into account an able-bodied user, an individual with intellectual disabilities requiring assistance with a patient lift to transition into the bath, and the 'ultimate wellness experience' being considered as the ultimate goal (Figure 39)

Followed by the results of this brainstorming session was a deeper analysis of specific notions, considering the findings of the four distinct patterns of sensory processing established by the research of Dunn et. al. (Abacus Healthcare, 2022). Specific aspects such as the intellectually disabled user being present in the bathroom while the caregiver is preparing the bath, putting on music, and placing Tobbe around the neck of the user after the top of the body is undressed are drawn from these potential user journey trajectories and consciously re-integrated in the final trajectory (Figure 40). Although the final user journey can be seen as a general method to experience the Tobbe design, small differences between the 4 different patterns of sensory processing can be noticed in relation to their self-regulation strategies. Hence, we highly recommend that caregivers at Oro adapt the user journey trajectory where necessary (e.g. hard touch or soft touch when placing Tobbe around the neck) based on the specific sensory processing profile of each resident.

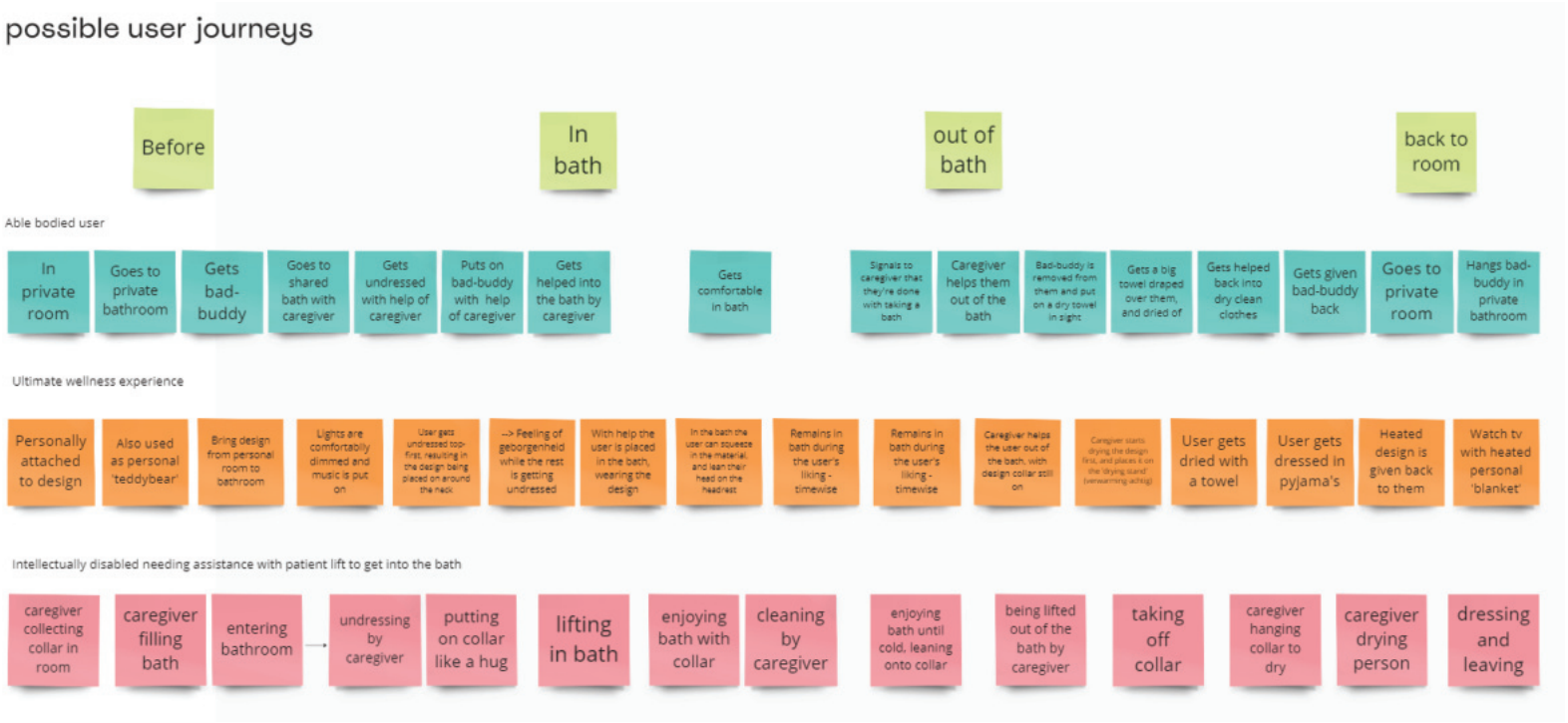

Figure 39.
User journey concepts

USER JOURNEY

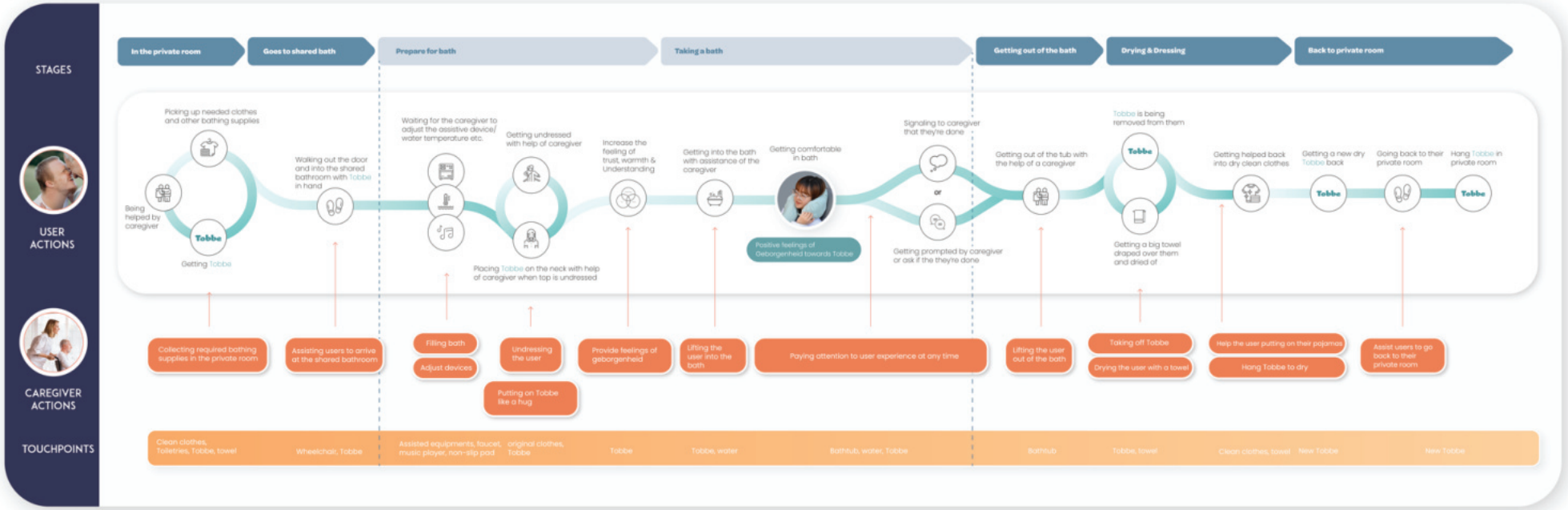

Figure 40. User journey Tobbe

VALIDATION OF THE DESIGN

To validate the design in practical use we triangulated three methods: a second-person perspective user test (dry test); a first-person perspective user test (wet test); and lastly an expert interview. By utilizing these methods, we have outlined an initial approach to conducting these tests with the actual target group.

Dry test

To validate the design in practical use we triangulated three methods: a second-person perspective user test (dry test); a first-person perspective user test (wet test); and lastly an expert interview. By utilizing these methods, we have outlined an initial approach to conducting these tests with the actual target group.

Sampling

We opted for convenience sampling participants that are in close approach to ourselves. As a result, this establishes a testing environment where everyone feels comfortable.

Set-up

The test itself was performed with three participants, all of whom were asked to lie down in an empty bathtub with their clothes on, wearing our design. Once positioned, the participants were asked

a series of questions. These questions can be found in Appendix D.

Results

The results consist of open responses to closed questions, quantitative answers to closed questions, and observations by the researcher. All results were noted down by the researcher whilst participants were in the bathtub. Eventually, the results were used to illustrate multiple boxplot data visualizations (Appendix E).

Analysis

The results were consequently analyzed through a combination of open and closed-coding. The three categories of *Geborgenheid* were used for closed-coding, whilst everything that did not fit under these codes was open-coded.

From the analyzed open-coding, three themes arose: shape, experience, and fabric. Conversely, the closed-codes represented the themes of Warmth, Trust, and Understanding.

Conclusion

- **Shape**

  It becomes very apparent that the unusualness of the shape invites discussion. This discussion centered around the appendix extending from the design, where cuddling instinctively results from wearing it.

- **Experience**

  It is important to point out that during the usage experience of the design, people tend to value the whole experience, taking into consideration not only the prototype itself but also how it feels and is experienced when putting it on.

- **Fabric**

  When discussing the design and its sensory experience, the fabric tended to elicit a positive reaction about both its softness and smoothness. This emotional response also highlights the importance of the choice of the right fabric.

- **Warmth**

  The design gave people a sense of warmth through its invitation for hugging and its embrace.

- **Trust**

  A distrust arose in the conversations, mainly concerned with the safety aspects of the design. Showing the importance for us to focus on the safety aspect of the design, to achieve the full Geborgenheid. -A critical note to be made here, is that this prototype version did not have a clasp yet, which could have contributed to this feeling.

- **Understanding**

  Understanding was felt on a surface level, the participants instinctively understood the design. But the deeper level of emotional connection elicited by the design was lacking, and should be developed further.

Wet test

