

**THE DESIGN OF SALIVA WICKING SCARVES FOR INDIVIDUALS WITH
ORAL-MOTOR IMPAIRMENTS**

by

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A thesis submitted to the Faculty of the University of Delaware in partial
fulfillment of the requirements for Master of Science in Fashion and Apparel Studies

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TABLE OF CONTENTS

LIST OF TABLES	vii
LIST OF FIGURES	viii
ABSTRACT	x

Chapter

1	INTRODUCTION	1
2	LITERATURE REVIEW	4
2.1	Drooling.....	4
2.2	Clothing for individuals with disabilities	5
2.3	Scarves for children with special needs	6
2.4	Function design process	7
2.5	Functional needs.....	9
2.5.1	Thickness.....	9
2.5.2	Stiffness	10
2.5.3	Wicking properties	10
2.6	Expressive needs	10
2.7	Aesthetic needs.....	11
2.8	Accessibility needs	12
3	METHODS.....	13
3.1	Participants	13
3.2	Stage 1: Needs Assessment	13
3.2.1	Methods for content analysis.....	13
3.2.1.1	Sampling	13
3.2.1.2	Coding	14
3.2.2	Protocol for interviews	14
3.3	Stage 2: Prototype development.....	15

3.3.1	Methods for textile testing.....	15
3.3.1.1	Samples	15
3.3.1.2	Thickness test	16
3.3.1.3	Softness test.....	17
3.3.1.4	Vertical wicking test.....	17
3.3.1.5	Moisture management test.....	18
3.3.2	Prototype design and development.....	19
3.4	Stage 3: Prototype testing.....	19
3.4.1	Method for preliminary testing.....	19
3.4.1.1	Apparatus building	20
3.4.1.2	Preparation process.....	21
3.4.1.3	Testing process	22
3.4.2	Method for human subject testing.....	22
4	RESULTS AND DISCUSSION.....	24
4.1	Content analysis	24
4.2	Interviews	27
4.2.1	Participants	27
4.2.2	Caregivers' ratings toward their children's current clothing protectors	29
4.3	Textile tests.....	36
4.3.1	Top layer (Outer layer of the prototype)	36
4.3.1.1	Thickness	37
4.3.1.2	Softness	38
4.3.1.3	Vertical wicking test.....	39
4.3.1.4	MMT-wetting time	40
4.3.1.4.1	Right side.....	40
4.3.1.4.2	Wrong side.....	41
4.3.1.5	MMT-max wetted radius.....	41
4.3.1.5.1	Right side.....	41
4.3.1.5.2	Wrong side.....	42

4.3.1.6	MMT-spreading speed.....	42
4.3.1.6.1	Right side.....	43
4.3.1.6.2	Wrong side.....	43
4.3.2	Middle layer.....	43
4.3.2.1	Thickness	44
4.3.2.2	Stiffness	45
4.3.3	Bottom layer	46
4.3.3.1	Thickness	46
4.3.3.2	Stiffness	47
4.4	Preliminary testing	48
4.5	Design process.....	49
4.5.1	Initial design ideas.....	49
4.5.2	Fit testing.....	55
4.6	Human subject testing	57
4.7	Online survey	60
4.7.1	Participants	61
4.7.2	Respondents' feedback about scarf prototypes	62
4.7.2.1	Children eight years and older.....	67
4.7.2.2	Children younger than eight years old.....	70
4.7.2.3	Did not mention the children's ages.....	73
5	CONCLUSION	77
	REFERENCES.....	80
Appendix		
A	MEDICAL & HOME HISTORY FORM	82
B	INTERVIEW QUESTIONS.....	85
C	CLOTHING PROTECTOR PARTICIPANT LOG	94
D	DESIGN SURVEY FOR SCARVES FOR CHILDREN WITH ORAL- MOTOR IMPAIRMENTS	104
E	DIY MANUALS	111
F	IRB/HUMAN SUBJECTS APPROVAL	177

LIST OF TABLES

Table 1. Fabrics used in the textile testing	16
Table 2. The material list for products with a double-layer structure	25
Table 3. The material list for products with a triple-layer structure.....	26
Table 4. Caregivers' ratings of their current clothing protectors	31
Table 5. Participant log and feedback	59
Table 6. The pictures and description of each prototype.....	63
Table 7. Grading standard	66
Table 8. The distribution of participants' ranks of six designs	67
Table 9. The ratings of each design*	68
Table 10. The distribution of participants' ranks of six designs	70
Table 11. The ratings of each design*	71
Table 12. The distribution of participants' ranks of six designs	73
Table 13. The ratings of each design*	74

LIST OF FIGURES

Figure 1. Research process	3
Figure 2. A multi-layer clothing protector (Mum 2 Mum Youth Special Needs Bandana Wonder Bib - Waterproof)	7
Figure 3. The FEA Consumer Needs Model. (Lamb & Kallal, 1992, p. 42)	8
Figure 4. The FEA2 Model. (Hall & Lobo, 2018)	9
Figure 5. Wicking rate testing (Bagherzadeh et al., 2012)	18
Figure 6. Moisture management test (Bagherzadeh et al., 2012)	19
Figure 7. The schematic diagram of the apparatus*	20
Figure 8. Preparation process for the testing	21
Figure 9. Distribution of child participants' reported level of skin irritation	27
Figure 10. Distribution of the number of times that children's mouths need wiping ..	28
Figure 11. Distribution of children's feelings toward drooling problem	29
Figure 12. The mean value of the thickness results of each test sample	37
Figure 13. The mean value of the stiffness results of each test sample.....	38
Figure 14. The mean value of the vertical wicking test results of each test sample	39
Figure 15. The mean value of the MMT-Wetting time results of each test sample	40
Figure 16. The mean value of the MMT-Max wetted radius results of each test sample.....	41
Figure 17. The mean value of the MMT-Spreading speed results of each test sample.....	42
Figure 18. The mean value of the thickness results of each test sample	44
Figure 19. The mean value of the stiffness results of each test sample.....	45

Figure 20. The mean value of the thickness results of each test sample	46
Figure 21. The mean value of the stiffness results of each test sample.....	47
Figure 22. Mum 2 Mum Wonder Bib Bandana.....	49
Figure 23. E Z Topp Youth	49
Figure 24. The initial design ideas	50
Figure 25. Color selections.....	53
Figure 26. Participants' preferences toward all initial design ideas	54
Figure 27. Participants' preferences toward all color selections	55
Figure 28. Scarf designs after accepting caregivers' advice	57
Figure 29. The testing scarf design.....	58
Figure 30. The wider and longer version of Design 2	60
Figure 31. The distribution of participants who responded to the online survey	61
Figure 32. The distribution of the number of clothing protectors that the child (caregivers care for) uses in a typical day	62

ABSTRACT

Children with oral-motor impairments have trouble in swallowing their saliva, leading to problems with drooling (Hornibrook & Cochrane, 2012). Most children with this problem wear a bib-like clothing protector to avoid drool wetting their shirts or remaining on their neck, which might cause skin irritation. However, there do not exist a lot of choices for clothing protectors on the market. Caregivers of children with disabilities revealed that there were not enough color and style options for them to choose. This research aimed to develop quick-drying and high wicking scarves for children with oral-motor impairments, which would be aesthetically pleasing and functional to absorb liquid. The scarves also needed to be easy to make so that individuals who have interests and sewing skills could make them in the community. I aimed to create do-it-yourself (DIY) manuals for the scarves developed in this thesis to be shared through posting online after completion of testing. The first stage of the study involved assessing the end-users needs. This was conducted from two sources: posted consumer reviews of products on the market and interview conducted with participants recruited. Then I developed several scarf designs, performed textile testing, and evaluated the final prototypes via feedback from end users.

Chapter 1

INTRODUCTION

Sialorrhea, or drooling, is a common concern for children with physical or cognitive impairments (Hornibrook & Cochrane, 2012). Sialorrhea is a major disability and may be a lifetime problem (Hornibrook & Cochrane, 2012). Children who have sialorrhea commonly utilize bibs or scarves to avoid drool chapping and irritating the facial and neck skin. Additionally, individuals may have their clothing dampened, and surrounding objects (such as electronic products) have the potential to be hazardously affected (Norderyd et al., 2017). Sialorrhea occurs in 10% to 37% of children with cerebral palsy, and about 10% of children with intellectual disability (Hornibrook & Cochrane, 2012; Leung & Kao, 1999).

The staff at John G. Leach School (New Castle, DE) raised the initial idea of this research, developing a scarf-like bib to keep drool from dampening the clothing. They indicated that the products they are currently using do not have a lot of color and style options. This research will be developed based on the FEA2 (Functional, Expressive, Aesthetic, and Accessible) design needs assessment model (Hall & Lobo, 2018; Lamb & Kallal, 1992). This model builds upon the FEA model, a framework that could be applied to functional apparel designs for people with particular needs (Lamb & Kallal, 1992). The FEA2 model is an expanded version of the model that adds the fourth dimension of accessibility (Hall & Lobo, 2018).

For older children with sialorrhea, there are a very limited number of products that are both functional and aesthetic. A commonly implemented solution for older

children with sialorrhea is the use of a bandana as a scarf. The bandanas are made of cotton fabric so they are breathable and comfortable, however they are extremely permeable, allowing saliva to penetrate through to underlying clothing (Mullen, 2018). Prior research has not focused on developing a functional, attractive, and comfortable scarf to meet the needs of children with sialorrhea.

The purpose of this research is to develop (design) a quick drying and high wicking scarf for children aged 9-21 years. The goal is for the scarf to be cosmetically pleasing, affordable, and functional to prevent saliva from dampening clothing. The prototype designed in this project aims to provide individuals with a more desirable way to contain drool but has no medical curing function.

This project consisted of three stages. The first stage involved assessment of the needs of end users. This was completed using two processes: 1) content analysis of the available solutions and of reviews of those solutions; and 2) interviews with end users and their caregivers to identify the needs of children with sialorrhea. The second stage of the project consisted of prototype development. The third stage of the project involved testing of the prototypes. Note that I had intended to perform extensive human subjects testing for the third stage, but instead gathered feedback on the final design solutions via an online survey as all human subjects testing was halted for the university at the time.

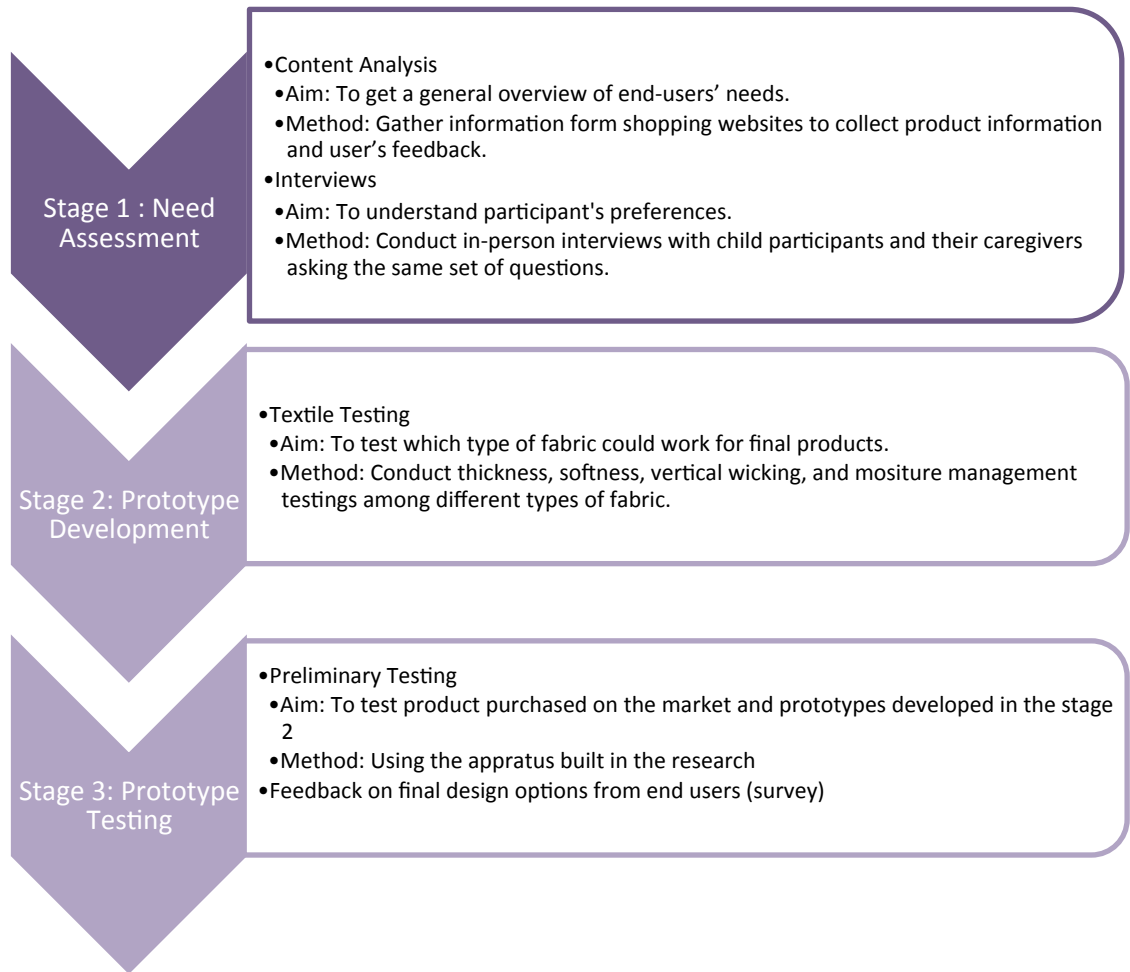


Figure 1. Research process

Chapter 2

LITERATURE REVIEW

In this section, the cause of oral-motor impairments and the current research of developing clothing for individuals with disabilities were reviewed. To create functional products with children with oral-motor impairments, the essential aspects that should be considered during the design process were summarized.

2.1 Drooling

Drooling (“sialorrhea”, “dribbling”, and “drivelling”) is defined as the unintentional escape of saliva from the mouth (Hornibrook & Cochrane, 2012). This condition can be considered as normal in healthy newborns and infants due to developing orofacial control, and usually resolves at 15-18 months of age (Mato et al., 2010). Although mild "normal" drooling is not uncommon in healthy children (usually boys that are five years old) (Hornibrook & Cochrane, 2012), most articles indicated that it could be considered pathologic after four years of age (Mato et al., 2010; Sousa et al., 2018).

Instead of excess saliva production, drooling is caused by the inability to retain saliva (Hornibrook & Cochrane, 2012). This can be due to oral motor dysfunction, lip incontinence (a defective swallowing ability), decreased oral sensation, poor posture or communication disorders (Mato et al., 2010; Sousa et al., 2018). This is an especially common problem among pediatric patients with neuromuscular disorders (cerebral palsy, for instance) and cognitive disabilities (Mato et al., 2010). For example, it has

been found to occur in 10% to 37% of young people with cerebral palsy; about 10% of children with intellectual disabilities (Hornibrook & Cochrane, 2012). Also, it is common in children with Down's syndrome or learning disorders (Mato et al., 2010).

Drooling may cause psychosocial and physical health problems and have significant impacts on child and family quality of life. For children with drooling problems, socialization might be a problem. They may be alienated because of the appearance of saliva on their shirts (Reddihough, Erasmus, Johnson, McKellar, & Jongerius, 2010) or may become a target of mocking that can lead to self-esteem issues (Ward & Rodger, 2004). In addition to psychosocial problems, physical health problems may manifest with facial chapping or rashes as excessive drooling can irritate the skin (Norderyd et al., 2017; Reddihough et al., 2010). For parents, changing dampened clothes, scarves, and bibs on a frequent basis can be a time-consuming burden (Norderyd et al., 2017).

2.2 Clothing for individuals with disabilities

Due to limited research on developing a functional scarf for adolescents to meet special needs, the literature review here was expanded to include apparel research for disabilities in different age groups. Several researchers analyzed user's perception of functional clothing for people with physical disabilities (Freeman, Kaiser & Wingate, 1985; Klerk & Ampousah, 2002). Freeman et al. (1985) suggested that functional clothing designers should incorporate the user's expressive needs into consideration. Their participants stated that product designers should understand individuals with disabilities' utilitarian and social needs (Freeman et al., 1985). Klerk and Ampousah (2002) developed evaluation research around 40 physically disabled women focused on garments for disabilities. The results of their research displayed

that 86% of the respondents complained about the style and found fitting problems (Klerk & Ampousah, 2002).

Stokes and Black (2012) interviewed 33 adolescent girls with disabilities about their satisfaction and needs with garments. They found that the fit and ease of donning and doffing were users' major considerations (Stokes & Black, 2012). Their participants also reported self-esteem and insecurity issues since sitting might raise the skirts and might show the appearance of their skinny legs (Stokes & Black, 2012). For adolescent girls, the style of clothing is of importance to them. Some of the participants reported a lack of fashionable and stylish garments for adolescents with physical disabilities (Stokes & Black, 2012). This research indicated that adolescent girls with disabilities were concerned about their own appearance, and items of clothing that combined functional, expressive, and aesthetic needs still need to be developed for this population.

2.3 Scarves for children with special needs

The most common type of clothing protector for older children with special needs is a bandana bib. Bandana bibs use cotton fabric to maximize breathability and comfort. A more sophisticated multi-layer option uses cotton fabric as the top layer and places a polyester fabric under for water resistance (Figure 2). For example, the Mum 2 Mum bib uses this two-layer design. The top layer is 100% cotton toweling and the bottom is waterproof fabric.



Figure 2. A multi-layer clothing protector (Mum 2 Mum Youth Special Needs Bandana Wonder Bib - Waterproof)

2.4 Function design process

This research was developed based on the FEA consumer needs model (FEA model for short) (Lamb & Kallal, 1992) and FEA2 model (Hall & Lobo, 2018). The FEA model is a framework that could be applied to functional apparel designs for people with particular needs (Lamb & Kallal, 1992). The model helps assess users' needs and consumers' preferences. Lamb and Kallal (1992) stated that during the functional design process, three aspects should be considered, including (a) functional needs, (b) expressive needs, and (c) aesthetic needs.



Figure 3. The FEA Consumer Needs Model. (Lamb & Kallal, 1992, p. 42)

The FEA2 model (Figure 4) was developed by Hall and Lobo (2018) by adding the fourth aspect - accessibility. They also viewed the user as the center and updated the original FEA model with a specific focus on inclusive design. The previous research noted that user-centered design models were effective solutions for users with medical needs (Gorden & Guttmann, 2015). Aiming to meet the board needs of end-users, based on the initial concerns about expressive and aesthetic needs, and strong demand for the solutions to be accessible, the FEA 2 modal was selected in this research.

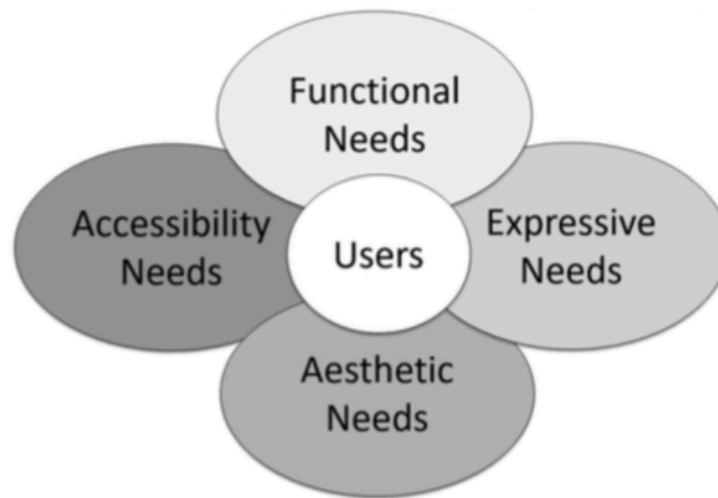


Figure 4. The FEA2 Model. (Hall & Lobo, 2018)

2.5 Functional needs

Functional needs deal with how well the garment functions to fulfill the specific purposes and the comfort of the garment (Lamb & Kallal, 1992). For clothing for people with special needs, the specific purpose pertains to its fundamental use (Hall & Lobo, 2018). In this section, the thickness, stiffness, water wicking ability of the fabric was tested.

2.5.1 Thickness

Fabric thickness has a significant influence on the comfort of the fabric. Mehrtens and McAlister (1962) stated that the high value of fabric thickness led to a low level of comfort. Thinner fabrics would be expected to provide better wearing comfort.

2.5.2 Stiffness

Another factor that influences the comfort of the fabric is stiffness of the fabric. Mary, Harriet and Nancy (1984) found that the overall comfort was positively correlated with the softness of the fabric. They stated that softer fabrics were evaluated highly in the overall comfort rating (Mary et al., 1984).

2.5.3 Wicking properties

Liquid transporting rate is a significant factor that should be considered in this study. The products are expected to be able to transport a large amount of saliva and keep the shirt from dampening. Wicking is the spontaneous flow of liquid driven by capillary action (Fangueiro, Filgueiras, Soutinho & Meidi, 2010). It allows moisture to travel through the porous substance and move against gravitational forces (Venkatraman, 2015). Fabric's wicking ability differs depending upon the thickness, density, and capillary pathways (Fangueiro et al., 2010; Venkatraman, 2015). The same fabric's warp and weft direction wicking performance may be comparably different.

2.6 Expressive needs

Expressive needs relate to user's social interactions and personal identification (Hall & Lobo, 2018). For individuals with physical or cognitive disabilities, their garments often focus on the functional aspect and neglect the importance of users' personal expression.

Cobb and Lapolla (2019) developed research on co-designing the textile's surface pattern to enhancing palliative care. They conducted a co-creative design with participants by asking their preferences and hobbies (Cobb & Lapolla, 2019). The surface design patterns were then developed based on the interview results. The

surface designs were printed and used to make small items like a hat or scarf as the final products that can express users' values and identities (Cobb & Lapolla, 2019). They found that participating in the whole research process had a positive influence on participants' well-being, and also the participants showed positive interest in the co-design process since the design was unique to each participant (Cobb & Lapolla, 2019; Ehresman, 2014).

In the current study, the expressive needs will be considered and identified by interview questions. Questions related to the participants' favorite color and pattern will be asked and be used in the prototype designs.

2.7 Aesthetic needs

Aesthetic needs involve information conveyed by the garment and the sense of delight and enjoyment gained from the aesthetic of the garments (Lamb & Kallal, 1992). This is a major consideration in this research since the staff that raised the idea of this research emphasized highly that there were not a lot of fashionable and stylish clothing protectors available on the market. Previous researchers found that users were unsatisfied with the style of the clothing for individuals with disabilities (Klerk & Ampousah, 2002). Also, previous studies found that users, especially adolescents, desired fashionable garments (Stokes & Black, 2012).

In this case, several styles of design will be provided to the participants, their caregivers, and their parents. End users will be asked about their preferred design and the most frequently selected designs will be evaluated for final selection by participants.

2.8 Accessibility needs

Accessibility needs require designers to consider the affordability and availability of the design (Hall & Lobo, 2018). Instead of selecting expensive materials, using inexpensive yet low-tech materials and creating manufacturing instructions or videos as online sources would benefit users across the world (Lobo et al., 2016). As for this case, DIY manuals will be created as open-sources to publish online. These manuals will contain the material purchasing link, patterns of the prototypes and instructions regarding the sewing process.

Chapter 3

METHODS

3.1 Participants

Children 9-21 years of age with sialorrhea and/or their caregivers were recruited with a goal of recruiting 5-10 child participants and their caregivers. Inclusion criteria included the need for a clothing protector and availability of the child and/or caregiver to engage in the interview process verbally in English. This project was approved by the University of Delaware's Internal Review Board. Adult caregivers (school or nursing staff) provided informed consent to be interviewed. Parents of child participants provided consent for child participants; they also provided consent so they could be interviewed. Child participants who were able provided informed assent. Participants engaged in the Stage 1 interviews.

3.2 Stage 1: Needs Assessment

3.2.1 Methods for content analysis

3.2.1.1 Sampling

To get a general overview of end-users' and caregivers' preferences, we collected information from existing solutions and consumer reviews of those solutions. Searches were completed on Google and Amazon, and the search terms were: "bibs for special needs youth," and "clothing protectors." The first three pages of search results were reviewed. Each source was analyzed to determine whether or not it should

be included in the content analysis results. Inclusion required that each source consisted of relevant products and/or had consumer reviews.

3.2.1.2 Coding

Information was coded for each source in relation to: 1) the information offered from the product description (including target consumer age range, gender of the target consumer, materials, product structure, product dimensions, color options, retailer-provided product description), and 2) the consumer comments and concerns. During the review process, the researcher listed the key terms related to the product description and consumer reviews. Two independent coders coded all of the sources. Product description information was compared between the two coders for accuracy. Coding of consumer comments and concerns involved coders making decisions about the categories under which to place these comments and concerns (for example, aesthetics, comfort, function, cost); therefore, inter-coder reliability was assessed by documenting the frequency of instances of agreement and the frequency of instances of disagreement and calculating: $[(\text{Agreed}/(\text{Agreed}+\text{Disagreed}))\times 100]$.

3.2.2 Protocol for interviews

For convenience and comfort of the participants, interviews were conducted in the child's home, school, or at another location of the participant's choosing. Interviews were conducted via one meeting. At this meeting, participants were asked to complete the Medical & Home History Form (Appendix A). This form gathered information regarding medical history and diagnoses, therapeutic services, and demographic and socioeconomic characteristics of the participants. Then, participants were video recorded as they engaged in the interview process with the researcher.

Video recording allowed for coding of their responses by two independent coders after the session. This allowed us to determine inter-rater agreement. It also allowed the same coder to recode a subset of the data for the determination of intra-rater reliability.

The interview questions included a combination of Likert rating items and open-ended items (Appendix B). Items gathered information about the needs of the users, the likes and dislikes of users for their current products, and the preferences of users for alternative solutions. The interview questions were developed based on the FEA2 consumer needs design model. The first section of the interview questions originated from a study conducted by Reid, Johnson, and Reddihough (2010) and were modified to fit this research. The second section was developed by our team to identify the participant's preferences, needs, and opinions about the previous products in relation to the categories of the FEA2 model (Hall & Lobo, 2018; Lamb & Kallal, 1992). Interview data were analyzed descriptively.

3.3 Stage 2: Prototype development

The prototype development stage consisted of two parts: textile testing and design process. The textile testing was conducted among fourteen fabrics to identify the materials for the final prototypes. The design process aimed to determine the style and color selections of the prototypes.

3.3.1 Methods for textile testing

3.3.1.1 Samples

Six wicking fabrics, five waterproof fabrics and three absorbent fabrics were chosen as potential materials for prototype design (Table 1). Apart from the GORE-TEX waterproof fabric, the rest of the fabrics are available in the market through

online venues (Amazon, Seattle, Washington & Seattle Fabrics, Seattle, Washington) or a local fabric store (Jo-Ann Stores, Inc., Hudson, Ohio), ensuring the solution is an affordable and replicable option (may add price as basic information).

According to the ASTM standard method ASTM D1776 (Standard Practices for Conditioning and Testing Textiles), all of the fabric samples were conditioned in a standard atmosphere of 21°C and 65% relative humidity prior to the testing.

Table 1. Fabrics used in the textile testing

Fabric	Material List
Waterproof Breathable PUL knit fabric	100% Polyester fabric backed 100% Polyurethane coating
Waterproof PUL knit fabric	83% Polyester, 15% Polyurethane, 2% Agglutinant
GORE-TEX Waterproof fabric	Not available
GORE-TEX Waterproof fabric	Not available
GORE-TEX Waterproof fabric	Not available
Stay-Dri Wicking Knit Fabric	100% Polyester
Dryline Wicking Spandex knit fabric	A knit fabric containing spandex fiber
Honeycomb Wicking Spandex Mesh	85% Nylon, 15% Spandex
Active Dry Wicking Jersey Mesh	100% Polyester
DriFit Wicking Spandex Ripstop	84% Polyester, 16% Spandex
Dri-Qwick Sports Mesh Fabric	100% wicking polyester
Super Absorbent Shammy Cleaning Cloth	100% Rayon
Terry Cloth Pink Fabric	100% Cotton
Knit terry fabric	100% Cotton

3.3.1.2 Thickness test

The fabric thickness was measured using a portable thickness gauge (SDL Atlas Inc., Rock Hill, SC). The thickness tests were conducted based on ASTM D1777 (Standard Test Method for Thickness of Textile Materials). The experiments of each type of fabric were repeated ten times.

3.3.1.3 Softness test

To maximize comfort for the prototype, the softness of each fabric was tested. Softer fabrics would be expected to provide better wearing comfort. The softness of the fabric was measured on a Handle-O-Meter Tester (Thwing-Albert Instrument Co., Philadelphia, PA) per standard test method ASTM D6828-02 (Standard Test Method for Stiffness of Fabric by Blade/Slot Procedure). The specimen size was 4 inches by 4 inches; each fabric was tested across five samples. Each sample was loaded into a machine that uses a knife to bend the fabric on both sides in two directions. The force needed to bend the fabric was reported.

