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Applying Pattern Recognition as a Conceptual Tool to Design Positive Experiences: Report of Two Case Studies

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Abstract

This paper explores the application of pattern recognition in enhancing positive user experiences within Positive Design. To achieve this, the theoretical foundations of pattern recognition were examined, tracing its historical evolution. The investigation highlights the contributions of influential figures such as Christopher Alexander. Two case studies demonstrate the practical application of pattern recognition in design. In the first study, 20 mothers with young children were observed and interviewed to identify emotional needs and behavioral patterns related to bathing experiences. A design concept inspired by the Ice Age cartoon was developed through an iterative process to address children's emotional needs during bathing. The second study engaged 30 participants from an upper-middle-class background, focusing on family dynamics and behavioral patterns. Through storyboarding, perceptual mapping, and idea generation, a comprehensive design concept was developed to meet the identified needs. The findings suggest that pattern recognition provides a robust framework for enhancing positive user experiences in design. Additionally, the study indicates that pattern recognition can serve as an inspirational tool for design practitioners. Designers were able to effectively navigate the complexities of human-centered design, amplifying the impact of Positive Design practices.

Keywords

Pattern Recognition, Positive Design, Design for Children.

Introduction

Pattern recognition helps designers discover underlying patterns of behavior, emotion, and meaning that shape users' experiences, using them as sources of inspiration and innovation. It also aids in creating positive user experiences that enhance well-being, happiness, and personal development (Desmet & Pohlmeyer, 2013).

Pattern recognition is more than a tool for innovation; it represents a fundamental shift in perspective. It not only facilitates the analysis of large and complex datasets but also enables the discovery of latent layers of interaction between users and products or their environments. At its core lies a deceptively simple yet profound premise: meaning does not reside solely in the observer's subjective mind or the object's objective qualities; it emerges through interaction.

Moreover, pattern recognition proves especially valuable in contexts where designers must operate under budget constraints or tight deadlines, which often render comprehensive and methodologically rigorous research difficult, if not unfeasible. In such situations, pattern recognition offers a compelling alternative by legitimizing the use of small sample sizes, particularly in pilot studies. More than a methodological workaround, it serves as a generative tool that provides inspirational data, enabling design researchers to uncover meaningful insights even from limited observations. This capacity allows them not only to address pressing design challenges but also to identify latent opportunities, thus fostering a more dynamic, responsive, and contextually grounded approach to design research.

It is recommended that pattern recognition be employed after the data gathering process, serving as a critical analytical lens through which meaningful insights can emerge. Rather than relying solely on objective or subjective data categorization, which, as the authors have observed, is a common pitfall among design researchers, pattern recognition encourages a more nuanced and integrative interpretation of data. Techniques such as metaphorization and anthropomorphism exemplify how abstract patterns can be synthesized and communicated in design-relevant ways. Notably, the degree of interactivity within the dataset enhances the quality of insights that pattern recognition can yield; the more interaction-rich the data, the more useful it becomes for revealing deep structures and relationships.

To support this process, methods such as daily observation, 360-degree analysis, and reported experience are particularly valuable, as they capture the complexity of human behavior and environmental context. The most effective data gathering approaches are often rooted in ethnographic studies, further enriched by anthropological inquiry and art-inspired research methods, all of which provide fertile ground for the emergence of meaningful patterns in design research. Through this interactive process, previously unrecognized behaviors can be identified, symbolically interpreted, and ultimately externalized. This transformation of tacit patterns into explicit forms allows for a deeper understanding of systemic dynamics and supports the development of more intuitive and responsive design solutions.

Designing positive experiences and implementing Positive Design pose significant challenges for professionals and researchers due to the multifaceted nature of human-centered design. This research contributes to the field by employing pattern recognition as a foundational framework to enhance the development of positive user experiences. This is achieved by integrating interactivity concepts and associated elements. Central to this approach is recognizing three fundamental dimensions of designed artifacts: Intentionality, Directionality, and Causality, as proposed by Winograd and Flores (1986). These complex and interconnected dimensions are not easily isolated or empirically verified. In response, scenario-based design emerges as a strategic methodology for exploring diverse possibilities in the design process. By using techniques like personas and stakeholder system maps, a comprehensive understanding of user needs, motivations, and interactions can be achieved. This holistic approach helps identify distinct patterns that serve as building blocks for Design Scenarios.

Through systematically integrating these methods, designers can navigate the complexities of Positive Design, fostering the creation of impactful, meaningful user experiences. In other words, integrating pattern recognition into scenario-based design enhances designers' capacity to conceptualize and articulate potential outcomes, rather than merely focusing on causality and intentionality, key goals of a robust Positive Design approach. This paper presents two case studies that use pattern recognition as a conceptual tool for designing positive experiences.

Where the Story Began

The story of this paper began with Sohrab Vosoughi's historical trip to Tehran, where he acted as the founder of Ziba Design and as a messenger of creative communication between Iran and the USA. In his workshop, he introduced pattern recognition as a set of tools and an approach to address the complexities of the consumer market. He emphasized the importance of not falling into the traps of either stupid simplicity or hopeless complexity.

The second author recalls how the concept of pattern recognition sparked debates in design schools from TU Delft to the Polytechnic University of Milan. The first two authors have since observed how this concept could be enriched through discussions of affordance, interactivity, and semiotic studies. These observations led them to explore the potential of pattern recognition as a valuable ideation tool in various case studies and dissertations.

We believe that pattern recognition can save design from an ideological crisis. In the 1960s, socialism was a driving force for canonizing design. After the collapse of the Soviet Union in the 1990s, many designers turned to humanism as a mental sanctuary to protect humanity's values. Unfortunately, today, under the banner of post-humanism, the values, dreams, and even humans themselves are being sacrificed at the altar of technology with the guillotine of mechanical and rational thinking. We assert that pattern recognition offers designers and practitioners a valuable alternative for overcoming the crises facing humanity in design by embracing diversity, ideality, and objectivity simultaneously. This paper explores the potential of pattern recognition as a tool to address the challenges in the design field.

Problem Statement

Design problems are not just complex; they are also complicated. They are often considered ill-defined or even wicked problems (Rittel & Webber, 1973). A problem is termed *wicked* when it is poorly defined, when the client has a wrong answer in mind, or when there are more unknowns than equations to solve. Roozenburg acknowledges this by explaining that while the process of designing from form to function is well-defined, the process from function to form is not (Figure 1).

Roozenburg distinguishes between two main types of abduction: explanatory abduction and innovative abduction. Explanatory reasoning, commonly associated with abduction, contrasts with innovative abduction referred to as i*nnoduction*, which involves moving from function to form. This implies that the form of a design is not necessarily predetermined by its function, and multiple viable solutions often exist (Roozenburg, 2002). This process is typically facilitated through quick, rough prototyping. Eric Ries refers to this as creating a Minimum Viable Product (M.V.P.), emphasizing the necessity of quick prototyping and testing (Reis, 2011). This research is grounded on the premise that incorporating elements of interactivity and using interaction patterns derived from market segmentation and ethnographic data leads to improved and faster results compared to conventional prototyping methods.