With the goal of gathering opinions of people having knowledge of the design concept the wet test was done using three of the four researchers themselves. Next to this sampling method we also used the same setup as the dry test, with the only difference being the bath being filled with warm water and the participants (us) being in swimming attire. The last part that is the same as the dry test is the results that were gathered, again open and closed responses were written down together with any observations made.

Analysis

The results were analyzed through open coding, this was chosen because the participants (the designers of this project) were already familiar with the three categories of *Geborgenheid* and thus more diverse themes could arise through this lens. From the open coding two themes arose: Shape & material, and experience.

Conclusion

- **Shape & material**

  The prototype exceeded expectations when it came to shape and material, where the shape created a nice mix between dry and wet, and freedom and restriction. The material invited feeling, cuddling, and caressing the prototype, it was also commented that the way the material soaked up the water was a perfect mix between heavy, cooling, and playful.

- **Experience**

  Within the theme experience the values of Geborgenheid clearly arose. With participants talking about the childhood memories it evokes (overlap between understanding and warmth), but also about the sense of safety, especially in the participant who can't swim well.

The only problems that arose within the experience are related to the amount of water the prototype would suck up over time, and the tendency of the prototype to slip off.

Expert interview

In order to validate our design from an expert's view, we executed an interview with two participants working at Oro, with an expertise in ergotherapy, physiotherapy and swimming for people with an intellectual and/or physical disability.

Sampling

For sampling our experts we approached the collection of physical therapists available at Oro, with help of Evelien Joosten (research collaborator in this project). After initiating contact an interview was set up with participant 2, who used to be a physical therapists for the target group and now has a managerial position in this context. Upon the interview itself participant 2 brought along participant 1, an ergo and SI therapist. This participant has 20+ years of experience at Oro alone.

Set-up

The expert interview was semi-structured, with pre-prepared questions, in order to allow the flow of conversation to influence the topics that were addressed (Appendix F). The interview itself was held on location, and lasted just under an hour. During the interview one person was responsible for taking notes, one for engaging the experts, and one for taking photographs. An impression of the interview are illustrated in Figure 41.

Results

This resulted in a collection of notes. Divided up in participant 1 and 2.

Analysis

In order to analyze the context of the interview, all the notes were digitalized and subsequently split in context and feedback. The next step was highlighting notes that pertain to the context and design in which we are busy. All non highlighted notes were deleted. From here the remaining notes were grouped, resulting in the following 5 themes: Customization and price, Positive remarks pertaining to the design, Testing and final validation with the target group, CE certification, Clip strength.

Figure 41. Impression expert interview

Conclusion

- **Customization & price**

  Whilst there is a positive attitude towards the idea and possibility of customization, something that comes back again and again is that this will drive up the cost significantly. However a first step towards reusability and driving the cost down could be making the label writable and erasable, so that the design can be reused without having to sew in a new label. Another is limiting the amount of colors/patterns the design is available in.

- **Confirmative remarks pertaining to the design**

  The first thing that jumped out is the overall positive attitude towards the material of the design, pulling attention to the fabric look and feel. On top of that the novelty of the shape spoke to the experts, remarking the neck support generated by the ridges of the design. But also the multi-use of the tail. Whilst cuddling was remarked as something positive, the experts actually brought in a new use case. In this case the client would hold on to the tail of the design whilst a caregiver puts it around their neck, this way a connection and feeling of ownership gets fostered in the process of putting the design on. Lastly, as answer to the question: "What number would you give this design when it comes to warmth, trust, and understanding?", the experts gave a resounding positive rating of 8, and 8 or 9, stating that the device communicated warmth and *Geborgenheid*.

