TEKNOBUGA Vol. 14 No.1 (2026)

p-ISSN 2085 4056
e-ISSN 2528 7087

JURNAL TEKNOLOGI BUSANA DAN BOGA

https://journal.unnes.ac.id/journals/teknobuga/index

The Transformation Wardrobe: Integrating Indonesian Batik and Modular Design for Sustainable Stage Wear

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ABSTRACT - The global fashion industry is facing increasing environmental challenges due to rapid consumption patterns and the short lifespan of garments. This condition highlighted the urgent need for more sustainable design approaches. This study developed a transformable garment themed *"Ratri Sagara"* by adapting the visual elements of *Batik Kencana Padjajaran*, interpreted through the imagery of nocturnal ocean waves. The primary objective of the research was to create a garment design capable of presenting two distinct appearances through a simple transformation mechanism without excessive additional modules, thereby extending the product's lifespan. The study employed a Research and Development (R&D) method based on the ADDIE model, encompassing the stages of analysis, design, development, implementation, and evaluation. The design process involved pattern-making and draping techniques, while feasibility evaluation was conducted by an expert panel using an assessment instrument consisting of six main indicators. The evaluation results showed an average score of 93%, placing the garment in the "Highly Feasible" category. The highest scores were achieved in the indicators of transformation performance and garment uniqueness, confirming the effectiveness of the transformation system and the innovative value offered. This research demonstrated that a transformable design approach can serve as an effective strategy for creating garments that are aesthetic, functional, and responsive to sustainability issues. The findings open opportunities for further development of transformation systems in contemporary fashion design, both for stage performance purposes and broader applications in everyday wear.

Keywords: Transformable garment, sustainable fashion, *Batik Kencana Padjajaran*.

INTRODUCTION

In recent decades, the global fashion industry has exhibited increasingly intensive patterns of production and consumption, largely driven by the fast fashion model that accelerates trend cycles. Numerous academic studies indicate that this model significantly contributes to the growth of textile waste, as most garments are produced for short-term use and discarded before reaching their full potential lifespan (Bick et al., 2018). Low textile recycling rates further exacerbate this problem, allowing fashion waste to accumulate continuously within environmental systems. Moreover, garment production requires substantial amounts of resources, particularly water and energy, positioning the fashion industry among the sectors with the highest environmental burdens globally (Niinimäki et al., 2020). These conditions underscore that sustainability depends not only on material choices but also on design strategies that extend product lifespans, as highlighted in reviews of circular economy applications within the fashion industry (Abdelmeguid et al., 2022).

Growing awareness of environmental impacts has encouraged a paradigm shift from a linear to a circular model. Research demonstrated that extending garment lifespans through repeated use or transfer of ownership can significantly reduce carbon footprints and resource consumption compared to the continuous purchase of new clothing (Abagnato et al., 2024; Sawant et al., 2024). In this context, design approaches that emphasize flexibility, durability, and ease of maintenance played a crucial role in advancing circular fashion practices.

Transformable design has emerged as an innovative solution, enabling a single garment to serve multiple functions and appearances, thereby reducing the need for additional purchases. However, much of the existing literature focused on detachable modules or added components, which tend to increase production complexity and compromise user comfort (Alvic, 2010).

Addressing this gap, the present study introduced a simplified transformable garment, *Ratri Sagara*, which offered two distinct configurations through hem manipulation alone, without the use of additional modules. When the lower part is folded, it creates a shorter silhouette suitable for casual or semi-formal occasions, while leaving it extended produces a longer, more elegant look appropriate for formal events. This approach was expected to align with contemporary consumer needs for stylistic flexibility, efficient use, and more environmentally responsible fashion consumption (Hosa & Katiah, 2025). This study aimed to design, produce, and evaluate the *Ratri Sagara* garment to assess the feasibility of a simple transformation mechanism in real-use contexts, while also contributing to the body of literature on sustainable fashion design.

METHOD

This study employed the Research and Development (R&D) method, focused on product development and the validation of its effectiveness or feasibility through systematic evaluation procedures (Rayanto, 2020). The R&D method was selected because the study centered on the creation and quality assessment of the transformable stage gown *Ratri Sagara*, which represented the concept of *Meta Nusantara* through the integration of local cultural aesthetic elements, nocturnal marine visuals, modular construction techniques, and garment functionality.