3.3.1.4 Vertical wicking test

To optimize functionality for the scarves, it was essential to investigate the wicking performance of multiple knitted fabrics. The vertical wicking test identified the ability of water to diffuse vertically in fabrics. The wicking heights were measured and recorded. Both directions of the six wicking fabrics were tested. To measure the functional aspect of moisture management performance, a vertical wicking rate test was conducted. For the experimental design, a 500 mL beaker of solution tinted with red food coloring was prepared to gauge the diffusion distance. Three 1" × 10" samples of each fabric were cut along both the warp and weft directions. On each sample, a pencil line was drawn one centimeter away from the shorter edge of the fabric sample. A glass rod was placed across the top of the 500 mL beaker. The end of the unmarked fabric sample was attached to the glass rod. The sample then was submerged to the one-centimeter pencil mark in the dye solution for five minutes (Figure 5). After five minutes, the strip was removed from the beaker and placed on a paper towel. The diffusion distance was measured immediately after testing.

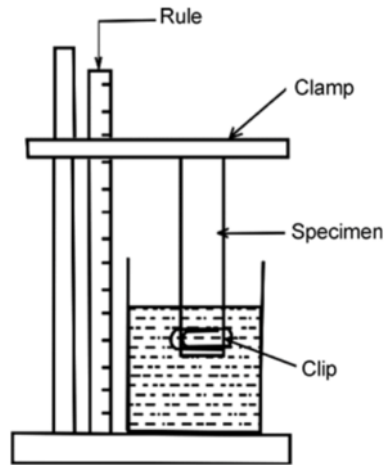


Figure 5. Wicking rate testing (Bagherzadeh et al., 2012)

3.3.1.5 Moisture management test

In the moisture management test, a moisture management tester (MMT) was used based on AATCC Test Method 195 (Test Method for Liquid Moisture Management Properties of Textile Fabrics) (Figure 6). The MMT consisted of two series of sensors and the specimen (8cm×8 cm) was placed in the middle of them. A pipette dropped sodium chloride solution (0.9% NaCl) on the top surface of the sample and the resistance changes were recorded by a computer. The data were collected as follows:

- (a) Wetting time - Time (sec) when the top and bottom surfaces of the specimen begin to be wetted.
- (b) Maximum wetted radius - The greatest ring radius measured on the top and bottom surfaces.
- (c) Spreading speed - The accumulated rate of surface wetting from the center of the specimen there the test solution is dropped to the maximum wetted radius.

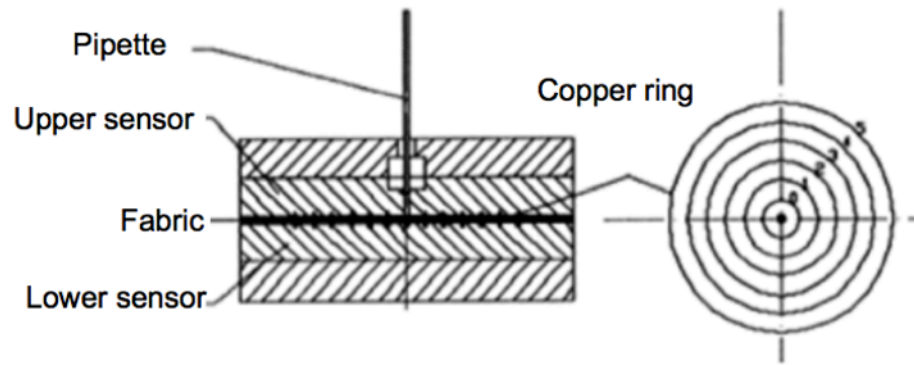


Figure 6. Moisture management test (Bagherzadeh et al., 2012)

3.3.2 Prototype design and development

Since everyone has their preferences, six different styles of designs were developed as initial design ideas for participants to choose from. All designs were given to participants and their caregivers, asking them to select the top three designs and their comments for improving the designs. The designs were changed or added according to their feedback. The DIY manuals of the top three choices across all participants would be made.

3.4 Stage 3: Prototype testing

3.4.1 Method for preliminary testing

Preliminary testing was conducted to evaluate the ability of existing products and our prototypes to capture liquid. Although the MMT could test the fabric's wicking properties, it was only able to drip water for 20 seconds and could not test whether the product had the ability to capture large amount of water.

3.4.1.1 Apparatus building

An apparatus was built for the preliminary testing to test the products' and prototypes' ability to capture liquids. Figure 6 is the schematic diagram of the apparatus. This apparatus consisted of five components: (1) a metal shelf, (2) a plastic water bottle, (3) a rubber band, (4) a lid of the water bottle, (5) a cardboard box.

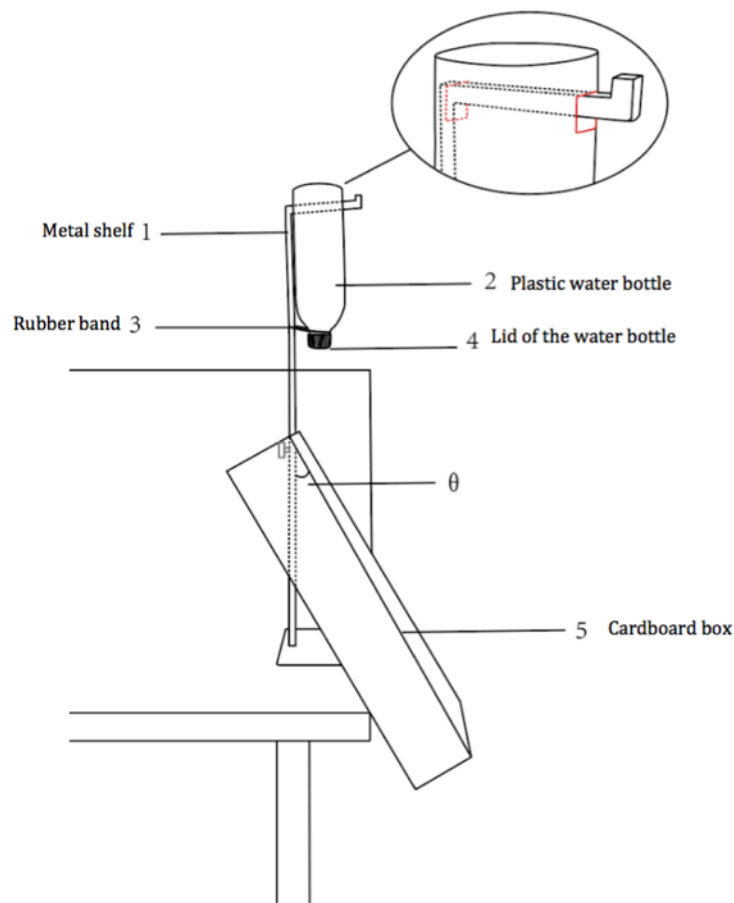


Figure 7. The schematic diagram of the apparatus*

As for the assembly process, the bottom part of the plastic water bottle was removed so that the water could be poured in the bottle easily, and then two square holes ($1\text{cm} \times 1\text{cm}$) opposite from each other (180 degrees) were cut (about one centimeter from the bottom cutting edge), to place the water bottle on the shelf. A rubber band was used to keep the water bottle still and ensure the bottle was at the same place at each testing. A small hole was pricked on the lid of the plastic bottle using a needle, allowing the water to drip down. The cardboard box acted as a platform to place the product or the prototype. To assemble the cardboard box on the shelf, a square hole ($1\text{cm} \times 1\text{cm}$) was cut in the middle of the shorter side of a rectangle box. The shelf consists of a screw (original function is to control the height of the shelf) that could act as a block to hang the cardboard box. The angle (θ) that the shelf and the surface of the cardboard box formed is set to be 30° .

3.4.1.2 Preparation process

Before the testing, a plastic sleeve was placed to cover the cardboard box to protect the box from getting wet. Then, a piece of paper was placed on the plastic cover to provide a clear vision on which part was moist after the experiment. The product or prototype was then placed.



Figure 8. Preparation process for the testing

3.4.1.3 Testing process

For each test, 60 mL of water was poured into the bottom of the water bottle and was allowed to drip over a time period of 30 minutes. When pouring the water in the bottle, the researcher covered the small hole on the lid. Once the dripping was started, the researcher removed the cover and started the timer. The whole process was video-recorded and a picture was taken every five minutes. After the testing, pictures of the front and the back of the product or the prototype, and also a picture of the base paper, were taken.

I had originally planned to conduct testing on both the commercially available products and the prototypes developed in the thesis. However, due to unanticipated university closures, only the purchased products were tested.

3.4.2 Method for human subject testing

The original plan for human subject testing was to have each participant test three types of prototypes. Two of them were to be the top two style choices across all the participants, and the third one was to be the style that the participant chose outside of the two common top choices. Testing with each of the prototypes was planned to be continued for a week. Then the participants were to be asked to engage in testing with their current solution for one week. We were to collect data through a Clothing Protector Participant Log (Appendix C) given to the caregivers of the participants. The caregivers were to be asked to log the time the clothing protector was put on and taken off and document the reason(s) for taking the clothing protector off each day. Also, they were to be asked to record when the clothing protector was washed and to note the washing method.

Due to human subject testing restrictions imposed at the University and the closure of the participants' school due to the current pandemic, human subject testing was only able to be conducted with the first design. To gather user feedback about the designs given the current circumstances, our team decided to shift to get feedback through an online survey approved by the University of Delaware's Internal Review Board.

The online survey included Likert scale questions and open-ended questions (Appendix D). Questions were designed to gather information about how survey participants felt about their needs and to gather feedback on the final scarf prototypes developed in this project. The survey was completely voluntary. All answers were anonymous and no identifying information was collected.

Chapter 4

RESULTS AND DISCUSSION

4.1 Content analysis

About 1,230,000 results were found using "bibs for special need youth" as the search phrase. While using "clothing protector" as the term for searching, we found about 118,000,000 results. The first three pages were reviewed for each of these two searches (72 items in total). After excluding items that did not meet our inclusion criteria, 31 items were included. The inter-coder reliability was 90.4%.

The information provided by the merchants and from consumers' reviews was coded. However, there were a few limitations. Some of the merchants did not provide enough product information, such as information about materials, structures, and accessories. As for the consumers' reviews, not all of the products had consumers' reviews, and some reviews for a product were actually describing different products. Also, the users of the products are unknown. Researchers could not know for whom the products were purchased to determine whether the reviews discuss use for a child with disabilities or not.

The functionality of clothing protectors is a crucial factor to consider. Merchants use various structures and materials to maximize functionality of the clothing protectors, aiming to be more absorbent. To characterize functionality, all the items were categorized by their structures (number of layers they contain). The materials, designs, and consumer reviews were also analyzed.

Nine out of 31 products used a single layer structure. Six of those used cotton terry (80% cotton + 20% polyester or 86% cotton + 14% polyester) as their materials. The remaining three used cotton, neoprene, or microsuede. As for consumers' reviews for these nine single-layer products, four of them contained negative reviews, with comments such as the materials are thinner than expected or the color would bleed and look old after a few washes. Interestingly, those products were all made of cotton terry. Two of them did not have any reviews, and the reviews for the remaining three were all positive reviews revealing those clothing protectors are perfect for their children and willing to buy more in the future.

Table 2. The material list for products with a double-layer structure

#	#1(upper)	#2 (bottom)
1	Cotton terry front	Nylon backing, waterproof interior barrier
2	Unknown	Unknown
3	Cotton front (to soak up moisture)	Fleece (moisture-wicking backing)
4	Cotton	Absorbent terrycloth
5	Clear vinyl	100% cotton designer fabric
6	Cotton/polyester	Waterproof PUL
7	Cotton Blend	100% PVC fully waterproof
8	Soft polyester tricot top layer	Woven vinyl layer
9	Terry cloth	Waterproof lining
10	Unknown	Waterproof lining
11	Cotton	Waterproof vinyl
12	Poly/cotton blend (65%/35%)	Waterproof lining
13	Cotton blend	PVC full waterproof
14	80% cotton 20% polyester double ply	80% cotton 20% polyester double ply
15	Cotton/polyester	PVC waterproof cloth
16	Cotton/polyester	Waterproof vinyl back with a

		polyester scrim
17	Unknown	Unknown
18	Terry cloth	Vinyl backing
19	Terry cloth	Water-resistant backing
20	Cotton/polyester	Waterproof vinyl barrier

As shown in the Table 2, most of the double-layer products used cotton or cotton/polyester blend as their top layer (the layer facing out) and waterproof fabric as the bottom layer as a barrier layer. Some consumers reviewed that the products were not that absorbent and had leaking problems. Most of the consumers' reviews were positive such as products are well made using nice quality fabrics and are suitable for children with drooling problem, suggesting double-layer structures might work better than single-layer designs.

Table 3. The material list for products with a triple-layer structure

#	#1 (upper)	#2 (mid)	#3 (bottom)
1	Cotton	Stay-dry liner	Solid reverse side
2	Bamboo Velour (70% viscose from Organic Bamboo/28% Organic Cotton/2%poly)	100% Nylon moisture resistant line	Cotton

Two products used a triple-layer design structure (See Table 3). Interestingly, the first one was created by a company that was unique in that it is owned by a mom who has a child with disabilities. All of the products in her company are homemade. She has a lot of cotton fabrics for consumers to choose among and can customize products for consumers since the consumer would place the order first, and then she will make it for them. However, sadly, she stopped selling the products.

4.2 Interviews

All interviews were video recorded. Two independent coders coded all videos separately. The inter-coder reliability was 91.3%

4.2.1 Participants

All nine child participants had frequent drooling issues. All 13 adult caregiver participants revealed that drooling was a frequent and everyday occurrence for the child in their care ($M=4.9$, $n=13$). Twelve of 13 rated 5 in the question “How frequently does your child have trouble with excess saliva and drooling”, with 5 representing “every day” and 1 representing “not at all”, the remaining caregiver rated 4 in that question.

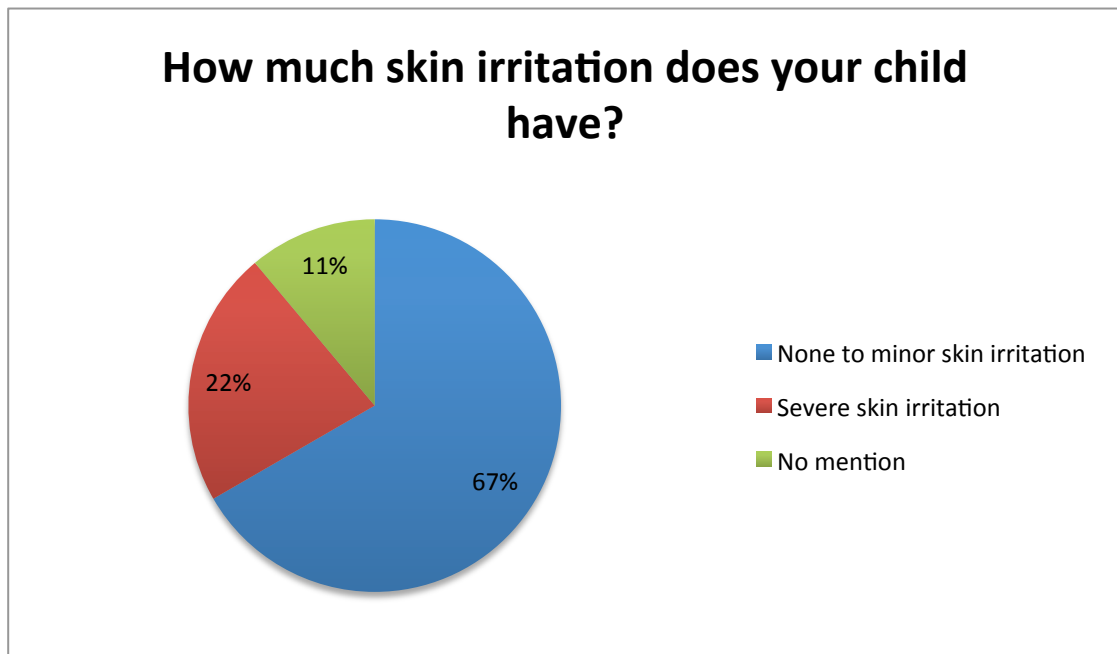


Figure 9. Distribution of child participants' reported level of skin irritation

Two children’s teachers mentioned their kids had “severe” skin irritation because of the drooling problem (see Figure 9). Six of them reported “none” to “minor” skin irritation, the remaining child participant’s parents said the child’s skin irritation’s situation was hard to grade, she preferred not to give the answers.

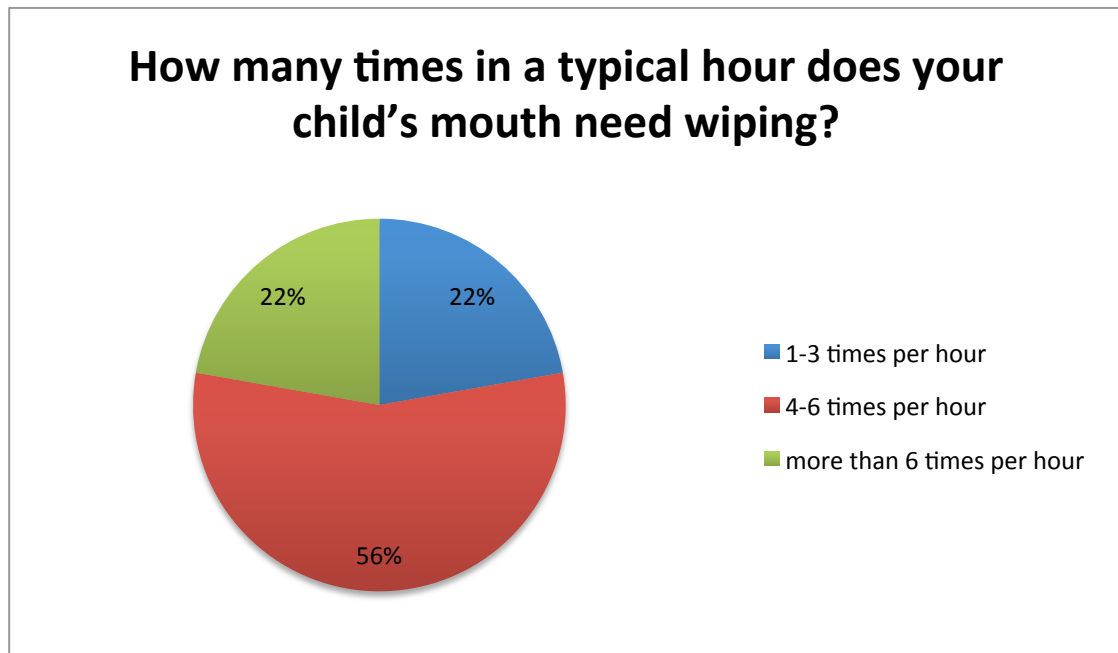


Figure 10. Distribution of the number of times that children’s mouths need wiping

According to caregivers (teachers and parents), child participants’ drooling was a constant and fairly frequent activity. For the question “How many times in a typical hour does your child’s mouth need wiping?” two children’s caregivers answered 1-3 times in an hour. Five child participants require their caregivers do it 4-6 times per hour. Two child participants need it more than 6 times per hour.

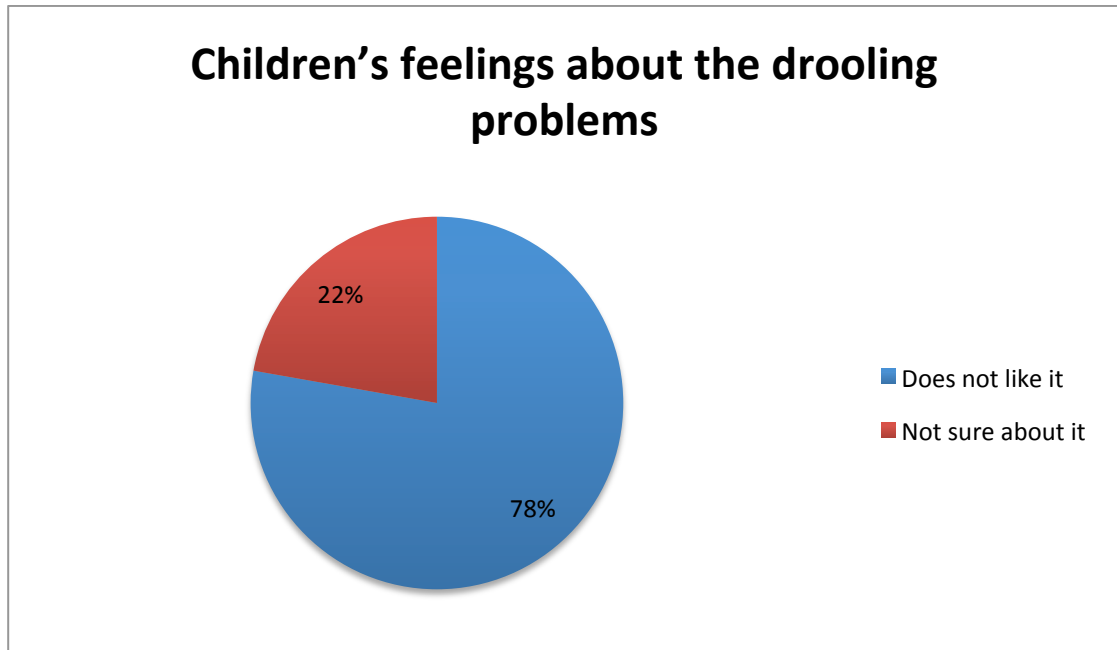


Figure 11. Distribution of children's feelings toward drooling problem

As for children's feelings about the drooling, most of the kids (seven out of nine) did not like it and found it very annoying. Caregivers revealed that some children do not like others wiping their mouth for them and would wave their arms or shake their heads to avoid that. The remaining two children's caregivers were not sure about their children's feelings toward drooling.

4.2.2 Caregivers' ratings toward their children's current clothing protectors

Teacher and parent average ratings of their current clothing protectors generally ranged from 2.7-4.3 on a scale from 1-5 with 5 representing more positive ratings (see Table 4). Specifically, teachers and parents agreed in their evaluations of absorption, durability, the softness of the fabric, fit, coverage, self-esteem, clasping, and affordability as above average, suggesting they were quite satisfied with the

function and the price of their current products. However, some of the clothing protectors were home-made and donated to the school without any cost; that's why some teachers rated them so affordable. Also, although they rated high on the clasping of the products, they suggested they liked snaps rather than Velcro. They have used products with Velcro before, and fibers would stick to the Velcro making it worn out after several washes. So, they specifically pointed out they did not want to try products using Velcro as the clasping mechanism.

Both teachers and parents rated their current solutions relatively low for ease of donning, attractiveness, and the pattern of the products. One of the teachers mentioned that she would mess the child's long hair up when she wears the clothing protectors for the child since the snaps are at the back of the neck. They rated the appearance of their current clothing protectors below average. A few rated higher since they make the clothing protector by themselves for their children so they could choose the pattern of the fabric.

Teachers and parents disagreed on the ratings of comfort, breathability, and color options. Teachers rated those three aspects lower than average; meanwhile, parents rated them higher than average. The main reason is children would use the market products during school time; most of them do not have a lot of color options and use thick materials to prevent leaking. When they are at home, sometimes parents would use their homemade clothing protectors, which incorporated self-selected fabrics and multiple colors.

Parent's ratings were higher than the teacher's ratings. Partially because they have purchased a lot for their kids, and when we asked them to give a rating, they thought and rated the one that performed the best in each category. Even when we

prompted them to focus specifically on one product, they had difficulty with this task, since they have so many clothing protectors.

Table 4. Caregivers' ratings of their current clothing protectors

	Questions	Rating scale	Teacher		Parent		Comments
			<i>N</i> *	<i>M</i> ± <i>SD</i>	<i>N</i> *	<i>M</i> ± <i>SD</i>	
Absorption	How well does the clothing protector protect the clothes from moisture?	1 = completely unsatisfied; 5 = fully satisfied	4	3.5 ± 0.5	7	3.7 ± 1.2	

Comfort	Does your child feel comfortable wearing the clothing protector?	1 = extremely uncomfortable; 5 = extremely comfortable	3	2.7 ± 0.5	7	4.3 ± 0.7	
Durability	How well does the fabric hold up to daily usage?	1 = not at all durable; 5 = extremely durable	6	4.5 ± 0.8	7	4.6 ± 0.5	
Fabric-softness	How satisfied are you with the softness of the material?	1 = extremely stiff; 5 = extremely soft	4	3.8 ± 1.3	5	3.8 ± 1	

Fabric-breathability	How satisfied are you with the breathability of the material?	1 = extremely unbreathable; 5 = extremely breathable	3	2.7 ± 0.9	7	4.1 ± 0.6	
Sizing-fit	How well does the garment fit around the neck?	1 = extremely poor fit; 5 = extremely good fit	4	3 ± 1.2	6	4 ± 1.2	
Sizing-cover	How well does the garment cover the clothing?	1 = extremely poor coverage; 5 = extremely good coverage	2	3.5 ± 1.5	7	3.4 ± 1.3	Should be wide enough to cover child's shoulder

Self-esteem	How does your child feel when wearing the garment?	1 = not at all confident; 5 = extremely confident	4	3.3 ± 1.5	7	4.1 ± 0.8	
Attractiveness	How do you like the appearance of the garment?	1 = not at all; 5 = very much	4	2.3 ± 1.6	7	2.4 ± 1.4	
Color Selection	Are you satisfied with the color options?	1 = not at all; 5 = extremely	4	2.8 ± 1.5	7	3.3 ± 1.7	

Pattern Selection	Are you satisfied with the shapes or design style options?	1 = not at all; 5 = extremely	3	2 ± 0.8	6	2.8 ± 1.7	Most of them are solid, it would be better to have some patterns
Clasping	How well does the garment stay fastened?	1 = very poorly; 5 = extremely	1	5 ± 0	6	4.3 ± 0.9	Velcro does not work at all
Ease of donning	How easily can your child take the garment on/off without assistance?	1 = not able; 5 = fully able	6	1 ± 0	7	1 ± 0	

Affordability	How satisfied are you with the price of the garment?	1 = not at all; 5 = extremely	2	4 ± 1	6	5 ± 0	
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*The number of participants contributing data for each outcome differed at times because participants at times reported they were unsure of their answer.

4.3 Textile tests

All of the fabrics were separated into three categories based on the three-layer structure design idea (top layer group, middle layer group, and bottom layer group). The textile test results of each fabric were analyzed and compared within each group. The requirements of each layer were demonstrated as well.

4.3.1 Top layer (Outer layer of the prototype)

The top layer is the outer layer that would first contact children's drool, so the fabric of this layer needs to have the power to spread and allow the liquid to penetrate the liquid in a short time. This group contains six fabrics: Stay-dri fabric, Dryline fabric, Honeycomb fabric, Active Dry fabric, DriFit fabric, and Dri-Qwick fabric. Thickness, stiffness, vertical wicking, and MMT tests were conducted among those fabrics.

4.3.1.1 Thickness

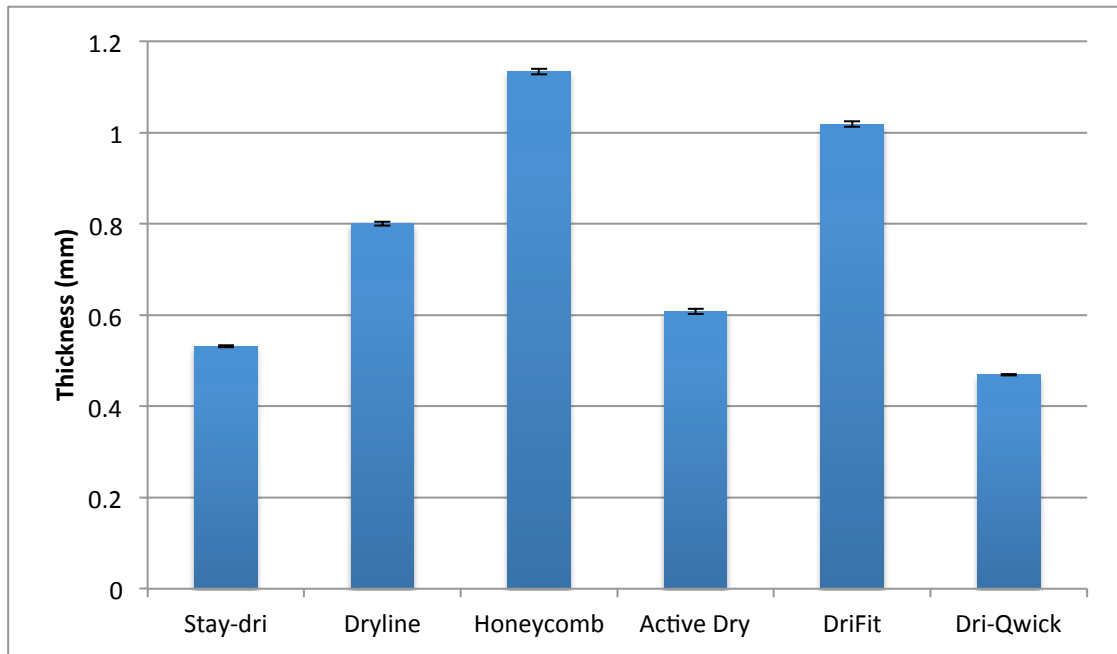


Figure 12. The mean value of the thickness results of each test sample

One-way ANOVA was used to compare the thickness test results among fabrics. There are significant differences among the thickness of each fabric ($F=8456.711, p < .01$). Tukey HSD post hoc test separated the fabrics into 6 groups (significant at $p < .05$): Dri-Qwick < Stay-dri < Active dry < Dryline < DriFit < Honeycomb.