- **Testing and final validation with the target group**

  In order to truly validate with the target group it is really important to focus on longevity, since communication with the target group is difficult, the next best thing is observation. The newness and novelty of the design could wear off, this combined with the limited communication means that observation over a longer period of time is the best way to gauge if the design has a positive impact on the target group. Preferably done by caregivers who closely interact with the target group.

- **CE certification**

  Before a care facility can use or buy any product it should be validated according to CE- certification.

- **Clip strength**

  The clip strength is not big enough for emergency situations. Whilst taking pinch possibility and sound into account where good ideas, with this the safety of the clip was compromised. It is really important that it can sustain great forces and movements, as it should work in the worst situation possible, not in the best.

Triangulation

By using the dry test as an unfamiliar body testing and feeling of the design, we tried to approach the experience of someone unfamiliar with both the design and its design goal. Using the wet test as an actual in situation test of the design and the experienced users reaction to this interaction with water, with this getting an expert opinion about the interaction between water, shape and material.

Capping it off with an expert interview, someone who knows and understands the target group and with this can gauge their reaction.

By using three approaches to individual aspects of our target group we can create a rough interpretation of the opinion of said target group.

DESIGN SAFETY

Given that the primary objective of the design is to ensure safety, it becomes vital that safety regulations will be taken into account to apply the design into real practice. A list of require ments for

life jackets (Canada, 2023) has been used to validate our current design. To demonstrate compliance, we formulated a table consisting of the pertinent regulations and explained how our design complies with these rules. This resulted in a table that can be seen in Appendix F. This mainly resulted in the implementation of an invisible zipper, as well as invisible seams. Also volume measured up to the listed requirements, while more attention should be given to research on drainage, channeling and seam strength.

FUTURE WORKS

Limitations

For a more complete validation of the prototype, further user research with the target group in context is valuable, since the value of testing with the target group is an extension of the first and second-person perspective, as was elaborated in the expert interview. Adding on to this, more testing with a greater diversity of body types could add a more well-rounded validation since the prototype is now based on a group of people who all had comparable abled body types. Lastly more tests with the interaction between the design and assistive technology such as a lift or crane can be established.

We mainly base our work on the interactions we've had with people who now mostly occupy management positions. Although these people have worked in the field as a caregiver in the past, this may not directly reflect on the current working climate, resulting in a possible created bias.

A practical exploration of the achievability of implementation into the envisioned context can be a further elaboration on the practical application by caregivers. With this elaboration a more nuanced look at the time sensitivity of the design can be made, and with this a more realistic look at the user journey as it is right now

Future steps

During the last prototype presentation, Evelien Joosten was very enthusiastic and said she would like us to introduce our idea to the innovation team of Oro to investigate the future possibilities of the design and its business context.

In order for the design to be legible in real live use it must comply with conformité européenne regulations (better known as CE certification). This would mean a procedure to get certified would need to take place before an organization like Oro would be able to use and/or buy the product.

When looking at the buoyancy capacity of the design, opportunities arise. One of these opportunities is using the excess force to incorporate technology and or electronics into the design. Examples of future design options that could be incorporated are heating elements or even speakers. This again all depends on the wants and needs of the user, and it is important to not overcomplicate the design.

Since the design also functions outside of the water, in future research it could be interesting to see its applicability in other contexts or target groups, such as wearing it while sitting in a chair, whilst taking a long train ride, or when lying down.

This is a first step into increasing the wellness experience in the bathroom, however we found out more aspects concerning the interior can be adjusted to create a nicer bathing atmosphere. The list can be found below.

1. The current lighting is rather white. We recommend using a yellower light source, because a yellow-colored light evokes feelings related to wellness, such as joy and happiness (The Subconscious Effect of Colored Lighting | Signify, z.d.)

2. The general look of the bathroom can come off as kind of clinical. In order to step away from this aesthetic, some small changes could make a big difference, such as colored tiles, and accessories like plants, more personal elements could also greatly enhance the bathroom.
3. Smell is something to consider when redesigning a bathroom. Research has shown that smell can both negatively and positively impact a person's mood (Weber & Heuberger, 2008). This can be implemented by placing scented candles or odor diffusers.
4. The bathroom floor is rather cold. Implementing something textural could create a more fun or relaxing experience when entering and moving through the bathroom.

Learnings about designing for the target group

- Due to a high sensitivity to sensory experience, the target group will instinctively react to aspects that are directly in their environment to show whether they do/don't like it, as is the case with the design. As such, the target group reacts with emotion, facial expression, and body movement. For a caretaker, these signals are easily identifiable, that's why their collaboration is essential for designing for this target group.
- Incorportating multiple points of view in future design processes will improve the likelihood that an approximation of the target group can be met, think of more input from caregivers and other people close to this group.
- All clients just like other people are very different so it is not a one size fits all solution.
- Usually in this branche caregivers have limited time so this will influence how the design can be used in actual context. In designing for this target group you are just as much designing for the caregiver as the person with ID.
- The target group likes to have visual or auditory communication so they can prepare themselves on the actions of the caregiver. This factor should be taken into account when designing for the target group, in order to minimize stress.
- People possessing an intellectual disability can be categorized into four distinct patterns of sensory processing; sensory sensitivity, sensory avoiding, sensory seeking, and low registration. In regards to the emotional and physical well-being of the person with ID, it is important to determine which category a specific individual belongs. Establishing this sensory categorization could validly shape a design and support its targeted development.
- Overall it is important when no direct interaction with a target group is possible to get as much information from the context of this group. Be it a respectful way of embodying the group and designing from a first-person perspective, or talking to people who support or know this group well to gain a second person perspective on the subject. A third person perspective is important as well, but this is something more approachable and standard to do. Lastly, a good way to work with an unavailable target group is to isolate parts of this group and test those out on groups presenting these parts that you do have access to. All in all, don't be afraid to split up characteristics, and there isn't anything like having too much information.

ACKNOWLEDGEMENT

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enhancing our understanding and enriching our work. Lastly, Special thanks go to Holly Krueger from the Wearable Senses Lab at the TU/e for her guidance and support in the realm of material exploration, which greatly contributed to the project's development.