The development model adopted in this study was the ADDIE model, which consisted of five stages: Analysis, Design, Development, Implementation, and Evaluation. Each stage contributed to producing outcomes that meet the predefined feasibility and development criteria (Cahyadi, 2019), as illustrated in Fig 1.

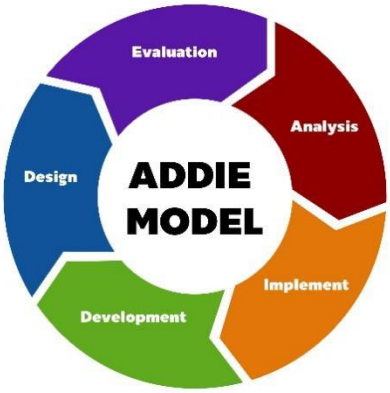

FIGURE 1. Chart ADDIE model.

The application of the R&D method is appropriate for the context of this study, as it supports a creative and technical process that is systematically organized and academically accountable. This study employed data analysis techniques applied to the feasibility assessment of the *Ratri Sagara* gown, conducted by a panel of experts consisting of lecturers and fashion observers. Product evaluation was carried out through a series of trials to ensure overall product quality. The R&D approach implemented in this study represented an adaptation of a development process comprising the following stages: (1) Analysis, (2) Design Planning, (3) Product Development, (4) Feasibility Testing, and (5) Evaluation.

The analysis stage involved data collection and a review of previous studies related to transformable fashion trends, as well as the conceptualization of the theme *"Wave in Motion."* This stage included a literature review on modular design (Ivana, 2024), exploration of visual references depicting nocturnal ocean waves, and an analysis of the *Batik Kencana Padjajaran* motif to establish a strong conceptual foundation. This preliminary study served as the basis for determining the visual characteristics and transformation mechanisms embodied in the *Ratri Sagara* gown.

The design stage comprised the development of a mood board, the creation of initial appearance sketches (mini dress) and transformed appearance sketches (A-line silhouette), and material selection. This stage involved the application of design principles through the combination of bridal satin, tulle, and batik fabrics to articulate elegance,

the dynamic movement of waves, and the strength of feminine character that collectively define the *Ratri Sagara* concept, in alignment with modern fashion aesthetics that emphasize visual storytelling (Putri & Fatrina, 2025).

The product development stage represented the process of translating the design into a tangible garment. This stage included pattern making using the flat pattern system (J. H. Meyneke), draping techniques for ruffles, garment assembly, and the application of modular (detachable) connection systems such as snap buttons or concealed hooks. Construction quality was assessed based on the accuracy of sewing techniques, the neatness of finishing, and the structural stability of the garment during transformation, ensuring that the garment meets standards of comfort and functional feasibility.

Product feasibility testing was conducted through expert judgment by fashion design specialists. The evaluation utilized an assessment instrument consisting of the following indicators: Design, Fit, Aesthetics, Sewing Techniques, Fashion Performance, and Garment Uniqueness. The evaluation results were analyzed to determine the product's level of feasibility and to provide recommendations for improvement when necessary. The formula used to calculate the percentage score for each panelist is presented in Equation (1).

$$N = \frac{score\ obtained}{maximum\ score}\ x\ 100\% \qquad (1)$$

The resulting percentage values were then transformed into a table to facilitate the interpretation of the research findings. The criteria for feasibility percentages were determined using the following procedure:

1. Determining the ideal score percentage (maximum score): 100%
2. Determining the lowest score percentage (minimum score): 25%
3. Calculating the score range (100% - 25% = 75%)
4. Defining the desired classification intervals (Highly Feasible, Feasible, Fairly Feasible, Not Feasible)
5. Determine the width interval based on the score 75% : 4 = 18,75%

This calculation was used to establish the percentage ranges and corresponding feasibility criteria, as presented in Table 1.

TABLE 1. Feasibility Percentage Scale

No	Percentage (%)	Category
1	81.25 – 100	Highly Feasible
2	62.50 – 81.24	Feasible
3	43.75 – 62.49	Fairly Feasible
4	25 – 43.74	Not Feasible

Through the application of the R&D method, this study successfully produced the *Ratri Sagara* gown, which effectively represents the concept of the nocturnal sea and Nusantara culture, while meeting fashion product feasibility criteria in terms of aesthetic design aspects, transformable construction techniques, and functional performance.