In this study, pattern recognition is applied to understand and predict human behaviors and practices ranging from daily routines to consumer habits and even patterns in language and communication. The paper introduces pattern recognition in the design discourse, referencing the works of Christopher Alexander and contributions from Patrick Whitney and Sohrab Vosoughi in product design research (Breslin, 2008). It also discusses the importance of pattern recognition in opportunity framing, appropriate innovation, and generative design.

Moreover, the concept of Positive Design and the contribution of pattern recognition to implementing this approach are explored. Finally, the paper presents case studies and proposes further research opportunities, offering support to design practitioners.

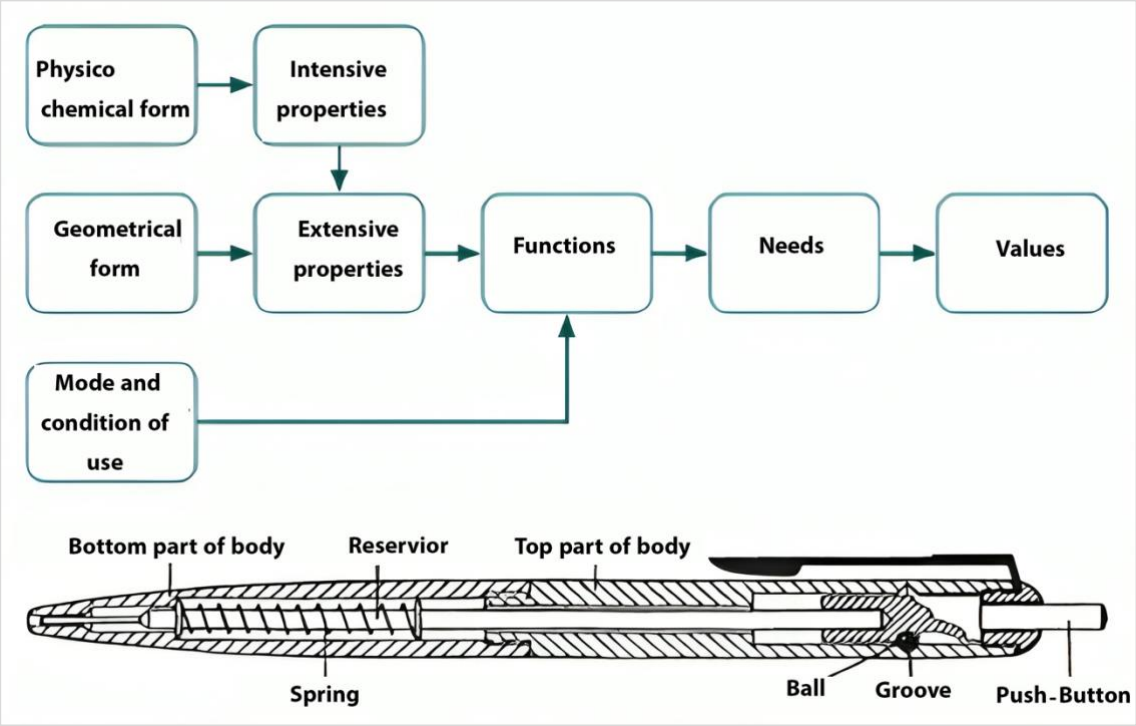

Figure 1: *Model of reasoning by designers (Roozenburg & Eekels, 1995).*

Theoretical Foundations

1. *Definition and Applications of Pattern Recognition*

Pattern recognition is essential across various fields, facilitating the identification of patterns within data. Drawing on mathematical, statistical, and psychological foundations, pioneers like Francis Galton and Karl Pearson established essential methods in regression and correlation for distinguishing patterns (Galton, 1886; Pearson, 1900). Fritz Zwicky made significant advancements in statistical methods for pattern recognition and classification, particularly in astrophysics, emphasizing multidimensional analysis for recognizing patterns in complex datasets (Zwicky, 1969). In the 20th century, researchers explored human perception of patterns, with Gestalt psychology highlighting how people group and interpret visual information (Wertheimer, 1982).

The mid-20th century saw significant advancements in pattern recognition through computers, notably with the development of neural networks. Frank Rosenblatt's Perceptron was one of the earliest neural networks capable of visual pattern recognition, laying the groundwork for future machine learning systems (Rosenblatt, 1958). Earlier, Ronald Fisher's work on discriminant analysis provided a mathematical foundation for robust classification tasks, enabling systematic analysis of complex data (Fisher, 1936). These milestones combined computational power with advanced statistical theories, marking a turning point in pattern recognition.

Christopher Alexander is renowned for integrating pattern recognition into architecture and urban planning. His concept of using patterns to create human-centered, sustainable environments influenced software development, particularly in Object-Oriented Programming (OOP). While not directly involved in OOP, Alexander's focus on patterns in design offered valuable insights into programming (Alexander et al., 1977).

His book, A Pattern Language: Towns, Buildings, Construction, lays out design principles based on recognizing and leveraging patterns that address human needs, shifting the focus from isolated design elements to understanding user habits and practices (Wu, 2012).

The evolution of pattern recognition continued with the advent of OOP, revolutionizing software development by introducing objects that encapsulate both data and behaviors, allowing programmers to conceptualize real-world entities rather than solely code (Cappellini et al., 1990; Dwivedi et al., 2019). Consequently, designers shifted focus from isolated design elements to understanding user habits and practices, or patterns (Monö et al., 1997).

Alexander's approach underscores the importance of comprehending human needs and behaviors before focusing on design elements. By applying patterns that reflect user interactions, designers can create solutions that are meaningful and user-centric (Alexander et al., 1977; Freeman & Robson, 2020). His emphasis on pattern recognition fostered a holistic, user-centered design methodology that resonates across various disciplines, inspiring designers to adopt a context-sensitive approach rooted in human needs (Alexander et al., 1977).

Alexander's contributions can be summarized into three key areas:

1. Pattern Language: He introduced the idea that recurring patterns in the built environment can lead to harmonious designs, emphasizing pattern recognition over subjective design elements (Alexander et al., 1977).

2. Patterns in Design: His influence extends to design patterns in computer science, providing reusable solutions to common problems and aiding developers in creating efficient, maintainable code (Overbeeke & Hummels, 2014).

3. Pattern Recognition: Alexander emphasized the importance of understanding habits and practices, focusing on creativity derived from pattern-based insights rather than merely categorizing users or products (Alexander et al., 1977). This perspective is particularly relevant to fields like Behavioral Economics and social innovation, where recognizing hidden demands is critical.

Patrick Whitney, a prominent design educator and researcher, has made notable contributions to design thinking and research, particularly in pattern recognition. He has developed methods and strategies that leverage pattern recognition in design decisions. Whitney emphasizes understanding and utilizing patterns to create innovative solutions, shaping how designers approach problem-solving (Kumar & Whitney, 2007).