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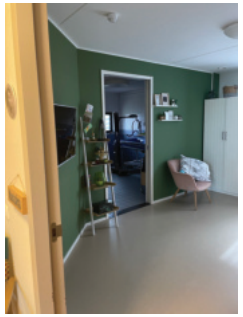
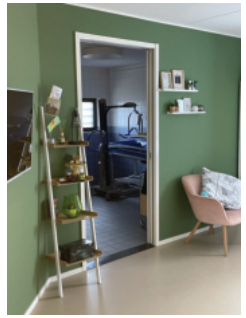
Appendix A Visit 1 Oro Rijtven Deurne









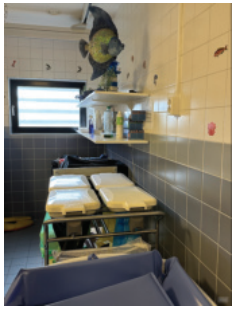





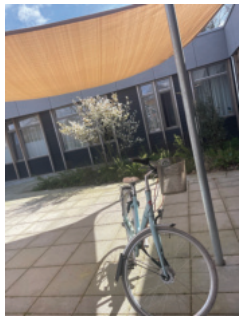








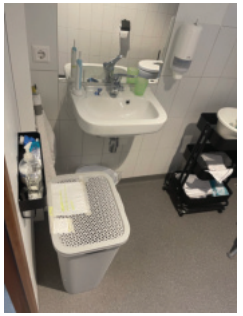
Appendix B Visit 2 Oro Rijtven Deurne

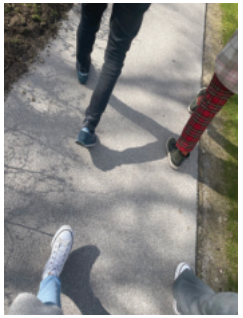











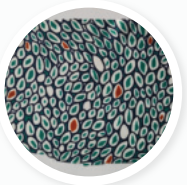




Appendix C Material exploration

	 ACOUSTIC FOAM	 POLYESTER & COTTON (THICK)	 SILK & COTTON	 POLYESTER & COTTON (THIN)
DRY	L Soft and squishy but rubbing it feels irritating on the skin, rough S Soft feeling when presssed on skin, rubbing however feels unnatural and rough A Relatively warm, I like squeezing it J Elastic and easy to squeeze, but is rough and has a lot of irritating grains, which is actually not very comfortable	L Really enjoy the weight, feel-wise it is comparable to 4 S The weight and thickness is very comfortable, could give feeling of geborgen heid. Feels soft in neck area A I really like the thick secure feeling, it feels warm J Warm feeling on the skin, the texture is very elastic	L Comforms the body nicely, has a smooth feel in one direction but rough in the other. Rubbing it against the skin is irritating S Feeling the presence of hairs on the arm when rubbing the fabric on skin. Roughness would describe the material experience A A bit scratchy but smooth when not pressed down to hard J Very light, but the weaving method makes it feel slightly rough when rubbed against the skin.	L Soft and squishy but rubbing it feels irritating on the skin, rough S Soft feeling when presssed on skin, rubbing however feels unnatural and rough A Relatively warm, I like squeezing it J Elastic and easy to squeeze, but is rough and has a lot of irritating grains, which is actually not very comfortable
HALF WET	L Feels moldy S Feels like wet noga, like there is something dirty inside A Dirty and cold J Water does not feel integrated with the material, which is a bit disgusting	L Static a similar feeling, dynamic it feels just as soft as static S Feels really nice, not that different from dry A Comparable to dry, still quite warm J A little colder, but comfortable	L Feels more flexible, but the directionality is still present S Although it does take away the roughness when wet, I was hesitant to touch it because it looked very light and not inviting A Smoother, but cold and still a bit scratchy J Very wet, like clothes that have been soaked in rain, the roughness is still there	L Soft and squishy but rubbing it feels irritating on the skin, rough S Feels kind of nice, you feel what you expect A The first few touches only left the drops and afterwards the water was quite integrated in the fabric J Colder, the water feels fused into the fabric
WET	L Feels like wet sand paper and a sponge mixed S Don't like the thickness in this case, the thickness doesn't add up in comfortable due to the harsh texture A Sponge like J Heavy, damp. Like a sponge that squeezes out a lot of water	L Keeps out water for a long time, feels like wet hair stuck to you S Very heavy when wet, feels like you are jumping in the water with your clothes on, not comfortable A Very wet feeling, inside remains dry. Feels like a sticky wet pants J Not comfortable. Very cold and wet, like clothes soaked in water for a long time	L Feels like dry again, only cold S Still very rough, due to the fabric being rough and thin, don't want to touch it A Very cold but not to moist J Very cold. The kind that will shudder when it touches the skin	L Wet paper towel, but more friction S The material feels cheap in a way, it is more comfortable than the thick cotton, still feels like I'm wearing wet clothes A Smooth but very cold, not too good J Cold and wet, not so nice

Appendix C Material exploration

	 FLEECE COTTON	 VELVET COTTON	 FLEECE	 POLYESTER THIN
DRY	L The 'fluffy' side is nice, especially in static touch, the underside is rough. both are not pleasant dynamically S Makes a sound when rubbing on skin, the material looks soft, but it dissapoints when touching it. A Main texture is super nice with hands and softer than flower one, but a bit scratchy J The fluff is soft and comfortable, It's very similar to the touch of a doll I'm holding to sleep, feel very safe	L Feels really soft and nice, both dynamically and statically S Teddybear feeling when rubbing on skin, very comfortable fabric for in the neck. It does tend to draw dust and other little filth A Very smooth and soft and warm but it depends on which direction J Fits the skin very well, feels like a high-grade fabric, and does not feel foreign body sensation when rubbing on the skin	L The weight of the fabric is right, and rubbing it whilst steady gives a pleasant soft feel, rubbing it repeatedly in the same spot, it becomes irritating. S It's soft but not incredibly comfortable on the skin, better options could be chosen in terms of softness. A Very soft J Soft plush, feels like a doll	L Similar to 4, slightly softer S Very light fabric, probably will rinkle upon the filling material. Itching feeling within neck A Smooth, relatively cold and a bit rough J Smooth, cold, light and skin-friendly
HALF WET	L Feels like wet animal, but not in a good way S Feels like a wet dog, not comfortable, I want to avoid touching the fabric A A bit gross wet towel, it leaves a lot of wetness on the skin J Disgusting, like a towel that never dries	L Still feels very comfortable, and somehow warm S Feels really nice, inviting to touch. The water droppets stick at a certain spot, it is not the case the whole fabric becomes wet. Suitable for keeping for instance the top part of the lifejacket dry, while the rest is in the water A Still enjoyable and smooth, very warm J Water makes it stickier, but is nice and warm	L Wet dog again, but somehow worse S Very moisty, want to avoid to touch it A Ugh dirty and cold like when your clothes are wet all day J Wet towel, not good	L Feels like a wet paper towel S Feels like a swimsuit, very thin A Same as 4 J Cold
WET	L After the initial stage of discomfort, it feels soft, and somewhat comforting S Feels like a wet sheep, looks dirty even though this might not be the case A Feels like indivudal waterdrops on you, not so nice J I have to compare it with a wet animal	L Slimy but in a comfortable soft way S Sticks incredibly to the skin now, don't know if that's a good thing. Does feel good and is not irritating A A bit sticky and unsmooth J A bit sticky, like a cooling pad, but not bad	L Feels sticky, not comfortable S I had to think about a wet 'boterham', not preferable A Very smooth J Not comfortable. wet rag	L Becomes super grippy S Actually like it wet, feels the best when fully drained A Smooth and soft, quite comfortable J A bit cold but quite smooth