RESULTS AND DISCUSSION

The application of the Research and Development (R&D) method using the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation) in the creation of the *Ratri Sagara* garment served as a crucial foundation for ensuring the quality of the final product (Ampera, 2017). The use of this model ensured that the resulting artistic work is not only aesthetically compelling but also functionally and technically validated. Through these systematic stages, the process of creating a transformable garment based on *Batik Kencana Padjajaran* can be scientifically documented, ranging from the identification of fashion waste issues to the validation of product feasibility by experts. This section presents the results obtained from each ADDIE stage, along with an interpretation of the feasibility test data.

Analysis

The analysis stage focused on two main aspects, users' functional needs and the exploration of visual concepts. Preliminary studies indicated that the fast fashion industry contributes to high volumes of textile waste due to the

relatively short lifespan of garments (Zheng, 2024). This condition is consistent with the findings of (Riesgo et al., 2024), who note that consumers increasingly prioritize functionality and seek to extend the lifespan of their clothing, with the practice of keeping garments for as long as possible being preferred over rapid disposal. Based on these considerations, a transformable fashion approach was selected as the design strategy, as modular design has proven effective in enabling multiple-use possibilities and extending product life cycles through flexible component interchangeability (Ahuja et al., 2025; Zhang et al., 2024)

The visual concept analysis centered on the *Batik Kencana Padjajaran* motif from Bogor. This motif features *ukel* and *paku* elements that philosophically symbolize growth and strength. These findings align with the study by (Bongkolu et al., 2025), which explains that traditional batik motifs embody cultural symbolism that can be reinterpreted within contemporary design. The curved forms of the motif were interpreted as representations of wave movement, while the dark color palette evokes a mysterious and elegant nocturnal atmosphere.

Design

At the design stage, the findings from the analysis process were systematically translated into visual and technical decisions. The *"Wave in Motion"* concept was realized not only through aesthetic expression but also through garment structures that support the transformation function. This stage included mood board development, design refinement, prototyping, and the selection of materials and color schemes.

Moodboard Development

The moodboard served as the visual foundation for the entire *Ratri Sagara* design process. It was composed by integrating visual references that represent the two primary sources of inspiration: nocturnal ocean waves and the *Batik Kencana Padjajaran* motif.

Elements of the night sea, such as deep blue tones, moonlight reflections, wave textures, and dark gradations—were used to establish the intended atmosphere. Meanwhile, the *Kencana Padjajaran* motif provided cultural proximity and reinforces the *Nusantara* identity. This approach aligned with the finding of Huang (Huang et al., 2023), emphasized that moodboard construction functions as a tool for establishing emotional direction while systematically mapping potential explorations of texture and color. The resulting visualization is presented in Fig 2. as an initial framework guiding all subsequent aesthetic decisions throughout the design process.

FIGURE 2. Fashion Moodboard.

Design Development

Fashion design represents an individual's ideas or concepts expressed visually through garment illustrations, achieved by applying appropriate design elements to create an appealing piece. These elements include line, shape, proportion, color, value (light and dark), and texture. Fashion design can therefore be understood as a garment plan composed through the organized application of these visual elements (Indah Febrianti & Suwasana, 2024).

The "Wave in Motion" concept was translated into design sketches by carefully considering silhouette, transformability, and artistic value. The bustier was constructed with a firm structure to emulate the form of coral formations, while layered tulle is employed to represent the gentle movement of nocturnal ocean waves. Draping techniques are particularly suited to creating organic visual effects such as wave motion and are therefore selected as the primary approach for forming ruffles and layered structures. The final design sketches are presented in Fig 3. and serve as the direct reference for the garment construction process.

FIGURE 3. Gown design "Ratri Sagara."

Material Selection

The selection of materials constitutes a fundamental aspect in supporting both the structure and narrative of the design. Bridal satin fabric was chosen as the primary structural material (inner layer) due to its high stability, which effectively supports the body's form. Meanwhile, a combination of soft tulle, hard tulle, and pleated tulle was utilized in layered composition to create a dramatic yet lightweight wave, like volume.