His contributions include:

1. Design Methods: Whitney emphasizes design methods that focus on pattern recognition, helping to identify recurring user behaviors and create user-centered solutions (Whitney, 2017).

2. User-Centered Design: His work highlights the importance of understanding user behaviors to ensure designs align with user needs (Kumar & Whitney, 2003).

3. Innovation: Whitney shows how pattern recognition can fuel innovation, revealing new opportunities.

Sohrab Vossoughi advanced pattern recognition in design by integrating it with organizational policy, facilitating the translation of policies into marketable products (Breslin, 2008). This reflects Alexander's influence, linking pattern recognition in computer science to habits and practices in design.

2. *Necessity of the Pattern Recognition Concept*

The necessity of pattern recognition emerges from its role in Opportunity Framing and Appropriate Innovation. Opportunity Framing is a key aspect of design thinking, involving defining and shaping the problems or opportunities designers aim to address (Meinel et al., 2011). This process helps clarify goals, identify the right problems to solve, and ensure that solutions are effective.

Kees Dorst has highlighted the importance of framing in guiding innovation (Dorst, 2015), while Heidegger critiqued its reductionist application in technology, referring to it as Gestell, the essence of technology (Heidegger, 1977). This emphasizes the need for a creative and inspiring approach to framing in design.

Perceptual mapping (or Biaxial Mapping) is commonly used by designers to frame opportunities (Gelici-Zeko et al., 2013), with creative axes often derived through abduction and abductive reasoning (Shanahan, 2005). The key elements of Opportunity Framing include:

1. Defining the Problem: Understanding the context, stakeholders, and constraints is essential for accurately framing a design problem (Brown & Katz, 2009).

2. Identifying Stakeholders: Empathizing with users and considering different perspectives helps designers uncover deeper insights.

3. Reframing the Problem: Designers may need to explore alternative perspectives if the initial framing is too narrow.

4. Generating Solutions: A well-framed problem leads to more targeted and innovative solutions (Liedtka et al., 2013).

Opportunity Framing integrates four dynamic elements:

1. Information: Drawn from interviews, observational studies, and user data, providing the foundational context.

2. Knowledge: Involves understanding deeper user needs, attitudes, and values, which helps in uncovering complex behavioral insights.

3. Insight: Developed through competitive analysis and foresight studies, offering a strategic view of market dynamics.

4. Ideation: Synthesizes information and insights into actionable ideas through brainstorming and creative mapping.

Pattern recognition plays a pivotal role in summarizing trends and correlations, enriching the ideation process within this framework. It helps detect meaningful connections in data, facilitating innovative solution generation and guiding designers toward more effective outcomes.

Appropriate Innovation in design theory refers to creating solutions that are novel, relevant, and beneficial to users and society. This approach involves considering social, cultural, environmental, and ethical implications, ensuring that innovation adds sustainable value. Constraints such as time and budget are common in design projects, making it essential to create solutions that are both practical and impactful (Roberts, 1998). Inspired by Mahatma Gandhi's idea of appropriate technology, which promoted self-sufficiency during colonial India, the concept emphasizes creating solutions that enhance the quality of life (Hoda & de Wilde, 1975).

Appropriate Innovation can be described through four principles:

1. User-Centered Design: Focused on understanding user needs and co-creating truly relevant solutions (Norman, 2013).

2. Sustainable Design: Emphasizes minimizing environmental impact through the use of eco-friendly materials and energy-efficient designs (Chick & Micklethwaite, 2011).

3. Ethical Design: Ensures considerations like user privacy, data security, and accessibility are integrated into the design.

4. Value-Centered Design: Aims to solve real-world problems and enhance the quality of life for individuals and communities (Thackara, 2006).

The integration of pattern recognition, Opportunity Framing, and Appropriate Innovation creates a comprehensive framework for meaningful design. While Opportunity Framing ensures that design projects address the right problems, pattern recognition identifies valuable insights, and appropriate innovation ensures solutions remain sustainable and relevant.

Looking ahead, integrating pattern recognition with emerging technologies unlocks new potential. The combination of computational power and intelligent algorithms transforms data into insights, reshaping our interactions (Wendzel et al., 2021). Key concepts include:

- Design Thinking and Patterns: A human-centered approach that blends user needs, technology, and business goals. Pattern recognition enhances computational thinking in design (Barrón-Estrada et al., 2022).
- Behavioral Economy and Market Segmentation: Understanding consumer behavior through pattern recognition enables more effective market segmentation.
- Blue Ocean Strategy: This strategy identifies untapped markets, using pattern recognition to discover unmet consumer needs and growth opportunities (Kim & Mauborgne, 2014).

3. *Designing Positive Experiences and Pattern Recognition*

The evolution of Positive Experience Design and Positive Design has been shaped by the intellectual discourse between Critical Designers and Functional Designers. Anthony Dunne and Fiona Raby, in *Hertzian Tales* (Dunne, 2008), introduced Critical Design, arguing that traditional functional design often overlooks the diverse needs of society, termed Abnormality. They traced Critical Design's roots to the Italian Post-Modern movement, which challenged established norms in functional design. This academic dialogue expanded as Northern European universities emphasized functionality while Southern European institutions explored contradictions in the proliferation of functionally designed objects (Branzi, 2007).

The discourse surrounding Critical Design is not merely a dichotomy between Universal and Cultural Design or a clash between Natural Science and Humanities; it also includes a divergence between Experimental Psychology and Cultural Psychology, as influenced by Michael Cole's work (Cole, 1998). Criticism in design serves not just to deconstruct but also to foster creativity, acting as a dialectical paradigm that enriches the creative process. Ideas are interconnected with Ideals and Ideology (De Monticelli, 2022), highlighting the necessity of a holistic approach in design thinking.

Donald Norman played a pivotal role in reconciling Critical and Functional Design by introducing Positive Psychology. He noted that while society showcases abnormalities, there exists a shared aspiration towards ideals. Positive psychology aids in navigating from the ordinary to the ideal, recognizing these abnormalities while striving for aspirational goals. This aligns with Kees Overbeeke's work, which emphasizes that excellent design transcends mere scientific inquiry and incorporates ethical considerations (Ross, 2008).

Pieter Desmet recognized this paradigm shift, founding the Delft Institute of Positive Design to focus on designing for positive experiences (Desmet & Pohlmeyer, 2013; Pohlmeyer, 2013). Despite growing interest, challenges remain in exploring and delineating domains within positive design. Consequently, the strategic introduction of Pattern Recognition is crucial to enhance positive experiences by extracting and formalizing patterns from aesthetics and interactivity, significantly boosting designers' creativity.

4. *The Concepts of Abduction and Innovative Abduction*

Abduction, as defined by Roozenburg and further developed by Salvatore Zingale, is crucial to the creative design process. It involves generating new ideas or hypotheses by spotting patterns and making inferences, with innovative abduction pushing the boundaries of creativity to reveal novel solutions (Roozenburg & Eekels, 1995; Zingale, 2012).