Appendix C Material exploration

	 POLYESTER THICK	 POLYESTER LAYERS (AIRTIGHT CURTAIN)	 POLYESTER EXTRA THIN	 POLYESTER/POLYUR - ETHAAN/PVC
DRY	L The material feels rough, but the change from static touch to dynamic touch is smaller and thus less irritating S Very rough fabric, would not recommend to use this within the design concept A Rough, scratching a bit J A bit rough and not as smooth and comfortable as other light fabrics	L Has the same static and dynamic feel, but not necessarily pleasant. Almost like air, you know its there but you don't feel it positively or negatively S Almost a velvet feeling on the skin, very comfortable and smooth. Within the neck however, the fabric is almost irritating A Smooth, but not as nice as 8 J Very smooth, but it feels a little bulky when you put it on your skin. It is not so easy to rub on the skin, feel a little sticky.	L Nice with slight pressure, really rough with more pressure S Feels like a camping tent, cold, but very light A Soft & smooth, a bit cold J Light & cold	L Cooling in static, rough dynamic S Not irritating on skin, but I feel a detachment from it, I don't feel united when touching it. A A little itchy but smooth when slowly moving J The coldest one, but it doesn't feel close to the skin
HALF WET	L Slightly less rough then dry, still irritating, dries quickly S Don't like it, still rough A Feels smoother then when dry J /	L Feels the same as dry S Very nice! Very comfortable. Would see this fabric in the design concept. A You dont feel the wetness at all, quite a nice feeling. J Feels comfortable, the fabric fits well with water	L It feels like wet paper towels and cold puke got a baby, and this is the sensory experience of that S Doesn't feel inviting or nice, cheap A Feels like getting drops on you when you dont expect them, very unpleasant J Like wet toilet paper, kinda gross	L Feels as coming home from a rainstorm, bad memories S Don't like it, the fabric doesn't unite A Cold and wet J Wet, water and cloth are not compatible, so the skin will feel the water directly
WET	L Super rough but somehow stretchy feeling as well S Very rough, irritating, and does not give in A Quite rough and sticky J Rough, feels like plastic	L Not dissimilar from dry S Feels not very wet, still really liking this fabric, feels luxurious as well A Neutral feeling J The water feels fused into the fabric, it is one	L Same as slightly wet S Still feels like you are interacting with a camping tent A Meh not nice and cold J Sticky and very wet, not good	L See slightly wet S Distant interation, don't know if this is preferable, that the fabric doesn't get wet A No difference to slightly wet J Water disappear quickly

Appendix C Material exploration

BAMBOO & POLYESTER

DRY

- L: Jike
- S: Material is light, but in a manner I feel it is not meant to be used on the skin, it doesn't have that 'warmt' feeling
- A: Smooth and cold, quite light, does remind me of cleaning material, a bit less the caring feeling
- J: Smooth, feels functional? sport

HALF WET

- L: Same feeling only now it gets really warm when rubbing it
- S: Feels like a life-jacket today, would avoid it
- A: First very wet and then smooth and normal like dry version
- J: Dry vert quick. same feeling

WET

- L: Feels nice, its really on top of the fabric and just feels like water and fabric
- S: Feels like it doesn't belong to be touched on the skin, not one of my favourites
- A: The moisture compliments the fabric
- J: Feel softer and not very wet, i quite like the feeling

COTTON

DRY

- L: Feels softer than it looks
- S: Reminds me of blankets for children, due to the color white as well, very soft
- A: Very soft and huggy. Also, because of the color it now seems very clean
- J: /

HALF WET

- L: Picking it up feels not so nice, whilst rubbing it on my skin is actually not to bad
- S: Feels great when rubbing on skin, don't know how to feel when pressing it however
- A: I do get the association of dirt with this wetness, but individual layers feel nice.
- J: /

WET

- L: Squishing feels really nice, rubbing over body is rough and not nice
- S: Like it better when it is fully drained for pressing it, rubbing it however is rough and not comfortable
- A: /
- J: /

VELVET POLYESTER

DRY

- L: Feels really soft and nice
- S: Soft, but attracts a lot of filth, don't know if it is the right material for the design
- A: Nice, and smooth. mainly in the right direction of the fibers
- J: /

HALF WET

- L: Feels nice in the non-stretch direction, not nice in the stretch, and the inside is nicer than the outside
- S: Not that different from dry
- A: Feels quite comparable to dry, not too bad.
- J: /

WET

- L: Really nice, all sides and directions, but especially the inside (non hair side)
- S: Like it when striking in the same direction as the hairs, don't like it when rubbing against it
- A: /
- J: /

Appendix D (Dry) user test questions

Questions User Test

Question 1
Can you describe how the shape of the prototype feels around your neck and around your body *on a scale of 1 to 10*?

Neck
Uncomfortable 1 2 3 4 5 6 7 8 9 10 Comfortable

Body
Uncomfortable 1 2 3 4 5 6 7 8 9 10 Comfortable

Additional comment ›

Question 2
Can you describe the level of warmth you feel when wearing the prototype *on a scale of 1 to 10*?

No feeling of warmth 1 2 3 4 5 6 7 8 9 10 Feeling of warmth

Additional comment ›

Question 3
Can you describe the level of trust in this prototype in regard to safety *on a scale of 1 to 10*?

No trust in safety 1 2 3 4 5 6 7 8 9 10 Trust in safety

Additional comment ›

Question 4
Can you describe the level of vulnerability you feel when wearing the prototype *on a scale of 1 to 10*?

Not feeling vulnerable 1 2 3 4 5 6 7 8 9 10 Feeling vulnerable

Additional comment →

Question 5
Can you describe the level of overlapping recognition you feel with your childhood when wearing the design *on a scale of 1 to 10*?