The lightweight and elastic characteristics of tulle significantly enhance body movement, as the material's behavior directly influences the quality of motion and garment performance. To reinforce the "Ratri Sagara" concept, Czech crystal beads and clear teardrop embellishments were applied to emulate the shimmering effect of water droplets. These materials are presented in Fig. 4, illustrating the fabric textures and their potential in shaping garment volume.

FIGURE 4. Tule plisket, soft tule.

Prototype Development

A prototype represents the initial realization of a design, created for the purposes of testing and evaluation before being advanced into a more detailed version. Prototyping constitutes a crucial stage in the fashion design process, functioning as an evaluative tool to assess form, function, and comfort of the established design and pattern so that necessary refinements can be made prior to execution in the actual materials (Indarti, 2020). The construction of the basic pattern was carried out using the flat pattern method with the J.H. Meyneke system to ensure measurement accuracy, particularly in the bustier and basic skirt sections.

To minimize production errors, the process commenced with the creation of a prototype using calico (toile) fabric. This stage is essential for evaluating fit, the placement of modular joints, and silhouette proportions before cutting the

final fabric. Draping techniques were applied directly on the mannequin to form ruffles on the outer layer of the gown, allowing the fabric to fall naturally and evoke the visual impression of ocean waves. Evaluation at the prototyping stage ensured that the transformation mechanism operates smoothly and provides comfort for the wearer. The visualization of the prototype results is presented in Fig. 5., illustrating the initial structure of the "Ratri Sagara" gown prior to production using the final materials.

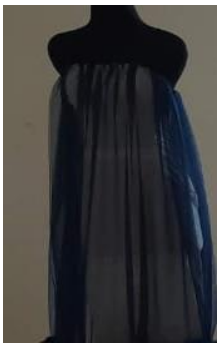

FIGURE 5. Prototype of "Ratri Sagara" gown.

Development

The development stage is the phase in which the realization of the developed product is carried out, transforming the design drawings into a tangible product (Handayani et al., 2022). At this stage, the designs formulated during the design phase are implemented through a structured and controlled production process. In this study, the development stage consisted of three main steps: pattern making and material cutting, the sewing process, and the finishing stage.

Pattern Making and Material Cutting

Garment pattern making is a critical factor in the apparel production stage, as the resulting pattern ensures that the garment fits properly and provides comfort when worn. Patterns also function as a reference to prevent errors during fabric cutting. Knowledge and technical skills in basic pattern construction are essential as a foundation for developing various types of garment patterns. To achieve the desired garment outcome, the dimensions of the basic pattern must be adjusted to the wearer's body measurements (Fatihaturahmi et al., 2023).

The initial stage of development began with the construction of the bodice pattern using the J.H. Meyneke method. This method was selected due to its ability to produce high measurement precision, particularly in bustier construction, which requires accurate body fit and structural stability. The pattern was adjusted to the model's body measurements to achieve balanced proportions between the upper and lower sections of the garment.

After the patterns were completed, the cutting of the primary materials was conducted, including batik fabric and bridal satin, as well as outer materials such as tulle and hard tulle. The cutting process was carried out with careful consideration of fabric grain direction, alignment of batik motifs, and the specific characteristics of each material. For tulle materials, which are elastic and prone to shifting, cutting was performed gradually to maintain stability of form and dimensions. This approach was supported by the study of (Kim & Bye, 2018), which emphasized that the success of modular design is highly influenced by the accuracy of pattern construction and material cutting.

Sewing Process

The sewing process began with the assembly of the main garment structure, consisting of a batik bodice combined with a short straight skirt as the base silhouette. In the bodice (bustier) section, the process was initiated by attaching interfacing (kufner) using pressing techniques to reinforce the structure and maintain the stability of the bustier when worn. Subsequently, the main batik fabric was joined with the bustier lining made of satin fabric, ensuring that the inner part of the garment remains comfortable in contact with the body.

The short straight skirt was then attached to the bodice by aligning the bustier seam lines and dart positions on the skirt. This stage was executed with precision to ensure a neat connection and to maintain balanced garment proportions.

Once the main structure was completed, the process continued with the construction of the outer A-line section by combining multiple layers of tulle. These layers consisted of shoulder sections and A-line connections, which were sewn using the French seam technique to achieve a cleaner finish and enhanced wearing comfort. To create the visual effect of ocean waves, hard tulle was gathered at a 3:1 ratio and layered twice, followed by the addition of a final layer of pleated tulle as a covering layer.