A primary challenge in utilizing abduction is sourcing creative ideas, which requires accessing diverse stimuli to inspire new patterns. By focusing on intentionality (Burnette, 2002), directionality, and causality (Wagemans et al., 2006), designers can unlock a hidden repository of positive patterns embedded in myths, the collective unconscious, and cultural heritage. These rich sources of inspiration, narratives, symbols, and traditions—can enhance positive experiences, reflecting universal themes and values. By tapping into this reservoir, designers can create products and experiences that resonate deeply with people, evoking emotions and connections that improve user experience (Wang et al., 2013).

Integrating pattern recognition, appropriate innovation, and positive design principles forms a comprehensive framework for creating innovative, user-centered, and socially impactful solutions. Pattern recognition helps identify recurring insights, while appropriate innovation ensures that design considers social, cultural, and ethical implications, driving sustainable value. The evolution of positive experience design, informed by critical perspectives and cultural heritage, emphasizes creating emotionally engaging experiences that align with users' ideals.

Furthermore, the notion of design patterns extends beyond physical products to encompass services and systems, enriching contemporary design discourse. Establishing a clear link between pattern recognition, positive design, and abduction necessitates incorporating case studies to enhance understanding and relevance for design practitioners and students within academic discussions.

Case Studies

To explore the potential of pattern recognition in design practice, we conducted two case studies, one focused on children's bathing and the other on shoe organization. We applied pattern recognition as a conceptual tool to create positive user experiences, grounded in the habits and practices of our users in Iran. Our goal was to develop and evaluate products that enhance children's bathing experiences and improve shoe organization by analyzing users' emotional and behavioral patterns. Through this approach, we aimed to design solutions that better align with everyday routines and needs.

Study One: Designing a Meaningful, Pleasant, and Acceptable Bathing Experience for Children

Children are a unique user group with distinct needs, preferences, and emotional responses compared to adults (Khodadadeh & Alaghband Hossaini, 2018). Designing for children requires a thorough understanding of their cognitive, physical, and social development, in addition to creating products that are safe, functional, and enjoyable (Read & Bekker, 2011). Cultural and social contexts play a significant role in shaping children's experiences, making it crucial for designers to use methods and tools that can effectively address the diversity and complexity of their lives (Hourcade, 2015).

Early childhood development (ECD) encompasses various aspects of a child's well-being and is crucial for ensuring healthy cognitive, emotional, and physical development. Investing in young children, particularly those under five years old, has significant economic and social benefits (Walker et al., 2015; Nosratabadi et al., 2021). These factors influence the quality of life and expectations of children and their families, presenting new challenges and opportunities for designers.

It has been observed that while some children enjoy playing with water, others find the bathing experience challenging. Designers play a crucial role in making this experience meaningful, pleasant, and acceptable for children, a process that can be likened to acculturation or adapting to a culture. This process involves understanding the deep and tacit layers of children's cognition, which adds complexity to data gathering, synthesis, and idea generation. This study aims to explore how the design process and resulting artifacts can enhance children's bathing experience, as well as validate the use of pattern recognition.

This case study focuses on designing for children's bathing experience, which is a complex and culturally sensitive issue. Bathing is not only a hygienic activity, but also a social and educational one, which involves the interaction of children with their parents, siblings, and peers, as well as with various products and environments. Bathing can also be a source of pleasure or discomfort, depending on the physical and emotional conditions of the child and the context of the activity. Therefore, designing for children's bathing experience requires a deep understanding of the factors that influence it and a creative approach to improve it.

Research Process

In order to identify the target demographic, a preliminary study was conducted by interviewing mothers in various regions of the city. The findings revealed that children's bathing practices were not deemed significant in certain areas, indicating a lack of necessity for specialized facilities catering to them. Consequently, the target group was selected from regions predominantly inhabited by upper-middle-class families. 20 mothers and children aged two to five years were randomly chosen from nurseries, playgrounds, and shopping centers. The mothers were interviewed regarding their children's bathing routines, habits, and behavioral tendencies, particularly during the bathing experience. Due to the children's young age, they were engaged through visual aids, such as pictures, comprising cartoons, colors, lines, and shapes, to express their preferences and interests.

To depict the emotional needs of children, trend boards and mood boards were created. The trend board reflected the children's interests, toys, favorite colors, games, foods, and snacks, while the mood board captured the various emotional states exhibited during bathing. Children's behavioral patterns were primarily discerned through discussions with their mothers and observations of their play activities. Several behavioral patterns were identified, with each child typically displaying a blend of two or three patterns, one of which was more prominent. Six of these patterns were analyzed. To delve deeper into the selected behavioral patterns, a storyboard was devised to chronicle the daily routine of the chosen child using clipart. Additionally, photographs were taken at various stages of the bathing process to employ the observational 360-degree technique.

Simultaneously, products associated with children's bathing were scrutinized by exploring national and international markets through direct observation and online research. These products were categorized into groups such as toys, towels, safety items like mats and thermometers, cleansing essentials like shampoo and sponges, grooming accessories, and other bath-related items. A perceptual map was constructed based on market analysis to assess the positioning of existing products and identify market gaps. This facilitated the identification of the ideal placement for the product that required design intervention. Numerous design concepts were generated, informed by insights from interviews and market investigations. Design specifications were established, leading to the selection of the final concept, which was further refined in detail.

Results

Based on the interview results, the preferred cartoons, hobbies, and colors of the target demographic were identified. Cartoons were universally appealing to all children, with Ice Age emerging as the most popular choice for forty percent of them. Twenty percent favored Tom & Jerry, while fifteen percent enjoyed watching TV cartoons, and the remaining twenty-five percent had diverse cartoon preferences. For example, some girls expressed a preference for girlish cartoons like Cinderella and The Little Mermaid. In terms of hobbies, playing digital games was the most favored activity, followed by playing and running in the playground with friends. Regarding color preferences, children showed a preference for vibrant hues such as pink, pure red, blue, and green, with red being the most attractive color among the interviewed children.

The findings of the study indicated that all children enjoyed water and playing with it, although thirty percent expressed a dislike for the washing process. The affinity for water activities may be influenced by the tropical climate of Kish Island, where the study was conducted.

Eighty-five percent of the children used a bathtub, while the remaining fifteen percent utilized a shower cabin. Ninety-five percent engaged in play while in the bath, with only five percent using the bath solely for washing purposes. Most children expressed a desire to attempt washing themselves, and those with siblings of similar age often assisted each other.

The trend board, depicted in Figure 2, showcases bright and vivid colors based on interview responses and additional research. The identified hobbies include playing with friends, running, and painting, while preferred snacks include chocolate and cake. Popular toys among the children include cars and Lego sets, and favored cartoons encompass Ice Age, Tom and Jerry, Disney animations, and Shrek. Figure 3 illustrates the mood board, capturing the diverse emotional states of children during the bathing experience.