No recognition childhood 1 2 3 4 5 6 7 8 9 10 Recognition childhood

Additional comment →

Question 6
Can you describe the level of wellness experience you feel when wearing the prototype *on a scale of 1 to 10*?

No feeling of wellness 1 2 3 4 5 6 7 8 9 10 Feeling of wellness

Additional comment →

Question 7
Can you describe the potential level of personal bond that could be formed when wearing this prototype repeatedly in the bath *on a scale of 1 to 10*?

No personal bond 1 2 3 4 5 6 7 8 9 10 Personal bond

Additional comment ›

Question 8
How likely are you to interact with this prototype outside of the bathtub *on a scale of 1 to 10*? If so, how and where?

Very unlikely 1 2 3 4 5 6 7 8 9 10 Very likely

Additional comment →

Question 9
How likely are you to buy a customized finalized version of this prototype for personal use following this initial experience *on a scale of 1 to 10*?

Very unlikely 1 2 3 4 5 6 7 8 9 10 Very likely

Additional comment →

Appendix E (Dry) user test data visualizations

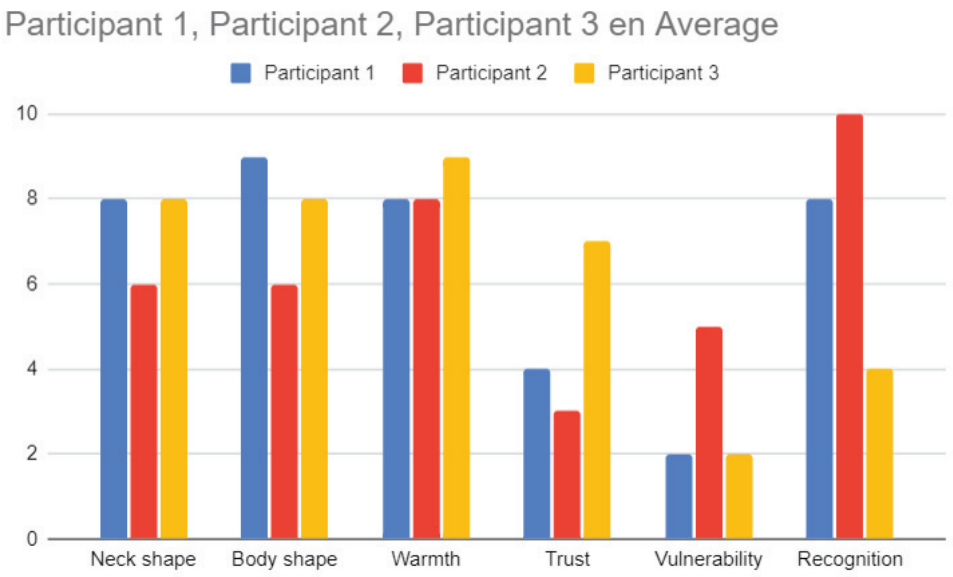


Figure E1. Subjective opinion (y-axis) of the accompanied notion (x-axis) on a scale of 1-10

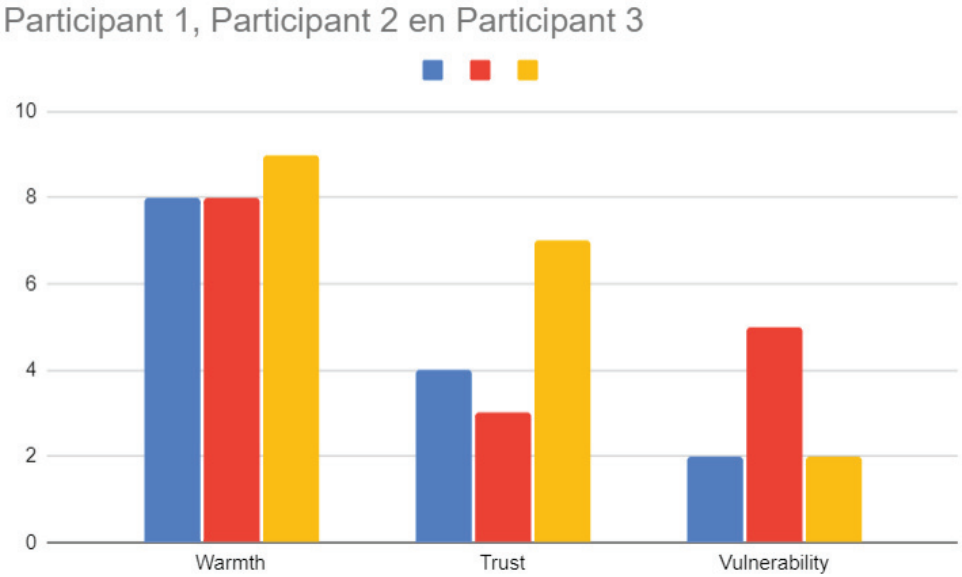


Figure E2. Subjective opinion (y-axis) of the accompanied notion (x-axis) on a scale of 1-10