The refinement of the ruffle form as a visual representation of waves was achieved using the box pleat (lipit sungkup) technique, with a visible pleat width of 10 cm. This technique was selected to produce consistent folding rhythms and to reinforce the dynamic impression at the lower part of the gown. The attachment of ruffles to the lower section of the gown was carried out using direct draping techniques on a dress form and was hand-sewn using a backstitch method. This approach allowed for direct adjustment of ruffle placement, resulting in a more natural wave-like texture that aligns with the intended visual concept.

The ruffle installation was performed gradually, starting from the lowest tier (fourth tier), followed by the third tier, the second tier, and concluding with the installation of the first tier. The final stage of the sewing process involved the attachment of hook fasteners on the ruffle of the first tier, adjusted to the wearer's waist circumference. These fasteners function as the primary modular system, enabling the garment to undergo visual transformation in accordance with the designed concep.

Finishing

The final stage in garment construction was the finishing process. Finishing serves as the concluding step in the garment-making process, aiming to refine the overall appearance and ensure that the garment was suitable for wear (Anggun Ica Maydasari et al., 2025). This stage is crucial, as it represents the last phase before the garment is worn by the user (Kesawamurti Anggarani & Zyahratil Umami, 2021).

In the "Ratri Sagara" garment, the finishing stage included the manual attachment (hand-sewn) of crystal embellishments, final seam refinement, and inspection as well as enhancement of the modular system, such as snap buttons and hooks. The embellishments were applied using hand-sewing techniques to prevent damage to the delicate tulle fabric while ensuring an optimal shimmering effect under stage lighting. After all elements were assembled, the modular system was tested through movement simulations to confirm that the additional skirt components remain securely attached during performance while still allowing for ease of removal during the transformation process.

Implementation

Implementation is defined as a planned set of activities carried out to achieve predetermined objectives (Salabi, 2020). The implementation stage in this study was conducted through wear testing (fitting) sessions and a fashion show presentation. During the fitting sessions, the primary focus was placed on evaluating freedom of movement and the smooth operation of the transformation mechanism, as illustrated in Fig. 6.

(a) (b)

FIGURE 6. *Fitting* session (a) look before transformation and (b) look after transformation

During the fashion show at the Gelar Karya event, the garment was presented under full stage lighting. The crystal embellishments applied during the development stage were proven to effectively reflect the stage lights, creating a visual effect of "shimmering water" in accordance with the initial design concept. This implementation demonstrates that the garment is not only visually appealing in still photography but also exhibits a dramatic effect during dynamic movement, as shown in Fig. 7.

(a) (b)

FIGURE 7. Stage presentation (a) look before transformation dan (b) look after transformation

As part of the implementation stage, the garment was subsequently evaluated by an expert panel using a scaled assessment instrument. The recapitulation of the evaluation results is presented in Table 2. The "Ratri Sagara" garment achieved an average score of 93%, which falls within the "Highly Feasible" category according to the feasibility range of 81.25–100%.

TABLE 2. Recapitulation of the garment feasibility test results for "Ratri Sagara."

No	Indicator	Average Score (%)	Category
1	Design (*Design Concept*)	91%	Highly Feasible
2	Fit (*Fitting*)	92%	Highly Feasible
3	Sewing Technique (*Construction*)	93%	Highly Feasible
4	Aesthetics (*Aesthetic*)	93%	Highly Feasible
5	Garment Performance (*Transformability*)	96%	Highly Feasible
6	Uniqueness	96%	Highly Feasible
	Average	93%	Highly Feasible

The two indicators that achieved the highest scores were Transformability Performance and Garment Uniqueness. Both indicators obtained a score of 96%, underscoring the success of the transformation mechanism and its innovative value. Meanwhile, the indicators of sewing technique and aesthetics each received a score of 93%, indicating that both the technical execution and visual qualities of the garment were well appreciated by the panelists. The design indicator obtained a score of 91%, accompanied by a note that the basic pattern could still be refined to enhance freedom of movement.