Figure 2: *Trend board.*

Figure 3: *Mood board.*

Among the various stages of the pattern recognition process, detecting patterns is both the most critical and the most challenging task. This process goes beyond mere identification; it requires the development of a measurable or logically coherent coordinate system into which patterns can be meaningfully situated. Tools such as perceptual mapping or biaxial mapping serve this purpose, enabling researchers to spatially organize patterns in a way that highlights their relationships and relevance. This mapping is inherently reciprocal and iterative: patterns inform the structure of the map, and in turn, the evolving structure of the map refines the understanding of the patterns. This cyclical process continues until both a reliable mapping system and a set of validated patterns emerge.

This methodology draws conceptual inspiration from tools such as the 3C analysis — a strategic framework evaluating what is feasible from the standpoint of the Client, what is viable in the Competition, and what is desirable for the Customer. When applied in design research, such an analysis can be used to examine the validity and reliability of perceptual or biaxial maps, ensuring they are not only internally coherent but also externally relevant and applicable.

Crucially, once a perceptual map is established, it functions much like a railway system — its fixed structure can guide design directions, but altering it later can be complex and disruptive. The selection of parameters for such maps is especially demanding, as these must be detected, justified, and empirically supported.

In this regard, the most relevant form of reasoning is abduction, or more precisely, creative abduction, a logic of discovery that generates plausible explanations from limited data. Unlike deduction or induction, abductive reasoning embraces ambiguity and potential, making it particularly suitable for design research where intuition, creativity, and incomplete data converge. This aspect of pattern recognition, its reliance on abductive reasoning, warrants further exploration and constitutes a fertile domain for future inquiry.

Regarding the pattern recognition, six patterns were identified for children as follows:

- **A brave kid** is a kid who tries to do everything by himself/herself.
- **A cowardly kid** is a kid who is frightened of falling or slipping in the bath, or frightened of water pouring on his/her head.
- **An easy kid** is a kid who is flexible with problems and different situations.
- **A stubborn kid** is a kid who does whatever she/he shouldn't do and doesn't do whatever is told to do.
- **A lazy kid** is a kid that doesn't help washing him/herself or doesn't tidy up.
- **A Mischievous and playful kid** is a kid that is always busy with playing games and watching cartoons and prefers not to spend time in the bathroom. She/he is also very messy.

The study identified that the behavioral patterns of *easy kid* and *brave kid* typically do not pose challenges during bathing, whereas the patterns of *coward kid* and *lazy kid* may lead to some difficulties. However, the most significant challenges were observed with the patterns of *stubborn kid* and *mischievous and playful kid*. Given the prevalence of the latter pattern among children, it was selected as the focus for this study.

The findings of the market research were categorized into five groups: toys, towels, safety features, washing products, and bath accessories. The toy category exhibited a wide range of options, including various materials, colors, shapes, characters, and purposes such as entertainment, education, and experimentation. To cater to children's preferences, graphical patterns and images of cartoon characters were incorporated into these products. Elements like shampoo containers and bath sponges were designed to resemble dolls or cartoon characters. While some products featured three-dimensional elements, most bath accessories were presented as sets with simple forms and repetitive patterns on each component (Figure 4). Consequently, there was a lack of bath accessories that integrated unified 3D cartoon character elements. Moreover, the appeal of bathroom features was primarily based on their aesthetic design rather than functional attributes.

Figure 4: *Repetitive patterns on bath accessories as an example for the current products.*

Upon further clarification, it is noteworthy to mention that a comparative analysis between behavioral patterns and the market positioning of existing bathing tools revealed that current offerings in the bathing services sector predominantly featured cartoon characters as mere decorative elements on bathing equipment, lacking originality and innovation. In contrast, an examination of behavioral patterns indicated a strong desire among children to immerse themselves in a cartoon-inspired environment or utilize patterns derived from beloved cartoon characters.

One of the concepts drew inspiration from the popular Ice Age cartoon, identified as the favored choice among the target demographic in the study. The selection of the Ice Age pattern as a guiding framework for design was grounded in three interrelated considerations. First, this pattern was positively received and appreciated by the target user group, indicating a strong level of emotional and cultural resonance. Second, the narrative structure and interaction dynamics embedded within the Ice Age pattern were found to be particularly rich and inspirational for generating design scenarios, offering a flexible and engaging platform for creative exploration. Third, in light of the tropical climate of Kish Island, the Ice Age metaphor provided a strategically contrasting yet contextually meaningful reference, enabling the development of solutions that were both symbolically compelling and functionally relevant to the environmental conditions. This concept aimed to create an immersive environment where children could feel as though they were inside the cartoon world. Each element within this set was meticulously crafted to resemble characters or components from Ice Age (Figure 5), with dimensions tailored to children's anthropometric measurements. As mentioned above, due to the tropical climate of Kish Island, where the study was conducted, the Ice Age cartoon was deemed suitable for evoking a sense of coolness, which could enhance the overall experience for children. The design of the bathtub resembles a block of ice and features a Plexiglas shield to contain the water and prevent spillage. The Plexiglas shield is adjustable to various heights and can be controlled by a parent using a foot pedal. An advantage of utilizing Plexiglas over a traditional curtain is that it allows the parent to maintain control over the child during the bathing process when the shield is raised (Figure 6). The shower faucet is designed in the likeness of Scrat, the squirrel character. Positioned out of the child's reach, the faucet is strategically placed to prevent accidental burns from hot water. Operation of the faucet is overseen by the parent, who can also utilize a built-in thermometer for added safety measures (Figure 7).

Figure 5: *Ice Age bath.*

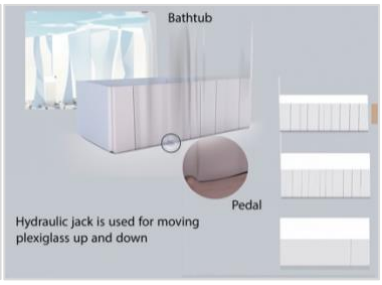

Figure 6: *Bathtub.*

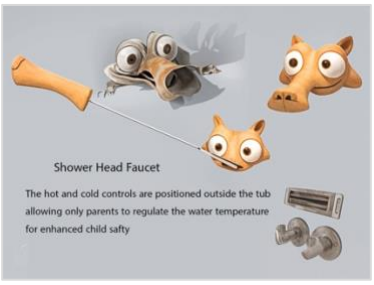

Figure 7: *Faucet.*

The drain cover is designed to resemble the top of an oak tree, inspired by the narrative of Scrat perpetually chasing after an acorn and inadvertently causing cracks in the ice. In alignment with this theme, the safety bath mat features a pattern resembling the distinctive crack in the ice (Figure 8). The toy basket is crafted in the likeness of Sid, a prominent character, with the intention of promoting tidiness among children by encouraging them to store their toys within the basket. An innovative feature of this design is the incorporation of a mechanism that conveys emotions through Sid's expressions — appearing sad when the basket is empty and happy when it is full. This interactive element operates through a simple spring mechanism (Figure 9). A laundry basket resembling dinosaur eggs was created with dual compartments to encourage children to segregate their soiled garments based on dark or light colors. Additionally, a hair dryer was innovatively designed to connect to the wall, featuring a design inspired by Peaches, the young mammoth character. The flexible snout of Peaches serves as the air outlet, providing ease of use for the hair dryer (Figure 10).