Appendix E (Dry) user test data visualizations

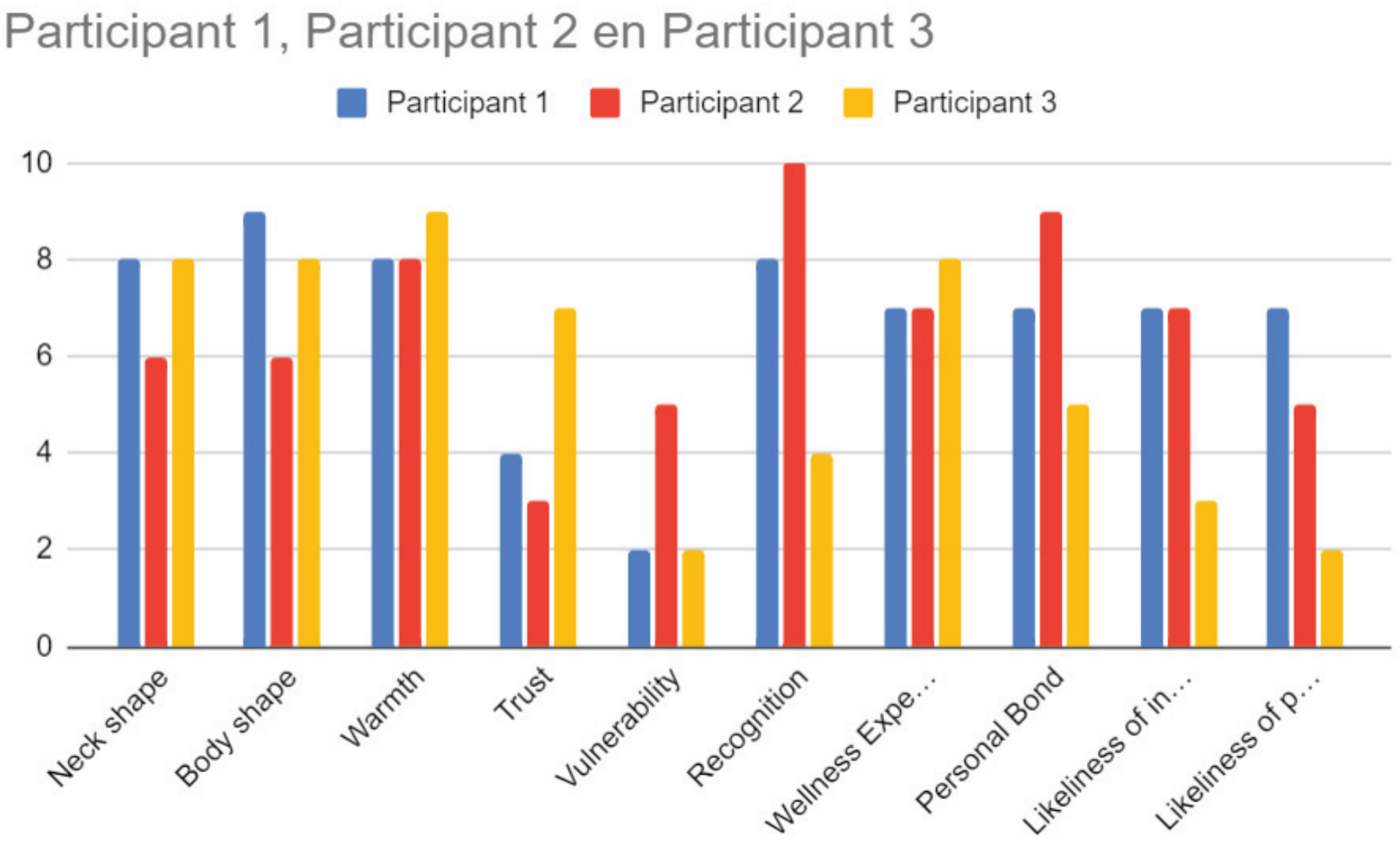


Figure E3. Subjective opinion (y-axis) of the accompanied notion (x-axis) on a scale of 1-10

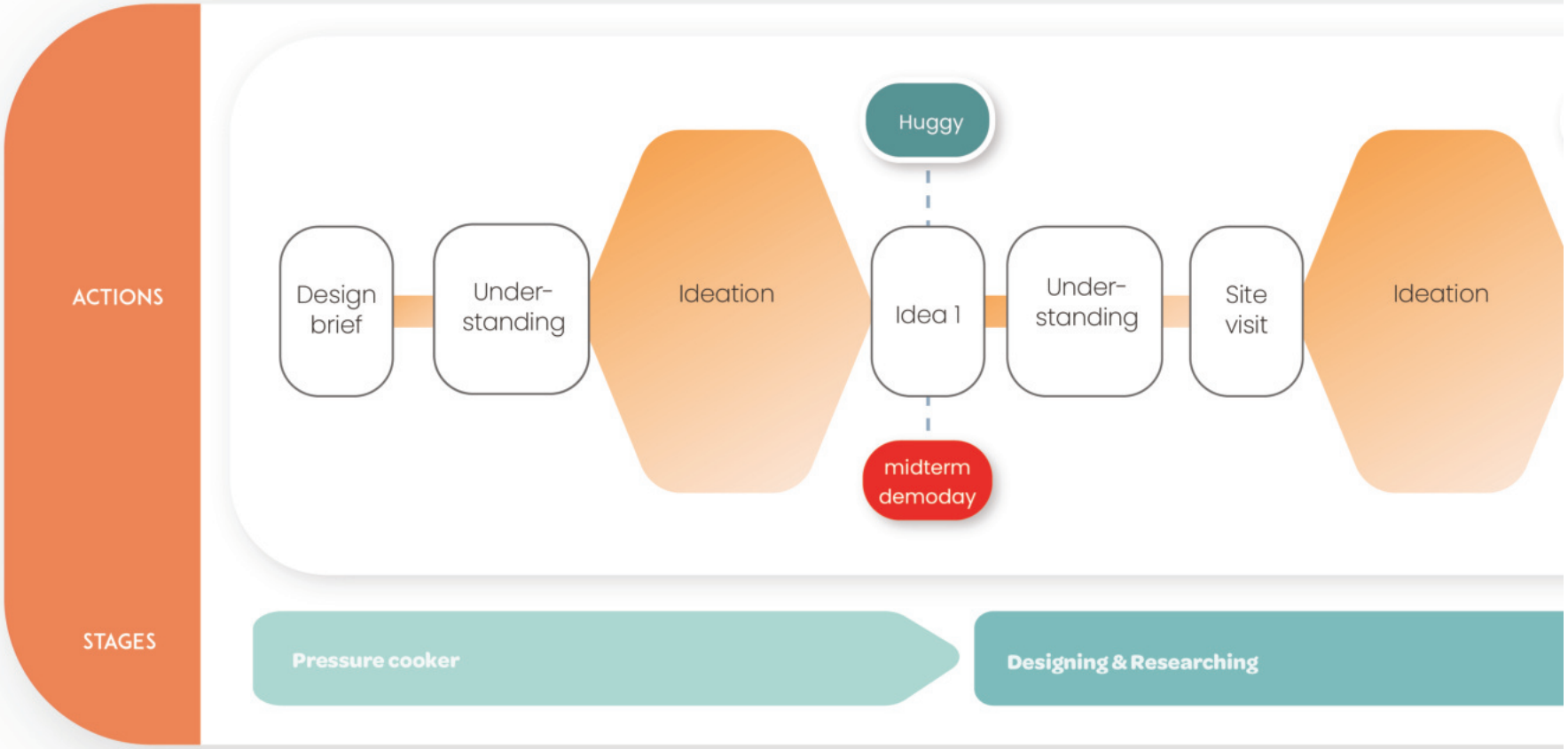
Appendix F Requirements producing lifevest