4.3.1.2 Softness

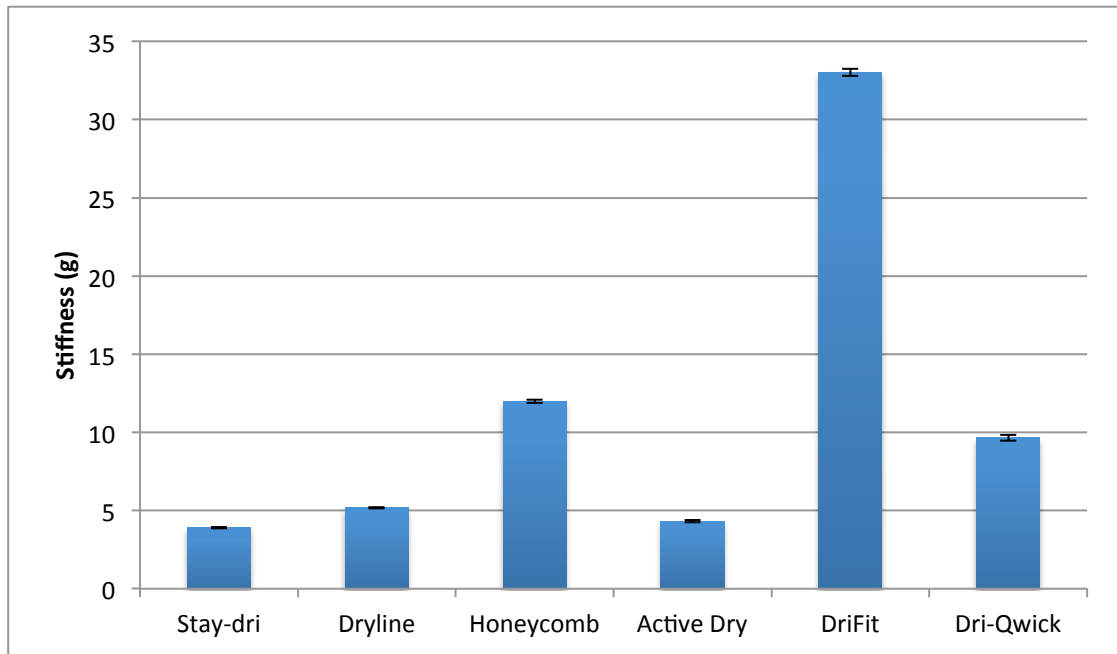


Figure 13. The mean value of the stiffness results of each test sample

One-way ANOVA was used to compare the stiffness test results among fabrics. There are significant differences among the stiffness of each fabric ($F=8689.088$, $p < .01$). Tukey HSD post hoc test separated the fabrics into 5 groups (significant at $p < .05$): (Stay-Dri = Active dry) < Dryline < Dri-Qwick < Honsycomb < DriFit. The Stay-dri Wicking and Active dry fabrics are softer than others.

4.3.1.3 Vertical wicking test

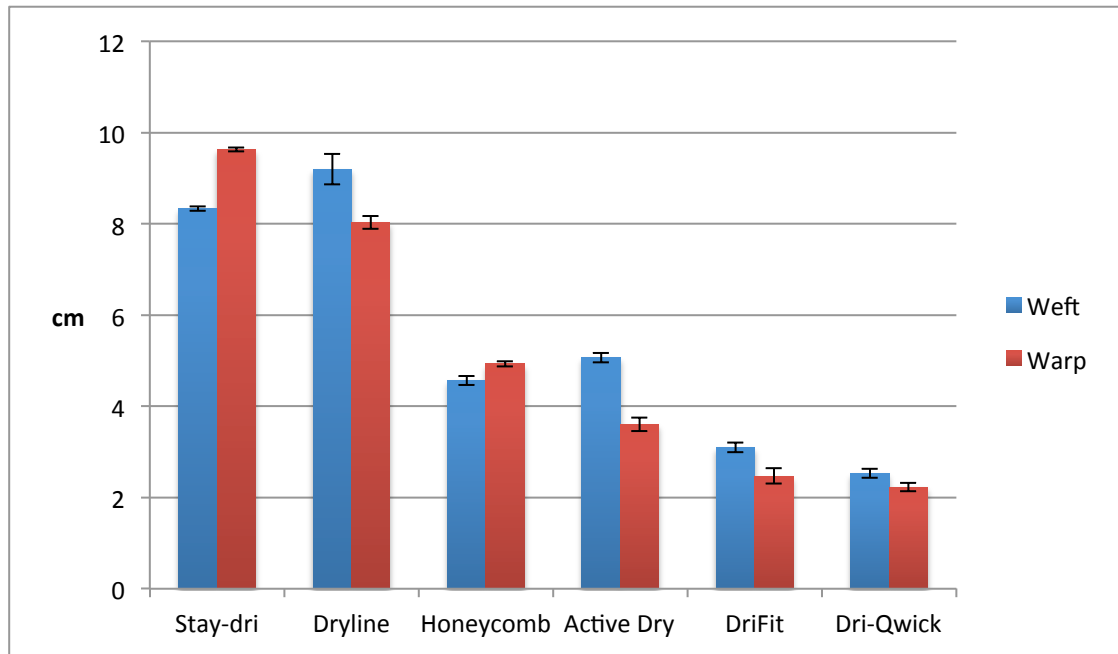


Figure 14. The mean value of the vertical wicking test results of each test sample

As mentioned above, each type of fabric had six samples, three were cut along the warp direction and the rest were cut along the weft direction. The max traveling height was collected. Figure 14 shows the mean value of six sets of data. One-way ANOVA was used to compare the vertical wicking test results among the fabrics. There were significant differences among fabric's weft vertical wicking performance ($F=142.465, p < .01$). Tukey HSD post hoc test separated the fabrics into 3 groups (significant sat $p < .05$): (DriFit = Dri-Qwick) < (Honeycomb = Active dry) < (Stay-Dri = Dryline). There were significant differences among fabric's warp vertical wicking performance ($F=324.492, p < .01$). Tukey HSD post hoc test separated the

fabrics into 5 groups (significant at $p < .05$): (DriFit = Dri-Qwick) < Active dry < Honeycomb < Dryline < Stay-Dri.

4.3.1.4 MMT-wetting time

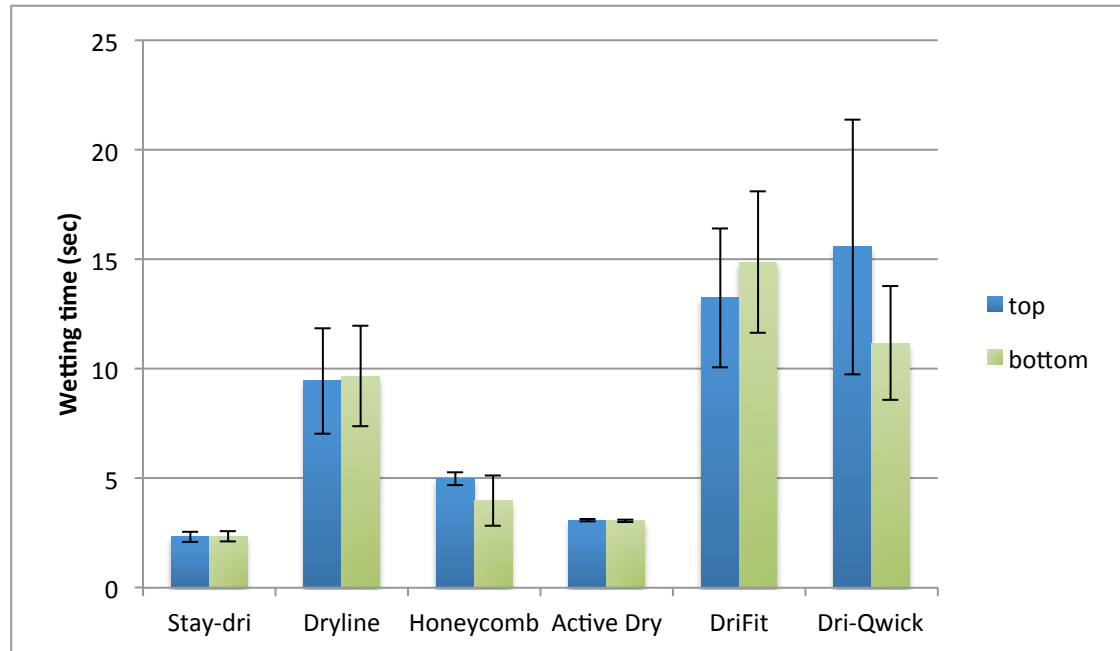


Figure 15. The mean value of the MMT-Wetting time results of each test sample

4.3.1.4.1 Right side

One-way ANOVA was used to compare the horizontal wicking test results among fabrics. There were significant differences among fabric's top layer wetting performance ($F=4.494$, $p < .01$). Tukey HSD post hoc test separated the fabrics into 2 groups (significant at $p < .05$): (Dri-Qwick = DriFit = Dryline = Honeycomb) > (DriFit = Dryline = Honeycomb = Active Dry = Stay-dri).

4.3.1.4.2 Wrong side

There were significant differences among fabric's bottom layer wetting performance ($F=8.324$, $p < .01$). Tukey HSD post hoc test separated the fabrics into 3 groups (significant at $p < .05$): (DriFit = Dri-Qwick = Dryline) $>$ (Dri-Qwick = Dryline = Honeycomb) $>$ (Dryline = Honeycomb = Active Dry = Stay-dri).

4.3.1.5 MMT-max wetted radius

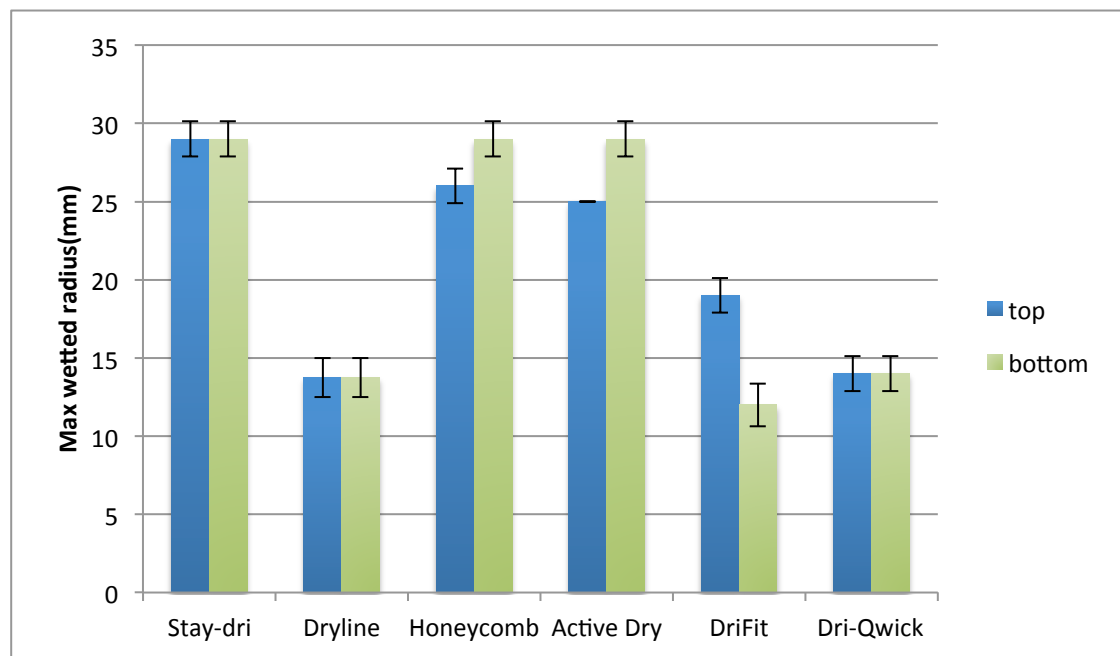


Figure 16. The mean value of the MMT-Max wetted radius results of each test sample

4.3.1.5.1 Right side

One-way ANOVA was used to compare the horizontal wicking test results among fabrics. There were significant differences among top layer's max wetted radius of each fabric ($F=46.4$, $p < .01$). Tukey HSD post hoc test separated the fabrics

into 3 groups (significant at $p < .05$): (Stay-Dri = Active dry = Honeycomb) > DriFit > (Dryline = Dri-Qwick). The Stay-dri Wicking, Active dry and Honeycomb fabrics performed better than others.

4.3.1.5.2 Wrong side

There were significant differences among bottom layer's max wetted radius of each fabric ($F=64.885$, $p < .01$). Tukey HSD post hoc test separated the fabrics into 2 groups (significant at $p < .05$): (Stay-Dri = Active dry = Honeycomb) > (DriFit = Dryline = Dri-Qwick). The Stay-dri Wicking, Active dry and Honeycomb fabrics performed better than others.

4.3.1.6 MMT-spreading speed

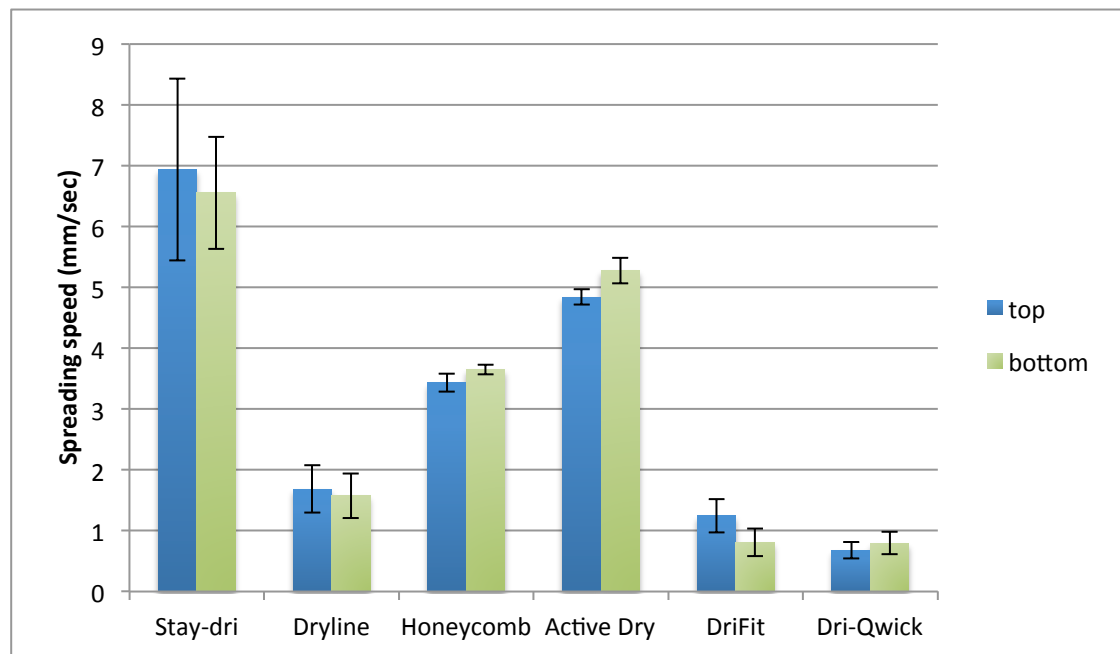


Figure 17. The mean value of the MMT-Spreading speed results of each test sample

4.3.1.6.1 Right side

One-way ANOVA was used to compare the horizontal wicking test results among fabrics. There were significant differences among top layer's max wetted radius of each fabric ($F=16.625, p < .01$). Tukey HSD post hoc test separated the fabrics into 4 groups (significant at $p < .05$): (Dri-Qwick = DriFit = Dryline) < (DriFit = Dryline = Honeycomb) < (Honeycomb = Active dry) < (Active dry = Stay-dri).

4.3.1.6.2 Wrong side

One-way ANOVA was used to compare the horizontal wicking test results among fabrics. There were significant differences among top layer's max wetted radius of each fabric ($F=38.855, p < .01$). Tukey HSD post hoc test separated the fabrics into 3 groups (significant at $p < .05$): (Dri-Qwick = DriFit = Dryline) < (Honeycomb = Active dry) < (Active dry = Stay-dri).

The Stay-dri and Active dry fabrics were softer than other fabrics and had better abilities for transporting the liquid. They had higher spreading speed, larger max wetted radius, and shorter wetting times than others. Although Dri-Qwick was the thinnest fabric among all sample fabrics, the Stay-dri and Active dry fabrics ranked the second and third in the thickness testing which also was acceptable. So the Stay-dri and Active dry fabrics were chosen for use in the prototypes.

4.3.2 Middle layer

The middle layer is the absorbent layer requiring the material to be absorbent, soft, and thin so that the product would be comfortable to wear. This group contained three testing samples: Terry Cloth in Gray fabric, Knit Terry fabric, and Super Absorbent Shammy Cleaning Cloth. Since the absorbency of the product also depends

on the design and size of the products, here only the thickness and stiffness were tested in this section.

4.3.2.1 Thickness

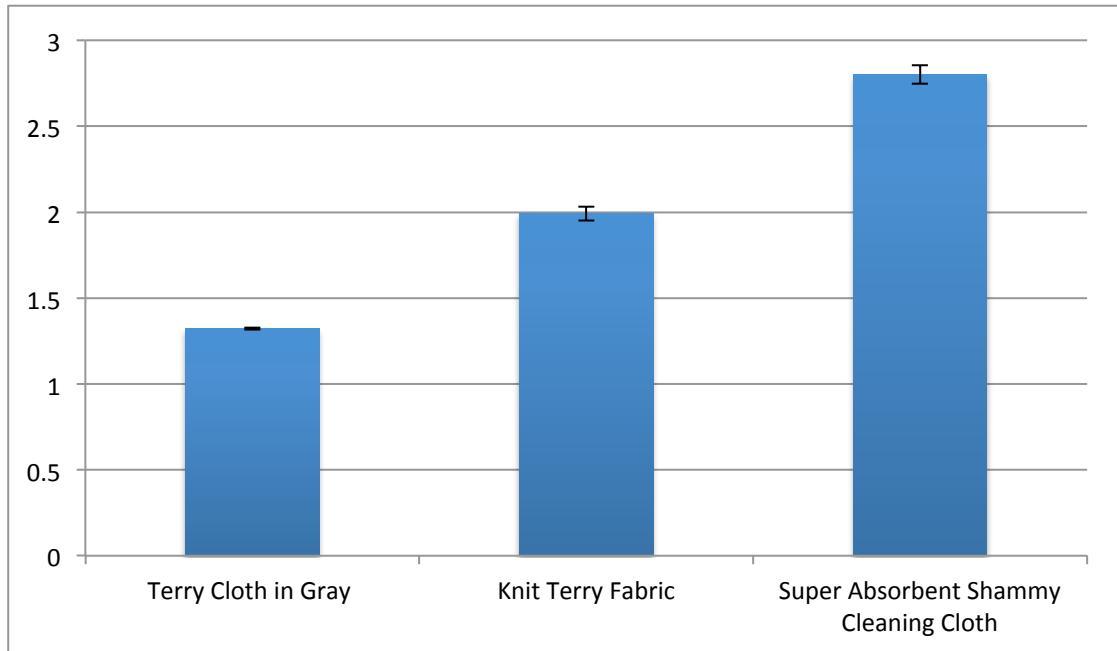


Figure 18. The mean value of the thickness results of each test sample

One-way ANOVA was used to compare the thickness test results among fabrics. There were significant differences among fabric's thickness ($F=890.161$, $p < .01$). Tukey HSD post hoc test separated the fabrics into 3 groups (significant at $p < .05$): Terry Cloth in Gray < Knit Terry Fabric < Super Absorbent Shammy Cleaning Cloth.

4.3.2.2 Stiffness

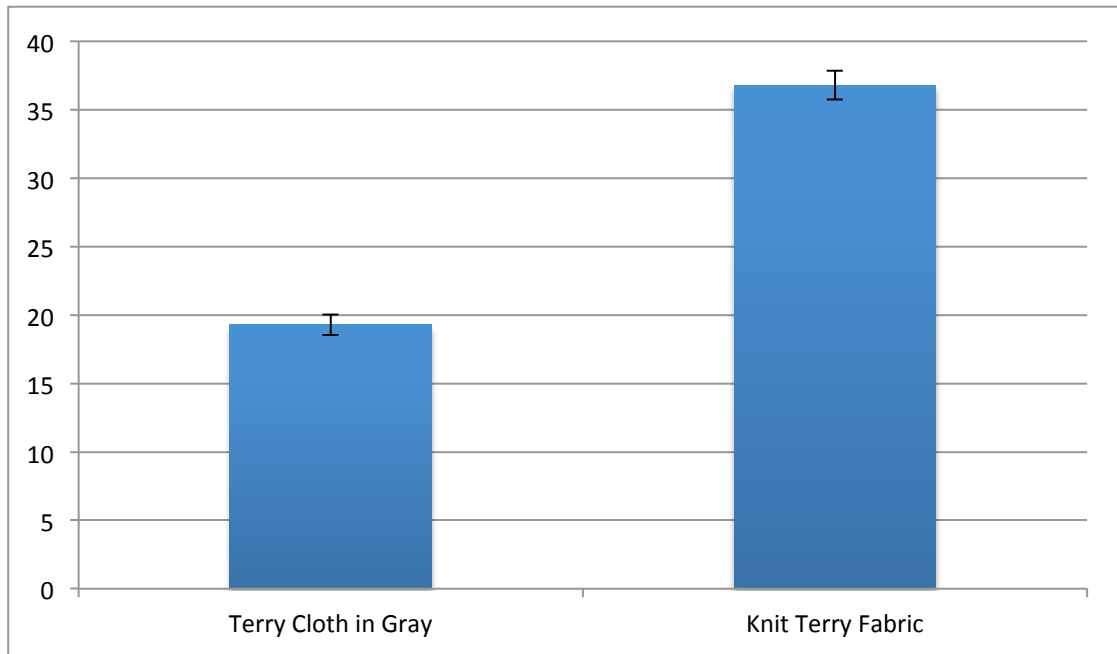


Figure 19. The mean value of the stiffness results of each test sample

As for the softness tests, the Super Absorbent Shammy Cleaning Cloth was not included since it was too thick and stiff, and the results were out of range (>100 g), which makes this fabric inappropriate for the final products. An independent-samples t-test was conducted to compare the softness of Terry Cloth in Grey and Knit Terry Fabric. There was a significant difference in the softness performance of Terry Cloth in Grey ($M = 19.29$, $SD = 1.48$) and Knit Terry Fabric ($M = 36.81$, $SD = 2.11$), $t(8) = -15.2$, $p < 0.01$.

Terry Cloth in Grey was the thinnest and softest fabric among other fabrics. The final product's middle layer would use Terry Cloth in Grey fabric.

4.3.3 Bottom layer

The bottom layer is the waterproof layer to prevent the liquid from leaking through. This group contains five kinds of fabric: Breathable PUL fabric, Waterproof PUL fabric, Gore-Tex®-green fabric, Gore-Tex® Pro-Shell Nylon Liner-Gray fabric, and Gore-Tex®-red fabric. Since all of these fabrics are waterproof fabric, they could not absorb and spread the liquid, only thickness and stiffness tests were conducted. Same as the middle layer requirements, the softer and thinner fabric would be chosen as the final material.

4.3.3.1 Thickness

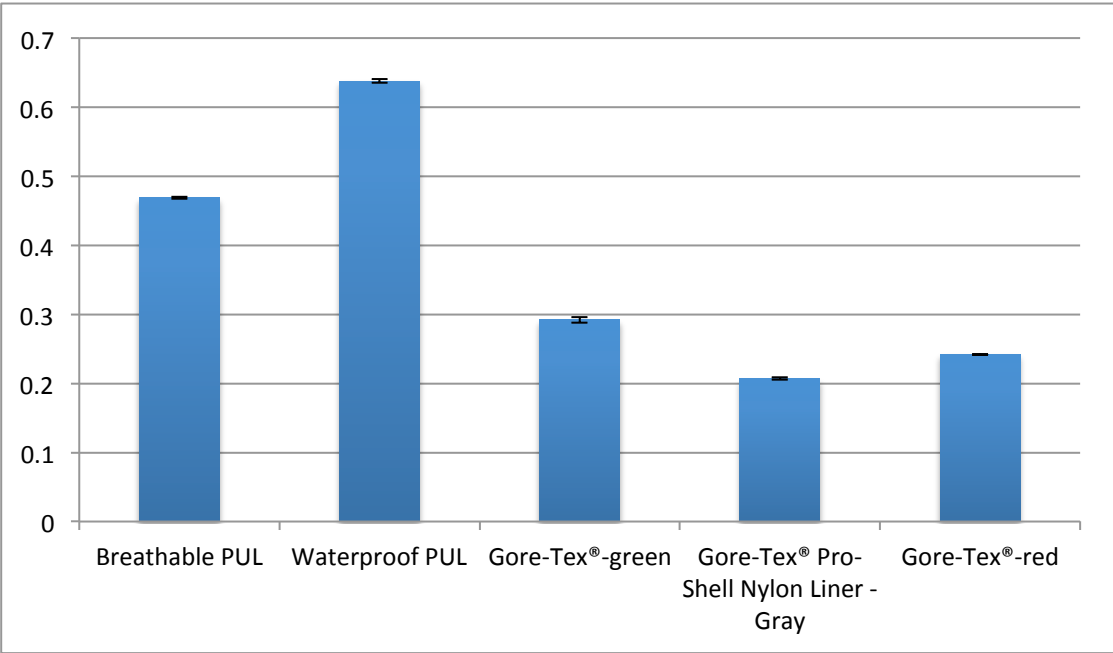


Figure 20. The mean value of the thickness results of each test sample

One- way ANOVA was used to compare the thickness test results among fabrics. There were significant differences among fabric's thickness ($F=16109.733$, $p < .01$). Tukey HSD post hoc test separated the fabrics into 5 groups (significant at $p < .05$): Gore-Tex® Pro-Shell Nylon Liner – Gray < Gore-Tex®-red < Gore-Tex®-green < Waterproof Breathable PUL knit < Waterproof PUL knit.

4.3.3.2 Stiffness

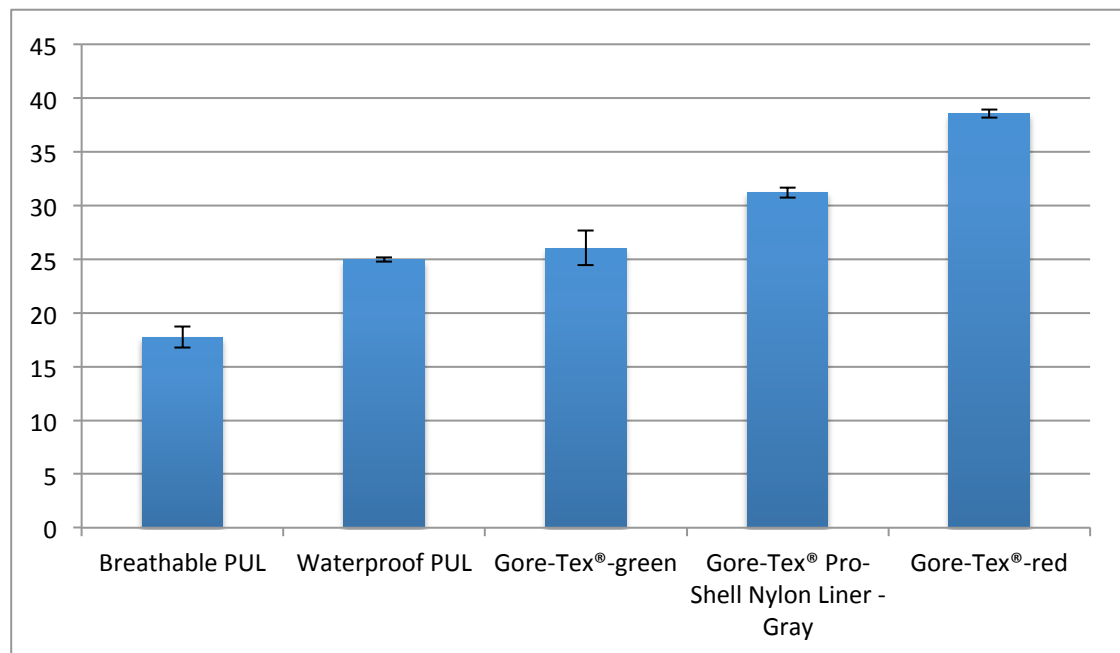


Figure 21. The mean value of the stiffness results of each test sample

One-way ANOVA was used to compare the thickness test results among fabrics. There were significant differences among fabric's softness ($F=94.948$, $p < .01$). Tukey HSD post hoc test separated the fabrics into 4 groups (significant at $p < .05$):

< .05): Waterproof Breathable PUL knit < (Waterproof PUL knit = Gore-Tex®-green)< Gore-Tex® Pro-Shell Nylon Liner – Gray < Gore-Tex®-red.

Gore-Tex® Pro-Shell Nylon Liner – Gray and Gore-Tex®-red were thinner but stiffer than Waterproof Breathable PUL knit and Waterproof PUL knit, which made the third rank of both tests Gore-Tex®-green the best for final product's bottom layer. Since the Gore-Tex®-green was donated by the company and could not be purchased on the market, a replacement could be commercially-available Gore-Tex® Pro-Shell Nylon Liner – Gray fabric. This fabric was thinner but stiffer than the Gore-Tex®-green fabric, but still a pretty good choice for bottom layer fabric.

