Simultaneous Use Dyad Design Model for User-Centered Design: A case study of kangaroo care garments developed for use in NICU environments

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Keywords: user-centered design, user dyad, design framework, clothing taskscape

Introduction and Literature Review: The design process is defined by specified steps that may be linear, cyclical, or even tangential. Designing a product is a complex problem-solving process in which the designer must consider the multiplicities of interactions between the user(s), the environment, the task, and the product. This results in an amalgamation of variables that best address the needs of the user(s). In a user-centered design process, the needs of the product user become a central focus, and often the user is a contributor and co-creator of knowledge during the design process. A user-centered design (UCD) approach aims to improve the quality of life for users by creating products that meet the users' needs (Cortes-Chavez, Rossa-Sierra, and Gonzalez-Munoz, 2021). UCD focuses on the needs, desires, and limitations of the users of products at each stage of the design process (Sanders, 2002). User-centered design has been conducted in various fields, including computer science, engineering, medicine, and textiles and apparel. These fields have primarily focused on designing products for one user at a time. However, there are circumstances in which a pair or dyad is defined as the main user. User dyads have been addressed in the field of medicine as caregiver-patient, where caregivers can be medical providers or even parents. In these dyads, the user roles are primary users and support users suggesting that the product is used by one individual at a time with the support of another. However, yet to be explored within the context of user-centered design, is the simultaneous use dyad (SUD). Meaning, circumstances in which two users are simultaneously using a product, and both are defined as the primary user. We have conducted a case study that examines the SUD of mother and infant through the exploration of creating a kangaroo care garment to be utilized by the dyad (mother-infant) in the NICU (neonatal intensive care unit).

Utilizing clothing taskscape (CT) theory as a guiding framework to conduct a needs assessment to help define design criteria (Tullio-Pow & Strickfaden, 2022), we applied this approach to better understand the utilization of kangaroo care garments. During this process, we examined the user-centered design process and discovered differences in processes when designing for the SUD. It is our goal to share the differences in the design process that we encountered so that other researchers will be better equipped when designing for SUDs. Therefore, we put forth the SUD user-centered design model which we consider a major outcome of our case study.

Method: In a case study, we explored the development of a kangaroo care (skin-to-skin contact) garment designed for mother-infant dyads. Through this process, we explore the inclusion of a user needs hierarchy and ways in which a design can negotiate the priorities of SUDs within one design. We propose a model which has been adapted from the user-centered design process models laid out by Koberg and Bagnall (1981) and depicted by Watkins and Dunne (2015).

The UCD framework has five stages: (1) *Research*: identify the context of use by examining the people who use the product and what they use it for, (2) *Definition*: determine the user goals, (3) *Idea Generation*: create design solutions based on the knowledge and experience of the users, (4) *Design Development*: determine design feasibility through user testing, and (5) *Evaluation*: assess the satisfaction of user needs and requirements (Koberg & Bagnall, 1981; Watkins & Dunne, 2015).

Results: We created this model (figure 1.) based on the design process outlined by Watkins and Dunne (2015) for user-centered design. The basic steps of the design process remain the same, however, we offer a more detailed model based on the unique experience of design for SUDs. The research phase of the design process is where the greatest difference in the process for a single user compared to a SUD occurs. Taskscape theory helps to guide our approach and explicate addressing multiple users' needs, which is why we have placed this theory centrally in our model. For each specific environment and task, the context of use affects how a SUD will interact with the product. Additionally, each SUD is three unique users: each individual user and the dyad. Therefore, during the user research stage, we are assessing the needs of 3 unique users.