Figure 8: *Safety bath mat.*

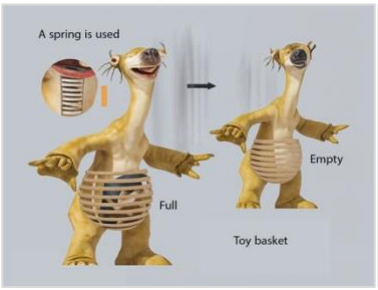

Figure 9: *Toy basket.*

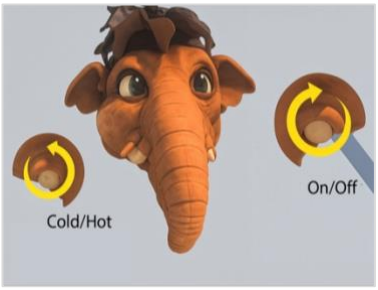

Figure 10: *Hair dryer.*

To promote water conservation habits among children, a device was developed featuring five oak-shaped lights. At the onset of the bathing process, all five oak lights are illuminated, gradually extinguishing one by one as water is used. This visual representation effectively conveys the concept that excessive water usage results in the depletion of lights/oaks, prompting the child to understand the correlation between water consumption and energy conservation (Figure 11). A towel hook was innovatively created to accommodate three towels, featuring a design concept that makes transitions from an ice-covered landscape to a green land with dinosaurs when a towel is hung. Inspired by the movie *Ice Age: Dawn of the Dinosaurs*, this design aims to encourage children to hang their towels after use. Furthermore, a special towel was crafted to match the fair skin tone of Eddie and Ellie, the father and mother mammoth characters (Figure 12). A rug and stool were intricately designed to mimic the appearance of ice floes floating on water. The stool features a textured surface made of bumpy plastics to prevent slipping when used as a step for children entering the tub. Additionally, the stool can serve as a convenient seating option for parents in the bathroom while supervising the child during playtime. Its lightweight and portable nature also allows for versatile use as a seating option for children during hair drying sessions (Figure 13).

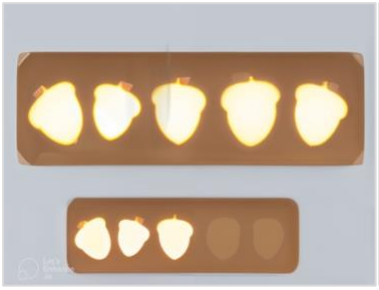

Figure 11: *Using water light.*

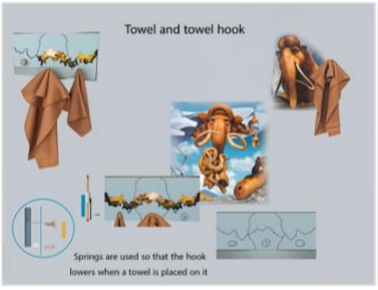

Figure 12: *Towel and towel hook.*

Figure 13: *Stool and mat.*

Study Two: Designing a Shoe Organizer to Improve User Behavior

The objective of this research was to examine the familial behaviors related to shoe storage practices. While customs vary across regions, with some cultures permitting indoor shoe-wearing and others emphasizing the removal of shoes to honor the sanctity of the home, the latter tradition has notably influenced aspects of Iranian culture, manifesting in certain families and religious ceremonies. The concept of a shoe-holder was envisioned as a transitional space between the external and internal realms of the home, facilitating a symbolic transition from the external world to the sanctuary of the home (Figure 14). Unfortunately, current observations suggest a decline in the recognition and value attributed to traditional customs, with a lack of acknowledgment of the positive cultural significance embedded in the design of modern shoe-making practices (Figure 15). The evolution of modern shoe-holders has failed to uphold the traditional values associated with shoe etiquette, such as independence, discipline, and footwear maintenance. Instead, contemporary shoe holders primarily emphasize expediency in shoe removal, often neglecting the importance of shoe care and upkeep. To assess the current landscape of shoe-holding products, a market survey was conducted.

Local market analysis revealed limited options, with Kish Wood Industry emerging as a prominent player in wooden furniture production, albeit with a sparse selection of shoe-holder offerings. In contrast, international companies like IKEA were identified as providers of high-quality shoe storage solutions.

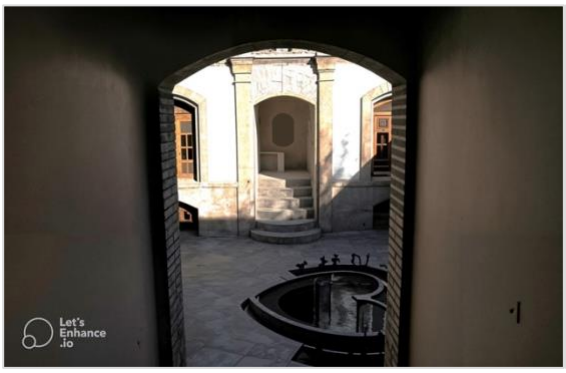

Figure 14: *Hashti, the Space between the interior and exterior of piles of traditional homes in Iran (Taken by the fourth author).*

Figure 15: *A traditional entrance of a home, shoes without maintenance (Taken by the fourth author).*

Research Process

In the pursuit of designing a device tailored to specific user needs, a comprehensive understanding of the target demographic and their behaviors was deemed essential. To achieve this objective, a study was conducted involving 36 participants randomly selected from Iranian middle-class families. Middle-class families were chosen for their perceived ability to afford such a device and the significance of a shoe holder in their daily lives. Ethnographic data revealed that lower-class families typically prioritize basic needs over organizational concerns such as shoe storage. The selected participants were observed and interviewed to gain insights into their habits, interests, and lifestyles. This information was utilized to create a trend board (Figure 16) and mood board (Figure 17), aiding in the exploration of target group behaviors and the identification of distinct behavioral patterns.