4.4 Preliminary testing

Two purchased products were tested in the preliminary testing, namely “Mum 2 Mum Wonder Bib Bandana” and “E Z Topp Youth (Adaptations By Adrian)”. As shown in the figure 22 and figure 23, both products were penetrated by liquid. Only the middle part of the bandana bib absorbed the liquid. It did not have the ability to transport the liquid to the rest part of the bib. As for the E Z Topp Youth, although its bottom layer used waterproof fabric, the neck ribbing was not be protected. The liquid penetrated through the neckline and wet the paper under it.

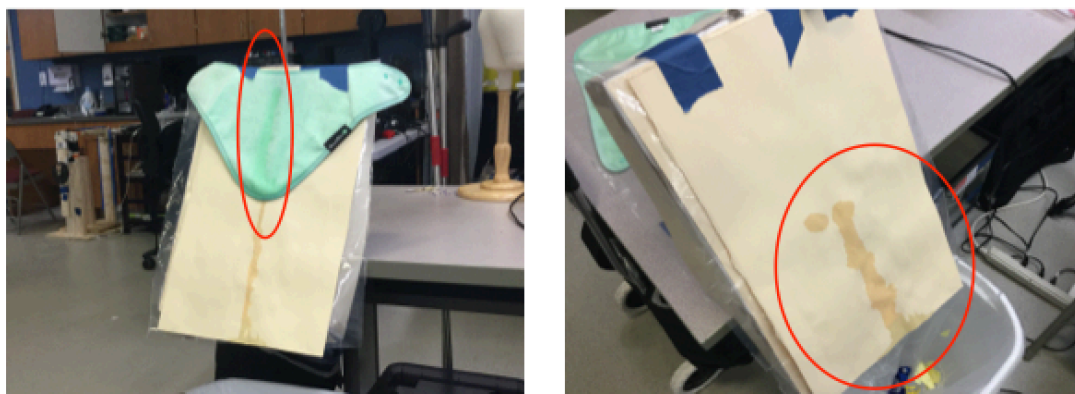


Figure 22. Mum 2 Mum Wonder Bib Bandana



Figure 23. E Z Top Youth

4.5 Design process

4.5.1 Initial design ideas

The initial design ideas were combining the fashion scarves with bibs so that prototypes would look appealing and also work properly for children with oral-motor impairments. The picture of the initial design ideas (see figure 24) and color selections

of the top layer fabrics that were chosen in the textile testing section were given to child participants and their caregivers during the first interview. They were asked to select their top three favorite designs and as many preferred colors as possible.

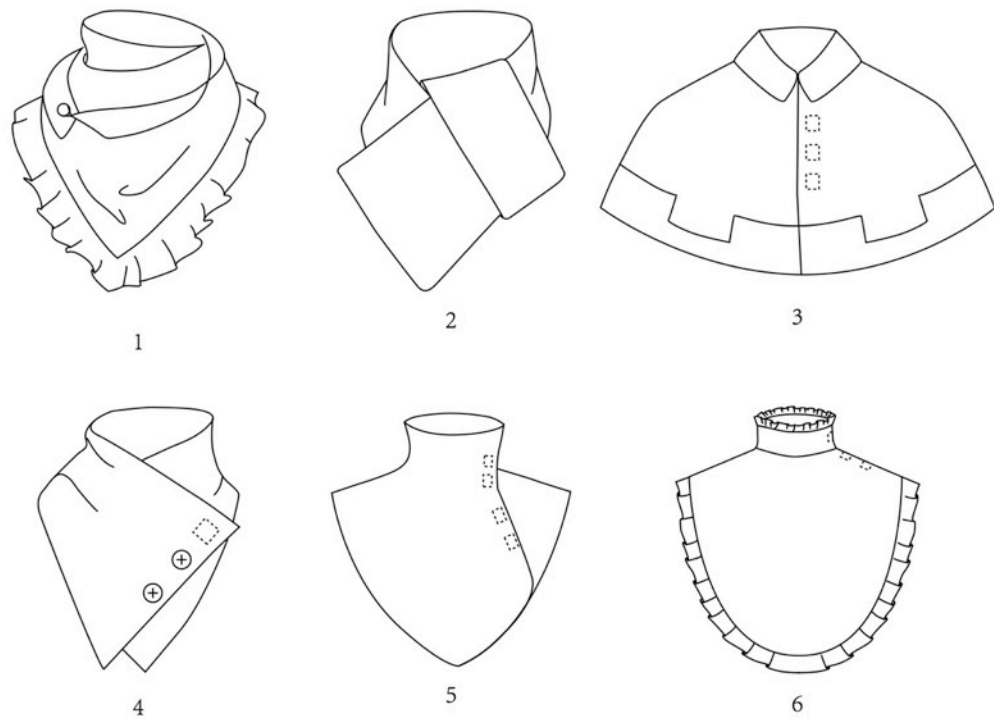
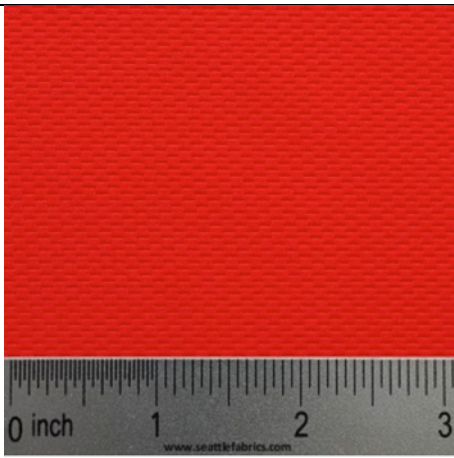
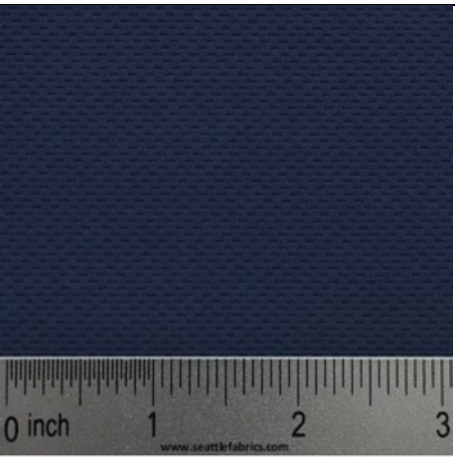
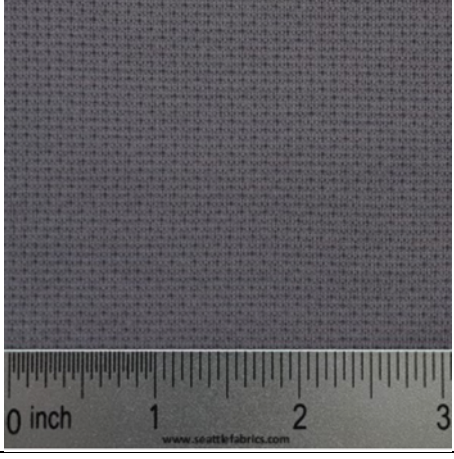
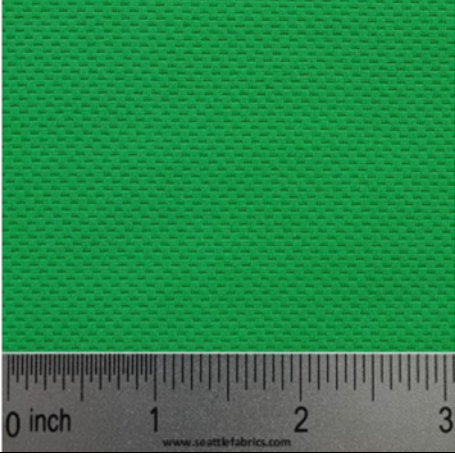
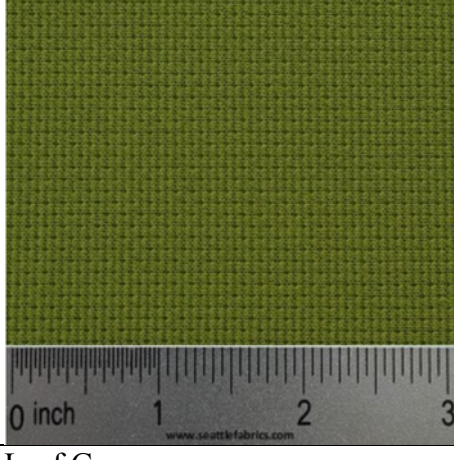
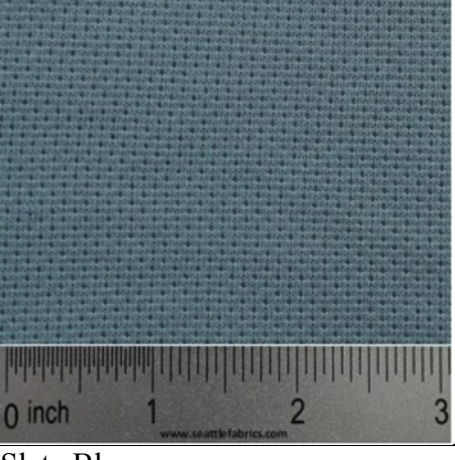


Figure 24. The initial design ideas

	
Pink ✓	Purple ✓
	
Green ✓	Yellow ✓
	
Red ✓	Brown ✓

	
Red	Navy
	
Pure Purple	Kelly Green
	
Leaf Green	Slate Blue

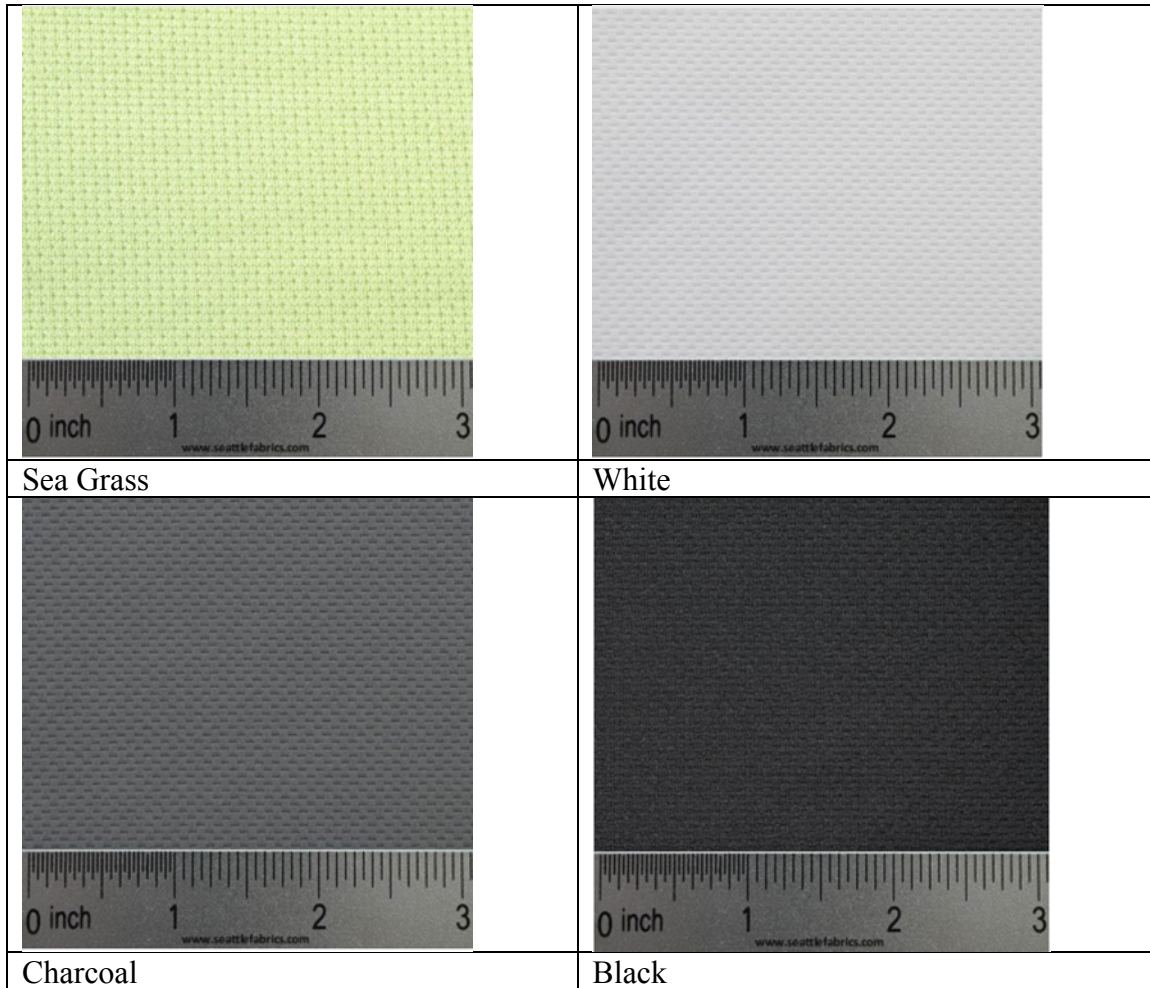


Figure 25. Color selections

As shown in figure 26, the most popular choice was Design 4, followed by Design 2, Design 5, Design 3, Design 1, and Design 6. Although Design 5 was chosen with the same frequency as Design 2, one adult participant revealed his/her dislike of Design 5, which made Design 5's ranking lower than Design 2. Based on the same reason, Design 6 ranked lower than Design 1.

The plan for human subject testing was having every child participant test three types of designs, two of them were design choices across all the participants, and the third one be the style that participants selected in addition to the two common styles. On the basis of participants' choices, Design 4 and Design 2 were chosen as two common styles. The third one was given depended on participants' preferences.

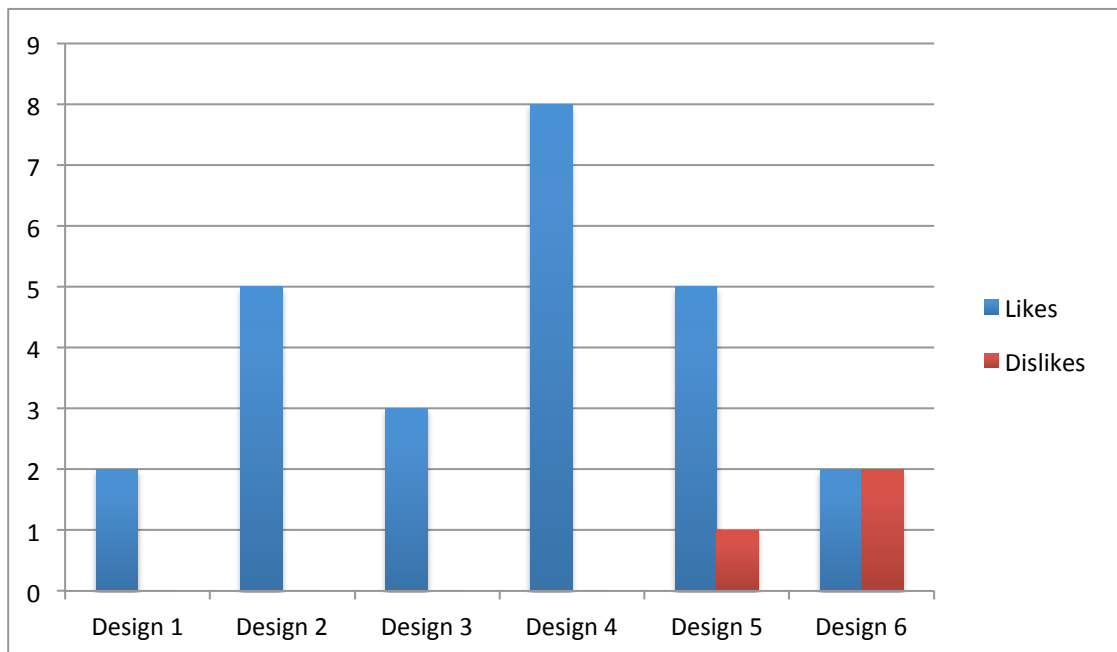


Figure 26. Participants' preferences toward all initial design ideas

As for color selections, red and Kelly green seemed to be the two most popular choices, following be slat blue, navy, charcoal, blue, yellow, purple, and brown. The prototypes would be made in either red or green.

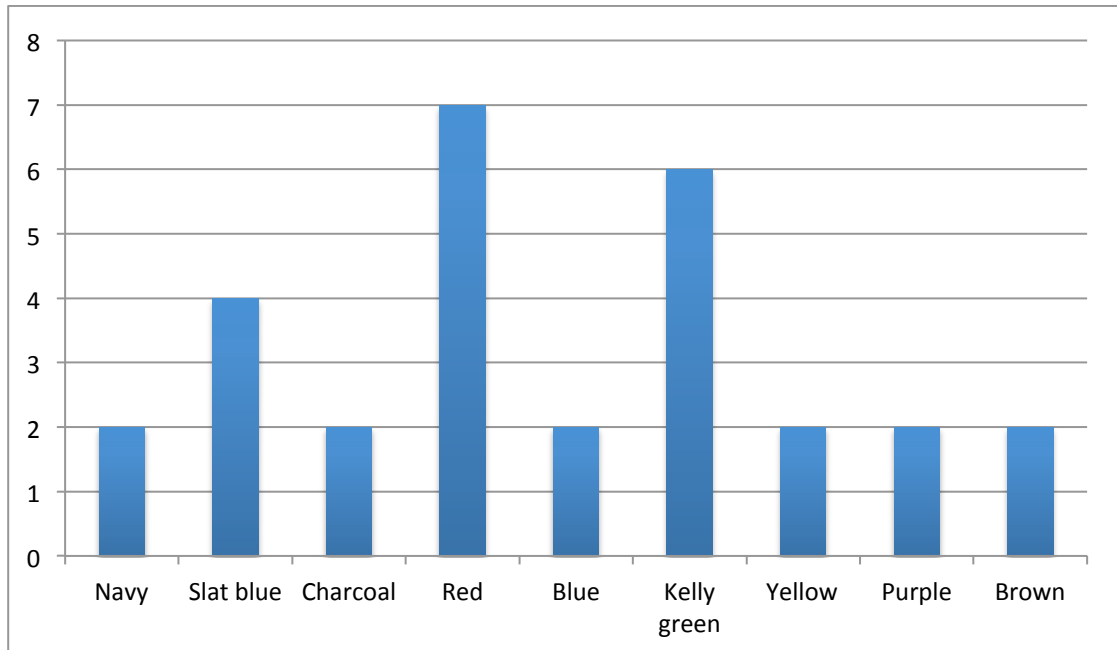


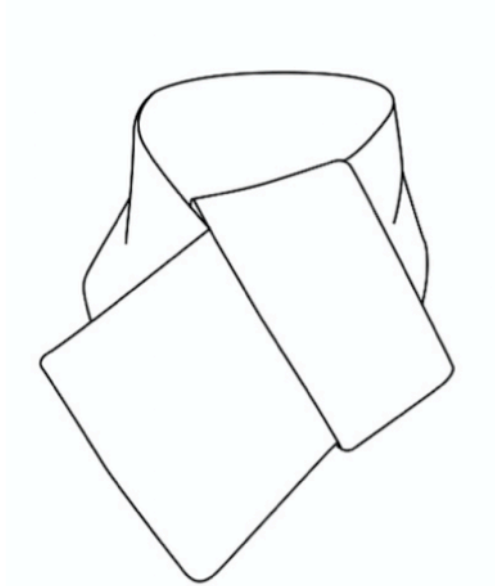
Figure 27. Participants' preferences toward all color selections

4.5.2 Fit testing

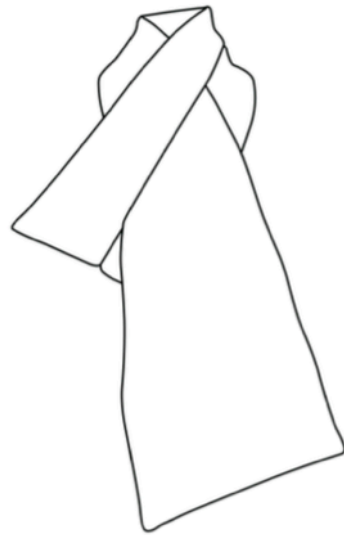
Fit testing was conducted before human subject testing. A few samples were made so that the final products sizes would fit. Also, caregivers' comments about the designs were asked as well.

The caregivers revealed that the length of Design 2 was good for children with slight drooling and a little short for some of the children with severe drooling. They wanted another longer version of it so that it would work better for those children. Also, they did not like the turtleneck design of Design 5 and Design 6. Design 1 and Design 3 were excluded since caregivers did not think those designs would work for their children. As they requested, a longer version of Design 2 was created, and Design 5 and Design 6 were changed accordingly (see Figure 28).

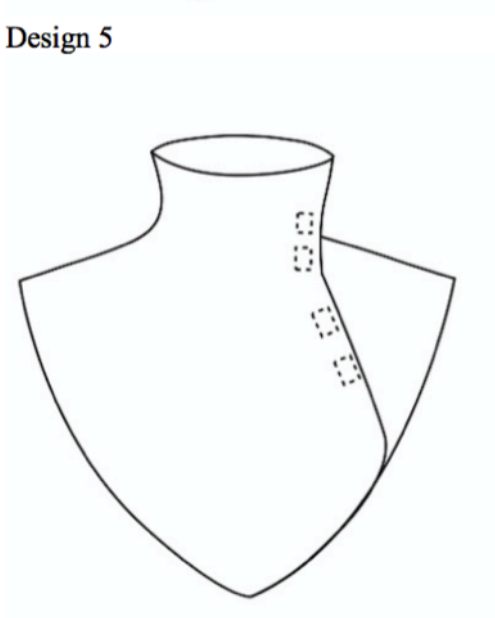
Design 2



Longer version of Design 2



Design 5



→
Change to



Design 6

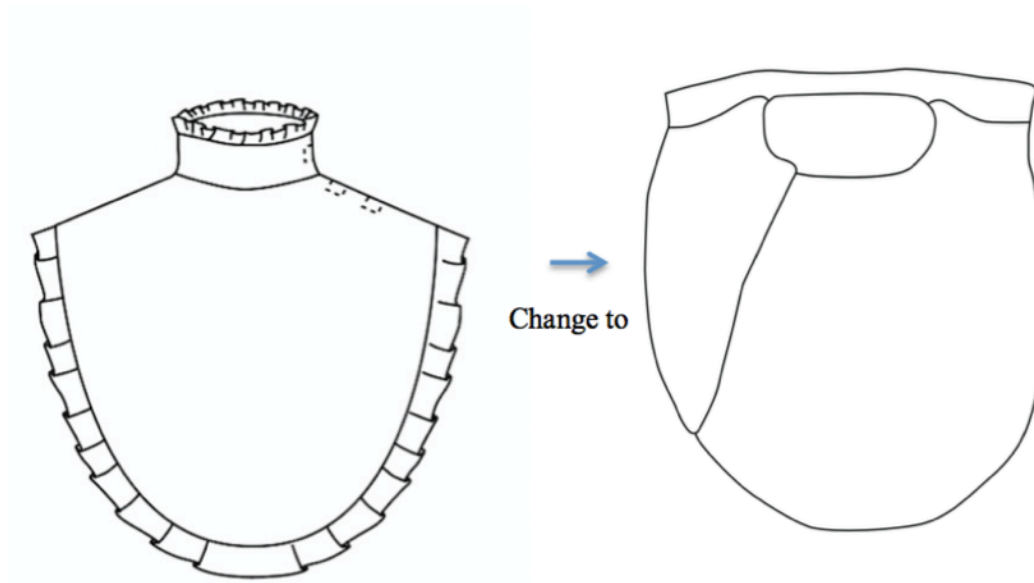


Figure 28. Scarf designs after accepting caregivers' advice

4.6 Human subject testing

Four child participants from Leach school participated in human subject testing. The prototype scarves were left for testing in the school for one week. They were asked to test it during school time. Child participants' teachers would document the start and end time of testing and give suggestions and ratings after the one-week examination. The first round testing was conducted from February 25, 2020 to March 3, 2020 in Leach school. The testing scarf design was shown in figure 29.



Figure 29. The testing scarf design

As shown in table 5, all participants tested the prototype for at least two days in the one-week duration. Three out of four child participants used only one scarf throughout the day. Their teachers rated the prototype above average, which also revealed that the testing scarf design could be a possible solution for child participants. The remaining child participant with severe drooling could only wear the scarf for about two hours, suggesting this solution could not work for him/her. The broader and longer design might work better for that participant.

The caregivers (teachers) mainly recommended making the prototype wider and longer to cover enough of the shirt. The advanced version was developed based on their suggestions. Unfortunately, due to COVID-19, the school was suspended in the second round of testing. Our subsequent human testing was also canceled.

Table 5. Participant log and feedback

Participant	Date (M/D)	Start time	End time	Reasons for stop using*	Average rating** ($\pm$ SD)	Suggestions
1	02/25	12:00pm	3:00pm	5	3.4 $\pm$ 1.1	
	02/27	11:00am	11:50am	4		
		12:30pm	3:00pm	1,5		
	03/02	9:05am	11:30am	4		
		12:30pm	3:00pm	5		
2	02/25	9:40am	11:45am	1	2.8 $\pm$ 0.9	Scarf needs to be wide and needs to be more absorbent.
	02/26	11:57am	1:30pm	4		
	02/27	8:30am	9:10am	1		
		12:30pm	2:00pm	1		
	03/03	8:45am	11:00am	2		
3	02/25	9:15am	3:00pm	5	3.5 $\pm$ 1.5	It would be better if it could be wider and longer.
	02/27	9:00am	3:15pm	5		
4	02/15	9:32am	3:00pm	5	3.8 $\pm$ 1.5	It would be better if it could be wider and longer.
	02/28	9:00am	3:15pm			
	03/03	9:00am	1:30pm	5		

*1 = Saturation; 2 = Leaking; 3 = Discomfort; 4 = Lunch/Snack; 5 = School dismissal

**** Rating scale: 1 = poor; 5 = excellent**

Based on caregivers' advice, a wider and longer version of Design 2 was developed and added in the online survey (see figure 30).

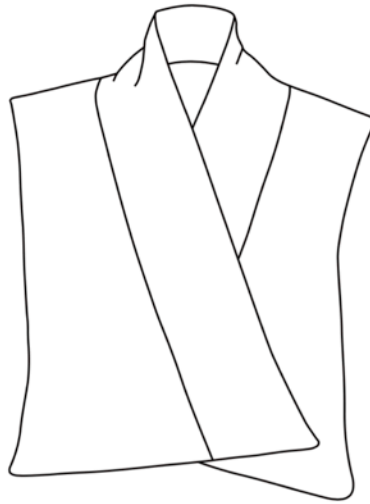


Figure 30. The wider and longer version of Design 2

4.7 Online survey

The online survey was published on April 30, 2020 and closed on May 17, 2020. In total, 33 responses were received. However, only 17 out of 33 were useful data. The others were excluded since the respondents did not finish the entire survey.

4.7.1 Participants

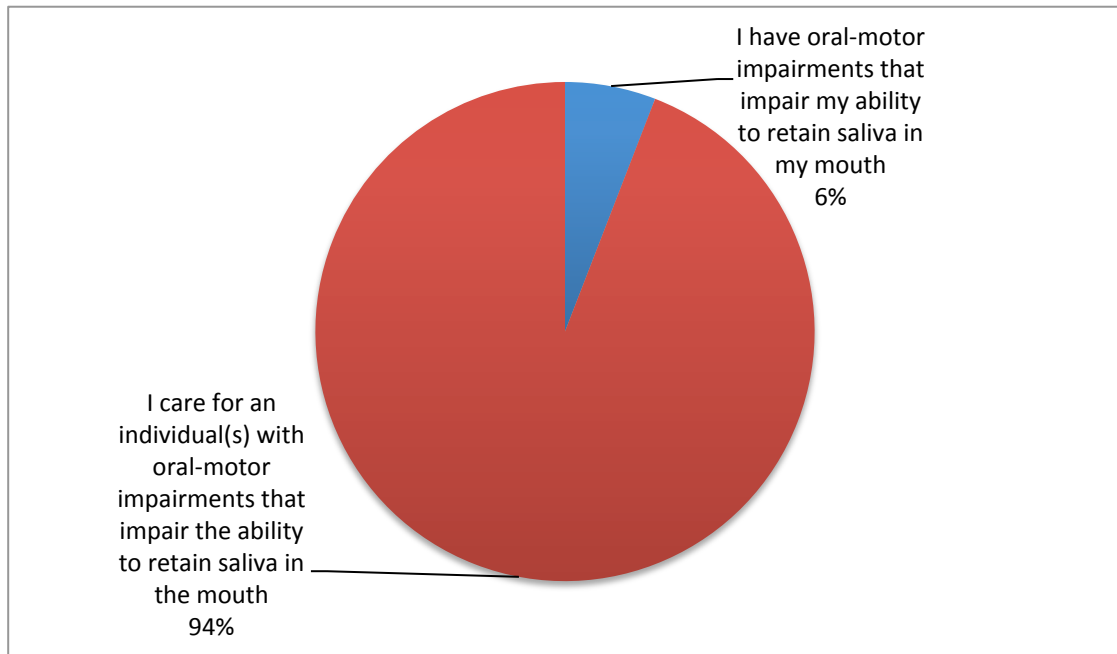


Figure 31. The distribution of participants who responded to the online survey

As shown in figure 31, one's respondent was a seven years old child with oral-motor impairments. According to the responses, he/she uses about four clothing protectors per day. The rest of the 16 respondents were caregivers.

