



## Size Adaptive Garments for Toddlers as an Approach to Maximize Fit and Durability

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This project aims to explore techniques for creating size adaptable clothing for toddlers that can grow along with the child's growth, and can be used over multiple ages. Devising such a system is based on analysis of three major sources; first the extensive number of sizes of the children apparel on the market, second the various sizing charts used by infant wear manufacturers, and third the diverse growth scales for children. Devising a system to tackle the sizing issue in children's apparel can bring a worthwhile and positive change to consumer's shopping experiences, especially as parents face challenges in finding garments compatible with their children's proportions and are adaptable to fit various body shapes. This study aims to determine the need for an adaptive garment for children through surveys of parents, and solicit their feedback in a redesign of children's apparel. The design-based research aims to focus on the United States children's wear size and anthropometric data to generate children's body adaptable garments to fit their diverse and particular shapes. Adaptive garments in this study were created for toddlers, age range from 12 to 24 months.

To guarantee that clothing is comfortable and fits children properly, their body variations need to be studied. In addition, growth is rapid in children and sizes vary widely as compared to the adult anthropometric data (Zakaria, 2016). When targeting children, body measurements and anthropometry can be challenging. Specifically, infants throughout the two first years of their life manifest a changeable rate of growth and often unpredictable proportions. According to the WHO Child Growth Standards (assessment tool for monitoring child growth) these sizes are variable from one child to another even when we consider the same generation of the same country (de Onis et al., 2012). The major factors that affect the diversity of children's growth patterns are related to adequacy of infant's feeding, geographic region, and urban versus rural location. Few children's apparel companies implement strategies to address the rapid growth of babies to create garments that can be used over longer periods, although a few researchers are attempting to address extended use and different adjustable systems. Mebby created a bodysuit from a new generation high-tech fabric that grows with infants in early stages of life (Mebby, 2017). A study of United States patents demonstrates that designers have continually looked for methods to incorporate adjustability into garments. For example, Beatrice F. Kramer (1955) patented a girl's dress made adjustable through a series of buttoned pleats (U.S. Patent 2,714,718). These approaches all involve using either an elastic-type material or a complicated adjustment system. These approaches have not seen wide use in the ready-to-wear market.

This study is based on two reinforcement theories: Adaptive Customization Theory and Universal Design Theory. *Adaptive customizers* change neither the product nor the representation of the product for individual customers; instead, they provide the customer with the ability to change both the product's functionality and its representation to meet his or her particular needs (Gilmore and Pine II, 1997). This approach matches well with the unique needs of children's

proportion diversities by offering clothing that could change based on each body shape in vertical and horizontal directions by directly applying a transformable grading system on each garment. Similarly, the Universal Design theory, promises the flexibility in use and improvement in product experience embedded within the design and development process for improved user involvement resulting in enhanced designed products, systems, and services (Tremblay, VanderMeer, Rothenberger, Gupta, and Yoon, 2014).

The primary goals of this study were to explore parental need for an adaptive garment for their children, explore parental views on the concept of adaptive garments, and determine whether these motivations or views are tied to ideas of sustainable consumption attitudes or behaviors and/or a better shopping experience. The final goal was to create prototype garments for testing. Therefore, survey questions were organized in order to cover two main concepts: (1) to explore the attitude towards the concept of size adaptive garments, and (2) to explore the opinions about the functionality of garments and the facility of the openings in garments such as pants, overalls, and T-shirts. This was a mixed method study that included both quantitative and qualitative methodology.

After obtaining IRB authorization, the research took place in a Child Development Laboratory due to the feasibility of a snowball case recruitment. A total of 25 parents answered demographic, technical, and motivational questions presented in an online questionnaire available through the Qualtrics online system to facilitate the process. According to results from 25 participants, only 30% purchased exactly the same size/age garment for their child, as it is sold in the market. The rest stated that they purchase one size/age larger, one Size/age smaller, or two or more size/age larger to best fit their children's body structure. In addition, only 20% of participants stated that their infant fits the size/age garments presented in the market, and they pick one size larger in order to use it for a longer time. The majority of participants (80%) stated that they would like to extend the life of their child's garment due to economic concerns, sustainability and/or better fit. Additionally, 84% also stated that if adjustable clothing for multiple sizes were available on the market, they would buy it even if it cost more than regular garments. Questions were also asked about preferred placement of openings and other needs for easy access and dressing of a child. Based on both parent opinions and on safety regulations for children's apparel production, a series of size adaptive garments for toddlers from 12 to 24 months was designed and prototyped. Size adaptability focused on vertical growth for ages/size 12, 18 and 24 months, but allowed enough ease to fit 3 sizes. Adjustment techniques implemented in these garments were explored to make sure the process of adjusting was an easy experience for parents. As a validation method, this study applied member checks and a participant feedback process. Future research will extend the range of prototypes based on feedback from focus groups of parents.

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