Figure 16: *Trend board.*

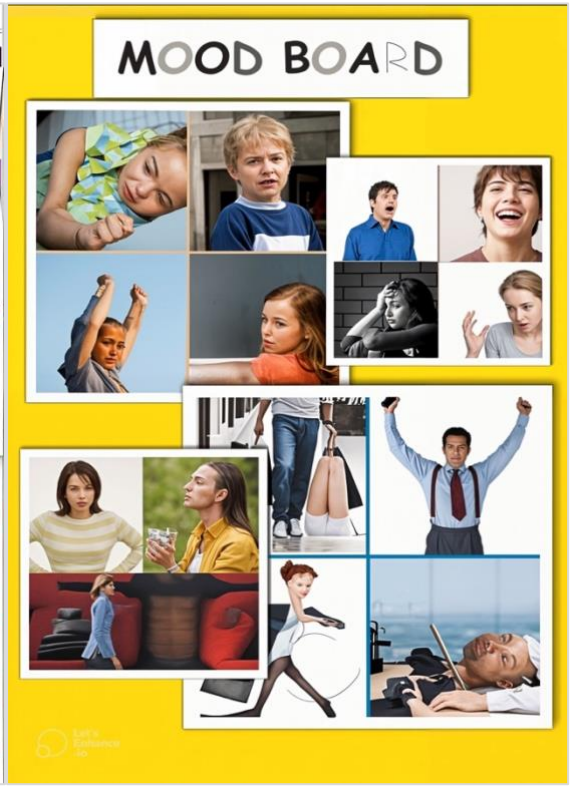

Figure 17: *Mood board.*

The relationship between the mood board and the resultant design solution is grounded in inspirational and abductive reasoning, which serves as a cognitive bridge for the designer. In this approach, visual and emotional cues such as the depiction of lazy or sleepy characteristics are not merely aesthetic choices but are interpreted as behavioral affordances. For example, such traits may imply a relaxed, unhurried interaction with products, which in turn informs design features such as ease of use, minimal effort, and soft behavioral discipline. These insights are not derived through deduction or induction but through abduction, wherein designers intuitively form hypotheses that link visual stimuli to user behavior. This mode of reasoning is particularly valuable in early design stages, where subtle emotional cues can inspire user-centered solutions that align with the intended mood and context of use.

Through observational data analysis and data sorting techniques, four primary patterns emerged, each encapsulating a unique characteristic:

- **Healthy Family Pattern** is characterized by a focus on self-care, including attention to food choices and footwear quality.
- **Messy Family Pattern** is typified by a hectic lifestyle resulting in disorganization and difficulty locating belongings, including shoes.
- **A Populated Family Pattern** marked by a large number of family members with diverse ideas, posing challenges in coordination.
- **Compact Family Pattern** comprises a few members living economically in limited space, reflecting minimalist tendencies in both possessions and living arrangements.

Among these patterns, the messy family pattern was selected as the focal target group for the study. A storyboard was developed to enhance visual comprehension of this group's characteristics (Figure 18). The 360-degree Analysis Technique was employed to capture user interactions with the product, identifying potential usage steps, as well as any associated challenges or issues. Subsequently, the research aimed to assess the market landscape and the extent to which existing products meet user needs. Perceptual maps were constructed using various factors and variables to visualize market space, highlighting areas of saturation and unmet needs (Figure 19).

Figure 18: *Storyboard designed for the target group.*

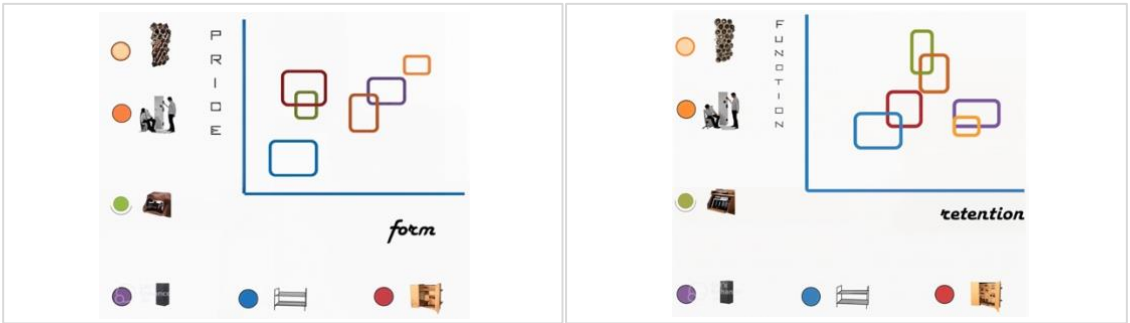

Figure 19: *Perceptual maps.*

Throughout the design process, numerous design concepts were generated, categorized, and refined. Criteria such as safety, ease of production, form acceptability, and affordability were utilized to assess and score each concept, and ultimately, one concept was selected and finalized. This design concept is rooted in the characteristics of the messy family pattern, aiming to address the challenges faced by such households in maintaining shoe organization. The key features of this design concept include:

- Individual compartments to encourage disciplined shoe storage practices.
- Allocation of specific locations for each family member's footwear.
- Incorporation of an aromatic system and semi-ventilator to eliminate shoe odors and maintain a clean environment within the shoe storage area.
- Inclusion of polishing devices within the shoe holder to promote regular shoe maintenance.
- A covered final form to ensure a visually pleasing aesthetic, suitable for both indoor and outdoor use.
- The design balances simplicity and appeal, prioritizing user-friendliness while also engaging the target user demographic with its visually attractive attributes.

The final outcome of this design process is illustrated in Figure 20 and is titled *Shoe Bar*, a metaphorical concept intended to evoke a more romantic and emotionally engaging experience of shoe storage and usage. It is worth noting that in various cultural and holistic perspectives, the foot is often regarded as the *second heart* of the human body; thus, a well-considered shoe holder can symbolically and functionally contribute to one's overall well-being. The Shoe Bar offers a healthier and more hygienic approach to shoe storage.

It is designed to allocate individual storage spaces for each family member, thereby encouraging personalized and thoughtful interactions, such as cleaning one another's shoes or leaving friendly notes. The integration of aromatic elements further enhances its emotional appeal, transforming a mundane routine into a sensory and caring gesture. Moreover, the cover helps reduce visual clutter, while the clean and minimal design improves usability, ease of maintenance, and precision in organization.

Figure 20: *Final Concept.*

Discussion

A major challenge in design is aligning strategic aims and objectives with their realization in product attributes. This gap often leads to designs that either focus on superficial aesthetics or default to basic functionality, failing to achieve true innovation. This research addresses this gap by proposing a pattern recognition-based methodology that identifies prevailing user habits and practices while fostering new, innovative attributes. This approach aims to bridge the gap between high-level design goals and tangible outcomes.

The value of pattern recognition in design research lies in its capacity to help designers generate intuitive data from observed materials, bridging the often-neglected gap between intuition and insight. Tools such as metaphorization, as well as functional and behavioral diagrams, support this translation by making abstract patterns more accessible and usable. In conventional scientific paradigms, intuitive data is frequently marginalized in favor of technically derived conclusions based on formal experimentation. In contrast, pattern recognition, especially when integrated with ethnographic approaches, restores the legitimacy of intuitive insights, thereby enriching the research process. This shift enhances the designer's role in research by allowing for a more empathic and human-centered understanding of the data.

At the heart of design thinking methodologies is the principle of empathy, the ability to *feel* the user even before subjecting their behavior to formal analysis. However, this empathic approach necessitates appropriate tools and methods. Recognizing and cultivating interactivity within observed data enables a transition from passive observation to proactivity and eventually to meta-activity, a deeper level of engagement where designers not only interpret but also anticipate and shape behavioral patterns. Thus, pattern recognition becomes more than a technique; it evolves into a generative framework, helping design researchers move beyond the production of random ideas toward the formation of structured, tangible opportunities that can be directly applied by design planners and practitioners.