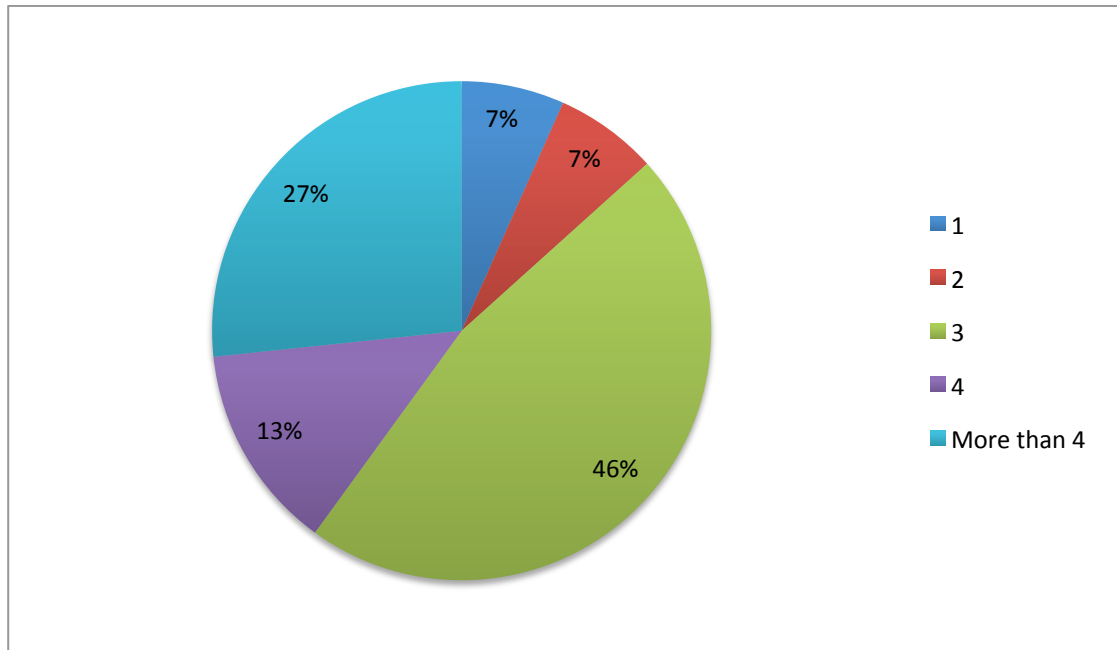


Figure 32. The distribution of the number of clothing protectors that the child (caregivers care for) uses in a typical day

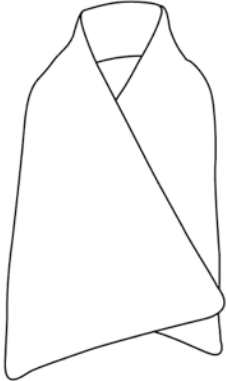
Five people cared for children below eight years old; seven people cared for children older than or equal to 8 years old, the remaining four did not mention the age of the child they cared for. As for their relationships toward their child, 4 out of 16 were parents or grandparents, 12 of them were caregivers in a school or hospital (teachers, therapists, or home health aides). Most of the children they cared for use three or more clothing protectors in a typical day (see Figure 32).

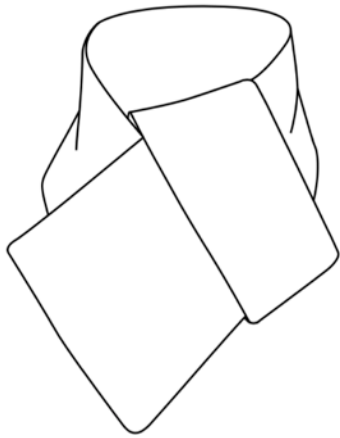
4.7.2 Respondents' feedback about scarf prototypes

The pictures and descriptions of each scarf prototype were provided in the online survey (see Table 6). Respondents were asked to rank them from 1 to 6, with 1 representing their favorite and 6 representing their least favorite. Then, respondents

were asked to rate each design on four aspects: attractiveness, coverage, fitness, and comfort.

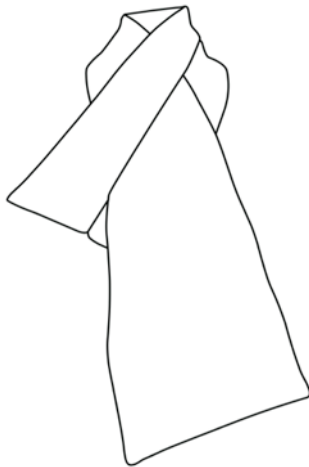
Table 6. The pictures and description of each prototype

Design 1	
	
This scarf snaps together at the front of the neck, with multiple snaps available to adjust the fit.	
Design 2	



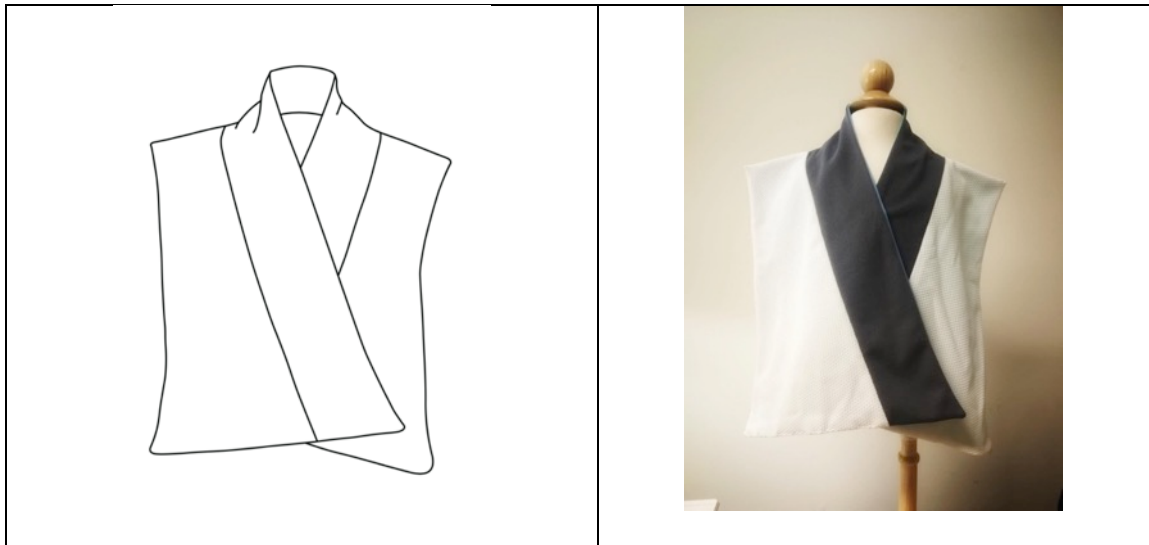
This scarf tucks through itself at the neck, allowing for adjustment of fit.

Design 3



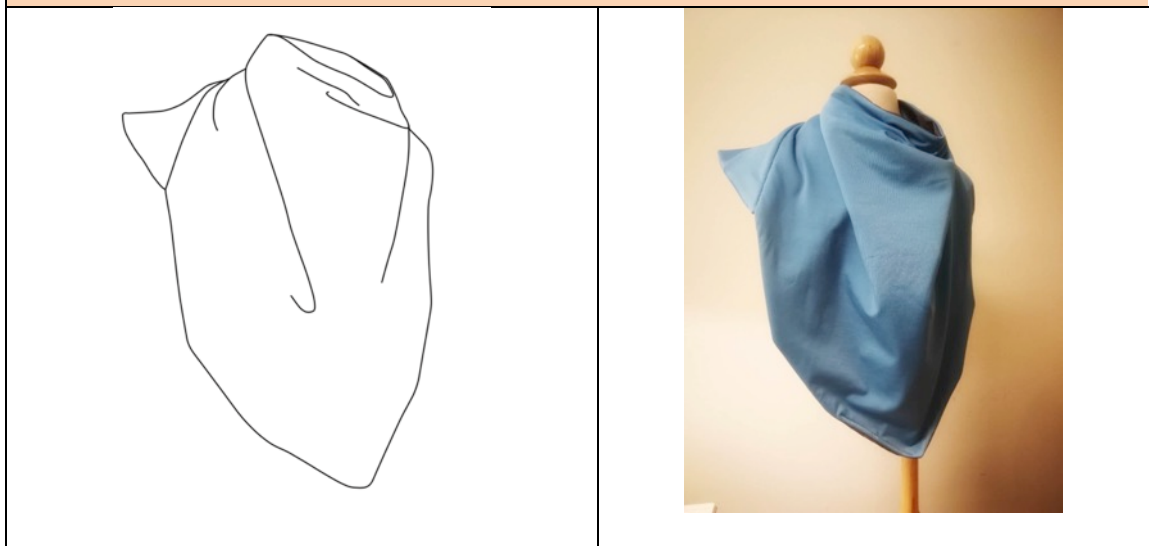
This scarf tucks through itself at the neck, allowing for adjustment of fit.

Design 4



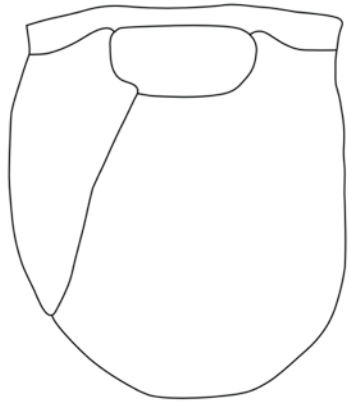
This scarf snaps together at the front of the neck, with multiple snaps available to adjust the fit.

Design 5



This scarf snaps together at the back of the neck, with multiple snaps available to adjust the fit.

Design 6

	
This scarf snaps together at the front of the neck, with multiple snaps available to adjust the fit.	

To determine which design ranked the highest and which design ranked the lowest, a grading standard was used.

Table 7. Grading standard

	Grading
1 st choice	+6
2 nd choice	+5
3 rd choice	+4
4 th choice	+3
5 th choice	+2
6 th choice	+1

The respondents were categorized into three groups: a) children older than or equal to eight years old, b) children younger than eight years old, c) did not mention the children's ages. We grouped participants in this way as our earlier experience with end users suggested that smaller designs might be more desirable to younger children while larger designs might be preferred for older children. The results were analyzed as follows.

4.7.2.1 Children eight years and older

Table 8. The distribution of participants' ranks of six designs

	1 st choice	2 nd choice	3 rd choice	4 th choice	5 th choice	6 th choice	Total score
Design 1	1*	1	1	2	2	0	+25
Design 2	1	0	0	3	3	0	+21
Design 3	0	0	2	1	2	2	+17
Design 4	2	2	1	0	0	2	+28
Design 5	0	4	2	0	0	1	+29

Design 6	3	0	1	1	0	2	+27
-------------	---	---	---	---	---	---	-----

*The number means how many people choose Design1 as their 1st choice.

Table 9. The ratings of each design*

		#1		#2		#3		#4		#5		#6	
	Questions	<i>N</i>	<i>M</i>	<i>N</i>	<i>M</i>	<i>N</i>	<i>M</i>	<i>N</i>	<i>M</i>	<i>N</i>	<i>M</i>	<i>N</i>	<i>M</i>
			±		±		±		±		±		±
			<i>SD</i>		<i>SD</i>		<i>SD</i>		<i>SD</i>		<i>SD</i>		<i>SD</i>
Attractiveness	How attractive is this scarf (keep in mind it could be made in different colors)?	7	4.7	7	4.7	7	3.9	7	4.9	7	4.4	6	4.7
			±		±		±		±		±		±
			1.2		1.5		1.6		1.5		1.7		2.4

Coverage	To what extent do you think this design would function to cover the areas you need?	7	4.1 ± 1.6	7	4.6 ± 1.5	7	3.7 ± 1.4	7	5.4 ± 1.2	7	5.4 ± 0.7	6	5.7 ± 1.4
Fitness	How well do you think this design would fit?	7	3.9 ± 1.6	7	4.4 ± 1.4	7	3.6 ± 1.3	7	5.4 ± 1.2	7	5.1 ± 0.6	6	5.8 ± 1.5
Comfort	How comfortable does this design look?	7	4.7 ± 1.7	7	3.9 ± 1.5	7	3.1 ± 1.1	7	5.6 ± 1.0	7	4.6 ± 1.2	6	5.7 ± 1.4
Average			4.4 ± 1.2		4.4 ± 1.1		3.6 ± 1.1		5.3 ± 1.1		4.9 ± 0.6		5.5 ± 1.5

*Rating scale: 1=poor; 7=excellent

As shown in Table 8, respondents associated with older children ranked Design 5 the highest following by Design 4, Design 6, Design 1, Design 2, and Design

3. Their ratings also revealed that participants were less likely to try Design 3 (see Table 9). All four aspects of Design 3 were rated lower than a 4 on average. As for other designs ratings, Design 6 got the highest score at 5.5, following by Design 4 (5.3), Design 5 (4.9), Design 1, and Design 2 (4.4). Since the top results of rankings and ratings were different, both designs, Design 5 (top choice) and Design 6 (highest score) were selected and their DIY manuals were created in the next step.

4.7.2.2 Children younger than eight years old

Table 10. The distribution of participants' ranks of six designs

	1 st choice	2 nd choice	3 rd choice	4 th choice	5 th choice	6 th choice	Total score
Design 1	0*	1	0	2	0	1	+12
Design 2	1	0	1	1	1	0	+15
Design 3	1	0	0	1	1	1	+12
Design 4	1	0	1	0	2	0	+14
Design 5	1	2	1	0	0	0	+20

Design	0	1	1	0	0	2	+11
6							

*The number means how many people choose Design1 as their 1st choice.

Table 11. The ratings of each design*

		#1		#2		#3		#4		#5		#6	
	Questions	<i>N</i>	<i>M</i>	<i>N</i>	<i>M</i>	<i>N</i>	<i>M</i>	<i>N</i>	<i>M</i>	<i>N</i>	<i>M</i>	<i>N</i>	<i>M</i>
			±		±		±		±		±		±
			<i>SD</i>		<i>SD</i>		<i>SD</i>		<i>SD</i>		<i>SD</i>		<i>SD</i>
Attractiveness	How attractive is this scarf (keep in mind it could be made in different colors)?	6	4.5	6	5.5	6	4.7	6	4.0	6	5.7	6	3.7
			±		±		±		±		±		±
			0.8		0.8		1.6		1.8		1.8		1.1

Coverage	To what extent do you think this design would function to cover the areas you need?	6	3.7 ± 1.4	6	5.5 ± 1.3	6	4.8 ± 1.6	6	4.8 ± 2.1	6	5.7 ± 1.8	6	5.3 ± 1.8
Fitness	How well do you think this design would fit?	6	3.5 ± 1.3	6	5.3 ± 1.1	6	4.5 ± 1.5	6	4.8 ± 2.1	6	5.5 ± 1.7	6	5.3 ± 1.9
Comfort	How comfortable does this design look?	6	5.5 ± 1.5	6	5.0 ± 1.3	6	4.8 ± 1.6	6	5.5 ± 1.0	7	5.7 ± 1.8	6	5.3 ± 1.8
Average		4.3 ± 1.0		5.3 ± 1.0		4.7 ± 1.4		4.8 ± 1.7		5.7 ± 1.8		4.9 ± 1.5	

*Rating scale: 1=poor; 7=excellent

Respondents ranked Design 5 as the highest, following by Design 2, Design 4, Design 1, and Design 3 (same total score in ranking), and the least was the Design 6.

All designs' average scores were above average in this group. Respondents gave Design 5 the highest score at 5.7 following by Design 2 (5.3), Design 6 (4.9), Design 4 (4.8), Design 3 (4.7), and Design 1 (4.3). Interestingly, Design2's average rating was higher in this group compared to group a) shown that Design 2 is more appropriate for younger children. The top two results of rankings and ratings were the same in this group, which were Design 5 and Design 2. To give children and their caregivers more options to choose, both designs' DIY manuals were created in the next step.

4.7.2.3 Did not mention the children's ages

Table 12. The distribution of participants' ranks of six designs

	1 st choice	2 nd choice	3 rd choice	4 th choice	5 th choice	6 th choice	Total score
Design 1	0*	0	3	0	1	0	+14
Design 2	0	0	0	2	1	1	+9
Design 3	1	0	0	1	1	1	+12
Design 4	0	1	1	1	1	0	+14
Design	0	2	0	0	0	2	+12

5							
Design	3	1	0	0	0	0	+19
6							

*The number means how many people choose Design1 as their 1st choice.

Table 13. The ratings of each design*

		#1		#2		#3		#4		#5		#6	
	Questions	<i>N</i>	<i>M</i>	<i>N</i>	<i>M</i>	<i>N</i>	<i>M</i>	<i>N</i>	<i>M</i>	<i>N</i>	<i>M</i>	<i>N</i>	<i>M</i>
			±		±		±		±		±		±
			<i>SD</i>		<i>SD</i>		<i>SD</i>		<i>SD</i>		<i>SD</i>		<i>SD</i>
Attractiveness	How	4	4.8	4	1.8	4	4.0	4	4.0	4	3.8	4	4.5
	attractive is		±		±		±		±		±		±
	this scarf		1.3		0.8		1.6		0.7		1.6		0.5
	(keep in mind it could be made in different colors)?												

Coverage	To what extent do you think this design would function to cover the areas you need?	4	3.5 ± 0.9	4	3.8 ± 1.5	4	3.5 ± 1.7	4	4.5 ± 1.1	4	4.5 ± 1.1	4	5.5 ± 0.5
Fitness	How well do you think this design would fit?	4	4.8 ± 1.1	4	3.3 ± 2.0	4	3.3 ± 1.8	4	4.3 ± 1.1	4	4.0 ± 1.4	4	5.5 ± 0.5
Comfort	How comfortable does this design look?	4	5.8 ± 1.3	3	3.7 ± 1.0	3	3.7 ± 1.7	4	5.0 ± 1.2	4	4.3 ± 1.1	4	5.8 ± 0.4
Average		4.7 ± 0.9		3.2 ± 1.2		3.6 ± 1.6		4.5 ± 1.0		4.2 ± 1.2		5.3 ± 0.4	

*Rating scale: 1=poor; 7=excellent

Respondents' rankings and ratings were pretty consistent in this group. The highest ranked was Design 6, and its average rating was also the highest in this group.

Participants rated the attractiveness of Design 2 relatively low. According to them, Design 2 seemed bulky, especially for warmer seasons.

Across all groups, Design 2, Design 5, and Design 6 were most preferred, and their DIY manuals will be made in the next step, while Design 1, Design 3, and Design 4 were eliminated. In the three selected designs, Design 2 was more appropriate for younger children; Design 6 was selected for elder children, and Design 5 was appealed across both age groups. Other than rankings and ratings, the respondents were also asked to leave comments on how to improve all the designs. For Design 6, most of the respondents loved the coverage of the scarf but noted it looked a more like a bib. They would be more willing to let their children use it during mealtime. One possible reason could be that the color of the scarf shown in the picture was too bright. The color may be changed to a darker color and the bottom may be changed to a square shape. Some respondents revealed that they thought Design 2 and Design 5 seemed a little bulky in the picture. The reason was that the products were all made in the three-layer structure. A note would be added in the DIY manuals to suggest using a two-layer structure if a three-layer structure seems bulky to them.

Chapter 5

CONCLUSION

The research was conducted through three stages: need assessment, prototype development, and prototype testing. Stage 1-need assessment aimed to survey market product and understand end-user needs; included two steps: content analysis and interviews. The second stage, prototype development, consisted of textile testing to identify the most appropriate for making prototypes and design process to identify the potential style and color options of the prototypes. The final stage was prototype testing to examine whether the final prototypes would fit users' needs.

The interview results showed that it was feasible for caregivers or individuals in the community to make some clothing protectors for children with oral-motor impairments. Some of the scarves were homemade and donated to the school. However, the products involved quite simply sewing a piece of terry cloth fabric on a bandana. Also, the caregivers (teachers and parents) had a preference for the child's clothing protectors. They mentioned that they would avoid using any product with Velcro as a closure mechanism since it would stick to fibers and be worn out after a few washes.

Most frequently mentioned was lack of satisfaction with the appearance of the current products, especially related to color and pattern choices. This finding highlighted the importance of the study. Parents rated color options higher since they could let their children wear homemade clothing protectors at home so that they were satisfied with their own choices on the color of the fabric but not the color options of

the market products. Also, because parents had purchased so many clothing protectors for their children, their ratings might have been biased as it was hard for them to focus on just one specific product rather than rating the product that performed the best on the certain aspect, which is one of the limitations of the study.

The prototypes were designed based on users' preferences from the four FEA2 areas and improved according to adult participants' suggestions and feedback. The color choices of the prototype for each child participant depended on their color preferences. The initial plan was having each participant test three types of design. However, due to unanticipated school closures and a suspension of human subjects research, only one commonly chosen design was tested. The test results revealed that most of the child participants could wear the prototype for the entire school day. This contrasts with the reported need for three or four commercial or homemade clothing protectors throughout the day. The prototype worked better and a child only needed one per day. Also, most adult participants' ratings toward the prototype were above average.

As for online survey results, respondents associated with older children (children eight years and older) ranked Design 5 the top choice among all six types of design and rated Design 6 the highest. For respondents caring for children younger than eight years old, Design 5 and Design 2 were preferred over the other four designs. So, children's needs for clothing protectors changed in relation to the child's age and likely size. Also, children of all ages could find a desirable solution in the designs provided in the study, which means the designs developed in the study could meet the needs and preferences of children with oral-motor impairments.

As for the limitations, the human subjects testing and absorbency testing of the prototypes was interrupted and could not be resumed due to forces beyond my control. Future research should focus on this testing for a more complete picture of the ability of the prototypes to meet the needs of end users.

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Appendix A

MEDICAL & HOME HISTORY FORM

Participant's name: _____ Date of birth: _____

Current Date: _____

Name of person completing the form: _____

Relationship to participant: _____

1) Number of individuals living in the household with the participant:

Name of person living in household with the participant	That person's age	That person's relationship to the participant	Highest level of school completed or highest degree obtained	Occupation

2) Please circle the race with which you identify the participant.

American Indian

Asian

Black or African

American

Native Hawaiian or Other Pacific Islander

White

3) Please circle the approximate total household income before taxes:

\$0-15,000

\$15,000-\$24,999

\$25,000-\$34,999

\$35,000-44,999

\$45,000-59,999

\$60,000-79,999

Greater than \$80,000

4) Please circle the terms that best describe the relationship status of the participant or the participant's parents if the participant is a child.

Married

Living together

Not living together but in contact with one

another

Single

Living with non-parental partner

4) Does the participant have any diagnoses? _____ If yes, please list/describe. _____

5) Has the participant been hospitalized in the past?

Reason for hospitalization	Age at that time	Duration of stay

6) Has the participant had any prior surgeries?

Type of surgery	Age at that time

Is the participant receiving any intervention services?

Type	How often	Session length	Duration	Reason	
Type of service	How often receives service	How long is each service session?	How long has the participant received this service?	Who provides the service?	Why does the participant receive the service?
Physical Therapy					
Occupational Therapy					

Speech Therapy					
Monitoring by Childwatch					
List if other:					

7) Does the participant have any allergies or movement/activity restrictions?

If yes, please list:

Appendix B

INTERVIEW QUESTIONS

General Information

- Interview date:
- Location:
- Interviewee Name:
- Relationship with child:
- Name of the child associated with:

The purpose of this research is to design a water-wicking scarf that functions to capture liquid while also looking and feeling the way people want. Your input will be incorporated into our design process. We are interviewing children, parents, and caregivers to learn more about people's needs and wants for the scarves. I will record this interview so I can remember all of the things you say. Is it alright if I begin the recording?

Interviewer: Do you have any questions or concerns you want to ask me before the interview?

Microphone test; State the date of the interview and participant's number

Interviewer:

How frequently does your child have trouble with excess saliva and drooling? (1=not at all; 5=every day).

1 2 3 4 5

How much skin irritation has your child had due to drooling? (1=none; 5=severe irritation) (Is there anything you would like to share with me about that?)

1 2 3 4 5

How many times in a typical hour does your child's mouth need wiping? (Is there anything you would like to share with me about that?)

How does your child feel about their drooling?

How confident are you in your ability to assess your child's feelings about this topic? (1=very unconfident; 5=very confident)(Is there anything you would like to share with me about that?)

1 2 3 4 5

How much do you have to clean saliva from household items, e.g. toys, furniture, computers?
(1=not at all; 5=every day) (Is there anything you would like to share with me about that?)

1 2 3 4 5

To what extent does your child's drooling affect his or her life? (1=not at all; 5=greatly) (Is there anything you would like to share with me about that?)

1 2 3 4 5

To what extent does your child's drooling affect you and your family's life? (1=not at all; 5=greatly) (Is there anything you would like to share with me about that?)

1 2 3 4 5

Now, I am going to ask some questions about products that you may have purchased for your child

1. Have you ever used a bib-like garment or clothing protector to assist your child with the absorption of their saliva? Y / N
2. Please describe the products you have used for your child.
 - a. What are you currently using? (Brand name/website)
 - b. What are your preferred products, why?

3. How often does your child need to switch clothing protectors throughout the day? Who switches them? Why are they switched?
 - a. How long can one be used for until it needs to be washed?
4. How often does your child need to switch shirts throughout the day because of wetting from saliva? Who switches them?
5. Has wearing a clothing protector affected your child's daily social interactions? If so, please elaborate:
6. Where did you purchase your favorite clothing protector (market or website)?
7. On average, how much do you spend on each clothing protector?
 - a. How many do you purchase for your child?
8. How long does a clothing protector last before it's not usable? What makes it unusable?
9. How long can your preferred clothing protector be used before it has to be washed?
10. Do you hand wash or machine wash the clothing protector?
11. Rate the quality of your child's preferred clothing protector in the chart below on a scale of 1 to 5.

Circle *1* if you are *completely unsatisfied* and *5* if you are *fully satisfied*. If they use more than one clothing protector, rate the favorite one that you most often use. As you provide your rating, please share your reasons or comments if you have them.

Absorption--How well does the clothing protector protect the clothes from moisture?

1	2	3	4	5
<i>completely</i>				<i>fully satisfied</i>
<i>unsatisfied</i>				

Comfort--Does your child feel comfortable wearing the clothing protector?

1	2	3	4	5
<i>Extremely</i>				<i>Extremely</i>
<i>uncomfortable</i>				<i>comfortable</i>

Durability--How well does the fabric hold up to daily usage?

1	2	3	4	5
<i>Not at all</i>				<i>Extremely</i>
<i>durable</i>				<i>durable</i>

Fabric----How satisfied are you with the softness of the material? (softness/stiffness)

1	2	3	4	5
<i>Extremely stiff</i>				<i>Extremely soft</i>

Fabric----How satisfied are you with the breathability of the material? (very unbreathable/very breathable)

1	2	3	4	5
<i>Extremely</i>				<i>Extremely</i>
<i>unbreathable</i>				<i>breathable</i>

Sizing--How well does the garment fit around the neck?

1	2	3	4	5
<i>Extremely poor</i>				<i>Extremely good</i>
<i>fit</i>				<i>fit</i>

Sizing--How well does the garment cover the clothing?

1	2	3	4	5
<i>Extremely poor</i>				<i>Extremely good</i>
<i>coverage</i>				<i>coverage</i>

Self-esteem—how does your child feel when wearing the garment?

1	2	3	4	5
<i>Not at all</i>				<i>Extremely</i>
<i>confident</i>				<i>confident</i>

Attractiveness—How do you like the appearance of the garment?

1	2	3	4	5
<i>Not at all</i>				<i>Very much</i>

Color Selection—Are you satisfied with the color options? [Are there color options? Yes/No]

1	2	3	4	5
<i>Not at all</i>				<i>Extremely</i>

Pattern Selection—Are you satisfied with the shapes or design style options? [Are there shape or design style options? Yes/No]

1	2	3	4	5
---	---	---	---	---

<i>Not at all</i>			<i>Extremely</i>	
Clasping Mechanism--How well does the garment stay fastened?				
1	2	3	4	5
<i>Very poorly</i>			<i>Extremely</i>	
Ease of donning-- How easily can your child take the garment on/off without assistance?				
1	2	3	4	5
<i>Not able</i>			<i>Fully able</i>	
Affordability--How satisfied are you with the price of the garment?				
1	2	3	4	5
<i>Not at all</i>			<i>Extremely</i>	

11. Which of the characteristics above are most important for you? Rank the top 3, with 1 being the most important.
12. Which of the characteristics above do you think are the most important for your child? Rank the top 3, with 1 being the most important.
13. Are there any other elements of a clothing protector that would appeal to you that were not previously listed? If so, please elaborate.
14. What colors, fabric designs/styles, and accessories would appeal the most to your child?
15. What special features (material, clasping mechanism, etc.) would you want the scarf to have to meet your child's needs?

16. Do you have other suggestions, needs, or ideas for the clothing protector you would like to share with me?

Which of the characteristics above do you think are the most important for your child?

Rank the top 3, with 1 being the most important.