In addition to providing quantitative assessments, the panelists also delivered constructive qualitative feedback to support further development. The first panelist highlighted the neatness of the stitching, particularly at the seam junctions, which was considered an aspect that could be further improved to achieve a cleaner and more precise finish. This panelist also noted that the placement of embellishments significantly influences the final appearance of the garment; therefore, the balance of embellishment composition should be carefully considered to reinforce the visual concept without appearing excessive.

The second panelist focused on the garment silhouette, especially in the hip area. Although the garment was generally deemed feasible, adjustments to the silhouette in this area were considered capable of improving freedom of movement while refining the wearer's body proportions. Furthermore, the second panelist encouraged more exploratory creative development in the design, particularly in terms of form manipulation or detailing that could strengthen the identity of the transformable garment.

Meanwhile, the third panelist emphasized the sustainability aspect by suggesting further exploration of more environmentally friendly materials. This feedback opens opportunities for future development so that the sustainability value of the garment is not only reflected in its transformable concept and extended lifespan, but also in the selection of materials with a lower environmental impact.

Overall, the evaluation results indicate that the applied development method was able to produce a garment that is not only aesthetically appealing but also functional and innovative. The transformation mechanism was assessed to operate effectively, be easy to use, and successfully present two distinct looks without compromising wearer comfort. The feedback from the expert panelists does not diminish the product's feasibility; instead, it serves as a strong foundation for subsequent design development. Accordingly, this study affirmed that a transformable design approach, when combined with thorough technical planning and awareness of sustainability aspects, holds significant potential as a design solution within the contemporary fashion industry.

Evaluation

The evaluation stage represented the final phase of the ADDIE model and aimed to assess the quality, accuracy, and feasibility of the product after completing the stages of analysis, design, development, and implementation (Syuhada et al., 2023). At this stage, the evaluation focused not only on the final visual outcome but also on the alignment between the initial concept and its technical realization, the effectiveness of the transformation function, and the potential for future product development.

The evaluation examined the extent to which the *Ratri Sagara* garment fulfills its design objectives as an aesthetic, functional, and sustainability-oriented transformable garment. The assessment involved an expert panel consisting of lecturers and fashion practitioners, ensuring that both academic perspectives and industry practices are represented. The evaluation instrument comprised six main indicators: design concept, fitting, sewing techniques, aesthetics, transformation performance, and garment uniqueness. These indicators were selected to provide a comprehensive overview of design quality, from conceptual development to technical implementation.

Overall, the evaluation results indicated that this transformable garment achieved a "Highly Feasible" category, with a cumulative average score of 93%, particularly excelling in terms of functionality and conceptual innovation.

The applied transformable design approach was shown to successfully introduce fresh ideas in the exploration of form and function, while also opening pathways toward more sustainable fashion design.

Nevertheless, several technical and aesthetic aspects require further attention. In terms of sewing techniques, improvements in stitch precision at joint areas are necessary to achieve a smoother and more professional finish. Adjustments in sequin placement are also recommended to create a more balanced visual composition without diminishing the elegance of the design. From a design perspective, bolder and more continuous exploration is needed to further strengthen the distinctive character of the *Ratri Sagara* collection.

With refinements in form, comfort, and flexibility, this transformable garment has the potential to evolve into a product that is not only innovative but also of high quality and environmentally responsible.

CONCLUSION

This study produced a transformable garment themed *Ratri Sagara*, integrating the visual elements of *Batik Kencana Padjajaran* with the character of nocturnal ocean waves. The development process was carried out using the ADDIE model, beginning with concept analysis, followed by visual design, the application of construction techniques, and feasibility testing. The evaluation results indicated that the garment achieved an average score of 93%, placing it within the highly feasible category. These findings demonstrated that the design not only possesses strong aesthetic qualities but also fulfills technical, functional, and comfort related requirements.

The highest scores were obtained in the indicators of transformation performance and garment uniqueness, confirming that the transformation concept, allowing two distinct appearances within a single garment, functions effectively and provides significant innovative value. Although minor feedback was noted regarding the flexibility of the basic design to support more optimal movement. Overall, the garment was assessed as successfully realizing its intended concept and being suitable for application in a stage performance context.

This research contributed to the advancement of sustainable fashion design, particularly through the application of a transformable design approach that can extend garment lifespan without increasing consumption volume. Future development may focus on exploring more flexible pattern systems and modular mechanisms, enabling the garment to be applied not only in stage fashion but also in broader everyday wear contexts.

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