One of the potential outcomes of this research narrative is the development of a theoretical framework for pattern recognition grounded in interactivity. As supported by both the conducted studies and their associated timeline, this concept, along with its corresponding methodology, has proven not only effective in fields such as marketing and design management but also academically valuable for design researchers. However, within the legacy of Bauhaus design culture, which was later translated into a prominent design ethos in the United States, particularly through institutions like the Illinois Institute of Technology (IIT) and other leading design schools a more pragmatic interpretation of such concepts and methods often took precedence over deeper scientific or theoretical formulations. While a fully articulated scientific framework for pattern recognition in design deserves dedicated exploration in a separate publication, this paper aims to offer preliminary insights that may serve as a foundation for further theoretical development.

For us, the most compelling scientific interpretation of the pattern recognition concept and its associated methodology lies in the concept of interactivity. In this framework, meaning, whether discovered or created, emerges through interaction. It is neither purely subjective nor entirely objective; rather, it arises from the dynamic interplay between the observer, the context, and the artifact. If meaning is considered to pre-exist, it may be discovered; if latent, it may be resonated in the sense of Gibson's ecological psychology; and if absent, it may be created or inspired through objectivity and iterative exploration.

Building on these ideas, pattern recognition is proposed as an overarching or umbrella concept that informs a wider set of methods, which we refer to collectively as a pattern-based methodology. This methodology encompasses various tools and approaches, including biaxial mapping, behavioral-functional diagrams, metaphorized interaction, interaction relabeling, and several other exploratory methods. Together, these form a coherent methodological framework aimed at guiding both the discovery and design of meaningful interactions.

While this paper provides only an initial introduction to these ideas, it is our hope that future research will further elaborate and formalize this framework into a comprehensive design methodology.

The first case study highlights the application of pattern recognition in the design of products for children, introducing a novel method of using characters to represent patterns. This approach transcends traditional ornamentation, focusing instead on how children interact with and embody these characters. By viewing design through the lens of *design as theater*, inspired by Brenda Laurel's Computer as Theater (Laurel, 2013), the study encourages designers to engage in creative and empathetic processes that immerse them in a dynamic, character-driven framework. This approach not only enhances creativity but also fosters a deeper connection with users, especially children, by allowing them to inhabit the characters rather than merely observing them.

The application of pattern recognition in design for children offered several key benefits. It revealed diverse user patterns, going beyond simple market segmentation to show how different user segments behave and empathize. Pattern recognition enhanced designers' creativity by using perceptual mapping to identify unexplored market opportunities and inspire new concepts. This method also deepened understanding of user interactions by visualizing behavior through characters, providing valuable design insights that extend beyond scientific data to encompass a broader understanding of the design environment. This empathy-driven approach is crucial for making emotional and user-centered design discussions more feasible. Furthermore, pattern-based narrative structures positively impacted children's acculturation. Characters like Oak and Scrat were used to teach sustainable behaviors and cultural values, demonstrating the design's ability to foster learning and cultural awareness. This approach, grounded in historical traditions like Gulliver's Travels and Pinocchio, highlights design's role in advancing educational and cultural goals.

While the first study focused on generating innovative ideas, the second aimed at enhancing positive user experiences. It sought to transition users from *normal* to *ideal* through a process of acculturation, rooted in Positive Psychology. This involved understanding user culture and designing artifacts like the shoe-holder to exceed expectations, focusing not just on solving functional problems but on fostering cultural and emotional growth. By redefining emotional experiences through artistic associations and narrative extraction, the study was able to uncover hidden user needs and propose meaningful solutions. One key outcome of this study was the development of strategies to address identified user challenges, emphasizing the role of intuitive insights in guiding designers. While logic is often derived from comparison and analysis, intuition emerges from the context and environment. Pattern recognition played a critical role in revealing deeper layers of user understanding, though its effects were often implicit, suggesting a need for further research into more explicit methods and frameworks. The second study's focus on tools and methodologies aligns with the principles of Positive Design, with pattern recognition as a crucial element. Rather than serving as a mere data interpretation tool, patterns are understood as meaningful constructs that reveal the essence of user-environment interactions. These insights, whether captured synchronically or diachronically, are invaluable for designers.

Failure to recognize these underlying patterns can have consequences, such as the loss of traditional values, the unintended promotion of undesirable behaviors, or a disconnect between new technologies and societal values. This research aims to uncover hidden norms, values, and rituals through pattern recognition, aligning with Jeffrey Bardzell's concept of resonance (Bardzell, 2009) and James Gibson's theories (Gibson, 2014). These patterns can inspire new design ideas by connecting current habits with innovative concepts, enriching the creative process, and leading to more context-sensitive and culturally resonant designs.

Conclusion

This paper highlights the significant role of pattern recognition in shaping contemporary design disciplines, drawing on the foundational ideas of Christopher Alexander and Patrick Whitney. Alexander's theories on pattern language and design patterns have influenced fields from architecture and urban planning to software development, emphasizing user-centric, context-sensitive approaches. His vision of using patterns to create functional and harmonious designs has encouraged a holistic perspective that crosses disciplinary boundaries, integrating design with computer science and social innovation. Whitney's focus on recognizing patterns in design decisions further supports the use of pattern recognition to drive innovation and user-centered solutions.

The integration of Alexander's and Whitney's perspectives demonstrates how pattern recognition can enhance design practice, improving user experience and creative problem-solving. By identifying patterns in user behavior and interactions, designers can develop solutions that resonate with users and address complex challenges. This approach holds promise for advancing design thinking, behavioral economics, and social innovation, offering new pathways for creative problem-solving and user engagement.

This paper also underscores the value of pattern recognition as a conceptual tool within Positive Design. By focusing on dimensions like intentionality, directionality, and causality, designers can better understand user needs and interactions, forming the basis for effective Design Scenarios. Drawing from the insights of Terry Winograd, Fernando Flores, and Sohrab Vossoughi, we emphasize that recognizing patterns in behavior and communication is key to accelerating the design process and improving outcomes.

As the design field evolves, the adoption of pattern recognition as a core principle promises to drive transformative change, enabling solutions that address societal needs and advance human-centered design. Future research could explore its role in addressing complex, *wicked* design problems, enhancing opportunity framing, and fostering generative design practices. Integrating these techniques into the design process offers the potential to create impactful, meaningful user experiences that contribute to a more sustainable and harmonious world.

Finally, while pattern recognition has often been underutilized in design practice, this paper encourages a deeper engagement with its potential. Rather than relying solely on persona design or simple classification, designers can enrich their understanding through frameworks like abductive reasoning and the principles of Gestalt and affordance. This approach can help unlock new insights, furthering the understanding of interaction and meaning within design. We hope this work inspires further research and exploration in this promising area.

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