- Absorption--How well does the clothing protector protect the clothes from moisture?
- Comfort--Does your child feel comfortable wearing the clothing protector?
- Durability--How well does the fabric hold up to daily usage?
- Fabric----How satisfied are you with the softness of the material?
(softness/stiffness)
- Fabric----How satisfied are you with the breathability of the material? (very unbreathable/very breathable)
- Sizing--How well does the garment fit around the neck?
- Sizing--How well does the garment cover the clothing?
- Self-esteem—how does your child feel when wearing the garment?
- Attractiveness—How do you like the appearance of the garment?
- Color Selection—Are you satisfied with the color options? [Are there color options? Yes/No]
- Pattern Selection—Are you satisfied with the shapes or design style options? [Are there shape or design style options? Yes/No]
- Clasping Mechanism--How well does the garment stay fastened?

- Ease of donning-- How easily can your child take the garment on/off without assistance?
- Affordability--How satisfied are you with the price of the garment?

Appendix C

CLOTHING PROTECTOR PARTICIPANT LOG

Clothing Protector Participant Log – Day 1

Please test the following clothing protector

Name:
Picture:

Please log the time the clothing protector was put on and taken off., and circle the reason(s) for taking the clothing protector off. Circle whether the clothing protector was washed on this day and circle the washing method.

Date	Start Time	End Time	Reason (Circle all that apply) (1) Saturation (2) Leaking (3) Discomfort (4) Lunch or snack time (5) School dismissal	Washed? If Yes, please select: (Hand wash/ Machine wash)
--/--	--:--	--:--	(1) (2) (3) (4) (5) Other: _____	Yes / No (Hand wash / Machine wash)
	--:--	--:--	(1) (2) (3) (4) (5) Other: _____	Yes / No (Hand wash / Machine wash)
	--:--	--:--	(1) (2) (3) (4) (5) Other: _____	Yes / No (Hand wash / Machine wash)
	--:--	--:--	(1) (2) (3) (4) (5) Other: _____	Yes / No (Hand wash / Machine wash)

Do you have any comments about your experience or things we should consider to improve the design? If so, please describe:

Other comments:

Clothing Protector Participant Log – Day 2

Please test the following clothing protector

Name:
Picture:

Please log the time the clothing protector was put on and taken off., and circle the reason(s) for taking the clothing protector off. Circle whether the clothing protector was washed on this day and circle the washing method.

Date	Start Time	End Time	Reason (Circle all that apply) (1) Saturation (2) Leaking (3) Discomfort (4) Lunch or snack time (5) School dismissal	Washed? If Yes, please select: (Hand wash/ Machine wash)
--/--	--:--	--:--	(1) (2) (3) (4) (5) Other: _____	Yes / No (Hand wash / Machine wash)
	--:--	--:--	(1) (2) (3) (4) (5) Other: _____	Yes / No (Hand wash / Machine wash)
	--:--	--:--	(1) (2) (3) (4) (5) Other: _____	Yes / No (Hand wash / Machine wash)
	--:--	--:--	(1) (2) (3) (4) (5) Other: _____	Yes / No (Hand wash / Machine wash)

Do you have any comments about your experience or things we should consider to improve the design? If so, please describe:

Other comments:

Clothing Protector Participant Log – Day 3

Please test the following clothing protector

Name:
Picture:

Please log the time the clothing protector was put on and taken off., and circle the reason(s) for taking the clothing protector off. Circle whether the clothing protector was washed on this day and circle the washing method.

Date	Start Time	End Time	Reason (Circle all that apply) (1) Saturation (2) Leaking (3) Discomfort (4) Lunch or snack time (5) School dismissal	Washed? If Yes, please select: (Hand wash / Machine wash)
--/--	--:--	--:--	(1) (2) (3) (4) (5) Other: _____	Yes / No (Hand wash / Machine wash)
	--:--	--:--	(1) (2) (3) (4) (5) Other: _____	Yes / No (Hand wash / Machine wash)
	--:--	--:--	(1) (2) (3) (4) (5) Other: _____	Yes / No (Hand wash / Machine wash)
	--:--	--:--	(1) (2) (3) (4) (5) Other: _____	Yes / No (Hand wash / Machine wash)

Do you have any comments about your experience or things we should consider to improve the design? If so, please describe:

Other comments:

Clothing Protector Participant Log – Day 4

For today's test, please select the clothing protector you most prefer. This could be one of the clothing protectors we designed or it could be one of the solutions you were previously using.

Please circle the clothing protector you prefer and are using today.

Name of the prototype	Name of the prototype	Name of the prototype	Other (please name and/or describe here):
Picture of the prototype	Picture of the prototype	Picture of the prototype	

What is it you like about this clothing protector that made you choose to use it today?

Please log the time the clothing protector was put on, and when the clothing protector was taken off. Circle the reason(s) for taking the clothing protector off. Circle whether the clothing protector was washed on this day and circle the washing method.

Date	Start Time	End Time	Reason (Circle all that apply) (1) Saturation (2) Leaking (3) Discomfort (4) Lunch or snack time (5) School dismissal	Washed? If Yes, please select: (Hand wash/ Machine wash)
--/--	--:--	--:--	(1) (2) (3) (4) (5) Other: _____	Yes / No (Hand / Machine)
	--:--	--:--	(1) (2) (3) (4) (5) Other: _____	Yes / No (Hand / Machine)
	--:--	--:--	(1) (2) (3) (4) (5) Other: _____	Yes / No (Hand / Machine)
	--:--	--:--	(1) (2) (3) (4) (5) Other: _____	Yes / No (Hand / Machine)

Do you have any comments about your experience or things we should consider in improving the design? If so, please elaborate.

Clothing Protector Participant Log – Day 5

For today's test, please select the clothing protector you most prefer. This could be one of the clothing protectors we designed or it could be one of the solutions you were previously using.

Please circle the clothing protector you prefer and are using today.

Name of the prototype	Name of the prototype	Name of the prototype	Other (please name and/or describe here):
Picture of the prototype	Picture of the prototype	Picture of the prototype	

What is it you like about this clothing protector that made you choose to use it today?

Please log the time the clothing protector was put on, and when the clothing protector was taken off. Circle the reason(s) for taking the clothing protector off. Circle whether the clothing protector was washed on this day and circle the washing method.

Date	Start Time	End Time	Reason (Circle all that apply) (1) Saturation (2) Leaking (3) Discomfort (4) Lunch or snack time (5) School dismissal	Washed? If Yes, please select: (Hand wash/ Machine wash)
--/--	--:--	--:--	(1) (2) (3) (4) (5) Other: _____	Yes / No (Hand / Machine)
	--:--	--:--	(1) (2) (3) (4) (5) Other: _____	Yes / No (Hand / Machine)
	--:--	--:--	(1) (2) (3) (4) (5) Other: _____	Yes / No (Hand / Machine)
	--:--	--:--	(1) (2) (3) (4) (5) Other: _____	Yes / No (Hand / Machine)

Do you have any comments about your experience or things we should consider in improving the design? If so, please elaborate.

Appendix D

DESIGN SURVEY FOR SCARVES FOR CHILDREN WITH ORAL-MOTOR IMPAIRMENTS

This is a survey for individuals, or caregivers of individuals, with oral-motor impairments. The goal of this survey is to help researchers understand how survey participants feel about their needs and feedback on scarf prototypes developed by our team to protect clothing while still being stylish for children with oral-motor impairments.

This survey is completely voluntary. All answers are anonymous and no identifying information will be collected. You may skip a question(s) if you prefer not to answer.

1. Which of the following categories do you fit into?
I have oral-motor impairments that impair my ability to retain saliva in my mouth ☐
I care for an individual(s) with oral-motor impairments that impair the ability to retain saliva in the mouth ☐

Question for individuals with oral-motor impairments:

What is your age in years?

Questions for caregivers:

How old is the person for whom you care in years? (If you care for more than one person, please report the age of one of those individuals and think about that person when completing this survey).

What is your relationship to this person?

Mother ☐ / Father ☐ / Grandmother ☐ / Grandfather ☐ / Teacher ☐ / Nurse ☐ / Physical therapist ☐ / Occupational therapist ☐ / Speech therapist ☐ / Other ☐

-
2. How many clothing protectors do you use in a typical day?
0 1 2 3 4 More than 4

3. Which best describes the clothing protector solution you are currently using most often?

Product purchased on the market ☐ / Homemade product ☐

If selected “Product purchased on the market”, then:

Please write the name of the product.

Please provide a link to the product website if that is available.

If selected “Homemade product”, then:

Please share a description of the product.

Please share images if possible.

4. What do you like about the product that you are currently using? Select all that apply.

Appearance ☐ / Size ☐ / Feel ☐ / Price ☐ / Fit ☐ / Breathability ☐ /

Function ☐ / Comfort ☐ / Ease of cleaning ☐ / Fasteners ☐ / Other_____

(Could select more than one)

Then,

Please share anything you would like us to know about why you like this product. This will help us understand what is important to include in our scarf designs.

5. What improvements would you like to see to the product you are currently using?

Appearance ☐ / Size ☐ / Feel ☐ / Price ☐ / Fit ☐ / Breathability ☐ /

Function ☐ / Comfort ☐ / Ease of cleaning ☐ / Fasteners ☐ / Other_____

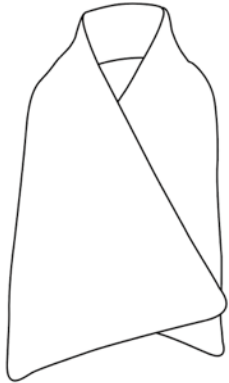
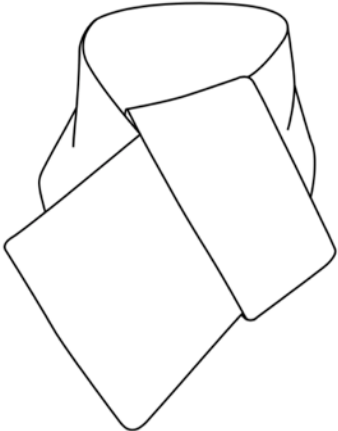
(Could select more than one)

Then,

Please share more details about what would need to be changed for this product to work better and be more desirable to you.

Below are some scarf designs for clothing protection our team has developed by working with end users.

Design 1

	
Details: The scarf is snapped together at the front of the neck, with multiple snaps available to adjust the fit.	
Design 2	
	
Details: The scarf is tucked through itself at the neck; This allows for adjustment of fit.	
Design 3	



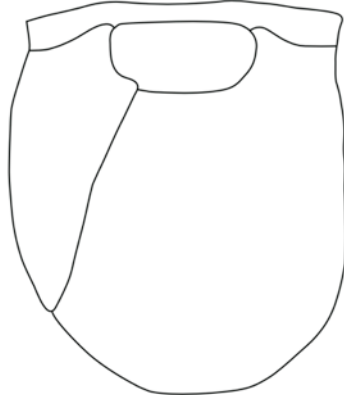
Details:
The scarf is tucked through itself at the neck; This allows for adjustment of fit.

Design 4



Details:
The scarf is snapped together at the front of the neck, with multiple snaps available to adjust the fit.

Design 5

	
Details: The scarf is snapped together at the back of the neck, with multiple snaps available to adjust the fit.	
Design 6	
	
Details: The scarf is snapped together at the front of the neck, with multiple snaps available to adjust the fit.	

6. Please rank the scarves from your favorite to least favorite:

- 1
- 2
- 3
- 4
- 5

6 __

Show image for Design 1 and ask:

A. How attractive is this scarf (keep in mind it could be made in different colors)?

1	2	3	4	5	6	7
Very unattractive						Very attractive

B. To what extent do you think this design would function to cover the areas you need covered?

1	2	3	4	5	6	7
Not well						Very well

C. How well do you think this design would fit?

1	2	3	4	5	6	7
Not well						Very well

D. How comfortable does this design look?

1	2	3	4	5	6	7
Very uncomfortable						Very comfortable

E. What do you like about this design?

F. What would you change about this design to improve it?

Repeat questions A-F for each of the 6 designs.

7. Are there any ideas of designs you would like to see us develop that are not pictured here?
Please describe and share links or pictures if possible

Thank you so much for completing this survey! Your input is critical in helping to guide our future designs so we can make something that actually works and pleases users. We appreciate your time and input.

Our team also works on other garment design and child development projects. If you want to learn more about our projects, please visit

<https://sites.udel.edu/move2learn/current-projects/> or contact us via email:
motorbehlab@gmail.com. Feel free to send us ideas for other design needs you may have.

Appendix E

DIY MANUALS

Scarf Design #2 DIY Manual

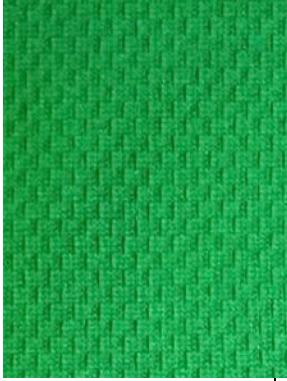
This DIY manual shows how to create a scarf to manage saliva for individuals with oral-motor impairments. The scarf uses a three-layer structure as a demonstration, namely a liquid wicking layer, a liquid absorbent layer, and a waterproof layer. Use these instructions as presented or modify them creatively on your own to meet the needs of the individual for whom you are designing. For example, you can change the color or pattern of fabric used. You could also use a two-layer structure (liquid wicking layer + waterproof layer) as a lighter, less bulky solution for an individual with mild drooling. You could also modify the fastener type or location to match your needs. Be creative and have fun creating!



The finished product

Material List

Here we provide specific information regarding the materials we used in fabricating the scarf. You do not have to use these exact fabrics. We describe the requirements for the fabric used in each layer so that you can find replacements that function similarly for your desired modifications.

Liquid wicking layer			
Material	Link	Pricing	Requirements
	https://www.seattlefabrics.com/Active-Dry-Wicking-Jersey-Mesh-1295-linear-yard-p_176.html	\$12.95/Yd.	This layer should have the capability to spread liquid quickly.
Tips: A 100% polyester knit fabric is appropriate for this layer. If you have some fabrics with you, but not sure whether it could work or not. You could pour a little water on it. If the material spreads the water and dry quickly, then that's what you want to use. If it forms into a water drop, be absorbed by the fabric, and then remains wet for a long time, that piece of fabric is not appropriate.			
Liquid absorbent layer			

Material	Link	Pricing	Requirements
	https://www.joann.com/performance-heather-terry-knit-fabric-grey/16717126.html?q=terry&start=1	\$11.99/Yd.	This layer should have the capability to absorb and retain large amount of water.
Tips: Cotton terry (or knit terry) fabrics are excellent choices for this layer. You could find a lot of different types of cotton terry cloth fabric on the market. The main difference is the weight of the material (measured in ounces per square yard). Typically, the higher the number, the better the ability to absorb liquid. Here, we recommend lower than 10 ounces per square yard fabric; that's good for most of the children.			
Waterproof layer			
Material	Link	Pricing	Requirements

	https://www.joann.com/babyville-pirates-pul-fabric/12850012.html?q=waterproof&start=1	\$10 .49/Yd.	This layer should have the capability to prevent water penetration.
Tips: The fabric would usually be labeled as a waterproof fabric. Those are easy to find.			

Directionality of Fabrics

Wicking Fabric



Right

Wrong

(Front)

(Back)

*The wrong side does not contain obvious meshes

Absorbent Fabric



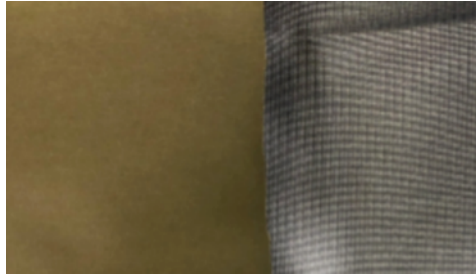
Right (Front)

Wrong

(Back)

*The wrong side has small loops

Waterproof Fabric



Right (Front) Wrong
(Back)

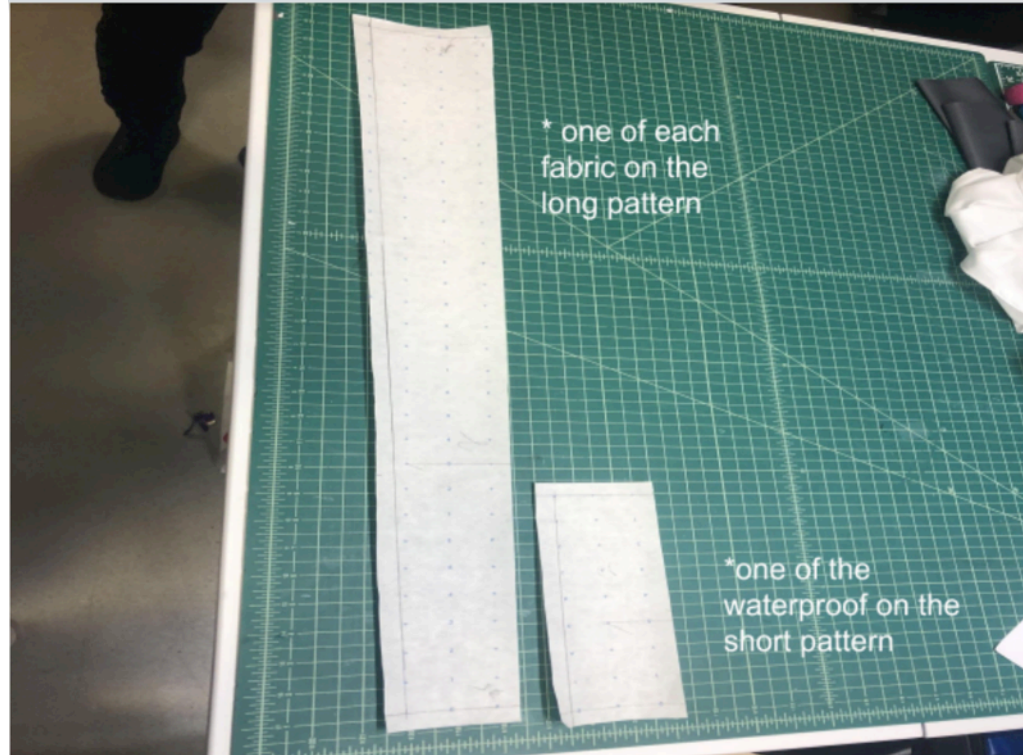
*The wrong side is reflective

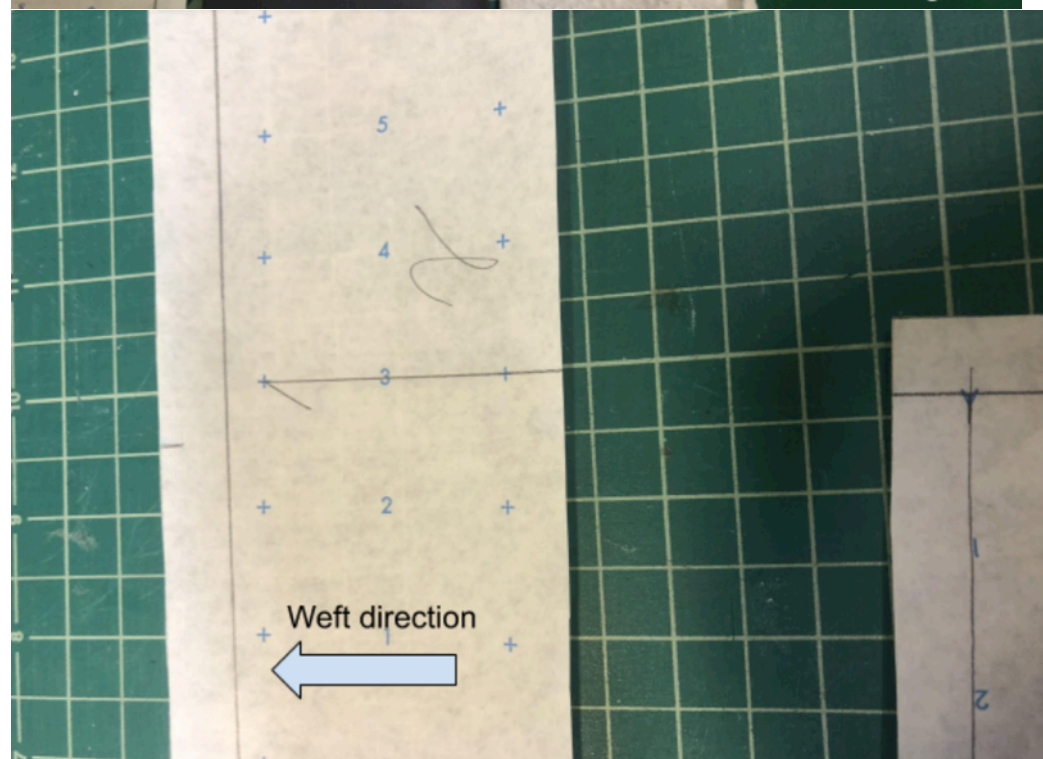
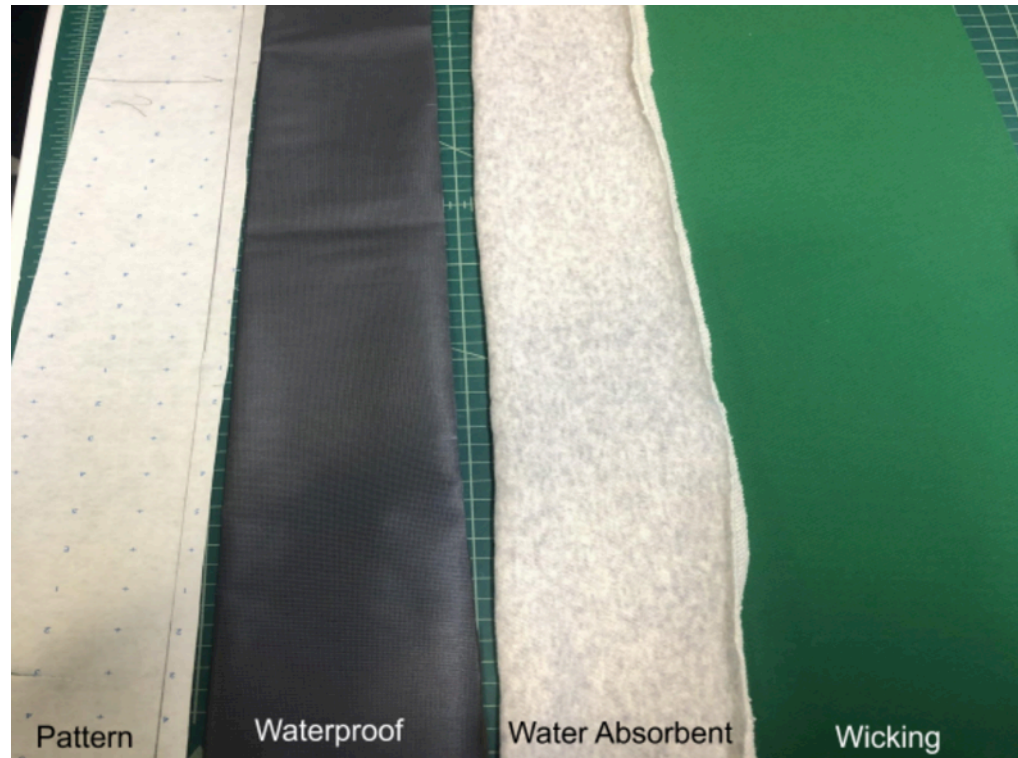
Tool lists:

- Sewing machine
- Paper-cutting scissors
- Fabric-cutting scissors
- Thread snip scissors
- Threads
- Tailors chalk
- Hand sewing needles
- Sewing clip (*optional)

Procedure

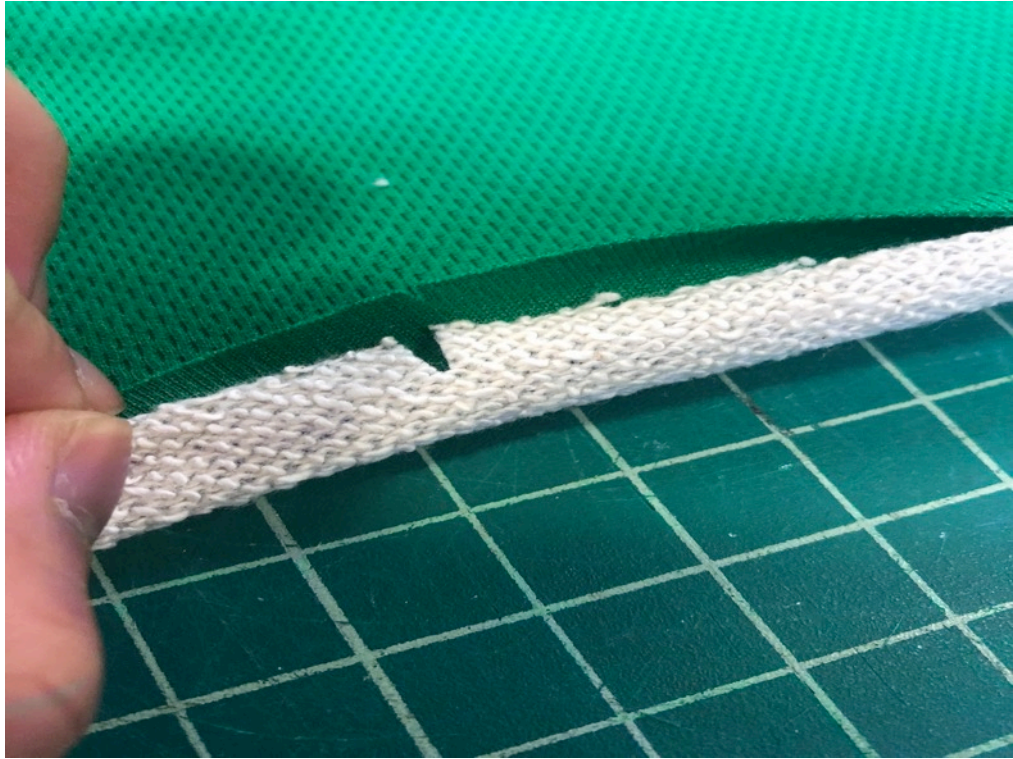
1. Using the patterns, trace and cut out one of each fabric (wicking, water absorbent, and waterproof). Only one waterproof fabric is required to be cut for the small pattern.



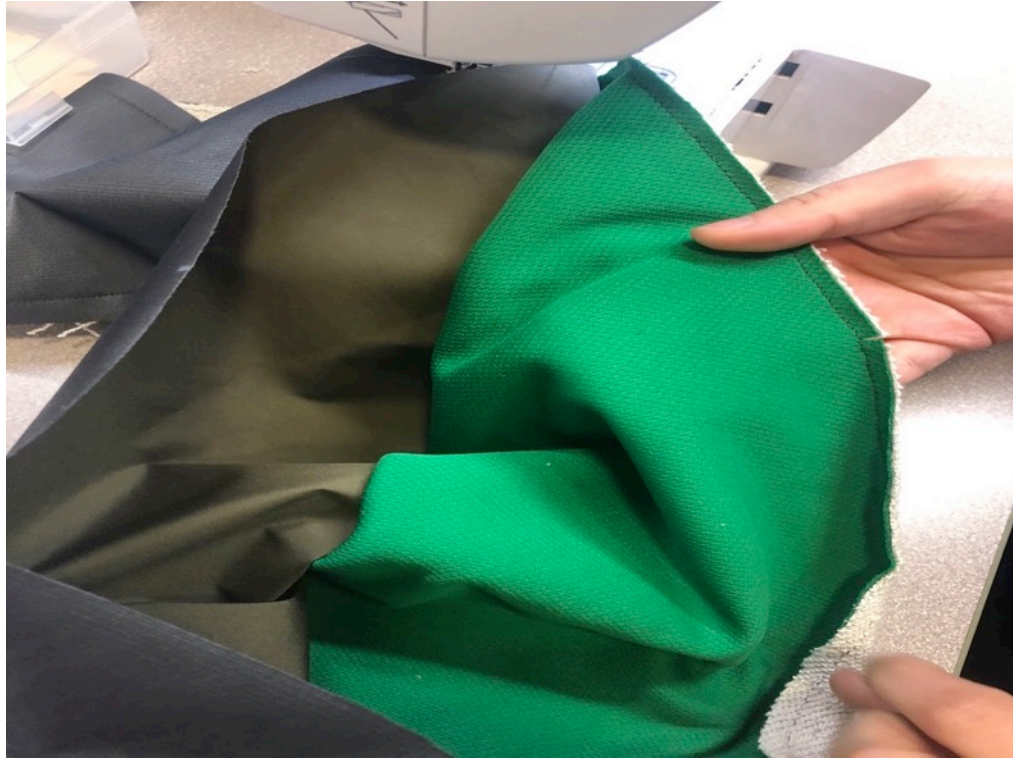


2. With the front side facing up, place wicking fabric on the front part of the water absorbent fabric. Align at the notches.