Relevant requirements	Solution/design approach
Finishing — Where there is a risk of unravelling, the cut ends of woven or braided components and construction features shall be turned under and stitched, or the equivalent, so as not to unravel. With the exception of fabric, synthetic materials such as webbing and lacing may be heat zealed in lieu of being turned under	Using an invisible zipper and no visible seams
Drainage — The life jacket shall provide for drainage of entrapped water, including water entrapped between the life jacket and the wearer.	During wet testing, no entrapped water was observed. For reliable results, further research is needed.
Channelling — The life jacket shall be designed so that it minimizes the formation of channels of water having a tendency to direct water into the face or to the head of the wearer.	During wet testing, no channeling was observed. For reliable results, further research is needed.
Strength of Seams — When tested in accordance with par. 7.5.4, the mean strength of all seams shall not be less than those in Table 1.	It is (time wise) impossible to test the seam strength of the prototype, but we advise to use a strong thread made from polyester
Seam Slippage — All sewn structural seams shall be stitched with lock stitches. Seams shall be located to assist in developing the full strength of the exterior. Seams shall be of a type that does not expose any raw edges.	Lock stitches are being used in the design, not exposing any raw edges.
Temperature Cycling — The life jacket shall not show signs of damage, such as shrinking, cracking, swelling, dissolution or change of mechanical qualities, when donned and secured subsequent to the temperature cycling test in accordance with par. 7.6.	Using an exterior material that is disattachable and replaceable when showing signs of damage.
Body Strength — The strength of the life jacket shall be sufficient to allow the wearer to be assisted from the water. The body strength of non-key-hole-style life jackets shall be tested and meet the requirements in accordance with par. 7.5.1	The volume and strength of Tobbe were calculated, shown in Figure 33. This results in a head weight of 14 kilos being able to be held up by the prototype.

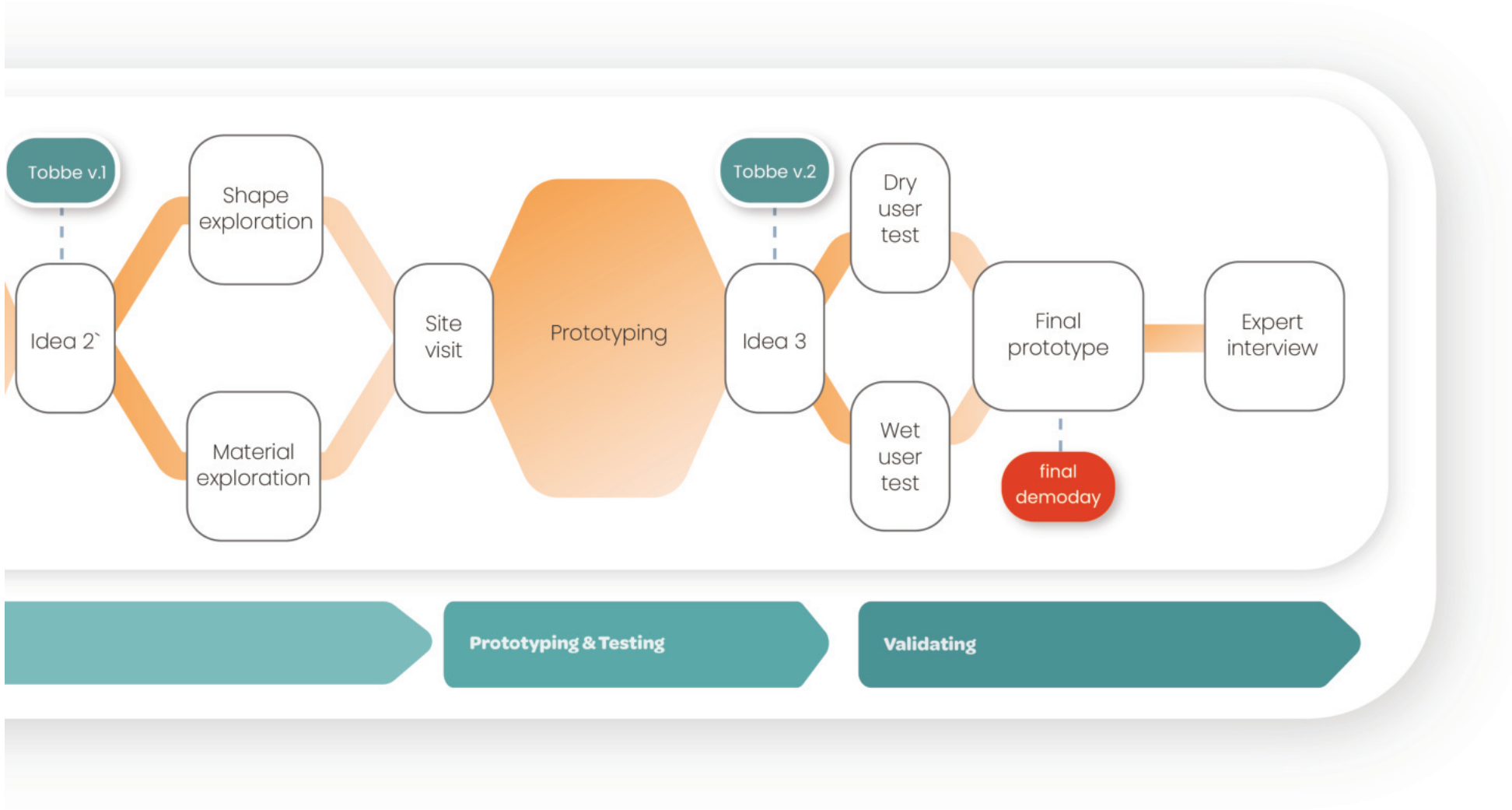
Table F. Requirements for producing lifevest concerning the Tobbe design (Canada, 2023)

Appendix G Design process

DESIGN PROCESS



Appendix G Design process



Appendix H Initial understanding

Nora

Remote service representative

Age 40-45

€800 - €900

ORO Rijtven Deurne

Shared bathroom

CORE NEEDS

- Routine
- Emotional support
- Safe space

PAIN POINTS

- Learning ability
- Social isolation
- Mental health challenges

INDEPENDENCE

- Household
- Work
- Sports
- Social activities
- Transport
- Independent living

DESIGN CHALLENGE

Initial understanding

"How might we enhance the independency in a group assisted living bathroom by creating a more personal wellness experience?"

Nora

Enjoys going on a trip for lunch

Lifevest oro

Mental Age 0-1

€0

ORO Rijtven Deurne

Shared bathroom

Personal Bathroom

CORE NEEDS

- Trust, Warmth, Understanding
- Feeling of safety
- Comfortability

PAIN POINTS

- Wearing a lifevest designed solely for safety
- Comorbidities limiting movement
- Strong presence of caregivers

INDEPENDENCE

- Household
- Work
- Sports
- Social activities
- Transport
- Independent living

DESIGN AIM

Later understanding

"enhancing the experience of wellness of intellectually disabled people by redesigning the bathroom experience considering the concept of trust, warmth and understanding for the organisation Oro, that houses these people"