After researching the needs of each user within the context of environment and task, a hierarchy of needs is created. We propose that a researcher creates a total of 3 needs hierarchies for the SUD so that the needs of each user, including the dyad, are considered. The following stage then is a comparison of user hierarchies to assess the agreements and conflicts amongst the 3 unique user groups. For example, in the case study we conducted, an agreement of needs would be the need for skin-to-skin time. Conversely, a conflict would be each user's need for temperature regulation such that an infant needs to be kept warm, between 97.7°F – 99.4°F (36.5°C – 37.4°C) axillary temperature, during kangaroo care and a mother wants to stay cool to avoid sweating. Based on the assessment of agreement and conflict, we suggest that the researcher determine the needs priorities, this can be created using a simple ranking system or by conducting a pairwise comparison analysis. While determining the needs priorities it is important to gather feedback from the users. Additionally, researchers must identify non-negotiable needs, for example in our case study, needs that address the health and safety of the user were nonnegotiable, such as the ability for the baby's heart rate and oxygen to be monitored appropriately and accurately. Nonnegotiable needs are those which if they are not met would make the product not feasible or unsuccessful. Furthermore, while determining the needs priorities the research must keep in mind the social, psychological, emotional, and behavioral needs of the users. As well as the power, expression, and knowledge of the users. For example, the researcher cannot overlook the needs of an infant who cannot express their needs in the same manner the mother is capable. Once the needs have been prioritized and aggregated, the researcher can use this data to define the design variables and create a framework for establishing the connection between the design requirements and the users.

While we mostly suggest a difference in process during the research phase, this data gathered, and information gained will be carried forward in the design process. We additionally suggest that researchers should go back to the determined needs and ultimately the users when assessing ideas, creating designs, and completing the evaluation. It is important to note, that during the design

development phase, conflict resolution in the design must occur by returning to make sure the nonnegotiable needs and needs priorities are not violated.

Implications and Significance: The proposed model will be beneficial for researchers who utilize a user-centered design approach within the context of a simultaneous use dyad. Additionally, the model will be helpful for designers who do not know how to integrate and evaluate the need of users within a design. Incorporating taskscape theory as a guiding framework also helps establish the use of this theory within the textile and apparel field. Within the area of design scholarship, it is important to build and disseminate theoretical models which help to delineate the design process.

Figure 1. Simultaneous Use Dyad Design Model
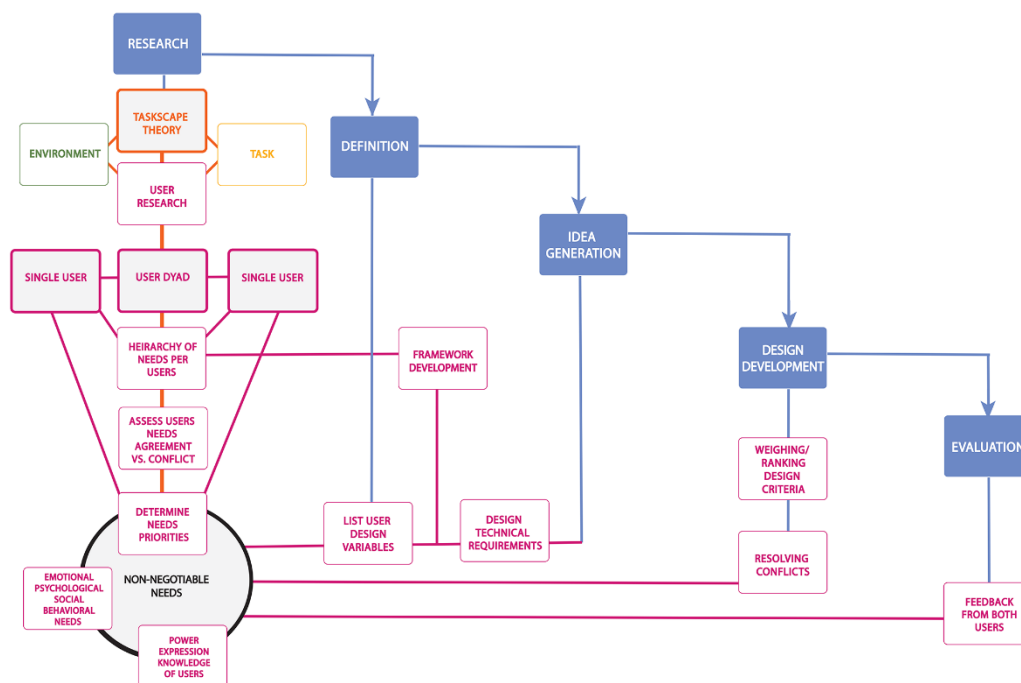
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