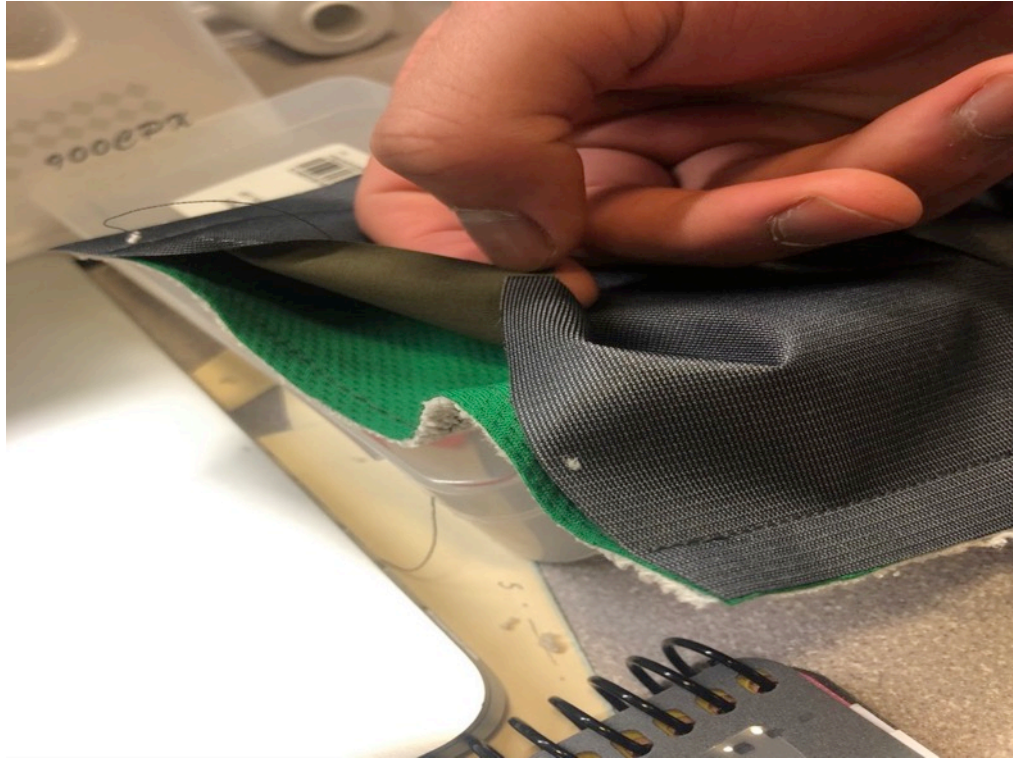




3. Stitch at a 1/4" seam allowance with a 5.0 stitch length.



4. With the front part of the waterproof fabric on the front part of the wicking fabric, stitch along the edge at a $\frac{1}{2}$ " seam allowance with a 2.5 stitch length and leave one short end unstitched.



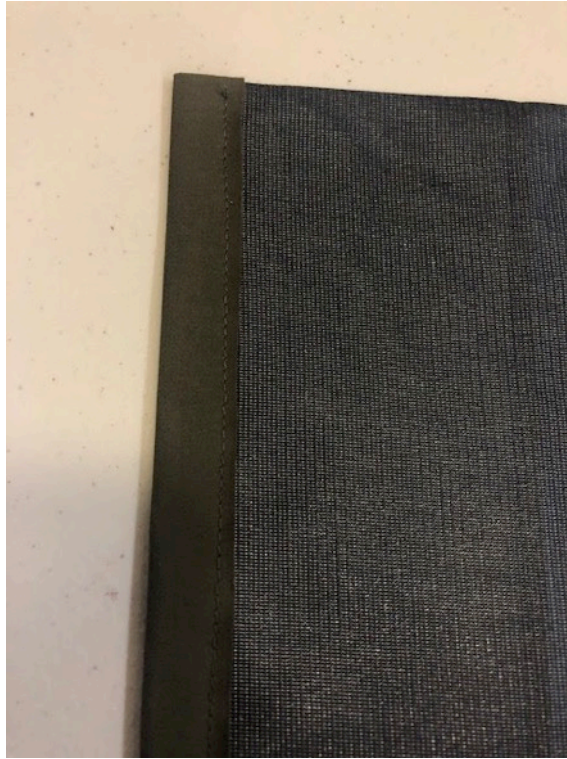
5. Trim $\frac{1}{2}$ of the seam allowance on the wicking/water absorbent pair.
Trim corners to reduce bulk.



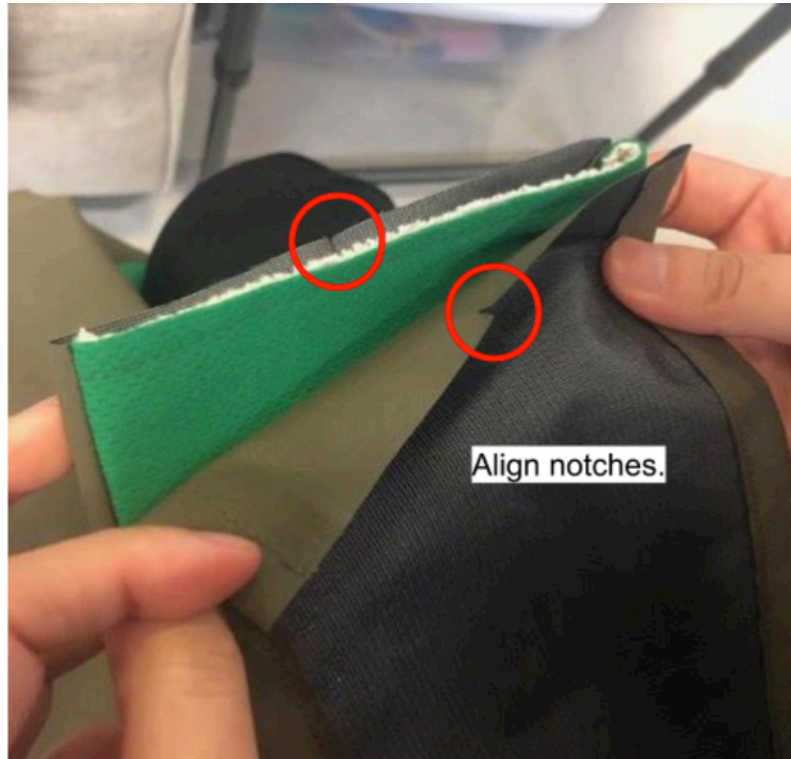
6. Flip the scarf inside-out from the opening.
7. With the small cut-out waterproof piece, draw a $\frac{1}{2}$ " line on the long side of the back side of the fabric. Fold sides on the line and press on cotton setting



8. Stitch down both of the folded lines at a 2.5 stitch length.



9. Align the notches on the short sides of the opening on the long pattern and the notches on the short pattern. The front of the short pattern should be placed on top of the wicking fabric.



10. Stitch the two pieces together down the short edge at a 2.5 stitch length.



11. Trim the fabric along the seam allowance.



12. Fold the excess seam allowance of the short pattern over onto the long pattern. Stitch.

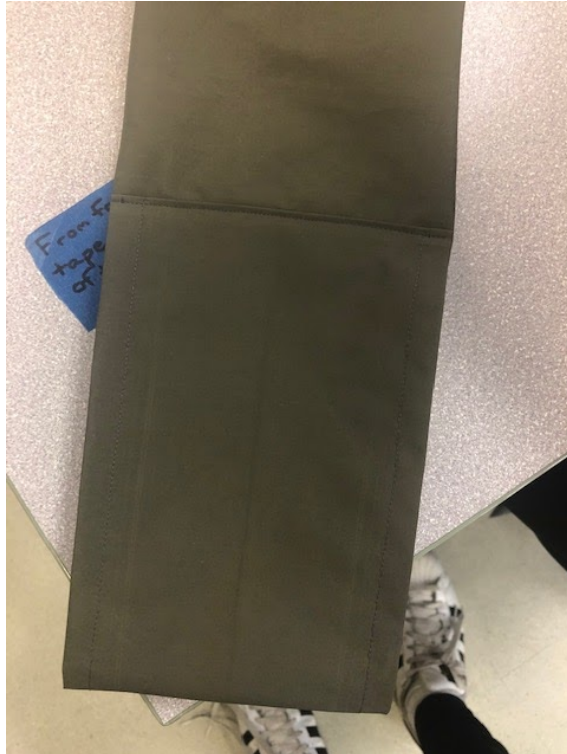


13. Draw $\frac{1}{2}$ " line on the non-stitched side of the short pattern. Fold edge to the line, fold again, then press.

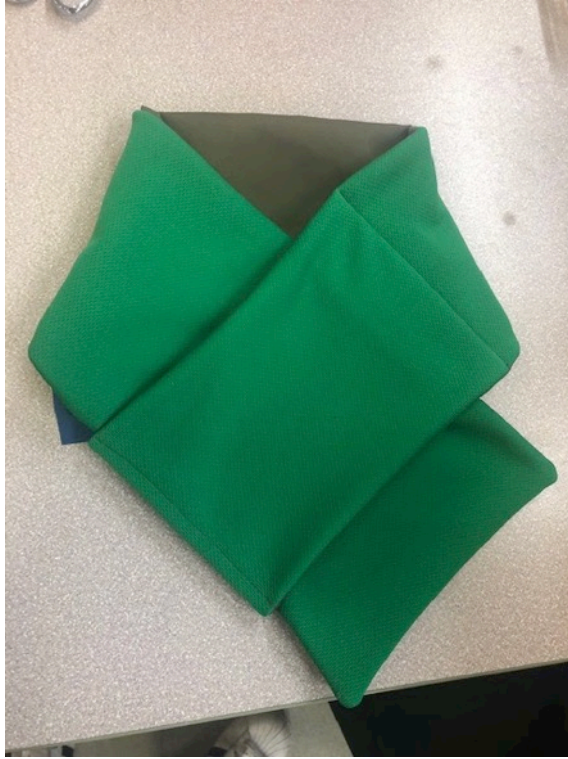




14. Fold the short pattern over onto the long pattern and stitch on the line.



FINISHED PRODUCT



Scarf Design #5 DIY Manual

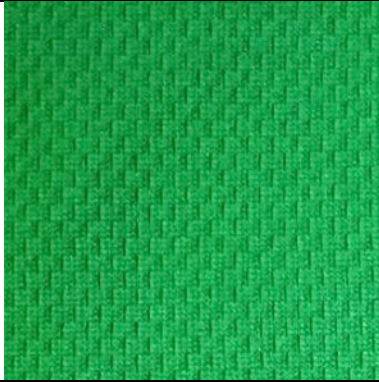
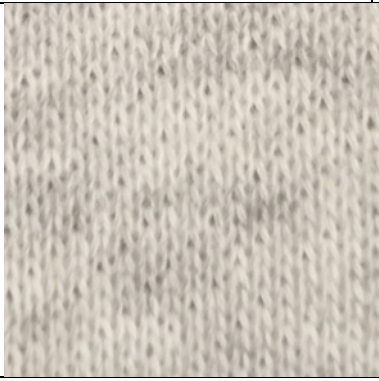
This DIY manual shows how to create a scarf to manage saliva for individuals with oral-motor impairments. The scarf uses a three-layer structure as a demonstration, namely a liquid wicking layer, a liquid absorbent layer, and a waterproof layer. Use these instructions as presented or modify them creatively on your own to meet the needs of the individual for whom you are designing. For example, you can change the color or pattern of fabric used. You could also use a two-layer structure (liquid wicking layer + waterproof layer) as a lighter, less bulky solution for an individual with mild drooling. You could also modify the fastener type or location to match your needs. Be creative and have fun creating!



The finished product

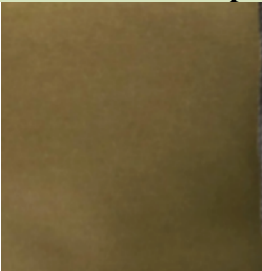
Material List

Here we provide specific information regarding the materials we used in fabricating the scarf. You do not have to use these exact fabrics. We describe the requirements for the fabric used in each layer so that you can find replacements that function similarly for your desired modifications.

Liquid wicking layer			
Material	Link	Pricing	Requirements
	https://www.seattlefabrics.com/Active-Dry-Wicking-Jersey-Mesh-1295-linear-yard-p_176.html	\$12.95/Yd.	This layer should have the capability to spread liquid quickly.
Tips: A 100% polyester knit fabric is appropriate for this layer. If you have some fabrics with you, but not sure whether it could work or not. You could pour a little water on it. If the material spreads the water and dry quickly, then that's what you want to use. If it forms into a water drop, be absorbed by the fabric, and then remains wet for a long time, that piece of fabric is not appropriate.			
Liquid absorbent layer			
Material	Link	Pricing	Requirements
	https://www.joann.com/performance-heather-terry-knit-fabric-grey/16717126.html?q=terry&start=1	\$11.99/Yd.	This layer should have the capability to absorb and retain large amount of water.
Tips: Cotton terry (or knit terry) fabrics are excellent choices for this layer. You could find a lot of different types of cotton terry cloth fabric on the market. The main difference is the weight of the material (measured in ounces per square yard). Typically, the higher the number, the better the ability to absorb liquid. Here, we recommend lower than 10 ounces per square yard fabric; that's good for most of the children.			

Waterproof layer			
Material	Link	Pricing	Requirements
	https://www.joann.com/babyville-pirates-pul-fabric/12850012.html?q=waterproof&start=1	\$10.49/Yd.	This layer should have the capability to prevent water penetration.
Tips: The fabric would usually be labeled as a waterproof fabric. Those are easy to find.			

Directionality of Fabrics

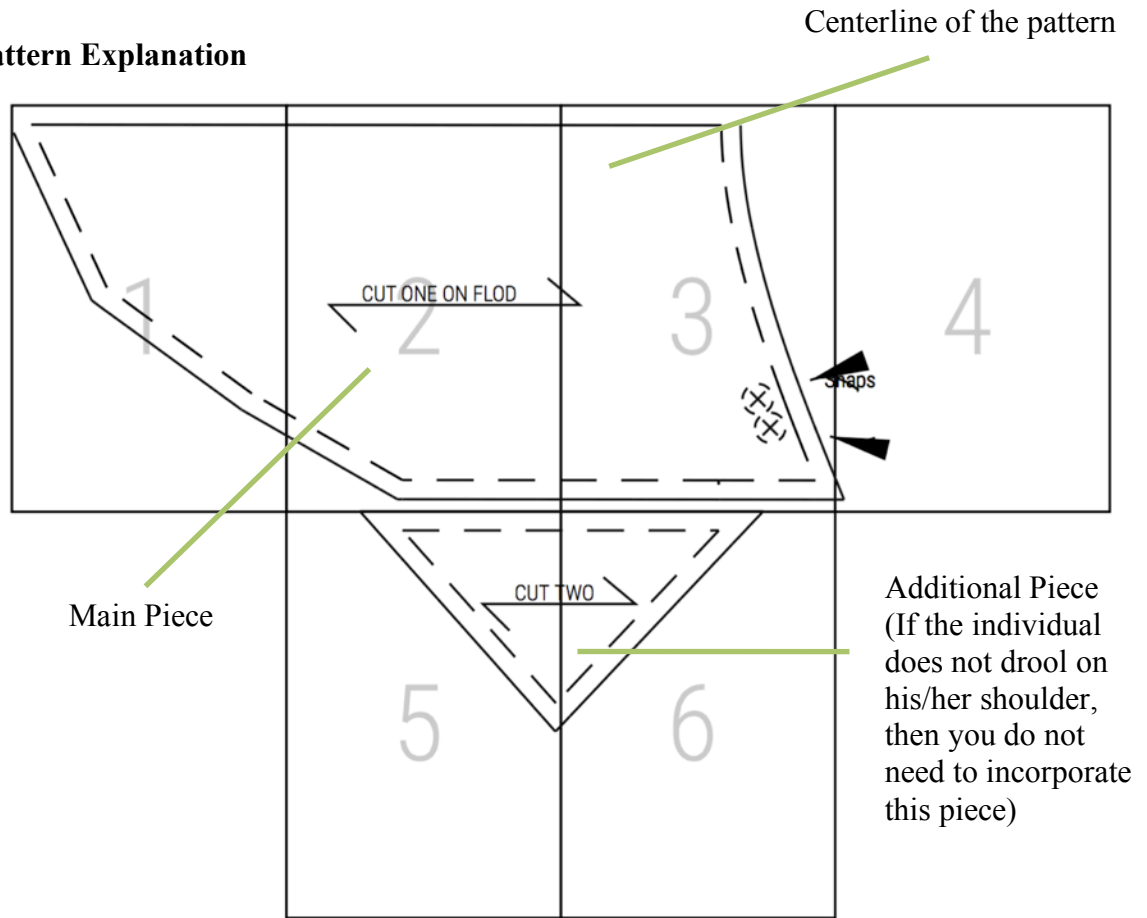
Wicking Fabric		Absorbent Fabric	
			
Right (Front)	Wrong (Back)	Right (Front)	Wrong (Back)
*The wrong side does not contain obvious meshes		*The wrong side has small loops	
Waterproof Fabric			
			
Right (Front)	Wrong (Back)		
*The wrong side is reflective			

Tool list



- Sewing machine
- Paper-cutting scissors
- Fabric-cutting scissors
- Thread snip scissors
- Threads
- Snap buttons (sizes of 8 mm/ 0.31 inch or 10 mm/ 0.39 inch)
- Tailors chalk
- Hand sewing needles
- Sewing clip (*optional)

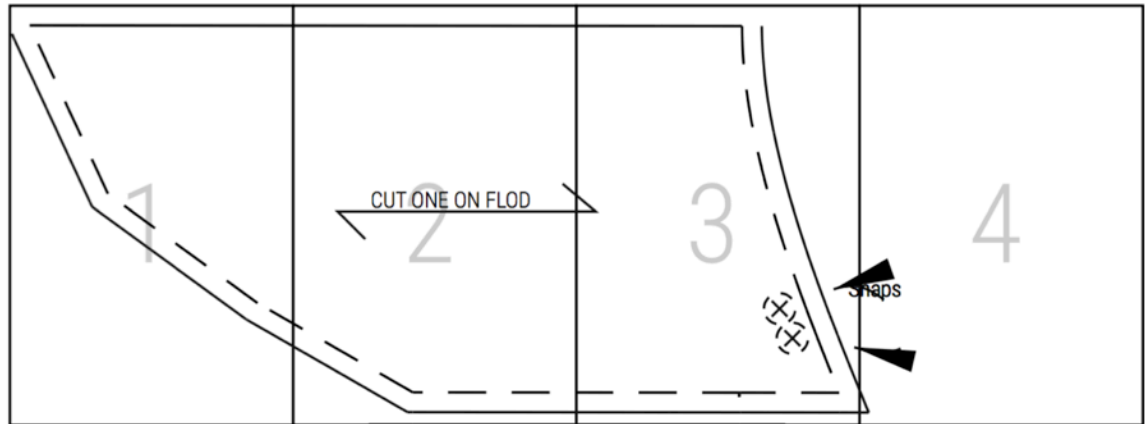
Pattern Explanation



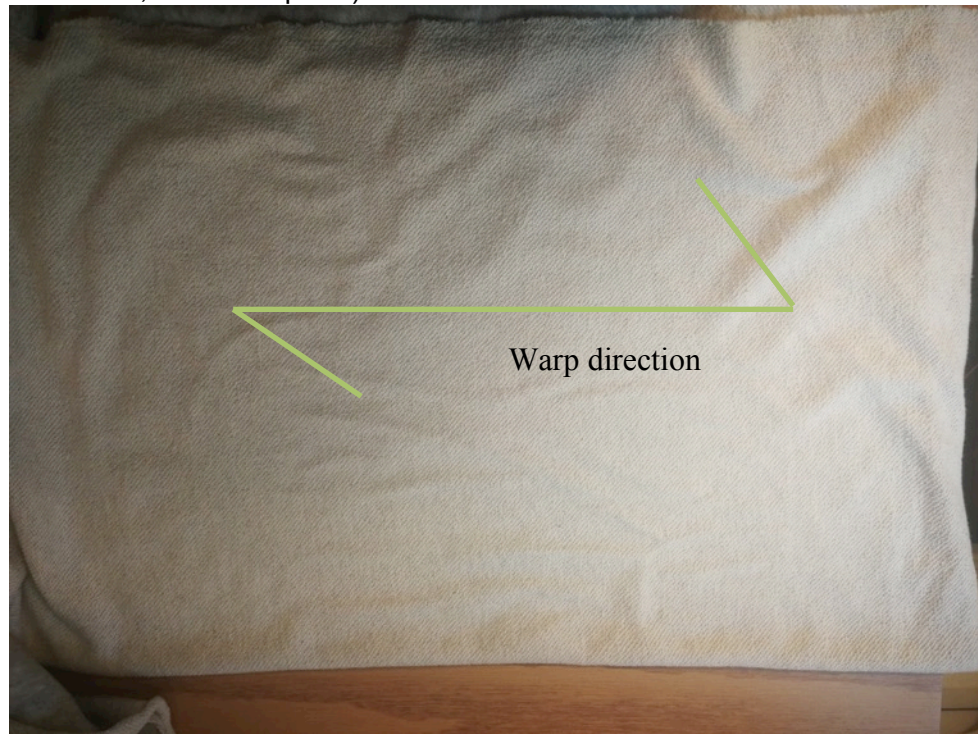
***Cut one on fold:** Fold the fabric along warp direction, put the pattern on the fabric, the centerline of the pattern coincides with the crease (fabric).

Procedure

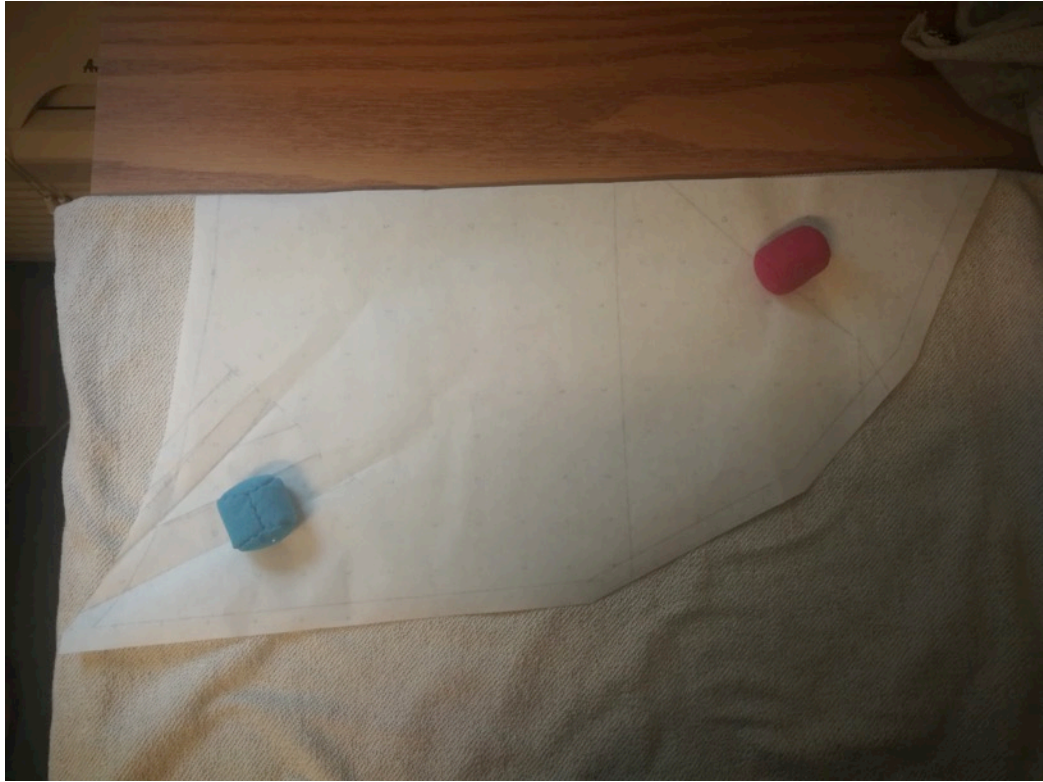
1. Cut out “Main Piece” patterns and join pieces with tape.



2. Using the patterns, fold the fabric along the warp direction (wicking, water absorbent, and waterproof).



3. Trace pattern onto fabric (wicking, water absorbent, and waterproof).



4. Cut out one pattern piece for each fabric (wicking, water absorbent, and waterproof).



5. With the front side facing up, place the wicking fabric on the front part of the water absorbent fabric. You could use clips to clip them together, but not have to.





6. Using a 5.0 stitch length, baste the two fabrics 1/4" from edge to secure two layers of fabric together. The stitch length is just a recommendation. Also what needle you would does not matter as well.

What is a basting stitch:

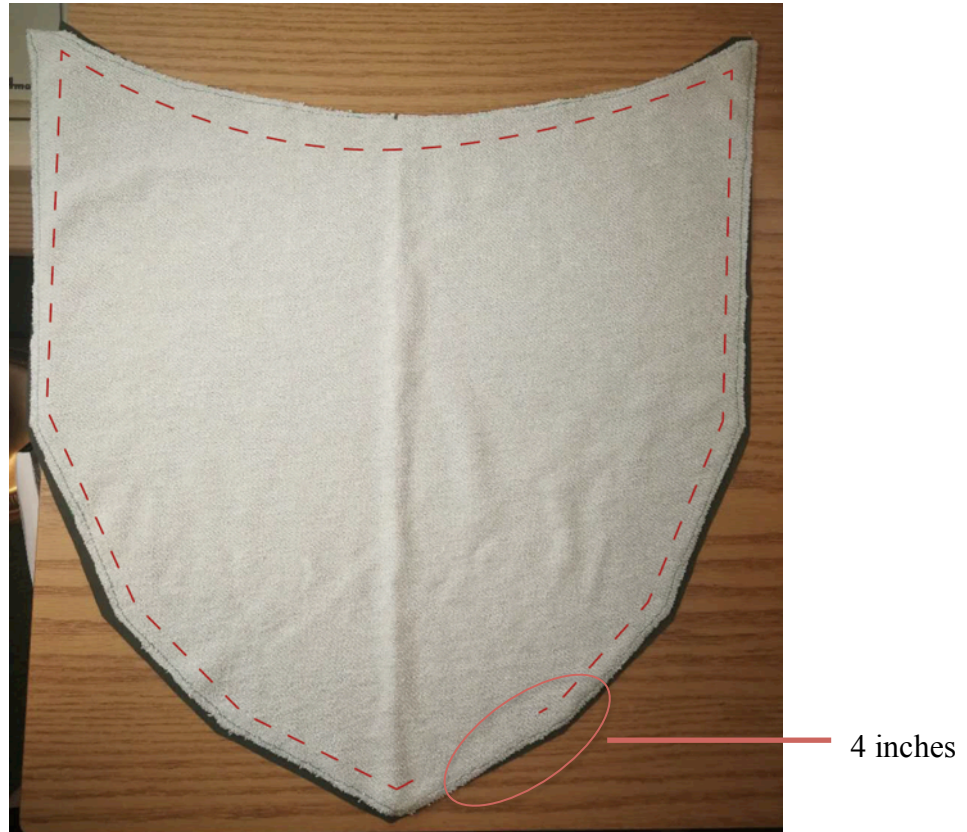
<https://www.youtube.com/watch?v=QKwOplpXwwk>



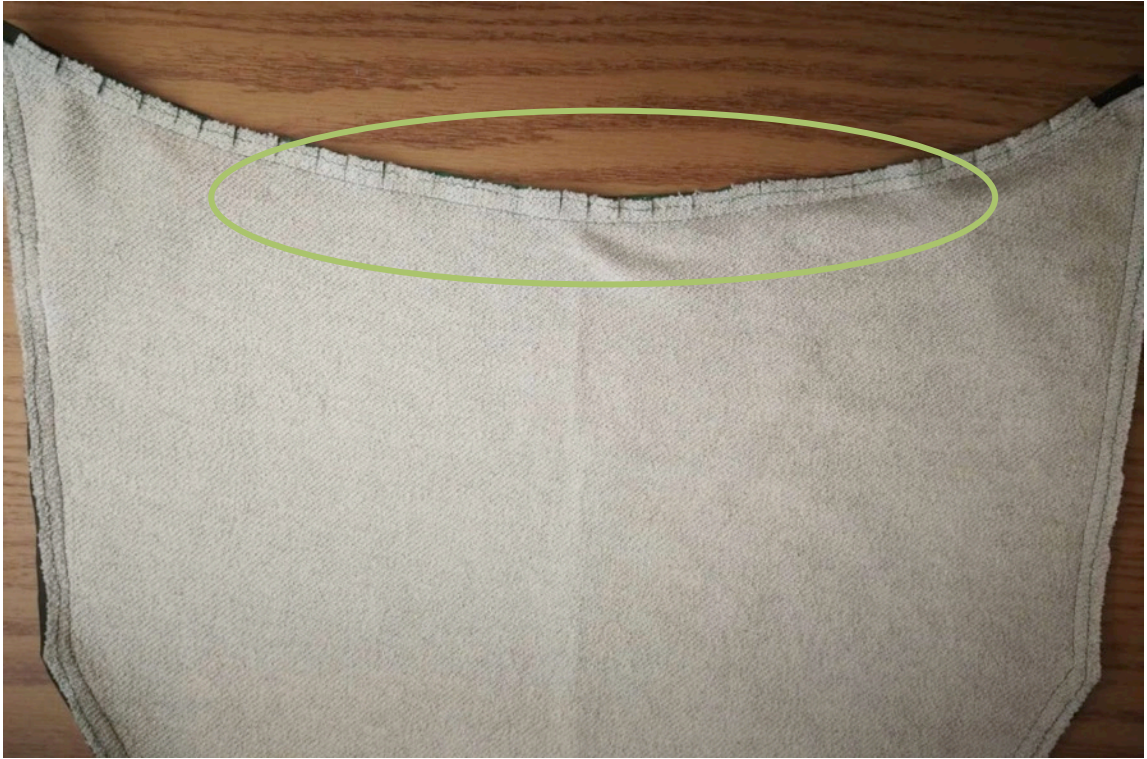
7. Place the right side of the waterproof fabric on the top side of the wicking fabric

matching the seam on both. Because you will need to invert the scarf, leave a 4-inch opening in the seam. Stitch around the remainder of the edge using 1/2" seam allowance.





8. Cut a few notches along the upper edge. Be careful not to clip your stitches. Notches were cut so that when you flip the inside out, the stitches could be kept flat.



9. Reduce bulk by clipping the corners of the fabrics. Be careful not to clip your stitches.



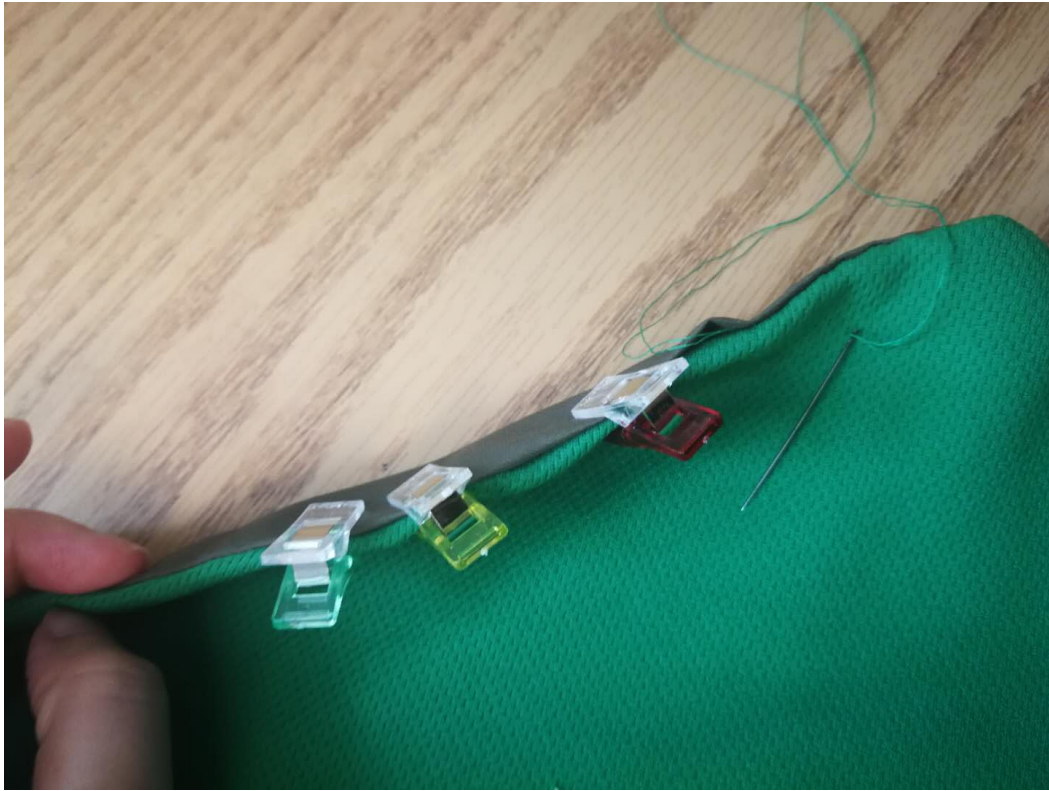
10. Through the 4" opening, pull the fabric to invert it so that it is right side out.



11. After inverting the scarf, hand sew the 4" opening with a slip stitch.

How to slip stitch:

https://www.youtube.com/watch?time_continue=81&v=WbE5hXt27uU&feature=em

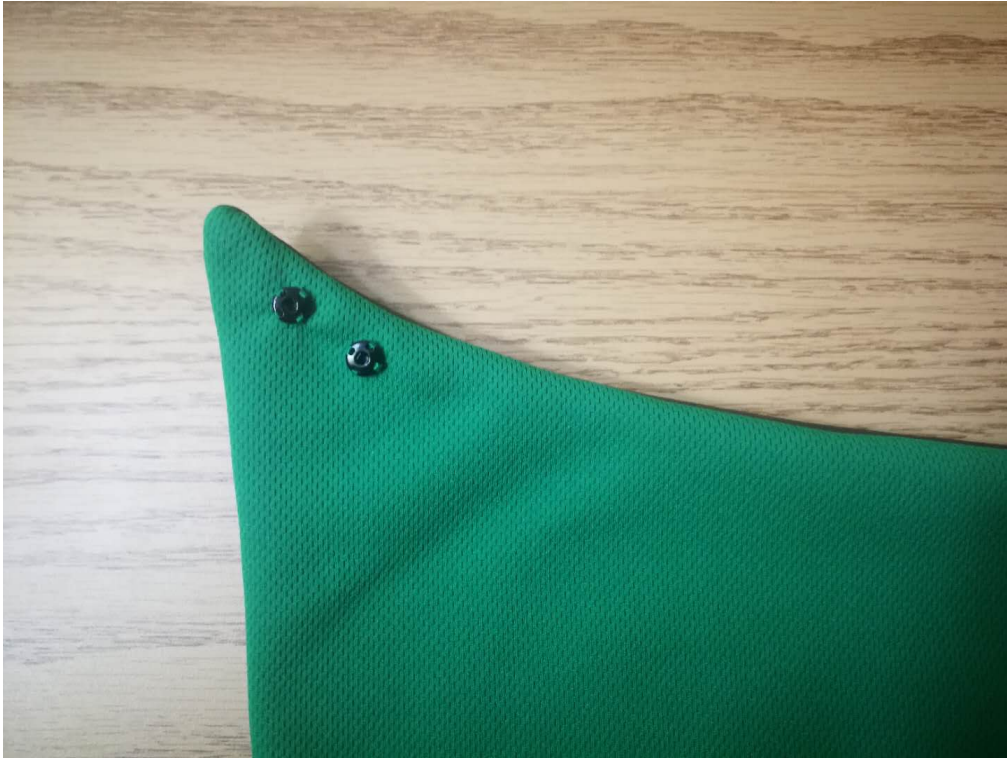


[b_logo](#)

12. Based on the pattern, mark the placement of the snaps and hand sew to attach those. (Snap button sizes of 8 mm/ 0.31 inch or 10 mm/ 0.39 inch can work well)

How to sew a snap button:

<https://www.youtube.com/watch?v=W0NMPTS6YGo>



13. If the individual you are making this for does not drool on his/her shoulder, then your finished product will look like this.



14. If the individual drools on his/her shoulder, you should add two additional pieces. The sewing procedures are same as for the main piece. Your finished product will be like this.



Final





Scarf Design #6 DIY Manual

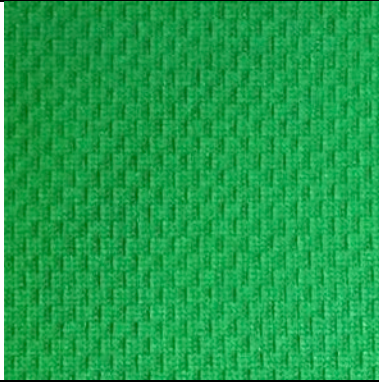
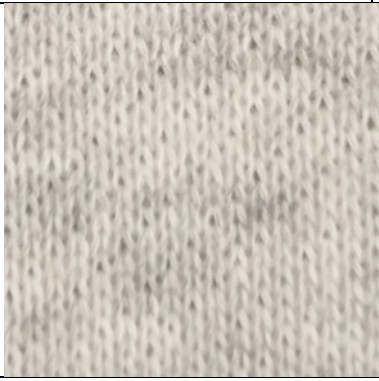
This DIY manual shows how to create a scarf to manage saliva for individuals with oral-motor impairments. The scarf uses a three-layer structure as a demonstration, namely a liquid wicking layer, a liquid absorbent layer, and a waterproof layer. Use these instructions as presented or modify them creatively on your own to meet the needs of the individual for whom you are designing. For example, you can change the color or pattern of fabric used. You could also use a two-layer structure (liquid wicking layer + waterproof layer) as a lighter, less bulky solution for an individual with mild drooling. You could also modify the fastener type or location to match your needs. Be creative and have fun creating!



The finished product

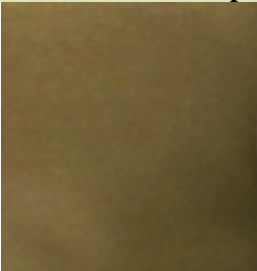
Material List

Here we provide specific information regarding the materials we used in fabricating the scarf. You do not have to use these exact fabrics. We describe the requirements for the fabric used in each layer so that you can find replacements that function similarly for your desired modifications.

Liquid wicking layer			
Material	Link	Pricing	Requirements
	https://www.seattlefabrics.com/Active-Dry-Wicking-Jersey-Mesh-1295-linear-yard-p_176.html	\$12.95/Yd.	This layer should have the capability to spread liquid quickly.
Tips: A 100% polyester knit fabric is appropriate for this layer. If you have some fabrics with you, but not sure whether it could work or not. You could pour a little water on it. If the material spreads the water and dry quickly, then that's what you want to use. If it forms into a water drop, be absorbed by the fabric, and then remains wet for a long time, that piece of fabric is not appropriate.			
Liquid absorbent layer			
Material	Link	Pricing	Requirements
	https://www.joann.com/performance-heather-terry-knit-fabric-grey/16717126.html?q=terry&start=1	\$11.99/Yd.	This layer should have the capability to absorb and retain large amount of water.
Tips: Cotton terry (or knit terry) fabrics are excellent choices for this layer. You could find a lot of different types of cotton terry cloth fabric on the market. The main difference is the weight of the material (measured in ounces per square yard). Typically, the higher the number, the better the ability to absorb liquid. Here, we recommend lower than 10 ounces per square yard fabric; that's good for most of the children.			

Waterproof layer			
Material	Link	Pricing	Requirements
	https://www.joann.com/babyville-pirates-pul-fabric/12850012.html?q=waterproof&start=1	\$10.49/Yd.	This layer should have the capability to prevent water penetration.
Tips: The fabric would usually be labeled as a waterproof fabric. Those are easy to find.			

Directionality of Fabrics

Wicking Fabric		Absorbent Fabric	
			
Right (Front)	Wrong (Back)	Right (Front)	Wrong (Back)
*The wrong side does not contain obvious meshes		*The wrong side has small loops	
Waterproof Fabric			
			
Right (Front)	Wrong (Back)		
*The wrong side is reflective			

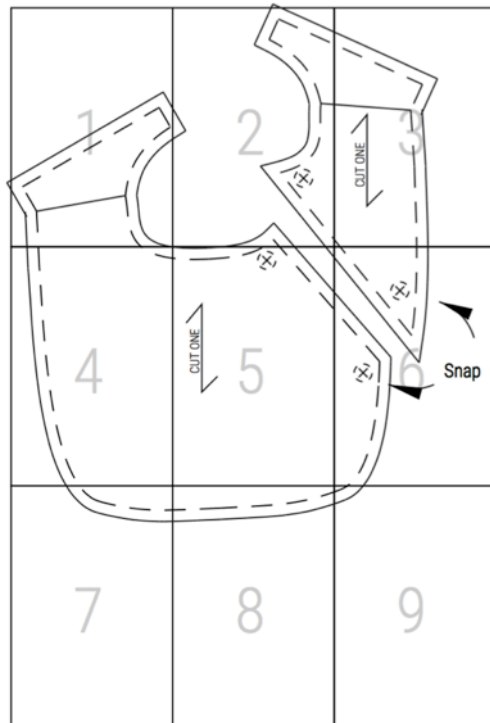
Tool list



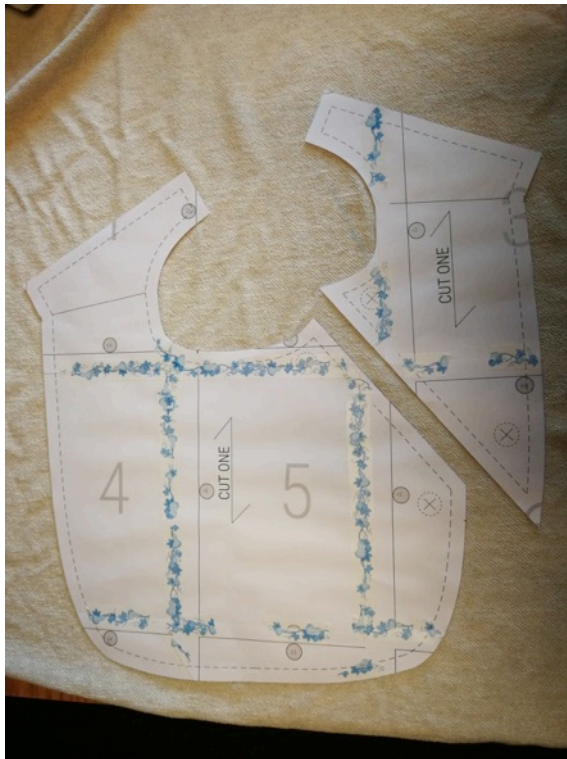
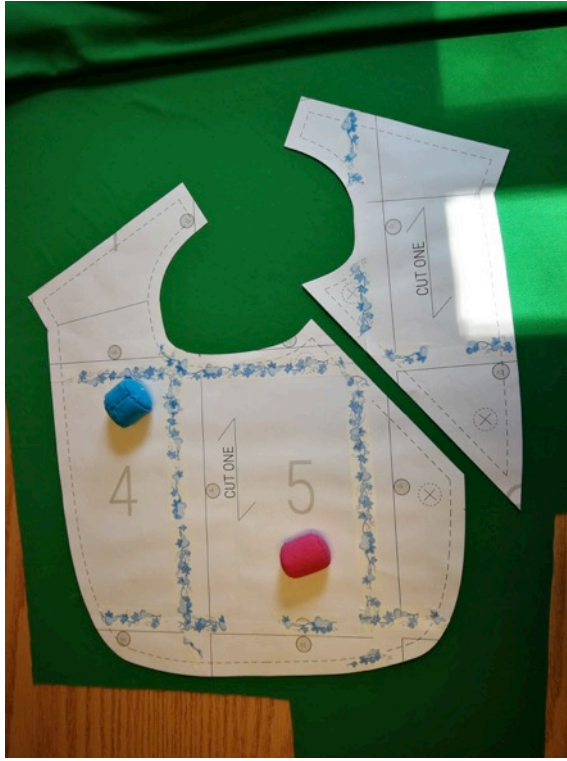
- Sewing machine
- Paper-cutting scissors
- Fabric-cutting scissors
- Thread snip scissors
- Threads
- Snap buttons (sizes of 8 mm/ 0.31 inch or 10 mm/ 0.39 inch)
- Tailors chalk
- Hand sewing needles
- Sewing clip (*optional)

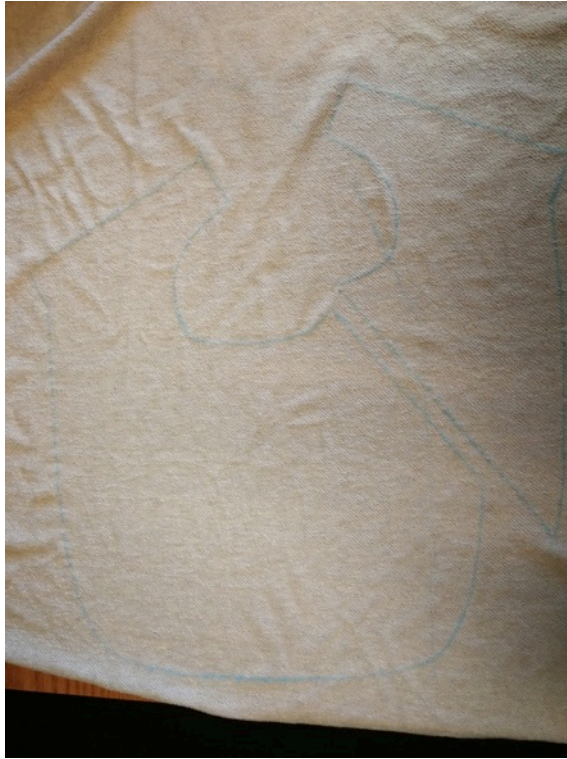
Procedure

15. Cut out “Main Piece” patterns and join pieces with tape.

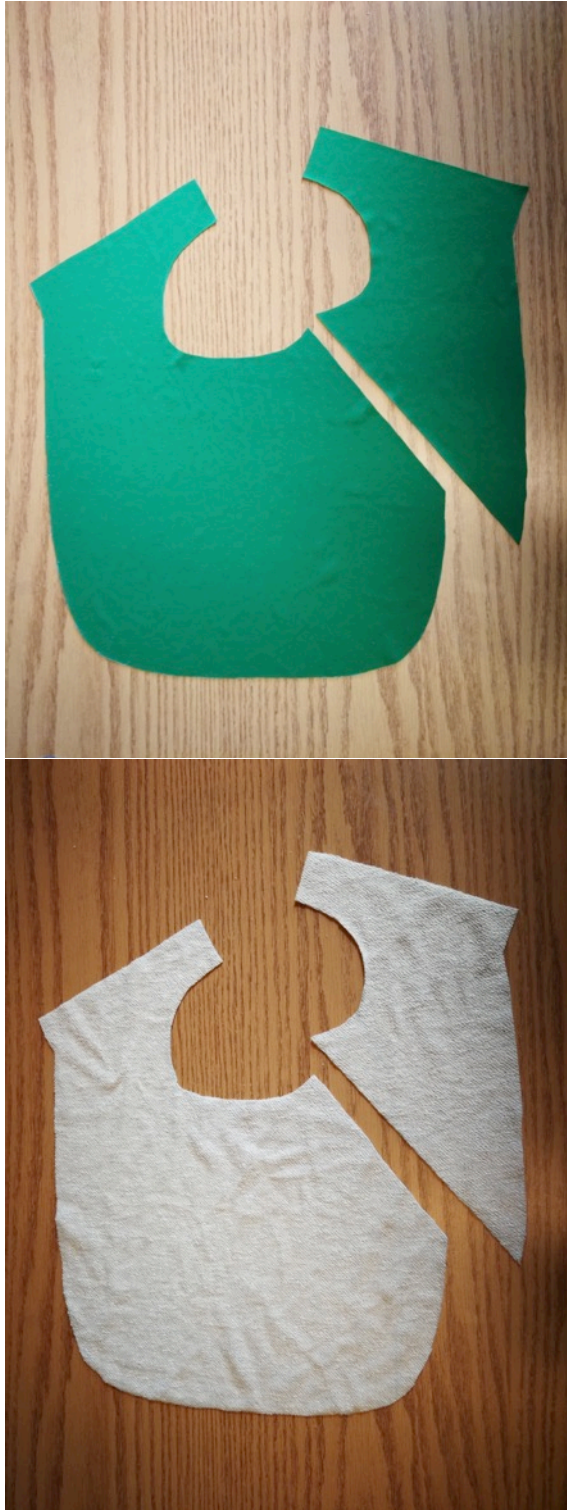


16. Trace pattern onto fabric (wicking, water absorbent)





17. Cut out the pieces for each fabric (wicking, water absorbent).



18. Put the backside of the pattern on the waterproof fabric and trace the pattern on

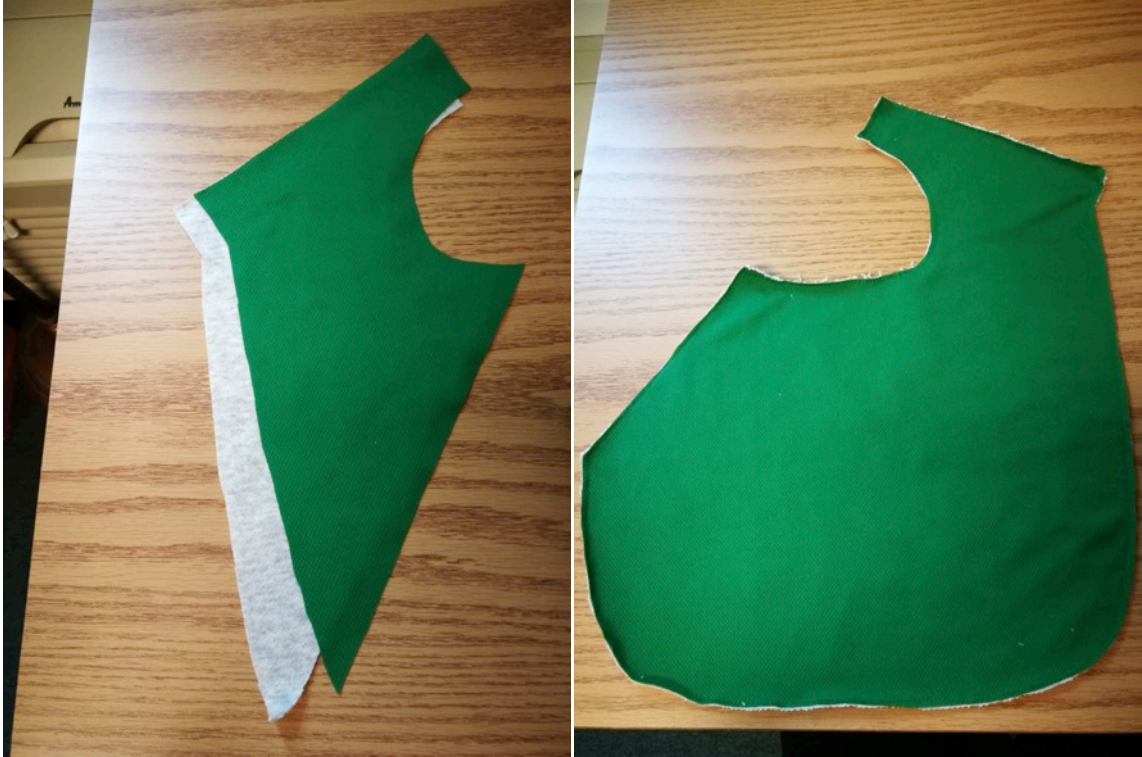
the fabric. We reversed the pattern since we want to use the right side of the waterproof fabric.



19. Cut out the pieces (waterproof)



20. With the front side facing up, place the wicking fabric on the front part of the water absorbent fabric. You could use clips to clip them together, but not have to.



21. Using a 5.0 stitch length, baste the two fabrics 1/4" from edge to secure two layers of fabric together. The stitch length is just a recommendation. Also what needle you would does not matter as well.

What is a basting stitch:

<https://www.youtube.com/watch?v=QKwOlpXwwk>



22. Place the right side of two pieces together with the short edge matching. Stitch

the short edge using 1/2" seam allowance.



23. Do the same step with waterproof fabric



24. Place the right side of the waterproof fabric on the top side of the wicking fabric matching the seam on both. Because you will need to invert the scarf, leave the top edge open in the seam. Stitch around the remainder of the edge using 1/2" seam allowance.



25. Cut a few notches along the upper edge. Be careful not to clip your stitches.
Notches were cut so that when you flip the inside out, the stitches could be kept flat.



26. Reduce bulk by clipping the corners of the fabrics. Be careful not to clip your

stitches.



27. Through the opening, pull the fabric to invert it so that it is right side out. After inverting the scarf, hand sew the opening with a slip stitch.

How to slip stitch:

https://www.youtube.com/watch?time_continue=81&v=WbE5hXt27uU&feature=emb_logo



28. Based on the pattern, mark the placement of the snaps and hand sew to attach those. (Snap button sizes of 8 mm/ 0.31 inch or 10 mm/ 0.39 inch can work well)

How to sew a snap button:

<https://www.youtube.com/watch?v=W0NMPTS6YGo>



Final





Appendix F

IRB/HUMAN SUBJECTS APPROVAL



Institutional Review Board
210H Hulihan Hall
Newark, DE 19716
Phone: 302-831-2137
Fax: 302-831-2828

DATE: September 19, 2019

TO: Michele Lobo, PT, PhD
FROM: University of Delaware IRB

STUDY TITLE: [906767-4] Interviewing Individuals with Motor or Sensory Impairment About Challenges with Daily Activities

SUBMISSION TYPE: Continuing Review/Progress Report

ACTION: APPROVED

APPROVAL DATE: September 19, 2019

EXPIRATION DATE: September 25, 2020

REVIEW TYPE: Expedited Review

REVIEW CATEGORY: Expedited review category # (6,7)

Thank you for your Continuing Review/Progress Report submission to the University of Delaware Institutional Review Board (UD IRB). The UD IRB has reviewed and APPROVED the proposed research and submitted documents via Expedited Review in compliance with the pertinent federal regulations.

As the Principal Investigator for this study, you are responsible for and agree that:

- All research must be conducted in accordance with the protocol and all other study forms as approved in this submission. Any revisions to the approved study procedures or documents must be reviewed and approved by the IRB prior to their implementation. Please use the UD amendment form to request the review of any changes to approved study procedures or documents.
- Informed consent is a process that must allow prospective participants sufficient opportunity to discuss and consider whether to participate. IRB-approved and stamped consent documents must be used when enrolling participants and a written copy shall be given to the person signing the informed consent form.
- Unanticipated problems, serious adverse events involving risk to participants, and all non-compliance issues must be reported to this office in a timely fashion according with the UD requirements for reportable events. All sponsor reporting requirements must also be followed.

Oversight of this study by the UD IRB REQUIRES the submission of a CONTINUING REVIEW seeking the renewal of this IRB approval, which will expire on September 25, 2020. A continuing review/progress report form and up-to-date copies of the protocol form and all other approved study materials must be submitted to the UD IRB at least 45 days prior to the expiration date to allow for the required IRB review of that report.

If you have any questions, please contact the UD IRB Office at (302) 831-2137 or via email at hsrb-research@udel.edu. Please include the study title and reference number in all correspondence with this office.



Institutional Review Board
210H Hulihan Hall
Newark, DE 19716
Phone: 302-831-2137
Fax: 302-831-2828

DATE: February 10, 2020

TO: Michele Lobo, PT, PhD
FROM: University of Delaware IRB

STUDY TITLE: [704060-8] Clothing Design for Individuals with Adaptive Clothing Needs
SUBMISSION TYPE: Continuing Review/Progress Report

ACTION: APPROVED
APPROVAL DATE: February 10, 2020
EXPIRATION DATE: February 22, 2021
REVIEW TYPE: Expedited Review
REVIEW CATEGORY: Expedited review category # (4,7)

Thank you for your Continuing Review/Progress Report submission to the University of Delaware Institutional Review Board (UD IRB). The UD IRB has reviewed and APPROVED the proposed research and submitted documents via Expedited Review in compliance with the pertinent federal regulations.

As the Principal Investigator for this study, you are responsible for and agree that:

- All research must be conducted in accordance with the protocol and all other study forms as approved in this submission. Any revisions to the approved study procedures or documents must be reviewed and approved by the IRB prior to their implementation. Please use the UD amendment form to request the review of any changes to approved study procedures or documents.
- Informed consent is a process that must allow prospective participants sufficient opportunity to discuss and consider whether to participate. IRB-approved and stamped consent documents must be used when enrolling participants and a written copy shall be given to the person signing the informed consent form.
- Unanticipated problems, serious adverse events involving risk to participants, and all non-compliance issues must be reported to this office in a timely fashion according with the UD requirements for reportable events. All sponsor reporting requirements must also be followed.

Oversight of this study by the UD IRB REQUIRES the submission of a CONTINUING REVIEW seeking the renewal of this IRB approval, which will expire on February 22, 2021. A continuing review/progress report form and up-to-date copies of the protocol form and all other approved study materials must be submitted to the UD IRB at least 45 days prior to the expiration date to allow for the required IRB review of that report.

If you have any questions, please contact the UD IRB Office at (302) 831-2137 or via email at hsrb-research@udel.edu. Please include the study title and reference number in all correspondence with this office.



Institutional Review Board
210H HULLIHEN HALL
NEWARK, DE 19716
PHONE: 302-831-2137
FAX: 302-831-2828

DATE: April 29, 2020
TO: Michele Lobo
FROM: University of Delaware IRB
STUDY TITLE: [1590600-1] The Design of Saliva Wicking Scarves for Individuals with Oral-Motor Impairments
SUBMISSION TYPE: New Project
ACTION: DETERMINATION OF EXEMPT STATUS
EFFECTIVE DATE: April 29, 2020
REVIEW CATEGORY: Exemption category # (2)

Thank you for your New Project submission to the University of Delaware Institutional Review Board (UD IRB). According to the pertinent regulations, the UD IRB has determined this project is EXEMPT from most federal policy requirements for the protection of human subjects. The privacy of subjects and the confidentiality of participants must be safeguarded as prescribed in the reviewed protocol form.

This exempt determination is valid for the research study as described by the documents in this submission. Proposed revisions to previously approved procedures and documents that may affect this exempt determination must be reviewed and approved by this office prior to initiation. The UD amendment form must be used to request the review of changes that may substantially change the study design or data collected.

Unanticipated problems and serious adverse events involving risk to participants must be reported to this office in a timely fashion according with the UD requirements for reportable events.

A copy of this correspondence will be kept on file by our office. If you have any questions, please contact the UD IRB Office at (302) 831-2137 or via email at hsrb-research@udel.edu. Please include the study title and reference number in all correspondence with this office.

*In-person research interaction with subjects cannot begin until the UD moratorium in response to the declaration of national emergency related to the COVID-19 pandemic is lifted. Please continue to reference <https://research.udel.edu/coronavirus> for the most up-to-date recommendations.

INSTITUTIONAL REVIEW BOARD

www.udel.edu